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From: Balsam, Briana *MB*
Sent: Thursday, April 12, 2012 12:51 PM
To: julie.crocker@nmfs.gov
Cc: Logan, Dennis; Susco, Jeremy; Smith, Maxwell; jegan1@entergy.com
Subject: Pilgrim: NRC's complete responses to 4-9-12 NMFS questions
Attachments: NRC Responses to NMFS 4-9-12 Questions_Complete 4-12-12.pdf

Julie,

I attached the NRC's completed responses to the questions on Pilgrim that you sent in your April 9 email to follow-up on our partial response dated April 10.

I will also be forwarding several zip files containing the documents referenced in the responses in subsequent emails. I tried to send them all as one zip folder, but it seems as if my agency's email attachment size limit is a bit higher than yours—the last email I was able to send, but it came back undeliverable. All of the references should also be publically available in our ADAMS system also, and I have included the accession number for each in the attached responses, so that would be another way for you to access those documents if email doesn't work.

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NRC Responses to NMFS's Questions on Pilgrim

April 12, 2012

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Note: A number of answers refer to the following studies, which are being provided to NMFS with these responses:

1. [EG&G] Global Environmental and Ocean Services. 1995. Pilgrim Nuclear Station Cooling Water Discharge Bottom Temperature Study, August 1994. Final Report to Boston Edison Company, Plymouth, Massachusetts. June 1995. 116 p. ADAMS No. ML061450065.
2. ENSR Corporation. 2000. 316 Demonstration Report for Pilgrim Nuclear Power Station, Redacted Version. Prepared for Entergy Nuclear Generation Company. March 2000. 357 p. ADAMS No. ML061390357.
3. Hartwell AD, Mogolesko FJ. Three-dimensional field surveys of thermal plumes from backwashing operations at a coastal power plant site in Massachusetts. 10 p. ADAMS No. ML061420520.
4. Normandeau Associates, Inc. 1977. Thermal Studies of Backwashing Operations at Pilgrim Station During July 1977. Prepared for Boston Edison Company, Boston, Massachusetts. 82 p. ADAMS No. ML061560291.
5. Normandeau Associates, Inc. 2011. Ichthyoplankton Entrainment Monitoring at Pilgrim Nuclear Power Station, January – December 2010. Submitted to Entergy Nuclear. April 27, 2011. 323 p.
6. Normandeau Associates, Inc. 2011. Impingement of Organisms on the Intake Screens at Pilgrim Nuclear Power Station, January – December 2010. Submitted to Entergy Nuclear. April 22, 2011. 35 p.

1. Are there any in-water acoustic impacts of the Pilgrim facility? Have any in-water measurements of underwater noise been taken here or at similar plants?

The NRC is unaware of any studies of underwater noise at Pilgrim or any other nuclear facility or evidence that nuclear facilities might cause elevated underground noise levels.

The EIS states that "noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term. The staff has not identified any new and significant information during its independent review of the PNPS ER, the site visit, the scoping process, evaluation of other available information, or

consideration of public comments. Therefore, the staff concludes that there would be no impacts of noise during the license renewal term beyond those discussed in the GEIS." This statement makes it unclear whether there is underwater noise associated with Pilgrim, but it would not rise to the level of being a concern, or whether there is not actually any underwater noise associated with operations. Could you clarify?

NRC evaluates above-ground noise as it relates to humans. The text that you reference in the Pilgrim supplemental environmental impact statement (SEIS) is based on Section 4.3.7 of the generic environmental impact statement (GEIS), which discusses noise impacts as a human health issue. For issues that the NRC concluded generically in the GEIS, the NRC does not repeat the analysis in the SEIS. You can access the discussion of noise in the GEIS on the NRC's public website: <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/>. During the NRC's review of Pilgrim, the staff did not find any new and significant information that would call into question the GEIS's conclusion, which is SMALL for all nuclear facilities. Click on "Volume 1, Main Report."

2. The dimensions of the thermal plume appear to be described in terms of delta T. Is the 1C delta T the extent change that is detectable? We are trying to use the size of the thermal plume as part of the description of the action area.

Both the surface and benthic thermal plume have been characterized in 1°C increments from Δ 1°C through Δ 9°C. The 2000 316 Demonstration characterizes the thermal plume in Section 5.1. Several tables beginning on page 5-45 in this report also provide the plume area, depth, and volume at both the surface and bottom:

Table 5.1-1. Measured Surface Plume Area, Depth, And Volume Enclosed by Various Delta T Isotherms During High Tide—MIT Studies, 1973.

Table 5.1-2. Model Predicted Plume Area, Measured Depth, and Corresponding Volume Enclosed by Various Delta T Isotherms During High Tide—MIT Studies, 1973.

Table 5.1-3. Measured Benthic Plume Dimensions (EG&G, 1995)

Two previous reports also studied the Pilgrim thermal plume. A 1974 study by Massachusetts Institute of Technology (MIT) studied the thermal plume at the surface, and a 1995 study by Global Environmental and Ocean Services (EG&G) studied the thermal plume at the bottom. Unfortunately, I cannot locate a copy of the MIT study, but this study is summarized in Section 5.1 of the 2000 316 Demonstration. The EG&G study is being provided with these responses. Section 4 of the 1995 EG&G report summarizes the findings of the study and characterizes the bottom thermal plume. Figures 22, 23, and 25 in this report graphically display the bottom thermal plume under various conditions.

3. Section 4.1.3 discusses the 1974 thermal plume study that characterized the surface plume. It states, "For example, water with a delta T of 3C (37.4F) covered approximately 216 acres (ac) in August when the ambient temperature was 17.0C (62.6F), but only 14 ac in November when the ambient temperature was 8.5C (47.3F)." The first part of that

sentence is confusing, do you mean that the 216 acre area had water that was 3C greater than ambient or 37.4F greater than ambient or something else??

The sentence you reference contains a temperature conversion error. The corrected sentence should read:

For example, water with a delta T of 3°C (~~delta T of 5.4°F 37.4°F~~) covered approximately 216 acres (ac) in August when the ambient temperature was 17.0°C (62.6°F), but only 14 ac in November when the ambient temperature was 8.5°C (47.3°F).

Also, can you provide the description of the size of the area that had a delta T of 1C at the surface (later text in the EIS describes that area for the bottom)?

The sections and tables of the 316 Demonstration and EG&G study mentioned on the previous page provide this description.

4. I also have a question about this statement -- "At the bottom, similar to the surface, the smallest temperature increment measured (1C or 33.8F) covered the largest area (up to 1.2 ac), and water with higher temperatures relative to ambient covered much smaller areas. For example, the highest delta T measured, 9C (48.2F), covered less than 0.13 ac of the bottom" (in 4.1.3) Did that heated area (1.2 acres) have temperatures that were 1C above ambient or 33.8F above ambient, because those would be two very different scenarios!

The 1.2-ac area had temperatures 1°C (1.8°F) above ambient temperatures. It appears that the temperature units were converted assuming a temperature rather than a change in temperature.

5. Thermal backwash - Can you describe the size of the plume? The EIS says it is thin and only lasts a few hours but can you describe how far from the discharge canal it extends and its temperature profile (e.g., the size of area with delta T of 3C, 1C etc.)

During July 1977, a study by Normandeau characterized the thermal plume created from backwash (which Pilgrim conducts at 1- to 2-week intervals). Section 6 of the Normandeau study provides a description of the backwash thermal plume and summarizes the study's findings.

In a summary of the 1977 Normandeau study (Hartwell and Mogolesko 1977) characterize the backwash thermal plume as follows:

These surveys showed that backwashing operations at Pilgrim Station form a relatively thin thermal plume averaging 3 to 5 ft (0.9 to 1.5 m) thick. Higher temperatures were observed during the low-water backwashing than during the high-water backwashing, presumably due to lesser amounts of available entrainment water. During the first survey the thermal plume persisted for about 2 to 2.5 hrs before being completely dissipated. The second weekend more heat treatment was required due to accumulated biofouling and the thermal plume persisted for almost 4 hrs. Initial momentum effects of the

backwashing flows apparently tend to carry the thermal plume northward and along the outer breakwater, with little tendency for warmed water to impinge the shoreline in front of Unit 1. During both surveys local winds also appeared to play a role in pushing the thermal plume seaward. Finally, observed near-bottom ambient temperature variations suggest that some water from the plant discharge can recirculate into the intake area.

3. Have there been any jellyfish (leatherback turtle prey) impinged or entrained at Pilgrim? I do not see any listed on table 4-3 on the EIS but it is not clear to me if that table includes invertebrates. Is there a list of the invertebrates that have been impinged or entrained? If it is in the EIS I am having trouble finding it.

The 2010 Normandeau impingement report indicates that Pilgrim impinged 744 jellyfish (Phylum Cnidaria) in 1981 and 940 jellyfish in 1983 based on extrapolated totals (see Table 9). However, no jellyfish have appeared in impingement samples since 1983.

4. Zooplankton -- As you know, right whales feed on copepods (mostly Calanus spp.). The EIS states , "Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." Does this mean that no zooplankton is entrained at Pilgrim?

No, this does not mean that no zooplankton are entrained at Pilgrim. This statement refers to the fact that the NRC considers the entrainment of phytoplankton and zooplankton is a generic license renewal issue, so the analysis appears in the GEIS rather than the individual SEISs (as described above for noise). Section 4.2.2.1.1 of the GEIS discusses entrainment of phytoplankton and zooplankton in more detail. The GEIS concludes that this issue would have SMALL impacts because there is no evidence of reductions of populations of phytoplankton or zooplankton at nuclear plants.

And if it is entrained, are there estimates of the annual loss?

The Pilgrim entrainment monitoring program only monitors for ichthyoplankton. The NRC is not aware of any studies that estimate annual losses of zooplankton at Pilgrim.

Also, the EIS refers to studies to characterize the zooplankton in the area conducted in the 1970s (2.2.5.3.3). Have there been similar studies carried out since Pilgrim became operational?

The NRC staff is not aware of any studies on zooplankton beyond those referenced in the SEIS.

Could you clarify what evidence was reviewed to make this determination.... "However, based upon the review conducted by the NRC staff, there is no evidence that the operation of the PNPS cooling system has had an impact on phytoplankton or zooplankton communities, or any resultant effects on the aquatic food web, in Cape Cod Bay." (from 4.8.1 Cumulative Impacts)

This statement refers back to the conclusion in Section 4.1 of the SEIS, which is based on the conclusion in Section 4.2.2.1.1 of the GEIS and the lack of new and significant information on this issue that would call into question whether the GEIS conclusion should apply to Pilgrim.

5. Crabs - The EIS states that cancer crabs (*Cancer spp.*) were the second most impinged invertebrate. Can you provide information on the number of crabs impinged per year?

Pilgrim impinged a mean of 273 cancer crabs (*Cancer spp.*) per year from 1980 through 2010 based on extrapolated annual totals (see Table 9 in the 2010 Normandeau impingement monitoring report). However, impingement has varied widely annually. Pilgrim impinged cancer crabs in only 2 year from 1980 to 1999, but from 2000 to 2010, Pilgrim impinged cancer crabs 9 out of the 10 years.

6. Atlantic herring: The EIS states, "and based on the 2005 Pilgrim monitoring data, the loss to the stock due to entrainment by PNPS appears to be significantly less than 1 percent (Normandeau 2006a)." Was an actual percentage provided in Normandeau 2006a?

Yes, the referenced Normandeau report provided a percentage. The most recent 2010 Normandeau ichthyoplankton entrainment report indicates that the 2010 equivalent adult value resulting from Pilgrim entrainment and impingement would account for about 0.01 percent of the spawning stock by biomass (see pages 84-86 of the report).

For more information on Atlantic herring impingement, refer to Figure 4 in the 2010 Normandeau impingement monitoring report, which depicts the extrapolated totals of Atlantic herring impinged per year from 1980 through 2010 and Table 3, which provides the extrapolated total number of Atlantic herring impinged each year from 1980 to 2010.

7. sand lance - Has there been an assessment of the effects of removal of sand lance like there is for some of the other fish species (i.e., less than 1% of the population or similar types of conclusions?).

No, Normandeau did not calculate such a percentage for sand lance. Page 34 of the 2010 Normandeau ichthyoplankton entrainment report notes that "sand lance have little to no commercial or recreational value, and therefore abundance data are unavailable to compare to the entrainment estimates." However, the 2010 Normandeau ichthyoplankton entrainment report includes entrainment numbers for the sand lance.

The 2010 Normandeau impingement monitoring report also includes information on sand lance. This report indicates that American sand lance (*Ammodytes americanus*) is impinged in only some years and at very low numbers (see Table 3). Other species in the genus *Ammodytes* are more commonly impinged and also appear in Table 3.