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Millstone Power Station
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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

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License No.	NPF-49

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
2021 ANNUAL ENVIRONMENTAL OPERATING REPORT

In accordance with Section 5.4.1 of the Environmental Protection Plan (EPP), Appendix B to the Millstone Power Station Unit 3 Operating License, Dominion Energy Nuclear Connecticut, Inc. hereby submits the Annual Environmental Operating Report (AEOR), describing implementation of the EPP for the previous year. Enclosure 1 transmits information for the period of January 1, 2021, to December 31, 2021.

Should you have any questions regarding this report, please contact Mr. Dean E. Rowe at (860) 444-5292.

Sincerely,

L. J. Armstrong
Director, Nuclear Station Safety and Licensing

Enclosures: 1

Commitments made in this letter: None.

cc: U. S. Nuclear Regulatory Commission
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Enclosure 1

MILLSTONE POWER STATION UNIT 3
2021 ANNUAL ENVIRONMENTAL OPERATING REPORT
JANUARY 1, 2021 – DECEMBER 31, 2021

MILLSTONE POWER STATION UNIT 3
DOMINION ENERGY NUCLEAR CONNECTICUT, INC. (DENC)

2021 Annual Environmental Operating Report (AEOR)

1. Introduction:

   This report covers the period January 1, 2021 through December 31, 2021. During 2021, Millstone Power Station Unit 3 (MPS3) operated within fuel cycle 21, which began in November 2020, and is scheduled to end in April 2022.

   As required by the MPS3 Environmental Protection Plan (EPP), Appendix B to the MPS3 Operating License, this AEOR includes:

   - summaries and analyses of the results of environmental protection activities,
   - a list of EPP non-compliances and the corrective actions taken to remedy them,
   - a list of all changes in station design or operation, tests, and experiments which involved a potentially significant unreviewed environmental question, and
   - a list of non-routine reports submitted in accordance with subsection 5.4.2.

2. Environmental Monitoring Activities:

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

   Section 10(A) of Millstone Power Station's (MPS) NPDES permit (the Permit), as issued to Dominion Nuclear Connecticut, Inc. (DNC; now Dominion Energy Nuclear Connecticut, DENC) by the Connecticut Department of Environmental Protection (DEP; now the Department of Energy and Environmental Protection, or DEEP) on September 1, 2010, requires, among other things, continuation of biological studies of supplying and receiving waters. These studies include analyses of intertidal and subtidal benthic communities, finfish communities, entrained plankton, lobster populations, and winter flounder populations. Section 10(A)(2) of the Permit requires an annual report of these studies to be sent to the DEEP Commissioner on or before July 31 of each year. The latest report that fulfills these requirements, "Annual Report 2020 - Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut" (Annual Report), dated July 2021, presents results from long-term studies, emphasizing those of the latest sampling year. Characteristics of and changes to the biological communities noted in these studies are summarized in the Executive Summary section of the Annual Report, which is attached as part of this report.

   2.2 Effluent Water Quality Monitoring:

   Several sections of the Permit require monitoring and recording of various water quality parameters at MPS intakes and at multiple monitoring points within the plant, including outfalls of each unit to the effluent quarry, and outfall of the quarry to Long Island Sound. Section 8 of the Permit requires that a monthly report of this monitoring be submitted to the DEEP. The report that fulfills these requirements, the "Monthly Discharge Monitoring Report" (DMR), includes discharge data from all MPS units. Consistent with prior annual AEOR submissions, water flow, temperature, pH, and chlorine data pertaining to MPS3 are summarized in Table 1.

   Each monthly DMR identifies NPDES permit exceedances (i.e., events where a parameter value was beyond permitted limits) or exceptions (i.e., events where

Permit conditions were not met) for the month. During 2021, there were no exceedances or exceptions at a discharge associated with MPS3.

2.3 NPDES Permit Renewal

By way of background, in 2014 MPS established a team, and scheduled milestones, to ensure that a completed permit renewal application was submitted to the DEEP, in accordance with general requirements, prior to the permit's expiration in August 2015. The permit renewal application was submitted on February 6, 2015, and the DEEP issued a Notice of Sufficiency on March 6, 2015; therefore, the permit is administratively continued and in effect until its reissuance.

3. Environmental Protection Plan (EPP) Non-compliances:

No EPP non-compliances were identified for MPS3 in 2021.

4. Environmentally Significant Changes to Station Design or Operation, Tests, and Experiments:

No MPS3 design change records or system operating procedure changes initiated during 2021 included a determination that a significant unreviewed environmental question existed.

5. Non-Routine Reports of Environmentally Significant Events:

No non-routine reports were submitted in accordance with subsection 5.4.2 of the EPP.

Table 1. MPS3 NPDES data summary, Jan 1-Dec 31, 2021. Selected water quality parameters for MPS3(1).

2021	Maximum Discharge Flow (10^6 gpd)	Discharge pH Range (SU)		Discharge Temp. Range (°F)		Average Discharge Temp. (°F)	Average Δ Temp. (°F)	Maximum FAC (ppm)	Maximum TRC (ppm)	Maximum SWS FAC (ppm)
		Min	Max	Min	Max					
January	1361.0	7.7	8.1	44.1	71.5	59.1	14.7	0.09	0.04	0.19
February	1360.5	7.8	8.1	54.1	67.2	58.9	17.2	0.10	0.03	0.18
March	1215.5	7.9	8.1	54.9	68.5	61.1	18.5	0.08	0.05	0.18
April	1170.5	7.7	8.1	60.4	80.5	72.7	27.4	0.07	0.04	0.18
May	1360.3	7.7	8.0	66.7	82.7	75.5	20.9	0.09	0.03	0.20
June	1360.3	7.7	8.1	58.5	84.7	72.6	10.4	0.10	0.04	0.17
July	1356.2	7.5	7.9	79.9	89.2	84.3	15.4	0.07	0.03	0.17
August	1361.8	7.5	7.9	83.4	92.5	86.6	15.0	0.07	0.04	0.17
September	1356.0	7.7	8.0	86.1	93.3	88.3	16.8	0.06	0.04	0.18
October	1360.5	6.8	8.1	78.4	90.9	84.2	17.8	0.08	0.06	0.20
November	1360.8	8.0	8.1	67.5	85.8	76.1	18.0	0.08	0.05	0.18
December	1360.5	8.0	8.2	65.3	79.2	70.0	20.5	0.11	0.04	0.20

Notes:

(1) Parameters are measured at MPS3 discharge (DSN 001C), except for TRC (total residual chlorine), which is measured at MPS discharge (quarry cuts; DSN 001-1), and SWS FAC (service water system free available chlorine; DSN 001C-5).

Attachment to the
2021 Annual Environmental Operating Report
January 1 – December 31, 2021

Executive Summary Section of
"Annual Report 2020 - Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, Waterford, Connecticut"
dated July 2021

Executive Summary

This report summarizes results of ongoing environmental monitoring programs conducted in relation to the operation of Millstone Power Station (MPS). MPS can affect local marine biota in the following ways: large organisms may be impinged on the traveling screens that protect the condenser cooling and service water systems; smaller ones may be entrained through the condenser cooling-water system, which subjects them to various mechanical, thermal, and chemical effects; and marine communities in the discharge area may also be subjected to mechanical, thermal, and chemical effects resulting from the outflow of the cooling water.

This report contains a separate section for each major biological monitoring program, some of which have been conducted without interruption since 1976. These long-term studies have provided the representative data and scientific bases necessary to assess potential biological impacts as a result of MPS construction and operation.

In addition to sections related to the biological monitoring program, this report includes a section providing a complete and thorough description of all National Pollutant Discharge Elimination System (NPDES) permit compliance work undertaken for the implementation of flow reduction and/or entrainment mitigation technologies, operational methods or other measures undertaken in 2020, and a section which provides a comprehensive summary of activities and accomplishments of Dominion Energy Nuclear Connecticut (DENC) in the Niantic River Nitrogen Work Group effort.

Rocky Intertidal Studies

Rocky intertidal habitats are extensive in the Millstone area, and support rich and diverse communities of attached algae and animals. Rocky intertidal studies at MPS are designed and implemented to characterize these communities. Analyses of rocky shore data to date indicate that changes attributed to MPS operation are minor, transient, and restricted to a small area along 150 meters of shoreline in the immediate vicinity of the discharge.

As in previous years, seasonal shifts in occurrence of annual algal species were noted at Fox Island (FI) during 2020. These shifts included absence or abbreviated season for cold-water species (e.g., *Protomonostroma undulatum, Spongomorpha arcta*) and extended season for warm-water species (e.g., *Antithamnion pectinatum* and *Grateloupia turuturu*). Similar shifts have been observed in most years included in this time-series. However, some species with cold-water affinity (e.g., *Protomonospora, Dumontia*) occurred less regularly at Millstone Point (MP) and White Point (WP) as well, reflecting regional temperature increases compared to earlier study years.

Thermal effects on dominant species' abundance and distribution patterns were also evident at FI in 2020, and most apparent in the low intertidal zone. Seasonally high abundance of *Hypnea musciformis*, a species observed for the first time in 2001, and expanded populations of *Corallina officinalis* and *Gelidium pusillum* now characterize the lower shore community at FI. *Melanothamnus* (previously *Neosiphonia*) *harveyi* maintained a perennial population at all three sites in 2020.

Ascophyllum nodosum growth, represented as the most recent internodal length, was greatest at MP in 2020, higher than FI and significantly higher than WP. With all sites combined, growth in 2020 was lower than 2019, and was the fourth lowest mean growth since this methodology began in 2011. This continues to demonstrate no clear relationships among monitoring sites, or correlation with station operating conditions, indicating that the thermal plume from MPS has had little effect on local populations. Natural influences of other factors, such as ambient temperature conditions, storms and wave action, nutrients and light, play the dominant role in determining *Ascophyllum* growing conditions in the Millstone area.

The rocky intertidal monitoring program has also documented regional patterns and modifications to shore communities unrelated to MPS operation. These include the introduction to the region of three exotic red algae (*Antithamnion pectinatum* in 1986, *Grateloupia turuturu* in 2004, and *Dasysiphonia japonica* in 2010), decreases in barnacle abundance in more recent years, and long-term increases in abundance of the common seaweeds *Fucus vesiculosus* and *Chondrus crispus.*

Eelgrass

Eelgrass (*Zostera marina* L.) was monitored at three locations in the vicinity of MPS. Data from 2020 surveys indicated that the two study sites nearest to the MPS thermal plume (Jordan Cove (JC) and White Point (WP)) supported healthy and

expansive eelgrass populations, consistent with results since the study began in 1985. While there has been moderate variability in abundance and distribution over the entire study period at these two sites, this variability was not related to MPS operation. Both predicted and measured thermal input to these sites from the cooling water discharge is at most minimal (< 1°C above ambient conditions) and well below levels considered stressful to eelgrass.

By comparison, high eelgrass population variability has been observed in the Niantic River, where complete and often sudden eelgrass bed losses were documented on six separate occasions prior to 2020. Data from the 2020 survey show continued recovery of some eelgrass beds in the Niantic River. Because the Niantic River is located well away from any influence of the MPS thermal plume, eelgrass population fluctuations there must be related to environmental factors such as increasing ambient seawater temperatures, disease, increased turbidity, and waterfowl grazing. Results from this monitoring therefore suggest that fluctuations in eelgrass populations observed at sites in the Niantic River are due to changes in local and regional environmental conditions and not to MPS operation.

Benthic Infauna

Benthic infaunal monitoring during 2020 documented continuation of long-term trends in sediment characteristics at subtidal sites in the vicinity of MPS. The effluent sampling site (EF) sedimentary environment remained coarse, with low silt/clay which is related to discharge of cooling water into Long Island Sound (LIS) at the quarry cuts. Sediments at the intake site (IN) have been generally consistent with sediment characteristics prior to dredging during MPS Unit 3 (MPS3) construction. Sediments at Jordan Cove (JC) continued to have the smallest mean grain size and highest silt/clay content of all four stations, attributed to the discharge area scouring and fine sediment deposition in the vicinity of the JC site. Sedimentary characteristics at the reference site at Giants Neck (GN) were similar to previous years' observations and continued to reflect natural variability unrelated to MPS.

Dominant taxa at all sites were reflective of climax communities that have undergone long-term successional development in response to their sedimentary environments. Multidimensional scaling showed distinct separation of communities affected by construction and initial operation of MPS3, but also illustrated regional temporal community shifts unrelated to MPS operation. Changes in community structure and functional group dominance at EF, JC, and IN during the 1980-2020 time series reflect not only effects related to construction and initial operation of MPS3, but other regional and/or local biotic and abiotic factors. Community changes at GN from 1980-2020 were attributed solely to these latter factors, and not to MPS operation.

Lobster Studies

Impacts associated with recent MPS operations on the local lobster population were assessed by comparing results of the 2020 study year to data collected from 1978 through 2019. Emphasis has been placed on assessing long-term trends in the abundance and population characteristics of lobsters collected in the Millstone Point area.

Throughout LIS, the lobster population was stable or increasing from 1978 through 1999. Commercial lobster catches in LIS precipitously declined from 2000 to 2013, and experienced a record low in 2017. Although the past three years (2018-2020) show increases in commercial catches, they remain low in comparison to historical records. In this study, lobsters in the MPS area have shown a similar trend, with abundance indices (total catch and catch per unit effort (CPUE)) approximately 75% lower in research pots and 99.7% lower in trawls during the past eight years (2013-2020), compared to highest levels in the 1990s. Declines in pot and in trawl catches were unrelated to MPS operations and attributed to an increase in mortality associated with ambient seawater temperature rise and temperature mediated stressors that include a shell disease affecting lobster populations from eastern LIS to the Gulf of Maine. Egg-bearing females have been disproportionately and negatively impacted by shell disease in comparison to other lobsters. In addition, predation by the high number of Tautog caught in traps contributed to record high lobster mortality during 2015 – 2020. Declines in the abundance of legal-size lobsters were attributed in part to the outbreak of shell disease and to a nearly 5 mm increase in the minimum legal-size since 1978. Recent reductions in landings of legal-size lobsters harvested by commercial lobster fishers in eastern LIS coincided with declines observed in this study, and lobster catches remained severely depressed in other areas of LIS since the lobster die-off observed in 1999.

Long-term trends observed in lobster population characteristics during the past four decades

(molting, female size at maturity, abundance and size characteristics of egg-bearing females) appear related to warmer ambient seawater temperatures and/or the recent outbreak of shell disease, and not MPS operation. Increased ambient water temperature may be responsible for the increased susceptibility and transmission of diseases affecting lobsters in LIS, which is at the southern boundary of their range of distribution in nearshore waters.

The number of lobster larvae entrained through the MPS cooling water systems was highly variable and very low in recent years, due to low adult lobster abundance and low larval densities throughout LIS. Impacts associated with impingement of lobsters at MPS have been greatly reduced by the use of aquatic organism return systems at both units, which return impinged lobsters to Niantic Bay with documented very high survival rates.

Fish Ecology Studies

Results from the Fish Ecology monitoring program suggest MPS operation has not had a discernible effect on local fish assemblages based on analysis of changes in community composition and long-term abundance trends. No significant long-term trends in abundance were identified for Anchovy, Cunner and Tautog eggs, Grubby larvae, or juvenile and adult Silversides. Atlantic Menhaden larvae showed a significantly increasing trend in abundance, as did juveniles collected in seines and trawls. A significant decreasing trend was exhibited for American Sand Lance larvae and Grubby collected in trawls. Over the past 45 years, Cunner and Tautog larval abundances have significantly increased. Juvenile and adult trawl catches of Cunner increased at the Niantic River (NR) station and decreased at the Jordan Cove (JC) trawl stations. Trawl catches of juvenile and adult Tautog have significantly increased at the NR station. No trends in the abundance of juvenile and adult Cunner and Tautog were observed at the Intake (IN) trawl station following the removal of the MPS3 intake cofferdam in 1983.

The magnitude of entrainment is dependent upon egg and larval densities and condenser cooling water flows during their periods of occurrence. Reductions in cooling-water flows have been implemented at MPS with the use of variable frequency drives and timed refueling outages during the peak period of Winter Flounder annual spawning. In addition to the Unit 3 fish return, which was in operation at unit start-up in 1986, impingement impacts were further reduced at MPS with the installation of a fish return at Unit 2 in early 2000. The implementation of these mitigation measures serves to minimize entrainment and impingement impacts at MPS.

Annual variations in ichthyoplankton entrainment likely reflected differences in spawning and transport of eggs and larvae within LIS. Other factors, such as extremes in seasonal water temperature, may also affect larval growth and development. A number of temporal and spatial changes were identified in the community of fishes and macroinvertebrates collected in the MPS trawl monitoring program. These changes were unrelated to the operations of MPS, but rather were associated with shifts in the dominance of individual taxa from changes in habitat, range extensions or contractions related to a warming trend in ambient seawater temperature, and changes in fishing rates and fishing regulations.

Winter Flounder Studies

Various life history stages of Winter Flounder have been monitored since 1976 to determine what effect, if any, MPS may have on the local Niantic River population, particularly through the entrainment of larvae. Over the past two decades, low Winter Flounder abundance levels have been found throughout LIS by the Connecticut Department of Energy and Environmental Protection (CTDEEP). During the same time period, adult Winter Flounder abundance in the Niantic River has remained low. Reflecting the continued trend of low abundance, the Δ-mean Catch Per Unit Effort (CPUE) for adult fish (>15cm) captured in the year-round Trawl Monitoring Program (TMP) in 2020 was the lowest (0.2) value since 1976.

In 2020, overall combined larval abundances in Niantic Bay (sampling sites EN and NB) and Niantic River (sites A, B, and C) were below average for their respective time-series. All abundances of larval stages (Stages 1 - 4) in the River and Bay stations were below time-series means. Relative to the Niantic River, larval abundance in Niantic Bay has slightly increased in recent years, suggesting higher production in LIS rather than in estuaries such as the Niantic River. Summer juvenile abundance from the 2020 Niantic River beam trawl survey was low for the time-series and reflected low larval abundance.

The number of larvae entrained at MPS is a measure of potential impact to Winter Flounder. Annual estimates of entrainment are related to

both larval densities in Niantic Bay and MPS cooling-water volume. The 2020 entrainment estimate of 79.3 million reflected lower than average Niantic Bay larval densities. Reduced entrainment in spring 2020 can be attributed to low larval density and reduced cooling water volumes from the use of the variable frequency drives (VFD) during the "Interval" from April 4 - May 18 (see NPDES Permit Compliance section) and pump shutdowns during the Unit 2 spring refueling outage from April 23 to June 6.

As a result of VFD use during the "Interval", Winter Flounder larval entrainment was reduced 42.6% when compared to that expected under baseline total permitted flow.

Processes that are unrelated to MPS operation and which occur after juvenile Winter Flounder leave shallow nursery waters during the fall of their first year of life seem to be operating to account for fewer adults. A bottleneck in recruitment may occur during the late juvenile life stage (ages-1 and 2), probably from predation. Environmental effects, including changes to the Niantic River habitat (e.g., widely fluctuating eelgrass abundance), a warming trend in regional seawater temperature, and interactions with other species (e.g., predation), especially during early life history, are also important processes affecting Winter Flounder population dynamics.

Results from Winter Flounder studies through 2020 suggest that MPS operations have had minimal effects on Winter Flounder biomass in the Niantic River. Declines in stock size have been greatly evident on a regional basis, including LIS, Rhode Island and all other Southern New England waters. Entrainment during the larval life stages of Winter Flounder occurs, however there has been large variation in the amount of larval mortality and recruitment in recent years, both occurring independently of MPS operations.