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Subject: Oyster Creek Nuclear Generating Station (OCNGS)  
NJPDES Discharge to Surface Water Permit NJ0005550  
Fish Kill Monitoring Report, January 2000

Dear Mr. Van Sciver:

The enclosed report entitled "Fish Kill Monitoring Report for January 2000" is being provided for your information.

If you have any questions or require any additional information, please contact Mr. Malcolm Browne of our Environmental Affairs Department at (609) 971-4124.

Very truly yours,

Sander Levin  
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SL:MEB:ew  
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FISH KILL MONITORING REPORT

FOR JANUARY 2000

GPU Nuclear, Inc.  
Oyster Creek Nuclear Generating Station  
Environmental Affairs Department

February 2000

## Executive Summary

The Oyster Creek Nuclear Generating Station was operating at about 65% power on the morning of January 21, 2000 when plant operators were required to shut down the reactor at 1049 hrs. The shutdown was required when a multiple recirculating water pump trip occurred. Subsequently, it was determined that a faulty signal from instrumentation controlling the recirculating water pumps was the apparent cause of the pump trips.

In order to reduce potential cold-shock effects on fish in the discharge canal, the two operating thermal dilution pumps automatically stopped operating when the reactor was shut down so that the temperature of the discharge canal would decrease as slowly as possible. However, as a result of the plant shutdown, the water temperature in the discharge canal rapidly decreased from approximately 48° F to less than 32° F during the initial fifteen minutes following the shutdown.

Fish within the discharge canal soon exhibited signs of cold-shock or died subsequent to the shutdown. In order to document this event, a fish sampling program was conducted by GPU Nuclear on the day of the plant shutdown and the days immediately following the shutdown. The results of that monitoring effort indicated that the several species of fish were affected, and that a total of approximately 3547 individuals died, apparently 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 several days after the shutdown.

Approximately 84% of the fish collected from the discharge canal and Oyster Creek were striped bass and nearly 9% were white perch. Over three percent of the fish collected were black drum and one percent were bluefish. While several other species were also collected (including gizzard shad, striped mullet, American eel, mummichog, tautog, Atlantic herring, weakfish, spotted seatrout, winter flounder, red drum, smooth dogfish and cunner), each comprised one percent or less of the total number collected.

## Introduction

This report documents the results of aquatic sampling conducted by GPU Nuclear, Inc. (GPUN) following a thermal shock fish kill which occurred on January 21, 2000 in the discharge canal of Oyster Creek Nuclear Generating Station (OCNGS) subsequent to an unplanned shutdown of the reactor. The objectives of the sampling program were:

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

The monitoring effort took place from January 21 through February 1, 2000.

OCNGS, which had operated continuously for the previous 434 days, was operating at approximately 65% power with three circulating water and two dilution pumps in operation on January 21. Operators had reduced power from 100% power to 65% power during the early morning, in order to prepare for the quarterly Main Steam Isolation Valve (MSIV) test which was scheduled to take place later that day. Later that morning, plant personnel were testing instrumentation which controls the recirculating water pumps in the reactor building when signals were erroneously sent to that instrumentation, which shut off all recirculating water pumps. As a result, Control Room operators were required to shut the plant down at 1049 hrs on January 21. The two operating dilution pumps automatically tripped as designed at the time of the plant shutdown.

GPUN Environmental Affairs personnel were notified of the plant shutdown and immediately initiated a sampling program in the discharge canal. Dead and dying fish were collected from the discharge canal and the canal banks during the morning and afternoon of January 21, as well as during the following several days prior to and immediately following restart of the OCNGS on February 1.

## Fish Kill Monitoring Activities –

Fish were collected by Environmental Affairs Department staff from the discharge canal using dipnets. Dead fish were gathered from a small boat and by personnel walking along the discharge canal streambanks, between the OCNGS discharge and the mouth of Oyster Creek. Surveys of the beaches along the western shore of Barnegat Bay, north and south of Oyster Creek were also conducted. All fish were identified and enumerated; length ranges were obtained.

The results of the monitoring effort indicated that a total of 3547 fish representing sixteen different species died during this fish kill event (Table 1). Most of the stressed or dead fish were collected between the Main Condenser Discharge (NJPDES Discharge Serial Number DSN 001) and the U. S. Route 9 bridge. All fish captured were identified, enumerated, and length ranges were determined for each species.

Striped bass Morone saxatilis (n=2981) accounted for over four-fifths of the mortalities, white perch Morone americana (n=305) for nearly 9%, black drum Pogonias cromis (n=117) for 3.3%, and bluefish Pomatomus saltatrix (n=34) for about 1% (Table 1). Twelve additional species including striped mullet Mugil cephalus (n=9), gizzard shad Dorosoma cepedianum (n=8), American eel Anguilla rostrata (n=7), mummichog Fundulus heteroclitus (n=5), tautog Tautoga onitis (n=3), Atlantic herring Clupea harengus (n=2), weakfish Cynoscion regalis (n=2), spotted seatrout Cynoscion nebulosus (n=2), winter flounder Pleuronecties americanus (n=2), smooth dogfish Mustelus canis (n=1), red drum Sciaenops ocellatus (n=1) and cunner Tautoglabrus adspersus (n=1) each contributed only a fraction of one percent to the total mortalities.

The striped bass ranged in length from 338 to 860 mm (13.3 to 33.9 in) forklength (FL). The white perch collected during the fish kill ranged from 285 to 299 mm (11.2 to 11.8 in) FL, the black drum collected ranged in length from 185 to 525 mm (7.3 to 20.7 in) total length (TL). The bluefish collected ranged in length from 360 to 648 mm (14.2 to 25.5 in) FL. Table 1 summarizes the numbers collected as well as the size range for each species collected.

## Discussion and Conclusions

The evidence indicates that the observed fish mortalities on January 21, 2000 and the days immediately thereafter were caused by cold-shock. These fish, primarily striped bass, white perch, black drum and bluefish, were residing in the heated condenser discharge of the OCNGS and may have been attracted to the elevated temperatures in the discharge canal during fall or earlier and remained there during the winter. The death of these fish, following a 16 °F drop in discharge water temperature in 15 minutes, down to a final water temperature of about 30.2 °F, is consistent with what is known about their thermal tolerances, lower lethal temperature limits and past observations of cold-shock events.

The January 21, 2000 fish kill event was probably due in part to the subfreezing cold and windy weather which occurred prior to and immediately following the plant shutdown. Intake canal temperatures were extremely cold, about -1.0° C (30.2° F), on the morning of January 21 due to the very cold weather conditions prior to the plant shutdown (Figure 1). The discharge canal temperature at the time of the shutdown was approximately 8.9° C (48° F), resulting in a delta T of about 9.9° C (17.8° F). The very rapid decrease in discharge temperature (from about 48° F to less than 32 °F in 15 minutes) which occurred following the plant shutdown (Figure 1) appeared to have resulted in nearly immediate cold-shock to many of the fish killed during the event, although some of the fish collected appeared to initially be stunned for a period of time prior to eventually dying.

During a December 18, 1995 fish kill which occurred under similar circumstances at the OCNGS, the 20 °F drop in discharge water temperature from about 56 °F to 36 °F which occurred following an unplanned shutdown, resulted in the relatively rapid cold-shock deaths of several individuals of five fish species with modest thermal tolerance for cold-shock (including bluefish, black drum, weakfish, spotted seatrout and smooth dogfish). All five of these species were also involved in the January 21, 2000 fish kill event. During the December 1995 fish kill, four additional species with greater thermal tolerance to cold-shock (including striped bass, white perch, American eel and gizzard shad) also died several days later when extremely cold weather conditions dropped the discharge canal temperatures to about 30 °F (-1.2° C). Likewise, all four of these species were involved in the January 2000 fish kill.

The other species collected during the January 2000 event (mummichog, striped mullet, tautog, Atlantic herring and cunner) are believed to have limited thermal tolerance to cold-shock and would not be expected to survive the rapid decrease in discharge temperatures to 30 °F followed by prolonged exposure to subfreezing water temperatures.

The observed mortalities of the species involved in the January 2000 fish kill are consistent with the available information on their thermal tolerances and lower lethal limits. For example, cold-shock experiments conducted by Ichthyological Associates, Inc. (Jersey Central Power & Light Company, 1978) demonstrated that striped bass are able to tolerate extreme temperature reductions of 9 to 28 °F, down to final temperatures as low as 35 °F. Cold-shock experiments have also demonstrated that striped bass can tolerate exposure to water temperatures as low as 32 °F for at least a few days but death occurs in a few hours at temperatures of 30.2 °F or lower (Gift and Westman, 1971; Public Service Electric and Gas Company, 1978).

The lower lethal limit for the white perch has not been determined. However, given their close taxonomic relationship to the striped bass and the similarity of their responses in cold-shock experiments, it is likely that the white perch mortality was also caused by ambient water temperatures falling below their lower lethal limit. For example, Texas Instruments (1976) demonstrated that adult white perch were able to survive a 23 °F drop from about 59 °F to 36 °F (as they did following the December 18, 1995 OCNGS shutdown) but are unable to survive a drop to a final temperature as low as 30 °F.

Other species involved in the January 2000 fish kill are known to prefer higher water temperatures than striped bass and white perch, and are even less likely to be able to tolerate the exposure to discharge canal water temperatures of 30 °F which occurred for several days following the plant shutdown (Figure 2). The relatively high salinity of the water in the OCNGS intake and discharge canals allows the water temperature to fall below the freezing point during periods of extremely cold weather. Air temperatures dropped into the low teens on January 21, 2000, depressing ambient water temperatures to extremely low levels of about 30 °F prior to the plant shutdown and for several days thereafter (Figure 2).

Cold-shock experiments have shown that juvenile bluefish exposed to an instantaneous 12 °F decrease in water temperature (from 59 °F to 47 °F) exhibited 50 % mortality (Hillman, 1979).

Furthermore, cold-shock mortality to bluefish has occurred during several previous OCNGS winter fish kill events when ambient water temperatures ranged from 34 ° to 48 ° F (1.1 ° to 8.9 ° C).

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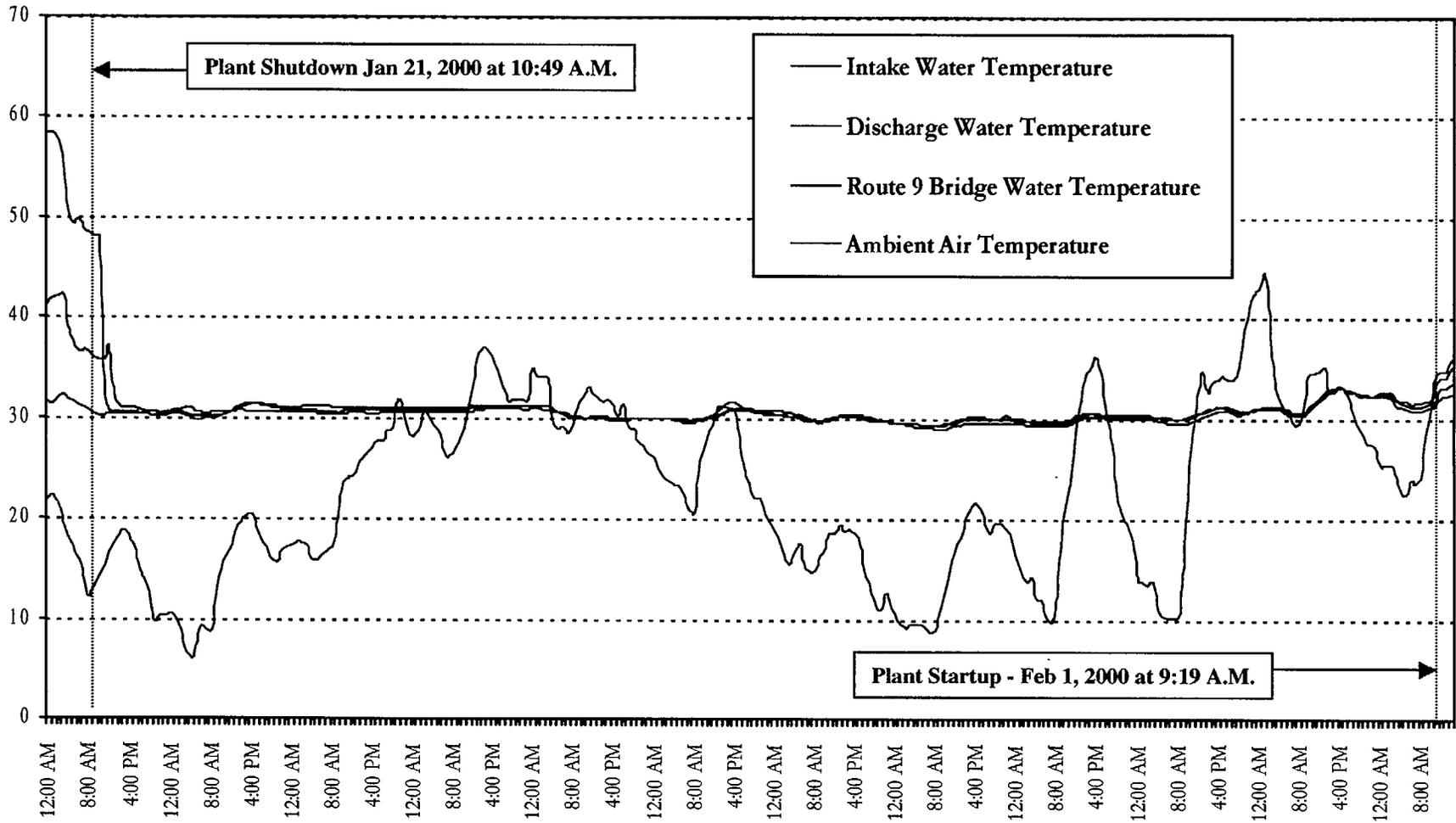
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Table 1.  
 Number and size of dead and stressed fish collected from Oyster Creek and nearby  
 Barnegat Bay following unplanned shutdown of the OCNGS on, January 21, 2000.

Species	Number (n)	Percentage of Total (%)	Minimum Length (mm)	Maximum Length (mm)
<u>Morone saxatilis</u> striped bass	2981	84.0	338	860
<u>Morone americana</u> white perch	305	8.6	285	299
<u>Pogonias cromis</u> black drum	117	3.3	185	525
<u>Pomatomus saltatrix</u> bluefish	34	1.0	360	648
<u>Mugil cephalus</u> striped mullet	9	0.3	285	524
<u>Dorosoma cepedianum</u> gizzard shad	8	0.2	280	305
<u>Anguilla rostrata</u> American eel	7	0.2	510	660
<u>Fundulus heteroclitus</u> mummichog	5	0.2	35	52
<u>Tautoga onitis</u> tautog	4	0.1	225	342
<u>Clupea harengus</u> Atlantic herring	2	0.1	252	258
<u>Cynoscion nebulosus</u> spotted seatrout	2	0.1	433	502
<u>Cynoscion regalis</u> weakfish	2	0.1	560	608
<u>Pleuronectes americanus</u> winter Flounder	2	0.1	232	295
<u>Mustelus canis</u> smooth dogfish	1	< 0.1	580	580
<u>Scaenops ocellatus</u> red drum	1	<0.1	446	446
<u>Tautogoglabrus adspersus</u> cunner	1	< 0.1	60	60
Unidentified	66	1.9	Not determined	Not determined
<b>TOTAL</b>	<b>3547</b>	<b>100.0</b>	<b>35 mm</b>	<b>860 mm</b>

**Figure 2**  
**Oyster Creek Nuclear Generating Station**  
**Air and Water Temperatures During Fish Kill Event**  
**21Jan2000 Through 01Feb2000**  
**(Temperature in Degrees Fahrenheit)**



**Figure 1**  
**Oyster Creek Nuclear Generating Station**  
**Air and Water Temperatures During Fish Kill Event - 21Jan2000**  
**(Temperature in Degrees Fahrenheit)**

