

NORTHEAST UTILITIES



The Connecticut Light and Power Company
Western Massachusetts Electric Company
Norfolk Water Power Company
Northeast Utilities Service Company
Northeast Nuclear Energy Company

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December 20, 1990
MP-90-1316

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

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

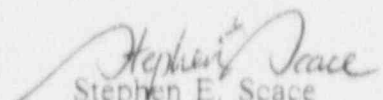
Reference: Facility Operating License No. DPR-65
Docket No. 50-336
Licensee Event Report 89-004-03

Gentlemen:

This letter forwards updated Licensee Event Report 89-004-03 required to be submitted pursuant to paragraph 50.73(a)(2)(ii).

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY


Stephen E. Scace
Director, Millstone Station

SES/PJP:mo

Attachment: LER 89-004-03

cc: T. T. Martin, Region I Administrator
W. J. Raymond, Senior Resident Inspector, Millstone Unit Nos. 1, 2 and 3
G. S. Vissing, NRC Project Manager, Millstone Unit No. 2

*IF22
1/1
Put No
PCN1450 856*

LICENSEE EVENT REPORT (LER)

Estimated burden per response to comply with this information collection request: 50 minutes. Forward comments regarding burden estimate to the Records and Reports Management Branch (D-430), U.S. Nuclear Regulatory Commission, Washington, DC 20545, and to the Paperwork Reduction Project (3150-0106), Office of Management and Budget, Washington, DC 20503.

FACILITY NAME (1)		DOCKET NUMBER (2)	
Millstone Nuclear Power Station Unit 2		0 5 0 0 0 3 3 6 1 OF 0 4	

TITLE (4)
Cracking Discovered in a Mechanical Plug From a Steam Generator Tube at MP2

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		
0 3	2 0	8 9	8 9	0 0 4	0 3	1 2	2 0	9 0	0 5 0 0 0 0 0 0 0 0 0 0		

OPERATING MODE (9):

POWER LEVEL (10): 0 1 0 1 0

THIS REPORT IS BEING SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (check one or more of the following) (11):

<input type="checkbox"/> 20.402(b)	<input type="checkbox"/> 20.402(d)	<input type="checkbox"/> 50.72(a)(2)(iv)	<input type="checkbox"/> 72.71(d)
<input type="checkbox"/> 20.405(a)(1)(i)	<input type="checkbox"/> 50.36(a)(1)	<input type="checkbox"/> 50.79(a)(2)(v)	<input type="checkbox"/> 72.71(e)
<input type="checkbox"/> 20.405(a)(1)(ii)	<input type="checkbox"/> 50.36(a)(2)	<input type="checkbox"/> 50.79(a)(2)(vi)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
<input type="checkbox"/> 20.405(a)(3)(iii)	<input type="checkbox"/> 50.79(a)(2)(i)	<input type="checkbox"/> 50.79(a)(2)(viii)(A)	
<input type="checkbox"/> 20.405(a)(1)(iv)	<input checked="" type="checkbox"/> 50.79(a)(2)(ii)	<input type="checkbox"/> 50.79(a)(2)(viii)(B)	
<input type="checkbox"/> 20.405(a)(1)(v)	<input type="checkbox"/> 50.79(a)(2)(iii)	<input type="checkbox"/> 50.79(a)(2)(ix)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Paul J. Parulis, Senior Engineer, Ext. 4423	AREA CODE: 2 0 3 4 4 7 - 1 7 9 1

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC
B	A	B P L U G W	3 5 1 1	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

EXPECTED SUBMISSION DATE (15)

YES if yes, complete EXPECTED SUBMISSION DATE: NO:

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewriter lines) (16)

Millstone Unit 2 (MP2) removed (4) mechanical plugs from Steam Generator #2 following notification from Westinghouse that plugs of suspect heat treatment may fail similar to the incident at North Anna 1. On 3/20/89 at 1015 hrs., with the plant in cold shutdown (Mode 5) a visual inspection of a mechanical plug which had been pulled revealed circumferential cracking at the top of the plug. This plug was marked with one of the suspect heats, NX3513. There was no operator action associated with this event since the steam generator was out of service for testing and repair. Suspect plugs in both steam generators' hot legs were repaired with a plug leak limiting device. Subsequent to a return to service, with the plant operating at 30% power (Mode 1), on 5/2/89, Northeast Utilities was notified by Westinghouse that an additional tube plug heat, NX4523, may be susceptible to Primary Stress Corrosion Cracking (PWSCC). Fifty plugs located in sleeved and stabilized hot leg tubes were identified by records to be from heat NX4523. Analysis and calculation by Westinghouse and NU concluded that MP2 could safely operate until December first 1989 without repair to the plugs from heat NX4523. Subsequent to the Westinghouse notification concerning heat NX4523, Northeast Utilities investigated the microstructures and corrosion data of heat NX5222 and found them to be similar to that exhibited by heat NX4523. This heat has not experienced cracking at any operating plant. Four plugs of heat NX5222 were installed during 1988, two with Combustion Engineering type stabilizers and two standard plug repairs. The latter two were repaired along with the plugs from heat NX3513. The two with stabilizers, along with all plugs of heat NX5222 installed in 1989 (28) were repaired during the Fall 1989 shutdown.

On 9/26/90, with the plant shutdown for refueling, MP2 was notified by Westinghouse that another plug heat, NX6323, could potentially be susceptible to PWSCC. There were 409 plugs of heat NX6323 installed in both hot legs at MP2 during the 1989 refueling outage. All hot leg plugs of heat NX6323 were repaired with the Westinghouse Plug-In-Plug. This work was recently completed during the cycle 10 refueling outage.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

Estimated burden per response to comply with this information collection request: 50 0 hrs. Forward comments regarding burden estimate to the Records and Reports Management Branch (p-530), U. S. Nuclear Regulatory Commission, Washington, DC 20555, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503.

FACILITY NAME (1) Millstone Nuclear Power Station Unit 2	DOCKET NUMBER (2) 0 5 0 0 0 3 3 6 8 9	LER NUMBER (6)			PAGE (3) 0 2 OF 0 4
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
		8 9	0 0 4	0 3	

TEXT (if more space is required, use additional NRC Form 366A, 6/11/77)

I. Description of Event

Millstone Unit 2 had made a decision to remove (4) mechanical plugs from the Steam Generator (SG) No. 2 based on the fact that Westinghouse suspect problem heat treated plugs were installed at MP2 and also based on the SG tube leak at North Anna 1. On 3/20/89 at 1015 hours, with the plant in cold shutdown (Mode 5), a visual inspection of a mechanical plug which had been removed from SG No. 2, line 78 row 74, showed indications of circumferential cracking at the top of the plug, above the expander. Since the plug, manufactured by Westinghouse, was marked with the heat number (NX3513) previously identified as being a heat which was suspected as being susceptible to primary water stress corrosion cracking, an immediate report was generated. There were no operator actions associated with this event since at the time of discovery, the Steam Generators were out of service for repair and testing.

Notifications from Westinghouse had identified three plug heats, NX3962, NX3279 and NX3513 to be susceptible to PWSCC. MP2 Steam Generators contained only one of these heats, NX3513. All hot leg standard Westinghouse mechanical tube plugs not installed in sleeved or stabilized tubes, that were installed from 1986 through 1988, were repaired with a Plug-In-Plug (PIP) device. There are no plugs with susceptible heats installed prior to 1986. The repairs included plugs of both susceptible and non-susceptible heats. This was required because the heat associated with specific line and row locations for plugs were not identified.

Subsequent to the plant returning to service, following repairs to mechanical plugs associated with heat NX3513, the plant, while operating in Mode 1 at 30% power (increasing), on 5/2/89, was notified by Westinghouse that an additional mechanical tube plug heat (NX4523) was found to be susceptible to PWSCC. This information was the result of cracked plugs discovered at other utilities. MP2 has determined that (50) mechanical hot leg plugs, in both sleeved and stabilized tubes, were from heat NX4523. There were no operator actions associated with this later event since no repairs are deemed necessary at this time.

Further investigations of microstructure and corrosion data by Northeast Utilities for Westinghouse plugs manufactured of Inconel 600 have shown similarities between heats NX5222 and NX4523. These similarities have caused Northeast Utilities to consider plugs from heat NX5222 to be suspect to the same crack growth rate as heat NX4523. All hot leg plugs from heat NX5222, not previously repaired, that were installed in 1988 and 1989 were repaired with a PIP during the Fall 1989 shutdown. There were (24) sleeved tube plugs and (4) standard tube plugs installed in 1989. Two stabilized tube plugs and two standard tube plugs were installed in 1988.

On 9/26/90, with the plant shutdown for refueling and maintenance, MP2 was notified by Westinghouse that another plug heat, NX6323, may also be susceptible to PWSCC. This notification was based on plug cracking discovered at North Anna Unit 2. There were 409 plugs from heat NX6323 installed at MP2, all in the hot legs and all installed during the 1989 refueling outage. A repair utilizing the Westinghouse PIP was implemented for each plug of heat NX6323 during the 1990 refueling outage.

II. Cause of Event

The root cause of plug cracking has been generally described by Westinghouse as Primary Water Stress Corrosion Cracking (PWSCC). PWSCC is correlated to a lack of grain boundary carbides resulting from inadequate post manufacturing heat treatment. Microstructure examinations of plugs from heats NX3513 and NX4523 substantiate this correlation.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

Estimated burden per response to comply with this information collection request: 60 0 hrs. Forward comments regarding burden estimate to the Records and Reports Management Branch (P-630), U. S. Nuclear Regulatory Commission, Washington, DC 20555, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503.

FACILITY NAME (1) Millstone Nuclear Power Station Unit 2	DOCKET NUMBER (2) 0 6 0 0 0 3 3 6	LER NUMBER (6)		PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
		8 9	0 0 4	0 3	0 3 OF 0 4

TEXT (if more space is required, use additional NRC Form 366A's) (17)

III. Analysis of Event

This event is being reported pursuant to the requirements of paragraph 50.73(a)(2)(ii) due to the degraded condition of the mechanical tube plugs. In reviewing the safety consequences of the initial notification, it was originally determined that if cracking were to occur, a leak before break condition would exist. Based on the Technical Specification leakage limit requirements, a controlled shutdown would be initiated. After reviewing the North Anna 1 incident, calculations were performed which showed that a plug top would be propelled up the tube causing a partial tube rupture event. Calculations were then performed utilizing a leak limiting device installed in the suspect tube plugs. The safety consequences of this event were reviewed with respect to the bounding conditions of a steam generator tube rupture event. It was determined that the plugs with the leak limiting devices installed in them created no safety concerns. This modification ensures that Technical Specification leakage limits and structural integrity margins of Regulatory Guide 1.121 are maintained.

Following notification of the additional suspect heat (NX4523), Northeast Utilities performed evaluations for the (50) plugs installed at MP2 from this heat. Westinghouse has developed algorithms that predict the time for plugs to crack to the extent necessary to duplicate the North Anna 1 type plug failure. All cold leg plugs, including those from heats NX4523 and NX3513, were determined to not need repair due to their much longer time to predicted crack initiation. The Westinghouse algorithm for the hot leg plugs from heat NX4523 postulated that they could exhibit similar PWSCC to that associated with the North Anna event before the end of operating cycle 10. Since Northeast Utilities had categorized plugs from heat NX5222 to be similar to heat NX4523, then this additional heat was also considered possible to exhibit PWSCC before the end of cycle 10.

All the hot leg plugs from heat NX4523 are installed in either sleeved (27) or stabilized tubes (23) at MP2. The safety consequences were examined for these plugs. A failed sleeve plug will travel up to two inches before it encounters the transition from the expanded to unexpanded sleeve. Interference transition configurations have been tested and analyzed to suggest that a failed plug top would be captured in the unexpanded portion, thereby precluding an event similar to North Anna. The stabilized tube plugs were also analyzed. Westinghouse stabilizer plugs are a one piece assembly consisting of an integrally attached steel cable stabilizer, about 40" long and a mechanical tube plug. Should a stabilizer plug crack, leak, then subsequently sever, the energy available to the plug top would be limited, due to the pressure equalization across the plug caused by the leakage past the plug into the tube. For both the sleeved plug and stabilized plug failure, if the tube contained a prior through wall defect, the pressure from the secondary side is sufficient to prevent the plug top from projecting upward and rupturing the tube. Tests were undertaken by Westinghouse both with Westinghouse stabilizer plugs and standard plugs with C.E. steel rod stabilizers installed within their tubes. The tests were conducted at energies in excess of that predicted by Westinghouse to be sufficient to penetrate a tube and damage adjacent tubes. None of the tests yielded a tube penetration. It is concluded that a failure of a plug associated with a stabilizer will not cause a multiple tube failure accident.

Northeast Utilities furthermore considered a worst case scenario assuming a plug top release and subsequent partial tube rupture. Such an event would result in a primary to secondary leak rate less than an analyzed accident event. Eleven simultaneous North Anna partial tube rupture events would be required to exceed the MP2 safety analysis. This is not considered likely.

An additional plug heat, NX6323, has been identified by Westinghouse to be potentially susceptible to PWSCC. This was based on cracking discovered at North Anna Unit 2. At the time of this notification MP2 was shutdown for refueling and maintenance. Preliminary assessments by Westinghouse indicated that MP2 may have been able to operate throughout some or all of cycle 11 without exceeding the predicted plug life, since these plugs were installed only 18 months earlier. It was decided to repair these plugs to preclude potential in-service failures or mid-cycle shutdown requirements. Plugs from heat NX6323 were only installed in hot legs at MP2.

There were no safety systems effected by these events.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

Estimated burden per response to comply with this information collection request 50 (hrs). Forward comments regarding burden estimate to the Records and Reports Management Branch (p-830), U. S. Nuclear Regulatory Commission, Washington, DC 20555 and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503

FACILITY NAME (1) Millstone Nuclear Power Station Unit 2	DOCKET NUMBER (2) 0 6 0 0 0 0 3 6 8 9 -	LER NUMBER (6)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
		0 0 4 -	0 3	0 4	OF	0 4

TEXT (if more space is required, use additional NRC Form 366A's) (17)

IV. Corrective Action

The tube from which the cracked tube plug was removed was replugged with a new mechanical tube plug. Other affected tube plugs associated with heat NX3513 were plugged with a leak limiting device. This "plug-in-plug" (PIP) device was torqued into the plug expander then tack welded to the bottom of the plug. This device was installed in all hot leg plugs that were suspected to be from heat lot NX3513. Westinghouse initially manufactured the plug lot in question in 1984. Millstone researched the QA records related to plugging programs since this time and found that the suspect plugs were installed in 1986, 1987 and 1988. A total of 446 PIPs were installed in the MP2 Steam Generators. All PIP installation work was reviewed with resident and senior resident NRC inspectors.

A Justification For Continued Operation (JCO) was prepared to address the issues associated with plug heats NX4523 and NX5222. The Unit 2 PORC reviewed the JCO and concurred with its findings and conclusions that no additional repairs be required at MP2 until the unit's mid-cycle shutdown, scheduled for October 1989. These conclusions were previously presented to the resident NRC inspector for MP2. All hot leg plugs from heats NX4523 and NX5222, installed in 1988 and 1989 were repaired with a PIP during the Fall 1989 mid-cycle shutdown.

Following notification by Westinghouse, MP2 repaired all hot leg plugs from heat NX6323 with the Westinghouse Plug-In- Plug.

Further updates will not be issued unless additional plug heats are identified for MP2 to be susceptible to PWSCC.

V. Additional Information

Plug Manufacturer: Westinghouse
 Model: 27 / C-E
 Size: 3/4 inch
 EHS Code: AG - PLUG - W351
 Steam Generator
 EHS Code: AB - SG - C490
 Similar Events: None