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An Exelon/British Energy Company

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United States Nuclear Regulatory Commission
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Subject: Oyster Creek Generating Station
Docket 50-219
Results of the Environmental Monitoring Inspection following a Reactor Shutdown

On November 11, 2001, a cable supplying the 480 VAC distribution system failed at the Oyster Creek Generating Station. As a result of this event, a normal reactor shutdown was performed. The decrease in temperature of the water in the discharge canal required an inspection of the shores of the discharge canal and lower reaches of Oyster Creek for an impact on aquatic life (Technical Specification Appendix B, Section 1.1.1.A.) The results of that inspection are enclosed with this cover letter.

If any further information or assistance is required, please contact Mr. John Rogers of my staff at 609.971.4893.

Very truly yours,

Rob J. DeGregorio, Vice President
Oyster Creek Generating Station

RJD/JJR
Enclosure

cc: Administrator, Region I
NRC Senior Project Manager
Senior Resident Inspector
NJ Department of Environmental Protection (3 addressees)

A623

OYSTER CREEK GENERATING STATION

FISH KILL MONITORING REPORT

AmerGen Energy Company, LLC

November 2001

Executive Summary

The Oyster Creek Generating Station (OCGS) was operating at 100% power on the morning of November 11, 2001 when plant operators determined that the 1B2 electrical bus, one of the major electrical cables supplying OCGS plant systems with electrical power, had developed a short and failed. Plant operators gradually reduced OCGS electrical output from 100% to approximately 25% between 0900 and 1500 hrs. At 1504 hrs on November 11 a manual shutdown was initiated.

In order to reduce potential cold shock effects on fish in the discharge canal, the two operating thermal dilution pumps were stopped prior to the reactor shutdown so that the temperature of the discharge canal would decrease as slowly as possible. Discharge canal temperatures were approximately 21° C (70° F) at noon on November 11 and decreased gradually to approximately 15°C (59° F) by 1504 hrs (the time of the manual shutdown). However, as a result of the plant shutdown, the water temperature at the main condenser discharge canal rapidly decreased from approximately 15°C (59° F) to slightly over 11.7° C (53° F) during the initial fifteen minutes following the shutdown.

Fish within the discharge canal began to exhibit signs of cold shock and some dead fish were observed later the same day. In order to document this event a fish sampling program was conducted by AmerGen Energy on the day of the plant shutdown and the days immediately following the shutdown. The results of that monitoring effort indicated that several species of fish were affected, and that a total of approximately 1407 individuals died due to cold shock. Although many of the fish which died as a result of the plant shutdown suffered lethal cold shock relatively rapidly, many others appeared to have survived for up to three days following the plant shutdown.

Over ninety-eight percent of the fish collected from the discharge canal and Oyster Creek were warm water migrant species including crevalle jacks, blue runners and lookdowns, which are typical of more southerly subtropical Atlantic waters. While several other species (including bluefish, bluespotted cornetfish, greater amberjack, southern stingray, Spanish mackerel and spotfin

butterflyfish) were also involved in the fish kill, each comprised less than one percent of the total number collected.

Introduction

This report documents the results of aquatic sampling conducted by AmerGen Energy Company, LLC (AmerGen) following a thermal shock fish kill which occurred on November 11, 2001, in the discharge canal of Oyster Creek Generating Station (OCGS), subsequent to an unplanned shutdown of the reactor and the plant's dilution pumps. The objectives of the sampling program were:

1) To determine the species composition, relative abundance and distribution of fishes in Oyster Creek which may have suffered thermal stress following the OCGS shutdown, and
2) To quantify the extent of any fish mortalities.

The monitoring effort took place from November 11 through November 14, 2001.

OCGS, which had operated continuously for the previous 177 days, was operating at 100% power with four circulating water and two dilution pumps in operation on November 11. Operators had determined during the early morning that the 1B2 electrical bus had failed unexpectedly,

Control Room operators manually shut the plant down at 1504 hrs on November 11. In order to reduce potential cold shock effects on fish in the discharge canal, the two operating thermal dilution pumps were stopped prior to the reactor shutdown so that the temperature of the discharge canal would decrease as slowly as possible.

AmerGen Energy Environmental Scientists were notified of the plant shutdown and initiated a sampling program in the discharge canal prior to the shutdown. Dead and dying fish were

collected from the discharge canal and the canal banks during the afternoon and evening of November 11, as well as during the following three days. Restart of the OCGS occurred on November 19, 2001 at 1059 hrs.

Fish Kill Monitoring Activities –

Fish were collected by AmerGen personnel from the discharge canal using dipnets. Dead fish were gathered from a small boat, as well as by personnel walking along the discharge canal streambanks between the OCGS discharge and the bayfront beaches near the mouth of Oyster Creek.

The results of the monitoring effort indicated that a total of 1407 fish representing nine different species died during this fish kill event (Table 1). Most of the stressed or dead fish were crevalle jacks and blue runners which were collected from shallow cove areas between the U. S. Route 9 bridge and the mouth of Oyster Creek, as well as the shallow nearshore areas north of the mouth of Oyster Creek. All fish captured were identified, enumerated, and length ranges were determined for each species.

Crevalle jacks Caranx hippos and blue runners Caranx crysos (n=1306) together accounted for 92.8% of the mortalities, lookdowns Selene vomer (n=78) for 5.5%, and bluefish Pomatomus saltatrix (n=11) for less than 1% (Table 1). Five additional species including bluespotted cornetfish Fistularia tabacaria (n=7), greater amberjack Seriola dumerili (n=2), southern stingray Dasyatis americana (n=1), Spanish mackerel Scomberomorus maculatus (n=1),) and spotfin butterflyfish Chaetodon ocellatus (n=1), each contributed only a fraction of one percent of the total mortalities.

The crevalle jacks and blue runners ranged in length from 128 to 214 mm (5.0 to 8.4 in) forklength (FL). The lookdowns collected during the fish kill ranged from 117 to 155 mm (4.6 to 6.1 in) FL, and the bluespotted cornetfish ranged in length from 310 to 340 mm (12.2 to 13.4 in) total length (TL). The greater amberjacks collected ranged in length from 470 to 495 mm (18.5 to 19.5 in) FL. The bluefish collected ranged in length from 328 to 384 mm (12.9 to 15.1 in) FL. Table 1 summarizes the numbers and size range for each species collected.

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Discussion and Conclusions

The evidence indicates that the observed fish mortalities on November 11, 2001 and the days immediately thereafter were caused by cold shock. These fish, primarily warmwater carangid species such as crevalle jacks, blue runners and lookdowns, were residing in the heated condenser discharge of the OCGS at the time of the plant shutdown. They were probably attracted to the elevated temperatures in the discharge canal during summer or early fall, and remained there during the fall when they would otherwise have migrated out of Barnegat Bay. The death of these fish following a 3.3° C (6° F) drop in discharge water temperature in 15 minutes, down to a final water temperature of about 11.7° C (53° F), is consistent with what is known about their thermal tolerances, lower lethal temperature limits and past observations of cold-shock events.

The November 11, 2001 fish kill event resulted from the inability of cold-sensitive species, such as jacks, blue runners and lookdowns, to tolerate the relatively low water temperatures they encountered in the discharge canal subsequent to plant shutdown. Intake canal temperatures were about 11.7° C (53° F), at the time of the plant shutdown on November 11 (Figure 1). The discharge canal temperature at the time of the shutdown was approximately 15° C (59° F), resulting in a delta T of about 3.3° C (6° F). The very rapid decrease in discharge temperature (from about 15° C / 59° F to less than 12° C / 53.5° F in 15 minutes), which occurred following the manual shutdown of the plant (Figure 1),appears to have induced cold shock within a few hours. The discharge canal temperature decreased to about 10° C (50° F) about twelve hours after the plant shutdown, then remained between 9° and 10° C (48° to 50° F) during the following three days (Figure 2). Hoff (1971) reported that a massive low temperature mortality of crevalle jacks occurred under similar circumstances in estuarine waters on the Atlantic coast of Massachusetts when water temperatures suddenly fell to 7.4° to 9° C (45.4° to 48° F). Hoff concluded that it is likely that many such late southern migrant

fish are involved in cold shock fish kills due to temperatures falling below their lower lethal temperatures in northern waters. At OCGS, either crevalle jacks or blue runners have been involved in cold shock fish kills on seven previous occasions between 1974 and 1989. The intake water temperatures at the time of those events ranged from 1.1° to 13.9° C (34° to 57° F). Therefore, it appears that the lower lethal temperature for crevalle jacks and blue runners is within a few degrees of 10° C (50° F). The relatively wide range of temperatures which resulted in cold shock deaths to crevalle jacks and blue runners in the seven previous events is probably due to variations in their thermal acclimation (i.e., how gradually water temperatures approached their lower lethal limit) and how large a temperature drop it was which resulted in the cold shock and ultimately their death.

David Littlehale, Collection Manager for the New Jersey State Aquarium, reported collecting fish specimens including numerous lookdowns, crevalle jacks and bluespotted cornetfish on two separate occasions, two to three weeks prior to November 11, from the beach and shallow nearshore waters immediately north of Oyster Creek (D. Littlehale, personal communication). Thomas Baum of the NJDEP Division of Fish, Game & Wildlife reported that small jacks, including crevalle jacks and blue runners, were unusually abundant this year in shallow nearshore waters near the Nacote Creek Research Center in Port Republic, NJ during early November. Baum felt that the unusually mild weather during late September through early November was responsible for so many southern migrant species being prevalent in local estuaries this late in the year (T. Baum, personal communication).

Although lookdowns and greater amberjack are known to be among the southern migrant species which are sometimes found in the waters near the OCGS during the summer and fall, these species have not previously been involved in any OCGS fish kill. Because lookdowns, greater amberjacks, blue runners and crevalle jacks have a relatively close taxonomic relationship (i.e., all members of the Carangidae family) and have similar geographic distributions, it is likely that the lower lethal temperature for lookdowns and greater amberjacks is similar to that of blue runners and jacks. This seems to have been borne out by the fact that cold-stunned and dead lookdowns and greater amberjacks were found during the first 24 hours after plant shutdown, and they were

collected from the same locations where the greatest numbers of dead crevalle jacks and blue runners were found.

A few days prior to the November 11 plant shutdown, several species of fish including bluefish, striped bass and southern stingray were observed congregating in the OCGS heated effluent at the Main Condenser discharge. During the first day following the shutdown, most of the bluefish continued to swim normally in the same location but some individuals began moving downstream and swimming more slowly. Most of the bluefish appeared to have moved out of the Main Condenser discharge area during November 13th, and a few cold-shocked bluefish were collected later that day. The remainder of the dead bluefish were collected on November 14th, between 48 and 72 hours subsequent to shutdown. These mortalities of bluefish during this fish kill are consistent with the available information regarding bluefish thermal tolerance, lower lethal temperature limits and past observations of cold-shock events. For example, during a December 10, 1982 OCGS fish kill in which bluefish, crevalle jack and blue runners were the prevalent species, cold-shock mortalities occurred when the fish were subjected to a final temperature of 8.9° C (48° F). Cold shock experiments have shown that juvenile bluefish exposed to an instantaneous 6.7° C (12° F) decrease in water temperature (from 15° C / 59° F to 8.3° C / 47° F) exhibited 50 % mortality (Hillman, 1979). Furthermore, cold-shock mortality to bluefish has occurred during several previous OCGS fall/winter fish kill events when ambient water temperatures ranged from 1.1° to 8.9° C / 34 ° to 48° F. Based on these results, and the fact that the bluefish observed following this plant shutdown were all adults (which are generally somewhat more cold tolerant than juveniles), it is likely that some bluefish that were in the discharge canal at the time of the OCGS shutdown survived.

Cold-shock experiments have also demonstrated that striped bass can tolerate exposure to water temperatures as low as 0° C (32° F) for at least a few days (Gift and Westman, 1971; Public Service Electric and Gas Company, 1978). Therefore, it is not surprising that the striped bass in the OCGS discharge canal at the time of the November 2001 plant shutdown appeared to be unaffected by the decrease in water temperature to 8.9° C (48° F) following the shutdown.

Although the lower lethal temperature of the southern stingray is unknown, it is a species which is found primarily in warmer southerly waters, and may be near its northern limit of geographic distribution in this area. Therefore, it is likely to have limited thermal tolerance to a relatively rapid decrease in water temperature to a final temperature below 10° C (50° F), such as that which occurred following the November 11 shutdown.

The three other species collected during the November 2001 fish kill, including bluespotted cornetfish Fistularia tabacaria, Spanish mackerel Scomberomorus maculatus and spotfin butterflyfish Chaetodon ocellatus, are additional southern migrant species which have not been involved in previous OCGS fish kills. These species are believed to have limited thermal tolerance to cold-shock, and the deaths of the few individuals of these species collected following the November 2001 shutdown can be attributed to ambient water temperatures falling below their respective lower lethal limits.

References

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Littlehale, D., 2001. Personal communication.

Public Service Electric & Gas Company, 1978. Annual Environmental Operating Report (Non-radiological). Salem Nuclear Generating Station. Unit 1. Vol. 3. Special surveillance and study activities. Public Service Electric & Gas Company, Newark, New Jersey.

Table 1.
Number and size of dead and stressed fish collected from Oyster Creek and nearby Barnegat Bay following unplanned shutdown of the OCGS on November 11, 2001.

Species	Number (n)	Percentage Of Total (%)	Minimum Length (mm)	Maximum Length (mm)
Caranx spp. Crevalle jack/ Blue runner	1306	92.8	128	214
Selene vomer Lookdown	78	5.5	117	155
Pomatomus saltatrix Bluefish	11	0.8	328	384
Fistularia tabacaria Bluespotted cornetfish	7	0.5	310	340
Seriola dumerili Greater amberjack	2	0.1	470	495
Chaetodon ocellatus Spotfin butterflyfish	1	< 0.1	83	83
Dasyatis americana Southern stingray	1	< 0.1	310	310
Scomberomorus maculatus Spanish mackerel	1	< 0.1	324	324
TOTAL	**1407**	**100.0**	**83 mm**	**495 mm**

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Figure 1
Oyster Creek Generating Station
Air and Water Temperatures During Fish Kill Event - 11Nov2001
(Temperature in Degrees Fahrenheit)

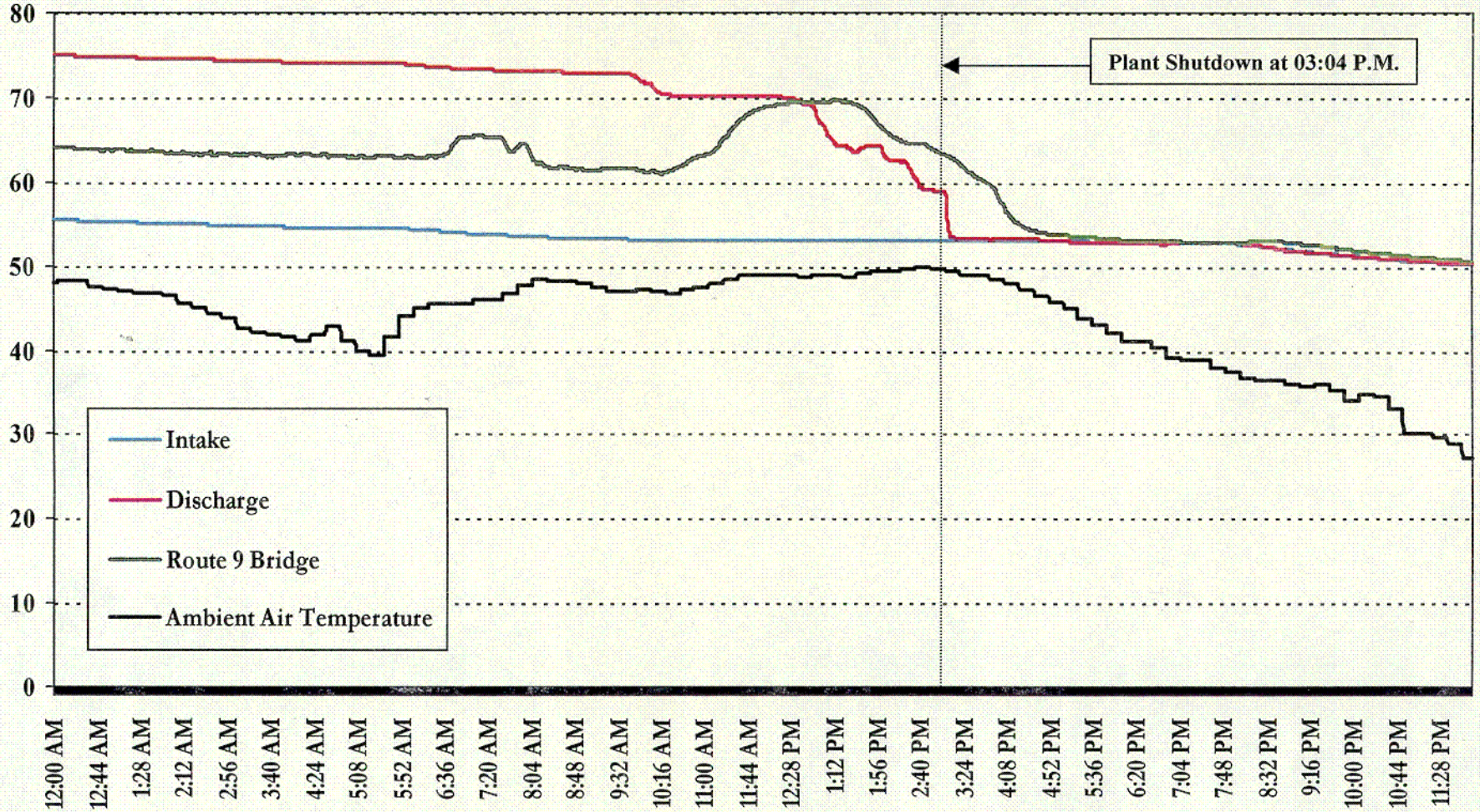

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Figure 2
Oyster Creek Generating Station
Air and Water Temperatures During Fish Kill Event
11Nov2001 Through 14Nov2001
(Temperature in Degrees Fahrenheit)