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The Northeast Utilities System

Donald B. Miller Jr.,
Senior Vice President - Millstone

Re: 10CFR50.73(a)(2)(i)(B)
10CFR50.73(a)(2)(ii)(B)

June 13, 1995
MP-95-186

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Reference: Facility Operating License No. NPF-49
Docket No. 50-423
Licensee Event Report 95-011-00

This letter forwards Licensee Event Report 95-011-00 required to be submitted within thirty (30) days pursuant to 10CFR50.73(a)(2)(i)(B) and 10CFR50.73(a)(2)(ii)(B).

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

Donald B. Miller, Jr.
Senior Vice President - Millstone Station

DBM/RM:dlr

Attachment: LER 95-011-00

cc: T. T. Martin, Region I Administrator
P. D. Swetland, Senior Resident Inspector, Millstone Unit Nos. 1, 2, and 3
V. L. Rooney, NRC Project Manager, Millstone Unit No. 3

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NRC Form 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES: 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Millstone Nuclear Power Station Unit 3	05000423	1 OF 5

TITLE (4)
Mussels in the Recirculation Spray Heat Exchanger

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
05	15	95	95	- 011 -	00	06	13	95	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	0	THIS REPORT IS BEING SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)					
POWER LEVEL (10)	0	20.402(b)		20.405(c)		50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)	OTHER
		20.405(a)(1)(iii)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iv)	X	50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Robert L. McGuinness, Senior Engineer	(203) 447-1791 Ext. 6855

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On May 15, 1995, while in a refueling outage in Mode 0, mussel shells were found in a Recirculation Spray System (RSS) heat exchanger which could have made it inoperable. The shells had been swept to the heat exchanger by Service Water flow during valve testing in the refueling outage. Upon removal of the inlet channel head covers, the number and size of shells found on the temporary screen for the A heat exchanger could have made it inoperable.

The apparent cause of the fouling was a high density of mussel plantigrades (late stage larvae) in the spring of 1994, concurrent with hypochlorite system problems which allowed the plantigrades to settle at that time.

The corrective action at the time of discovery was to remove the hydroids, mussels, and shells that accumulated on the temporary screen, and inspect the system piping and heat exchangers. All large bore Service Water piping and the other RSS heat exchanger temporary screens were inspected, with no significant amounts of mussels found.

The possibility of a recurrence has been greatly reduced by the installation of new hypochlorite metering pumps in the summer of 1994. To further reduce the likelihood of a recurrence, a surveillance will be written to flush the RSS heat exchangers at specific times to minimize plantigrade attachment and to remove any mussels or hydroids which have started to attach in the headers. Also, the use of permanent inlet screens in the channel heads will be evaluated to protect the tubes from being blocked by mussel shells.

The event had moderate safety significance. One of two RSS heat exchangers in the A-Train was potentially inoperable. The plant was in a refueling outage when the condition was identified. The condition could have existed for the previous six to nine months. During this interval there were also limited periods of time when the B-Train of Service Water or RSS was inoperable (for surveillance or other reasons). Thus, the plant could have been in a condition prohibited by Technical Specifications or in a condition outside the design bases of the plant.

I. Description of Event

On May 15, 1995, while in a refueling outage in Mode 0, mussel shells were found in a Recirculation Spray System (RSS) heat exchanger (E1A) which could have made it inoperable. The mussels had been swept into the heat exchanger channel head by the Service Water flow through the heat exchanger during inlet valve testing in the refueling outage.

Prior to scheduled inspections of the Service Water System pip ·g to the RSS heat exchangers, dynamic testing of the inlet valves to the heat exchangers was perform . Valve testing provided flows through the heat exchangers. Subsequent inspections of the inlet of the neat exchangers found mussels and hydroids deposited on the temporary screens of RSS heat exchangers E1A and E1B. Based on previous experience these temporary screens were specifically installed to prevent possible tube sheet fouling and cleaning problems. A very small amount (1/2 cup) of mussel shells and pieces were found on the inlet screen of heat exchanger E1C. There were no mussels or hydroids on the E1D screen. Both B-Train RSS heat exchangers (E1B and E1D) were operable as determined by the small number of mussel shells which could potentially plug tubes.

The valve testing flowed 6,400 gpm of Service Water through the E1A heat exchanger for approximately ten minutes. This is approximately 500 gpm greater than the required design basis accident flow. The Service Water side was then opened to clean any residual debris from the temporary inlet screen. More than two gallons of debris was removed, including almost two gallons of hydroids, 1536 intact mussel shells greater than one-half-inch in size, 40 shells less than one-half-inch, 18 live mussels greater than one-half-inch in size, two live mussels less than one-half-inch, seven half shells less than one-half-inch in size, and two-and-a-half cups of shell pieces. The inspection of the E1C heat exchanger revealed a half a cup of broken mussel shells and no hydroids.

Previously, on May 6, the Service Water side of the E1B heat exchanger was opened to clean debris from the temporary inlet screen after flow due to valve testing. The valve testing flowed more than 8,000 gpm of Service Water through the heat exchanger for approximately twenty minutes. Upon opening the heat exchanger, approximately a gallon and quarter of debris was found, including 29 whole mussels greater than one-half-inch in size, five whole mussels less than one-half-inch, 61 open and/or half shells greater than one-half-inch, two cups of half shells less than one-half-inch, and miscellaneous pieces and fragments of shells. This mussel accumulation was evaluated and the quantity of shells greater than one-half-inch was not sufficient to affect the operability of the heat exchanger.

The four RSS heat exchangers (E1A, E1B, E1C, and E1D) are cooled on the tube side by Service Water after receipt of a Containment Depressurization Actuation (CDA) signal. The heat exchangers have 1380 5/8-inch O.D. 70/30 copper nickel tubes each. The design basis accident flow for the heat exchangers is 5,900 gpm each. Heat exchangers E1A and E1C are in the A-Train of the Service Water and RSS systems. Heat exchangers E1B and E1D are in the B-Train of the Service Water and RSS systems.

Based upon inspections of the Service Water system piping, the supply piping to the RSS heat exchangers appears to be the most susceptible area to mussel and hydroid growth. This piping is a 26-inch supply header feeding a 3-inch branch line which flows approximately 200 gpm during normal plant operation. Due to the low flow condition, the Free Available Chlorine (FAC) residuals in the header are fairly low. The mussel shells and hydroid colonies which were found recently in E1A, E1B, and E1C had most likely grown on the gaskets which are located at the flange interface between the spools upstream of heat exchanger isolation valves. Hydroid colonies most probably settled first, due to low flows in the lines to the RSS heat exchangers, and the plantigrades (late stage larvae) settled within the hydroid colonies in the early summer of 1994. Because of higher flows in other Service Water branch lines, no significant mussel colonies occurred in other areas.

II. Cause of Event

The size of the mussels and shells indicates that the plantigrades became attached in the early summer of 1994. The recent existence of mussels in the Service Water system is attributed to two factors. First, the mussel plantigrade density in the vicinity of Millstone was over 1,400 per 500 cubic meters in the spring of 1994. This was more than an order of magnitude greater than any previously recorded number in the four years of monitoring these levels.

The growth of mussels within the Service Water system is dependent on the ability of the plantigrades to find a suitable place to attach. Among the limited suitable locations are rubber gasket surfaces which extrude into the pipe at flange pairs or in a living substrate such as a hydroid colony which is free of residual hypochlorite. No documented growth of hydroids or mussels have been noted in recent years on any copper nickel piping. The extremely large number of plantigrades in the spring of 1994 increased the likelihood that some of them would find a suitable substrate to attach to. The mussel and hydroid growth within the Service Water system in hideout areas is a manageable problem which is routinely controlled with hypochlorite and periodic maintenance.

The second factor that contributed to the recent growth of mussels in the Service Water system was related to minor problems which resulted in the hypochlorite system being out of service for short periods of time, or the system did not deliver the proper amount of hypochlorite. During 1994, the hypochlorite system underwent several design improvements. The original pumps were unreliable, and a design to incorporate eductors was installed. This design did not perform as expected and a new design using metering pumps was installed during the summer of 1994. As a result of the design changes, the free available chlorine (FAC) was not maintained at the desirable level for periods of time during the first part of the year. Following the installation of the metering pumps in the summer of 1994, hypochlorite levels have been maintained within a preferred band of 0.12 to 0.17 ppm, thereby minimizing the potential for plantigrade settlements since that time.

III. Analysis of Event

This condition is reported as a condition prohibited by Technical Specifications, and as a condition outside the design basis of the plant.

At the time of discovery on May 15, 1995, when a significant number of intact shells had been swept onto the E1A temporary inlet screen during valve testing, the plant was in a refueling outage with the A-Train out of service for outage work. At that time, the plant was in a safe condition, the affected heat exchangers were not required, and there was no potential impact on any required systems or equipment. Also, the potentially affected E1A had just passed an inlet valve test where flow through the heat exchanger was 6,400 gpm, which is 500 gpm greater than the required design flow.

An engineering review determined that the condition should be reported. It could not be conclusively determined if E1A would have met its designed heat transfer requirements if it had been required to function when the plant was previously operating. Although the test flow was adequate, it was analytically possible that the number and size of available shells in the channel head could have blocked enough tubes to reduce E1A performance below design requirements.

Two RSS heat exchangers must be operable in a train in order for the train to meet the RSS design heat loads following a design basis accident. The potential inoperability of E1A leads to the inoperability of the A-Train of RSS. This condition potentially existed from late-1994 (when the mussels reached sufficient size), until the beginning of the refueling outage in mid-April 1995. During this six-to-nine-month period, the B-Train was unaffected by the mussel shell condition and would have met design and Technical Specification requirements. The condition alone did not affect the operability of the B-Train. However, during this interval, there were limited periods of time when the B-Train of Service Water or RSS was inoperable (for surveillance or other reasons). Thus, there were occasions when the plant could have been in a condition where the plant design basis for the RSS system might not have been met.

The Technical Specification Limiting Condition for Operation (LCO) 3.6.2.2 requires that two independent RSS systems be operable during Modes 1 through 4. In the event that one of the systems is inoperable, the action statements require the other train to be operable, and they provide 72 hours to restore the affected train to operable status. It is possible that there were periods of time when the A-Train could have been inoperable for greater than 72 hours in Modes 1 through 4, and such conditions are prohibited by Technical Specifications.

IV. Corrective Action

The possibility of a recurrence has been greatly reduced by the installation of new hypochlorite metering pumps in the summer of 1994 which have proven to be very reliable.

All mussels, shells, hydroids, and debris were removed during the refueling outage. The entire Service Water system was robotically videotaped and/or visually inspected. No other major areas of mussel colonies were noted.

To further reduce the likelihood of a recurrence, a surveillance will be written to flush the RSS heat exchangers at specific times during the year to minimize the vulnerability from plantigrade attachment. Since the mussel growth appears to be in hydroid colonies, normal flows will easily tear away the hydroid colony and any mussels that are attached in the colony, depositing the debris on a temporary screen installed on the upstream tubesheet of the RSS heat exchangers. Also, the potential for installing permanent screens in the RSS heat exchangers will be investigated.

V. Additional Information

Millstone Unit 3 has had a history of mussel (*Mytilus edulis* - edible blue mussel) fouling of heat exchangers which have rendered several heat exchangers inoperable, and in one instance, caused the plant to shutdown. Additionally, the unit has had two instances in which hydroid growth has caused several small room cooler units to be inoperable.

LERs 90-020-01 and 90-023-01 reported the 1990 hydroid fouling of the B-Train Residual Heat Removal Area Cooler Unit (3HVQ*ACUS1B) and B-Train Containment Recirculation Spray Area Room Cooler (3HVQ*ACUS2B). The cause of the fouling was attributed to an inadequate surveillance which did not account for the enlargement of a drain hole between the inlet and outlet channel head divider plate. The enlargement of this hole decreased the differential pressure across the unit so the fouling went undetected. The units were cleaned of the hydroids, the hole was repaired, and the units were placed back in service.

LER 91-019-01, "Completion of Shutdown per Technical Specification Due to Service Water Mussel Fouling," reported mussel fouling in 1991 which rendered equipment inoperable. The affected equipment included a Control Building chiller, the B-Train Reactor Plant Component Cooling Water heat exchangers, the "C" Reactor Plant Component Cooling Water heat exchanger, and the "B" Diesel, which led to a plant shutdown in July of 1991. Investigations conducted for the cause of the mussel infestation found the B-Train Service Water system had a large mussel settlement in the 100-foot discharge header located in the intake building. Additionally, some very minor mussel colonies were found in the A-Train. The cause of the colonies was the design deficiency of the hypochlorite injection point which was 100 feet downstream of the B-Train pumps, and 30 feet downstream of the A-Train pumps. Since the chlorination system had not treated these portions of the system, colonization of mussels had occurred.

The 1991 mussel infestation was physically removed, flushed, and the hypochlorite injection points were moved to the pump suctions. Since the installation of these modifications, no hydroid settlements have caused the inoperability of any system, and mussel settlements have not caused inoperability of any system or component prior to the current event.

Since 1991, small amounts of mussels have been found in various parts of the Service Water system, predominantly in areas of low flow and/or areas of low hypochlorite concentrations. The mussels found in most cases were residual shells and shell pieces from intake mussel cooks which were entrained in the system. In a few instances, small numbers of live mussels were found growing in the drain lines of the "B" Diesel heat exchangers and in new inspection areas in the outlet channel heads of these heat exchangers. These minor occurrences had no impact on operability and are routinely managed with hypochlorite and periodic maintenance. Since the 1991 modifications to the hypochlorite injection point, no other significant mussel settlements have occurred except for the current reported event.

EIIS Codes

System

Service Water System - BI

Component

Heat Exchanger - HX