Comments of Paul Harmon

To

New Jersey Department of Environmental Protection

Oyster Creek Generating Station

Draft NJPDES DSW Permit NJ0005550

Public Hearing - February 24, 2010

My name is Paul Harmon. I am employed by Normandeau Associates, Inc., an environmental consulting firm that specializes in ecological issues faced by the power generating industry. My expertise is in the fields of fisheries and aquatic ecology. Throughout my 40-year career as an environmental consultant I have worked on a wide variety of projects involved with assessment of potential and actual ecological impacts of power plant siting, construction, and operation on aquatic and terrestrial environments.

I have been retained by Exelon as an expert regarding aquatic ecological impact issues at the Oyster Creek Generating Station since 2003 and have reviewed many of the pertinent documents based on the numerous ecological studies conducted at the station since the 1970s. I developed the detailed study plan and implemented the most recent impingement and entrainment studies which were conducted at Oyster Creek in 2005 through 2007 and I provided technical input to the Oyster Creek Generating Station Fisheries Report in 2007 (the "2007 Report").

Introduction

A comprehensive review of the Department's analysis of Oyster Creek's impact on the aquatic life of Barnegat Bay will be provided in Exelon's written comments to the draft NJPDES permit that are due on March 15, 2010. At this time I would like to present some information that provides an essential context when the public hears the raw data of the number of fish and aquatic life that have been impinged and entrained at the plant. In other words, what does it mean to the health of Barnegat Bay when the plant entrains billions of fish larvae through its cooling system? Does this result in an "adverse environmental impact," the standard that is set forth in the Clean Water Act?

It is my expert opinion that the raw numbers can be misleading, and it is important to examine the impact that the plant operation is having on the health of the Bay. And this is exactly the test that the Department and its consulting experts have used in the past to determine that the plant is not having a significant impact on the Bay and therefore was not required to install towers.

Section 316(b) of the Clean Water Act requires that cooling water intake structures reflect the best technology available to minimize adverse environmental impact. The term "adverse environmental impact" (AEI) has been traditionally defined as adverse changes in important population or community characteristics sufficient to threaten the sustainability of susceptible populations or to cause significant or potentially irreversible changes in population or community structure and function. The data does not support the conclusion that the plant is having this impact on the fish populations of the Bay. Therefore, I disagree with the Department's determination that Exelon is required to install closed-cycle cooling at Oyster Creek.

Context is essential to understanding what the term AEI reasonably may mean with respect to fisheries biology. Losses of even large numbers of early life stage individuals do not necessarily equate to AEI. This is because fish species inhabiting the Barnegat Bay and coastal waters typically exhibit reproductive strategies, such as production of very large numbers of eggs, which ensure sufficient offspring will survive to sustain populations, even in unstable environments characterized by the presence of multiple stressors.

While I agree with the Department's statements in the Fact Sheet that "the best starting point to evaluate Section 316(b) of the Clean Water Act is to refer to impingement and entrainment data sets" and that "assessment of these effects is integral to defining alternatives to minimizing these losses", it is my opinion that the Department did not appropriately analyze the data so that the potential for AEI could be reasonably assessed.

<u>The Cooling Water System at Oyster Creek</u>

It is important to understand that the Oyster Creek Station has two large water intakes that serve quite different purposes and require separate interpretation and analysis. They are the Dilution Water Intake which pumps water directly into the discharge canal (Oyster Creek) without heat addition or other modification, and the Circulating Water Intake which provides water that is heated as it passes through the power plant's cooling system.

The dilution water accounts for about 52% of the average combined water volume pumped by the Station. High survival of aquatic organisms was a reason for installing pumps that have several fish-friendly attributes, i.e., minimal change in pressure, low shear stress, low probability of injuring organisms by strikes with the pump blades, and minimal cavitation and turbulence. Both microscopic organisms, for example, fish eggs and larvae, and larger organisms that would be impinged on the intake screens at the circulating water intake, termed "impingeable-size organisms", pass through this intake.

Studies conducted at the dilution water intake have shown that many species pass through the pumps with a survival rate of over 80%. Impingement mortality is nonexistent because the dilution water intake has no fine mesh intake screens. To supplement and expand upon the historic studies, a special study was performed in 2007 to further evaluate survival of impingeable-size fish using best available methods adopted from survival studies performed on numerous hydropower turbines, which have many basic design features in common with the dilution pumps. The study found that over 85% of juvenile striped bass (approximately 6 inches in length) that passed through the dilution pumps survived the experience. In addition, the researchers performing the study concluded that, based on recent studies of fish friendly hydropower turbines, smaller fish, which are more prevalent at the Oyster Creek intakes, would have an even higher survival rate.

Based on these studies, it is reasonable to conclude that a very large percentage of organisms passing through the dilution pumps survive. Thus, the expected reduction in impingement and entrainment effects with a closed-cycle cooling system must be substantially reduced due to the high survival already occurring in about half the water pumped by Oyster Creek Station.

Impingement at the circulating water intake occurs when organisms too large to pass through the fine mesh intake screens are instead collected on the screen mesh or in the water filled troughs affixed to the screen panels.

In the most recent studies at Oyster Creek, three invertebrate species; sand shrimp, grass shrimp and blue crab; together accounted for about 80% of the impinged organisms. Of the remaining 20%, most organisms were the small young of several fish species and fish which have a small size as adults. Examples of the former include Atlantic menhaden and weakfish while Atlantic silverside and bay anchovy are included in the latter group. Fish of the sizes commonly taken by anglers are rarely impinged because they are able to avoid the low water intake velocity.

The Oyster Creek Station employs a technically advanced type of intake screening that is arranged as elongated belt in which the panels facing the incoming water continually move upward, carrying the impinged organisms up out of the water and placing them into a fish-friendly marine life handling system that conveys the impinged organisms to the unheated side of the discharge canal. Most organisms survive the experience. Survival rates range from 30 - 40% for sensitive fishes like bay anchovy to 70 - 80% and higher for most other fishes and the most abundant invertebrate species.

Again, the perceived benefits of reduced impingement that is expected from conversion to closed-cycle cooling will not be as great as the anticipated reduction in numbers implies.

It is well-known that very large numbers of aquatic organisms are entrained into Oyster Creek's cooling system. However, little information is in the record with which to interpret the numbers and, thereby, understand the magnitude of potential AEI.

Entrained fish are represented by eggs, newly hatched fish larvae, and very small juveniles, all of which are small enough to pass through the intake screens rather than becoming impinged upon them. Bay anchovy eggs and larvae usually account for the largest percentage of total fish entrainment. Other important species include Atlantic menhaden, winter flounder, and weakfish. However, considerable natural year to year variation is evident in numbers of the various species entrained. This variation is due to the relative reproductive success that the various species experience from year to year. As the Department has stated in the Fact Sheet, many factors other than plant operations can affect the species-specific entrainment rates, such as weather changes, abundance and distribution of spawning females, concentrations of eggs and larvae entering the Bay and Forked River, and prevalence of predators.

Only a small fraction of the entrained fish eggs and young normally survive to adulthood regardless of entrainment losses at the plant. For example, weakfish which mature at the age of one year and which may live 6 to 10 or more years of age, will produce 300,000 to over one million eggs per female each year. Female winter flounder at about 10 inches in length may produce nearly 200,000 eggs while those approximately 17 inches long may spawn one to three million eggs. Bay anchovy spawn multiple times over several months. Typically, only a very small percentage, often just a fraction of 1%, of the eggs survive to become sexually mature fish. Other sources of mortality include predation, disease, and starvation. Therefore, because nearly all of the eggs and larvae entrained would have died in any case, the numbers entrained reveal nothing about the potential impact of entrainment on fish populations or the aquatic community. What matters for the species in terms of AEI is whether or not entrainment significantly reduces the number of fish that survive the early period of high natural mortality to the point that population sustainability is threatened or causes significant changes in population or community structure and function.

Some cropping or harvest of aquatic organisms by man is acceptable and sustainable, as evidenced by recreational and commercial catch regulations. Fish populations naturally produce a surplus of individuals to support limited harvest. And, it should be noted, harvest of adults has greater importance to the population since each female represents potentially millions of eggs and young. In addition, fish populations can compensate for high mortality rates by directing more energy reserves to reproduction, experiencing reduced cannibalism when densities are reduced, avoiding over competition for preferred food resources, and more successfully avoiding predators.

Conclusions

While some research may indicate a decline in the health of Barnegat Bay, the most recent impingement and entrainment data show remarkable consistency in species composition and relative abundance over time within an overall context of very large inter-annual variability for many species. The major biological components of the Bay ecosystem have not changed substantially since the extensive ecological studies were conducted in the 1970s and 1980s. Several species that ranked among the most numerous in the previous studies were highly numerous in the recent work.

The Department's own independent consultant, Versar, Inc., after an extensive and critical review of the available data, concluded in 1989 that the operation of OCGS did not threaten the protection and propagation of a balanced community of aquatic life in Barnegat Bay (Summers *et al.* 1989). Additionally, an overview of the health of the Barnegat Bay published in 2001 (Kennish 2001) states : "Despite the large numbers of eggs, larvae, and small life forms of Barnegat Bay organisms lost via in-plant passage at the OCGS, these losses have not resulted in detectable impacts on biotic communities in Barnegat Bay. Effects of operation of the OCGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek."

There is no scientific basis to conclude that OCGS is having AEI on the aquatic community of Barnegat Bay, and therefore, closed-cycle cooling should not be required for this facility.

References Cited

Kennish, M.J. 2001. State of the estuary and watershed: an overview. Journal of Coastal Research, Vol.32, p.243-273. [This publication was reproduced in full in the estuarine Biotic Impacts section of Chapter 9 of the Characterization Report prepared for the Barnegat Bay National Estuary Program]

Summers, J. K., A. F. Holland, S. B. Weisberg, L. C. Wendling, C. F. Stroup, R. L. Dwyer, M. A. Turner, and W. Burton. 1989. Technical review and evaluation of thermal effects studies and cooling water intake structure demonstration of impact for the Oyster Creek Nuclear Generating Station, revised final report, volume I – text and volume II - appendices. Prepared for New Jersey Department of Environmental Protection Division of Water Resources. Versar, Inc., ESM Operations, Columbia, MD.