Northeast Utilities System

107 Selden Street, Berlin, CT 06037

Northeast Utilities Service Company
P.O. Box 270
Har ford, CT 06141-0270
(203) 665-5000

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Docket No. 50-423
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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

References:
1. Environmental Protection Plan (Nonradiological) Appendix B to Facility Operating License NPF-49, Millstone Nuclear Power Station, Unit No. 3, Northeast Nuclear Energy Company, Docket No. 50-423.
2. NPDES Permit No. CT0003263, Millstone Nuclear Power Station, Northeast Nuclear Energy Company, renewed December 14, 1992.

Millstone Nuclear Power Station, Unit No. 3
1995 Annual Environmental Protection Plan Operating Report

Section 5.4.1 of the Environmental Protection Plan (EPP), Reference 1, requires that Northeast Nuclear Energy Company submit an Annual Environmental Protection Plan Operating Report to the NRC, describing implementation of the EPP for the previous year. The attached report fulfills this requirement for 1995.

Should you have any questions or require further information, please call Mr. James Foertch, Northeast Utilities Service Company - Aquatic Services Branch, at (860) 447-1791 ext. 5055.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

M. H. Brothers
Director - Millstone Unit No. 3

cc: w/o attachment 2
S. J. Holbrook, Commissioner, CT DEP
T. T. Martin, NRC Region I Administrator
V. L. Rooney, NRC Project Manager, Millstone Unit No. 3
A. C. Cerne, NRC Senior Resident Inspector, Millstone Unit No. 3

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Attachment

Millstone Nuclear Power Station, Unit No. 3

1995 Annual Environmental Protection Plan
Operating Report

April 1996

Annual Environmental Protection Plan Operating Report
January 1 - December 31, 1995

Millstone Unit 3 Environmental Protection Plan

Prepared by: Jim Foertch

Reviewed by: Milan Keser

Annual Environmental Protection Plan Report - 1995

1. Introduction

This report covers the period January 1 - December 31, 1995. From April to June 1995, Unit 3 was shut down for its fifth refueling outage. An additional outage occurred for a two week period in December to repair a check valve in the reactor coolant system. The Unit remained at full power (nominal 1150 MWe) for the remainder of the year. During 1995, Unit 3 operated at an annual capacity factor of 81%.

As required by the Millstone Unit 3 EPP, this Annual Environmental Protection Plan Operating Report (AEPPOR) includes:

1) summaries and analyses of the results of environmental protection activities,
2) a list of EPP noncompliances,
3) a list of all changes in station design or operation which involved a potentially significant unreviewed environmental question, and
4) a list of non-routine reports, describing events that could result in significant environmental impact.

2. Environmental Protection Activities

2.1 Annual National Pollutant Discharge Elimination System (NPDES) Report of Ecological Monitoring (EPP Section 4.2)

Paragraph 5 of the referenced NPDES permit requires continuation of biological studies of Millstone Nuclear Power Station (MNPS) supplying and receiving waters, entrainment studies, and intake impingement monitoring. These studies include analyses of intertidal and subtidal benthic communities, finfish communities, entrained plankton, lobster populations, and winter flounder populations. Paragraph 13 of the permit requires an annual report of these studies to the Commissioner of Environmental Protection. The report that fulfills these requirements for 1995, Monitoring the Marine Environment of Long Island Sound at Millstone Nuclear Power Station, Waterford, Connecticut - Annual Report, 1995, presents results from studies performed during 3-unit operation, and compares them to those from 2-unit operation. The added cooling water flow for Unit 3 affects impingement and entrainment, causes sediment scouring near the MNPS discharges, and alters the characteristics of thermal effluent plume. The biological effects of these changes are summarized in the Executive Summary section of the above-named report (Attachment 1) and further discussed in the report itself (Attachment 2).

2.2 Effluent Water Quality Monitoring

Paragraph 6 of the referenced NPDES permit requires monitoring and recording of many water quality parameters at MNPS intakes and at 37 monitoring points within the plant, including outfalls of each unit to the effluent quarry, and outfall of the quarry to Long Island Sound. Paragraph 11 of the permit requires a monthly report of this monitoring to the Commissioner of Environmental Protection. The report that fulfills these requirements, Monthly Discharge Monitoring Report, includes data from all three Millstone units. Those data that pertain to Unit 3 are summarized in Table 1a. During 1995, no NPDES exceedances or exceptions were reported from a discharge associated with Unit 3 (Table 1b).

Sampling for hydrazine (N_2H_4), biological oxygen demand (BOD), and chemical oxygen demand (COD) is required only when discharging wastewater containing hydrazine. The major hydrazine discharges at Unit 3 are from DSN 001C-1a, releases following wet lay-up of steam generators during extended outages; during 1995, these discharges occurred in May and June. The maximum hydrazine concentration measured at DSN 001C-1a was 40.0 mg/L (permit limit 125 mg/L).

3. Environmental Protection Plan Noncompliances

During 1995, no EPP noncompliances were identified for Unit 3.

4. Environmentally Significant Changes to Station Design or Operation

During 1995, no Unit 3 Plant Design Change Records (PDCRs) met the acceptance criteria for inclusion in this report, i.e., a) were initiated during the report year, and b) included a determination that an unreviewed environmental impact could occur. Of the 72 PDCRs initiated during 1995, none involved unreviewed environmental issues. One PDCR (3-95-058 ARCOR Coating of Large Bore Service Water Piping) required an Environmental Review, but this Review determined that no unreviewed environmental issue was involved. Another PDCR (3-95-056 RFO6 Service Water Piping Modifications) was reviewed in early 1996, and this Environmental Review also determined no unreviewed environmental impact.

As of December 31, 1995, Unit 3 has 190 System Operating Procedures; of these, 84 were added or revised during 1995. In addition, many procedures were modified to reflect small changes, of insufficient magnitude to require the issuance of a new revision. However, each of these changes, as part of the review/approval process, included an environmental evaluation; none was determined to have involved an unreviewed environmental impact. Additionally, a review of design and system changes that had been initiated in previous years, but had an Environmental Review performed in 1995, indicated that none constituted an unreviewed environmental issue, per the EPP criteria.

5. Non-Routine Reports of Environmentally Significant Events

During 1995, no events occurred at Unit 3 that met the acceptance criteria for inclusion in this report, i.e., required submittal of a Licensee Event Report (LER) from Unit 3, and involved a situation that could result in a significant environmental impact. Of the 22 events that constituted reportable occurrences in 1995, none were determined to cause a significant environmental impact. One LER (3-95-011-00 Mussels in the Recirculation Spray Heat Exchanger) noted that the possibility of recurrence was greatly reduced by the installation of more reliable sodium hypochlorite metering pumps, but chlorine injection was regulated to ensure that discharge concentrations (FAC and TRC) remained within NPDES permit limits, so no environmental impact occurred.

Table 1. Millstone Unit 3 NPDES Data Summary, Jan. 1 - Dec. 31, 1995.

a). Selected water quality parameters for Unit 3[1].

	discharge flow range (10^3 gpm)	discharge pH range	discharge temp. range (°F)	discharge temp. (avg) (°F)	avg ΔT (°F)	max FAC (ppm)	max TRC (ppm)	SWS FAC (ppm)
Jan.	790-948	7.8-7.9	56.8-65.5	60.6	17.0	0.13	0.04	0.17
Feb.	790-942	7.8-8.0	48.0-60.8	55.9	17.6	0.12	0.03	0.17
Mar.	790-942	7.8-8.0	50.0-61.9	57.6	17.5	0.12	0.03	0.18
Apr.	30-948	7.7-7.9	43.9-63.1	52.4	7.5	0.12	0.06	0.14
May	15-942	7.6-8.0	46.0-57.0	51.8	0.1	0.15	0.03	0.22
June	790-942	7.5-8.0	54.7-82.0	72.1	13.4	0.12	0.07	0.17
July	790-948	7.6-7.9	79.7-88.7	83.9	18.0	0.12	0.06	0.19
Aug.	790-948	7.7-7.9	84.2-91.0	87.1	17.6	0.13	0.04	0.17
Sep.	0-948	7.6-7.9	83.1-89.1	86.2	18.0	0.10	0.02	0.16
Oct.	790-948	7.5-8.0	73.9-88.2	81.6	17.4	0.14	0.02	0.16
Nov.	790-948	7.7-8.0	48.2-80.1	71.9	17.3	0.11	<0.02	0.19
Dec.	334-942	7.8-8.0	41.4-63.1	52.8	9.5	0.13	0.05	0.17

b). Number of NPDES exceedances or exceptions during year[2].

pH	temp.	FAC	TRC	Susp. Sol.	BOD[3]	COD[3]	hydrazine[3]	Boric acid	conduct.	lithium	oil & grease	metals	other
0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1]Parameters are measured at Unit 3 discharge (DSN 001C), except for TRC, which is measured at MNPS discharge (quarry cuts; DSN 001) and SWS FAC (service water system; DSN 001C-5).

[2]Some parameters are measured at more than one point within Unit 3 or only under certain operating conditions. Values represent number of NPDES exceedances or exceptions for all discharge points; see text for additional details.

[3]Sampling for BOD, COD, and hydrazine is required only when discharging wastewater containing hydrazine; the major releases in 1995 occurred only in May and June.

Docket No. 50-423
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Attachment 1
to the
Millstone Unit No. 3
Annual Environmental Protection Plan
Operating Report
January 1 - December 31, 1995

Executive Summary

April 1996

Executive Summary

Lobster Studies

Several aspects of MNPS operation could impact the local population of American lobster (*Homarus americanus*). Early life stages of lobster (larvae) are planktonic and susceptible to entrainment through cooling-water systems, while adult and juvenile lobsters can be impinged on intake travelling screens or exposed to the heated effluent in the discharge area. Because of the regional economic value of the Connecticut lobster fishery ($2-8 million annually) and the ecological importance of this species, adult lobsters have been monitored annually from May through October since 1978 using wire lobster traps set at three stations around MNPS. Additionally, since 1984, studies have been conducted during the hatching season to estimate the number of lobster larvae entrained through cooling-water systems. The objective of the lobster monitoring program is to determine if operation of MNPS has caused changes in local lobster abundance beyond those expected from natural variability and high fishing pressure.

Legal-sized lobster abundance (catch-per-unit-effort; CPUE) has significantly declined since MNPS lobster studies began in 1978. This decline is attributed to increased fishing rates, which have more than doubled since 1978, and more recently, to the increases in minimum legal size. Total CPUE in 1995 was the lowest value observed in 10 years of three-unit operation. This decline in total CPUE in 1995 may lead to even lower legal catches in 1996, as fewer sublegal-sized lobsters are available to molt into legal size.

Lobster catches and molting peaked earlier during three-unit studies (1986-95) than during two-unit studies (1978-85), probably owing to regionally warmer May to August water temperatures observed in recent years; water temperatures in 1995 were among the highest recorded in these studies. Other changes in local lobster population characteristics during three-unit operation were related to implementation of new fishery regulations, rather than to power plant impacts. The increased proportion of berried females is associated with the increases in minimum legal size; larval production should increase as a larger proportion of females are able to spawn before reaching legal size. Similarly, implementation of the escape vent regulation in 1984 has led to lower percentages of lobsters missing one or both claws (culls) during three-unit operation.

The total estimated number of lobster larvae entrained through the MNPS cooling water systems during 1995 was the highest reported since entrainment studies began in 1984. The higher density of lobster larvae in 1995 may be due to increased abundance of berried females resulting from increases in minimum legal size. Entrainment levels have been substantially higher during three-unit operation than during two-unit operation, due to the additional cooling-water demand of Unit 3. The potential effect of higher larval entrainment on subsequent legal lobster abundance is difficult to assess because of the uncertainty concerning the source of entrained larvae and their survival rates and recruitment to legal size.

Marine Woodborer Study

Teredo bartschi remains present in MNPS discharge waters. However, in 1995, this shipworm was collected at only one site (EW), while it had been found at three sites in 1994 (QC, EB, and EW) and in 1993 (QC, EB, and HR). This trend indicates that distribution of *T. bartschi* has decreased in the MNPS discharge mixing area, and the current population is now confined to undiluted discharge waters. *Teredo bartschi* occurs in MNPS water by virtue of higher water temperatures than those normally found in Long Island Sound. Although a population has persisted in the MNPS Quarry since 1975, there is no evidence to suggest that *T. bartschi* has extended its occurrence to other areas in Long Island Sound unaffected by the MNPS discharge.

Rocky Intertidal Studies

Occurrence and abundance patterns of plants and animals on intertidal rock surfaces are sensitive to a variety of environmental factors. In the Millstone area, the degree of influence of each of these factors varies both spatially and temporally, with most of the differences among local communities attributed to natural variability in site orientation to prevailing wind-generated waves, the ability of available substratum (slope) to dissipate the horizontal force of those waves, and the character of that substratum (e.g., boulders, bedrock ledge). Rocky intertidal studies in 1995 also characterized nearby shore communities impacted by the MNPS thermal plume. Community differences beyond those attributed to natural factors were observed at sites located on Fox Island (FE and FN), and were directly attributed to MNPS operation. Various aspects of the impact-related community changes at Fox Island were identified through separate studies which included qualitative algal sampling, estimations of intertidal organism abundance, and studies of local *Ascophyllum nodosum* populations.

The unique algal flora at FE, developed under elevated temperature conditions caused by the three-unit thermal plume, continued to be evident in 1994-95 based on qualitative sampling. The most notable shifts in species occurrence at FE, relative to unimpacted sites, were the presence of warm water-tolerant species not typical of other sites, absence of common cold water species, and extended or reduced periods of occurrence of seasonal species with warm water or cold water affinities, respectively.

Impacts on dominant species abundance patterns, caused by two-cut water circulation patterns and by three-unit operation, were observed only at FE, and were most pronounced in the low intertidal, where temperature conditions were estreme. The low intertidal community at FE, which prior to 1983 had been unimpacted and characterized by perennial populations of *Fucus*, *Chondrus* and *Ascophyllum* and predictable seasonal peaks in barnacle and *Monostroma* abundance, has been replaced by a persistent community dominated by *Codium*, *Ulva*, *Enteromorpha*, and *Polysiphonia*. The FE community during 1995 was somewhat atypical when compared to recent years of three-unit operation. *Codium*, *Polysiphonia*, and barnacle populations were relatively low, likely influenced by a heavy and persistent mussel set. These mussels were eliminated by Autumn 1995, so this minor change is probably short-lived. More similar to recent years, populations of species observed in undisturbed transects only at FE (*Sargassum*, *Gracilaria*) continued to persist and expand during 1995.

Elevated temperatures (2-3°C above ambient) at the *Ascophyllum* station nearest the discharge (FN) caused plants to grow longer and more rapidly at this site, relative to stations farther away. A moderate level of growth enhancement was observed at FN during 1994-95, when compared to previous years, attributed to lessened thermal plume incursion resulting from an extended outage of Unit 2 for much of the peak growing season. As in previous years, *Ascophyllum* mortality or loss of tagged plants and tips at present sampling sites was not related to proximity to MNPS, but rather to degree of exposure storm forces.

Eelgrass

During 1995, eelgrass (*Zostera marina*) populations were monitored at three sites in the vicinity of MNPS; Jordan Cove (JC), White Point (WP), and the Niantic River (NR). The JC and WP sites have been sampled since 1985, while the NR station has been changed several times since 1985, including during 1995, because of declines in the overall abundance of eelgrass in the Niantic River.

The two eelgrass populations near MNPS (JC and WP) exhibited improved productivity in 1995, compared to the previous 3 years, while the overall health of the Niantic River population continues to be poor. The eelgrass population at WP appeared to be the most robust in MNPS area. Population parameters at WP (standing stock, shoot abundance and shoot length) were within the ranges established over the previous ten years. The deeper water at WP (>2 m depth) provides more protection against elevated temperatures from insolation in the summer, sediment freezing during extreme low tides in the winter and waterfowl grazing.

Eelgrass populations at shallow water sites (NR and JC, ≤ 1 m depth) are more susceptible to these stress mechanisms. Overall environmental stress was greatest in the Niantic River. *Zostera* populations experienced localized elimination in the Niantic River in 1986, 1993, and 1994. The reasons for this long-term decline are unclear. However, because this site is well beyond any influence of MNPS, the decline is not related to power plant operation, but rather to natural site-specific factors, such as grazing, water quality, and habitat degradation in the Niantic River.

While analyses of population characteristics indicated a population decline at JC over the 11-year study period, moderate improvement was observed in 1995. The eelgrass population in JC may also experience shallow-water related stress, such as temperature extremes. These extremes have been measured directly at JC in summer and were possibly responsible for periodic population declines observed previously at that site. However, elevated summer temperatures at JC were mainly related to insolation of the shallow sand flats in JC than to thermal plume incursion.

Benthic Infauna

Construction and operation of MNPS has impacted some nearby soft-bottom benthic infaunal communities. Benthic infaunal studies during 1995 continued to document ongoing changes related to those impacts by monitoring subtidal soft-bottom habitats in the vicinity of MNPS for changes in sedimentary characteristics and infaunal community structure (total abundance, species number and species composition). Results of these studies indicate that impact-related community changes continue to be observed at three of four study sites through the 1995 sampling year.

The GN reference site, located well beyond the influence of MNPS, continued to reflect long-term physical and biological stability; sediments collected at GN in 1995 were similar to previous years, and overall community composition was consistent over the study period. Specifically, the same four taxa (oligochaetes, *Tharyx* spp., *Aricidea catherinae* and *Mediomastus ambiseta*) have been numerical dominants at similar relative abundance levels over both two-unit and three-unit operational periods.

At two sites near the power plant (IN and JC), impacts have resulted from isolated physical disturbances that occurred over a relatively short duration (months or a few years). Community changes were detected earliest at IN, and were attributed to dredging and cofferdam removal during Unit 3 construction (1983-85). In subsequent years, sediment silt/clay content has declined to near pre-impact levels and indications of community recovery are evident through 1995. Species richness and abundances of oligochaetes and *Aricidea catherinae* (common taxa prior to 1983) have increased in recent years, while abundances of more opportunistic species (e.g., *Nucula proxima*) have declined. However, continued dominance of post-impact species, such as *Tharyx* spp., indicates the recovery is still ongoing at IN.

Siltation at JC occurred in 1986 after the start-up of Unit 3, and was associated with increased cooling-water flow and sediment scour in the immediate area of the discharge. Abundances of the previously dominant oligochaetes, and the polychaetes *Polycirrus eximius* and *Aricidea catherinae* quickly decreased. The impact of this siltation event has apparently lessened since 1986, as populations of some two-unit period dominants (e.g., *A. catherinae*) have recovered. However, long-term persistence of some of the deposited silt/clay was still evident after 1995 sampling, and community recovery is evident but slow at JC.

Discharge scour continues to impact the sedimentary environment and the infaunal community at EF. Sediments in 1995 were characterized by increased sediment grain size and decreased silt/clay levels relative to two-unit operational years. The infaunal community at EF has developed under the new, relatively stable, high current conditions in the discharge area. Populations of species common during two-unit operation (e.g., *A. catherinae* and *P. eximius*) have returned to EF, while other species (including *Tharyx* spp.) have declined or do not occur even during periods of area-wide increase (e.g., *M. ambiseta*). This new infaunal community at EF is expected to persist until the degree of sediment scour produced by the MNPS discharge changes.

Winter Flounder Studies

The local Niantic River population of winter flounder (*Pleuronectes americanus*) is potentially affected by the operation of MNPS, particularly by entrainment of larvae through the cooling-water systems of the three operating units. As a result, intensive studies of the life history and population dynamics of this valuable sport and commercial species have been undertaken since 1976.

Although monthly mean seawater temperatures recorded at the MNPS intakes from November 1994 through April 1995 were either the warmest or second warmest recorded during the past 20 years, mid-winter cold weather produced heavy ice cover in the Niantic River, delaying the start of the adult winter flounder survey until February 28. The median trawl catch-per-unit-effort (CPUE) of fish larger than 15 cm during the spawning season was 2.1, which only exceeded the record low CPUE of 1.9 for 1993. The Jolly stochastic model was used with mark and recapture data to estimate the absolute abundance of the adult spawning population. The abundance estimate for 1994 was 13,037 winter flounder, similar to estimates of about 10-16 thousand for 1992 and 1993, but considerably less than estimated population sizes between 33 and 80 thousand spawners during 1984-91. Between one-third to one-half of the winter flounder found in the Niantic River during the spawning period each year have been mature females. Female spawner abundance estimates have ranged from 5,749 (1995) to 74,421 (1982), with corresponding total egg production from about 4.5 to 42 billion each year.

The low abundance of newly-hatched larvae in Niantic Bay compared to the Niantic River suggested that most local spawning occurred within the river. In addition, abundance indices of Stage 1 larvae in the river were significantly correlated with independent estimates of female spawner egg production. Egg hatchability was relatively good in 1995, although abundances of Stage 1 and 2 larvae in the Niantic River were only about average. However, abundances of Stage 3 and 4 larvae during 1995 were among the highest observed since 1983. Annual larval abundances in the bay since 1976 appeared to reflect region-wide trends as they were highly correlated with abundance indices for Mount Hope Bay, MA and RI.

Smaller larval size-classes predominated in the river and larger size-classes were more prevalent in the bay. In Niantic Bay, growth and development were correlated with water temperature. In the river, growth appeared to be related to both water temperature (positively) and larval density (negatively). Growth and development were especially fast in 1995, likely due to the warm water temperatures. Estimated mortality of larvae in the Niantic River for 1984-95 ranged from about 82 to 98% and was 88.3% in 1995. Density-dependence was examined using a function comparing mortality and egg production estimates. Excluding 1993 data, a significant positive relationship was apparent, such that when egg production and larval abundance increased, mortality also increased.

Densities of newly metamorphosed demersal young were also relatively high in 1995. The median density during late summer was the largest found for one of the two stations sampled, but abundance was only average at the other station. An index of abundance calculated for young winter flounder taken during the late fall and early winter at the trawl monitoring program stations was 31.7 in 1994-95, the highest recorded since 1976-77. This high abundance resulted from the strong 1994 year-class. Since 1983, this abundance index has been significantly correlated with that of young fish taken in the Niantic River during summer. This index also indicated that the 1988 and 1992 year-classes were relatively abundant, whereas the 1993 year-class was weak. Few juveniles have been taken within the Niantic River during the adult spawning population surveys in recent years. Young-of-the-year abundance indices were not significantly correlated or were negatively correlated with those for age-3, 4, and 5 female adult spawners. Thus, none of the early life stages was a reliable index of year-class strength for Niantic River winter flounder stock.

Egg production estimates from annual spawning surveys were scaled to numbers of spawning females and used as recruitment indices. These indices, together with adult female spawning stock estimates and mean annual February water temperatures, were used to fit a three-parameter Ricker stock-recruitment relationship (SRR). Additionally, an indirect estimate of the winter flounder theoretical rate of increase (the SRR α parameter) was used for modeling winter flounder population dynamics for impact assessment. The value of α in biomass units was estimated as 5.95. The estimate of β (the second SRR parameter), which describes the annual rate of compensatory mortality as a function of stock size, has shown little annual variation since 1988. The third parameter in the SRR described a negative relationship between winter flounder recruitment and water temperatures in February, the month when most spawning, egg incubation, and hatching occur.

The number of larvae entrained through the condenser cooling-water system at MNPS is the most direct measure of potential impact on winter flounder. Annual estimates of entrainment were related to both larval densities in Niantic Bay and plant operation. The entrainment estimate for 1995 of 222.9 million was the second highest since three-unit operation began in 1986. Because of refueling outages, Unit 2 did not operate during the entire larval winter flounder season and Unit 3 was shut down from April 14 through June 7. This decrease in cooling water use resulted in a calculated reduction in entrainment of about 44% (177 million larvae) from that expected if all three units had operated fully during the season.

The impact of larval entrainment on the Niantic River stock depends upon the fraction of the winter flounder production entrained each year. Empirical mass-balance calculations for 1984-95 have shown that a large number of entrained larvae come from areas of Long Island Sound other than the Niantic River; an estimated 14 to 38% of entrained larvae originated from the Niantic River. The percentage of the total river production entrained annually ranged from 5.1 to 23.9%, but was 40.1% for 1995 because of high abundance of late-stage larvae this year.

A stochastic computer simulation model (SPDM) was used for long-term assessments of MNPS impact over a 100-year period (1960-2060). The winter flounder stock simulated was female spawner biomass (lbs), which is more directly related to reproductive potential than fish numbers. Conditional mortality rates corresponding to larval entrainment from mass-balance calculations and juvenile and adult impingement at MNPS were simulated according to historical information and projections. Natural and fishing mortality rates (F) were provided by the DEP and were different this year from values used previously. For simulation purposes, F was initially set at 0.40 in 1960 and reached a maximum of 1.33 in 1990. Based on proposed changes in fishing regulation, F was projected to decrease substantially over the next decade to 0.60 by 2006 and remained unchanged thereafter.

In the SPDM simulation, an initial stock size of 109,534 lbs was used to represent the theoretical (no fishing effects) maximum spawning potential (MSP) of the Niantic River female spawning stock. When fishing was added, the annual projections of the initially unfished stock become the baseline time-series of annual spawning biomass in the absence of any plant impact. Under the exploitation rates simulated, the stochastic mean stock size of the baseline declined to 52,287 lbs by 1970 and to its lowest point of 12,375 lbs in 1993. The latter value was less than one-half of a critical stock size, defined as 25% of MSP. Following simulated reductions in fishing, however, the stock rapidly recovered. New series of stock size projections were then simulated by adding the effect of larval entrainment at MNPS. The lowest projected stock biomass under simultaneous fishing and MNPS impact again occurred in 1993 (10,317 lbs), whereas the greatest absolute decline relative to the baseline occurred in 2000 (a difference of 14,211 lbs). Generally, greater reductions in stock biomass resulted from fishing than from larval entrainment. The simulated spawning stock returned to within about 1,700 lbs of baseline levels (47,075 lbs, or 43% of MSP) only 6 years after the scheduled termination of Unit 3 operation in 2025.

The probabilities that the Niantic River female spawning stock biomass would fall below selected reference sizes (25, 30, and 40% of MSP) were determined to help assess the long-term effects of MNPS operation. A stock smaller than 25% of MSP is considered overfished, whereas one that is at 40% of MSP can maximize yield to the fisheries while remaining stable. For both baseline and MNPS-impact simulations, stocks were likely ($p \geq 0.83$) greater than 40% of MSP in 1970. At the lowest point of both stock projections in the mid-1990s, all replicates were less than 25% of MSP. Simulated reductions in fishing allowed for a rapid increase in spawner biomass in 2000. By 2020, the stocks had a relatively high ($p \geq 0.70$) likelihood of being greater than 30% of MSP and the baseline stock had about an even chance of being greater than 40% of MSP. This recovery, however, assumed that changes in fishing regulations would be implemented as scheduled and that they achieved expected reductions in fishing mortality. Even with reductions in fishing mortality and termination of MNPS operation, there remained a one in three chance that the new equilibrium stock biomass would be smaller than 40% of MSP after 2040.

Fish Ecology Studies

Studies of fish assemblages in the vicinity of MNPS were conducted to determine the effects of station operation. These impacts have been defined as station-related changes in the occurrence, distribution, and abundance of fishes which can affect community structure. Potential effects include entrainment of early life history stages through the cooling-water system, impingement of juvenile and adult fish on the intake screens, and changes in distribution as a result of the thermal discharge.

Trawl, seine, and ichthyoplankton (fish eggs and larvae) monitoring programs were established in 1976 to provide information for the assessment of impacts from MNPS operation. These programs provided the basis for identifying taxa potentially affected, as well as information on long-term abundance trends used to measure changes in the local populations. More than 100 different fish taxa have been collected in these monitoring programs. Of these, six taxa: American sand lance, anchovies, grubby, silversides, tautog, and cunner were identified as having the potential to be impacted by MNPS, either by entrainment or exposure to elevated water temperatures.

Abundance data were analyzed separately for the two-unit (1976-85) and three-unit (1986-95) operational periods and for the entire 19-year data series (both periods combined) to determine if changes in abundance have occurred. Of the six fishes identified as potentially impacted, negative abundance trends were found for some life stages in four (American sand lance larvae, Atlantic silverside juveniles and adults, tautog eggs, and cunner and tautog adults) of the six taxa.

American sand lance larvae ranked third among entrained fish larvae and densities in entrainment samples have decreased after peaking in the late 1970s and early 1980s. Declines in sand lance abundance were also apparent in other areas of the Northwest Atlantic Ocean, with abundance found to be inversely correlated with that of Atlantic herring and Atlantic mackerel, which prey upon larval sand lance. However, abundance has begun increasing again in recent years and the entrainment estimate for 1994 (the latest year for which data are available) was among the largest. Given the large changes in abundance of this population along the entire Atlantic coast, effects of MNPS on sand lance abundance is difficult to ascertain.

The bay anchovy is typically the most abundant ichthyoplankton species collected in estuaries within its range and was the dominant larval taxon entrained at MNPS. Recent abundance has been relatively low in comparison to the mid-1980s, but this decline occurred prior to three-unit operation. The egg and larval densities and entrainment estimate for 1994 fell within their historic ranges.

Atlantic and inland silversides are among the most common shore-zone species along the Connecticut coast. Typical of short-lived species, the abundance of silversides is highly variable and annual catches by trawl and seine have ranged over two orders of magnitude. Recent catches of silversides by trawl and inland silverside by seine were within historic ranges. However, the Atlantic silverside has significantly decreased in abundance during the three-unit operational period at the Jordan Cove seine site. This decrease was probably not related to thermal effects, but may be related to a change in habitat (i.e., loss of eelgrass not attributed to plant effects) that may have affected spawning success.

The grubby is unique because unlike other potentially impacted species it experiences no fishing pressure and has little forage value. Both larval and adult grubby abundance indices have been stable throughout the 19 years of monitoring and have actually shown some increasing trends in recent years.

The tautog was the second-most abundance egg taxon entrained, accounting for over 30% of the total eggs collected since 1979. During the three-unit operational period a significant negative trend was found for densities of tautog eggs. However, larval densities were within their historic range. Catches of tautog by trawl have been declining, with young-of-the-year accounting for a high proportion of the catch since three-unit operation began. If the decline in adult abundance was caused by entrainment losses, the reduction in egg abundance would have lagged behind the decline of juveniles by several years because females do not mature until age-3 or 4. Therefore, the lower abundance of tautog eggs was probably due to a decline in the abundance of spawning adults, most likely due to fishing, rather than from the operation of MNPS.

The most abundant of the fish eggs entrained were cunner eggs, which accounted for more than 50% of the total collected since 1979. During three-unit operation, cunner eggs have increased in abundance with the density of cunner eggs in 1994 the fourth largest recorded and the 1994 entrainment estimate the highest of the entire 16-year period. The densities of larvae found in 1994 were within the historic range of values. Similar to tautog, young-of-the-year cunner accounted for a higher proportion of fish caught by trawl since three-unit operation began. The entrainment of eggs is the greatest potential impact of MNPS on the cunner population. However, if egg losses affected recruitment, then juvenile abundance should decrease in relation to older fish. This decrease was not apparent in the length-frequency distributions, and relative abundance of juveniles has increased during the three-unit operational period.

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Attachment 2
to the
Millstone Unit No. 3
Annual Environmental Protection Plan
Operating Report

January 1 - December 31, 1995

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