Northeast
Nuclear Energy

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Millstone Nuclear Power Station
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The Northeast Utilities System

October 7, 1996
Docket No. 50-423
B15900

Re: 10CFR 50.73(a)(2)(ii)(B)

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

This letter forwards Licensee Event Report 96-033-00, documenting a condition that was determined at Millstone Unit No. 3 on September 9, 1996. This LER is submitted pursuant to 10CFR 50.73(a)(2)(ii)(B).

The following are NNECO's commitments made within this letter:

B15900-01: As an interim measure in case a seismic event occurs, the minimum soluble boron concentration in the fuel pool shall be increased from the current Technical Specification value of 800 ppm, to a value of at least 1500 ppm at all times and will be sampled every 72 hours.

B15900-02: Fuel movement in the spent fuel pool will be suspended until such time as further evaluation has been performed.

B15900-03: A Technical Specification Change Request to increase the soluble boron concentration in the fuel pool due to a postulated seismic accident will be submitted for NRC approval.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

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

160003

IE22

Attachment: LER 96-033-00

cc: H. J. Miller, Region I Administrator
A. C. Cerne, Senior Resident Inspector, Millstone Unit No. 3
V. L. Rooney, NRC Project Manager, Millstone Unit No. 3

ACTION ITEM TRACKING AND TRENDING INFORMATION

A/R Number: _____ A/R Owed To: NucLicSupv A/R Due Date: _____

Document Cross References: LER 96-033-00, ACR M3-96-9124, B15900

Type Code: CATX Responsible Group: MP3 Ops Due Date: _____

Assignment Subject: Maintain & sample SFP boron

Text: As an interim measure in case a seismic event occurs, the minimum soluble boron concentration in the fuel pool shall be increased from the current Technical Specification value of 800 ppm, to a value of at least 1500 ppm at all times and will be sampled every 72 hours.

Type Code: CATX Responsible Group: MP3 Rx Eng Due Date: _____

Assignment Subject: Suspend Fuel movement in the SFP

Text: Fuel movement in the spent fuel pool will be suspended until such time as further evaluation has been performed.

Type Code: CATX Responsible Group: MP3 Design Due Date: _____

Assignment Subject: Credit Boron in SFP analysis

Text: A Technical Specification Change Request to increase the soluble boron concentration in the fuel pool due to a postulated seismic accident will be submitted for NRC approval.

Type Code: _____ Responsible Group: _____ Due Date: _____

Assignment Subject: _____

Text: _____

Type Code: _____ Responsible Group: _____ Due Date: _____

Assignment Subject: _____

Text: _____

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), 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 4

TITLE (4)

Spent Fuel Pool Storage Potentially Outside of Design Basis During Seismic Events as a Result of Boraflex Embrittlement

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	09	96	96	033	00	10	07	96	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
		20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
POWER LEVEL (10)	000	20.2203(a)(1)	20.2203(a)(3)(i)	[X] 50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
R. T. Laudenat, Nuclear Licensing Supervisor	(860)444-5248

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	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)

At 1545 on September 9, 1996, with the plant in Mode 5, an engineering review determined that during a postulated Safe Shutdown Earthquake (SSE) seismic event, the Boraflex panels in the spent fuel racks could crack and settle in their storage cavity. Under these conditions the Boraflex could be outside the assumptions of the criticality analysis. An immediate notification was made at 1545 hours on September 9, 1996, pursuant to 10CFR50.72(b)(1)(ii)(B) as a condition during operation that could result in the plant being in condition outside the design basis of the plant.

The cause of the event is that the original design seismic analysis of the spent fuel racks did not consider that Boraflex would become embrittled. The Boraflex panels used in the spent fuel racks became embrittled when exposed to the gamma radiation emitted by spent fuel.

The immediate action was to evaluate the spent fuel pool K-eff assuming the bounding case of no Boraflex due to the seismic event. This preliminary criticality evaluation determined that maintaining 1500 ppm of soluble boron in the fuel pool would maintain K-eff at less than 0.95, should a SSE event occur, without credit for any Boraflex. The spent fuel pool is normally borated to approximately 2700 ppm. Fuel pool boron concentration is currently being sampled every 72 hours. Fuel movement in the spent fuel pool has been suspended until further evaluation.

Following completion of the final criticality analysis, a Technical Specification Change is planned to be submitted, to increase the requirement for spent fuel pool boron concentration from the current value of 800 ppm to a larger value determined by the final criticality analysis. This proposed Technical Specification change would restore the pool to full qualification.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. Description of Event

At 1545 on September 9, 1996, with the plant in Mode 5, plant personnel determined that during a postulated Safe Shutdown Earthquake (SSE) seismic event, the Boraflex panels in the spent fuel racks could crack to such an extent that the Boraflex material might redistribute inside the cavity formed by the stainless steel sheets which encapsulate the Boraflex. If this occurred, Boraflex gap formation size and location could be outside the assumptions of the criticality analysis. The spent fuel racks were designed to maintain the neutron multiplication factor (K-eff) less than 0.95 at all times. As a result, this condition was outside the design basis of the spent fuel racks.

An immediate notification was made at 1545 hours on September 9, 1996, pursuant to 10CFR50.72(b)(1)(ii)(B) as a condition during operation that results in the condition of the nuclear power plant being in a condition that is outside the design basis of the plant.

II. Cause of Event

The cause of the event is the original design seismic analysis of the spent fuel racks did not consider the embrittlement of Boraflex and its effects during a seismic event. The Boraflex panels used in the spent fuel racks became embrittled when exposed to the gamma radiation emitted by spent fuel. The recent analysis concluded that widespread cracking of the Boraflex panels could occur during a postulated SSE seismic event. If this occurred, Boraflex gap formation size and location could be outside the assumptions of the criticality analysis. The spent fuel racks were designed to maintain K-eff less than 0.95 at all times. As a result, this condition was outside the design basis of the spent fuel racks.

III. Analysis of Event

Boraflex consists of boron carbide powder suspended in a rubber-like silicone polymeric matrix. Sheets of Boraflex are encapsulated in the cavity between the spent fuel rack stainless steel cell wall and a stainless steel wrapper sheet. The presence of Boraflex as a neutron absorber assists in maintaining the K-eff value of the spent fuel racks to less than 0.95 as required by Technical Specification 3.9.13. When exposed to gamma radiation, the Boraflex material shrinks and becomes brittle. The current criticality analysis of the spent fuel racks assumes in the limiting case, that gaps of 5.65 inches (4percent shrinkage) will form in all of the Boraflex panels due to shrinkage. These Boraflex gaps are assumed to be distributed in a random fashion in the axial direction, and K-eff remains less than 0.95.

As a result in ongoing investigations of Boraflex performance, unit engineers had questioned whether the Boraflex was capable of performing its reactivity function during a seismic event, given that the material was becoming brittle after exposure to radiation. As a result, an evaluation of the Boraflex performance during an SSE event was performed. To study the potential of seismic damage to the Boraflex, a series of analyses were carried out. First the input loading to the spent fuel rack was characterized by a set of time history accelerations of the spent fuel pool slab. Next the time history of the surface loading on a typical cell wall was derived by performing a 3-D seismic analysis of a spent fuel rack in the pool and extracting the fuel assembly to rack cell wall impact force history results. This dynamic analysis provided the impact force time history against the stainless steel plates. Next, simulating the details of fuel cell impact was performed by using a dynamic finite element code. The "flexed" profile of the stainless steel-Boraflex composite provided by a finite element code was processed to determine the presence and extent of Boraflex damage. The results of this seismic analysis predicted widespread cracking of the Boraflex during a SSE seismic event. Considering that shrinkage gaps could be present prior to the seismic event, it is possible that the seismic event could cause the Boraflex to crack and settle, leaving a coplanar gap at the top of the active fuel.

Further, the Boraflex cracking was predicted to be extensive enough that the post-seismic configuration of the Boraflex is difficult to predict. Additional settling of the Boraflex beyond just filling the assumed 4percent Boraflex shrinkage gaps could be possible.

The analysis of this event was performed using measured mechanical properties of heavily irradiated Boraflex. The unique results are believed to be primarily due to three factors: (1) the relatively thin wall thickness in the plant's racks, which is 60 mills of stainless steel; (2) the relatively small rack module sizes; and (3) the large weight of a fuel assembly, which produces rack wall deflection by shifting inside the cell during the SSE event.

Spent fuel pool boron concentration is normally maintained at approximately 2700 ppm independent of fuel handling operations or Technical Specifications. In addition, the plant has never experienced an SSE seismic to cause a degradation of the boraflex. Further, the condition of the Boraflex, as determined by testing, is better than the worst case conditions assumed in the criticality analysis. As such, there were no safety consequences and no reduction in the level of safety provided to the public as a result of this event.

IV. Corrective Action

The immediate action was to perform a preliminary criticality analysis of the spent fuel pool. This analysis used the limiting conservative assumption that no Boraflex was present to control reactivity after the seismic event occurred. The analysis determined that maintaining 1500 ppm of soluble boron in the fuel pool would maintain K-eff at less than 0.95, following a seismic event with no credit for any Boraflex. Technical Specifications currently require 800 ppm of boron in the storage pool water during fuel movement, to ensure that K-eff remains less than 0.95 under postulated accident conditions. Since the postulated SSE seismic event could require higher boron concentrations to maintain K-eff less than 0.95 with no credit for Boraflex, compensatory action was taken to require 1500 ppm boron in the spent fuel pool. Fuel pool boron concentration is currently being sampled every 72 hours. Fuel movement will not be allowed until further evaluations are performed. A final criticality analysis, conservatively assuming no Boraflex credit following the seismic event, will be performed. The spent fuel pool is normally borated to match the Refueling Water Storage Tank (RWST) boron concentration of approximately 2700 ppm.

Following completion of the final criticality analysis, a Proposed Technical Specification Change is planned to be submitted, to increase the Technical Specification requirement for spent fuel pool boron concentration from the current value of 800 ppm to a larger value determined by the final criticality analysis. Previous criticality analysis had concluded that 800 ppm boron in the water during fuel movement was sufficient to ensure that K-eff remained less than 0.95 under postulated accident conditions. The postulated seismic event condition will require a boron concentration in the spent fuel pool water greater than 800 ppm, and since the occurance of a seismic event cannot be predicted, the required boron concentration will have to be maintained at all times in anticipation of a possible seismic event. No boron in the water is needed to maintain K-eff less than 0.95 under non-accident conditions. This proposed technical specification change would restore the pool to full qualification.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

V. Additional Information

It is currently planned that when additional fuel storage racks are added to the unit's spent fuel pool, Boraflex will not be credited under any normal or accident conditions. This is currently planned to take place toward the end of fuel cycle 7. The unit is currently in fuel cycle 6.

Similar Events

None

Manufacturer Data

Westinghouse High Density Storage Rack Boraflex sheet
Part Number 3413C53