CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

April 9, 1997
Re: 10CFR50.73(a)(2)(i)
10CFR50.73(a)(2)(ii)
CY-97-029

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

Reference: Facility Operating License No. DPR-61
Docket No. 50-213
Reportable Occurrence LER 50-213/97-007-00

This letter forwards the Licensee Event Report 97-007-00, required to be submitted, pursuant to the requirements of the Haddam Neck Plant's Technical Specifications.

Very truly yours,

G. H. Bouchard
Unit Director

GHB/reb

Attachment: LER 50-213/97-007-00

cc: Mr. H. J. Miller
Regional Administrator, Region I
475 Allendale Road
King of Prussia, PA 19406

Mr. William J. Raymond
Sr. Resident Inspector
Haddam Neck

IE22

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)
Haddam Neck	05000213	1 of 5

TITLE (4)
Potential for Service Water System Water Hammer Following Loss of Normal Power

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
										05000
03	11	97	97	007	00	04	09	97	FACILITY NAME	DOCKET NUMBER 0500

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
		20.2201(b)	20.2203(a)(2)(v)	X 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)
Duncan Sabean, Engineering	(860) 267-2556

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)

On March 11, 1997, at approximately 1730 hours, with the plant defueled, a reportability evaluation determined that the service water (SW) supply line to the spent fuel pool (SFP) heat exchangers (HX) was inoperable. Following a loss of normal power (LNP), a potential exists for water hammer in the high point of the SW lines to the SFP HXs upon restart of a SW pump. The apparent cause of this event was that the original design of the plant and other earlier analyses did not identify the potential for water hammer. Short term corrective action consisted of revising a procedure and staging materials to allow installation of a temporary cooling line, using fire hose, in the event of the failure of the SW supply line to the SFP HXs. Long term corrective action consists of installing a check valve in the SW supply line to the SFP HXs which will hold the line full of water until pump restart following a LNP, thereby preventing water hammer.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Haddam Neck	05000213	97	--	007	--	00	2 of 5

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

BACKGROUND INFORMATION

The service water (SW) system (EIIS Code: BI) provides cooling water to both the primary and secondary systems during normal at power operation and plant cooldowns. It also provides cooling water to vital components during emergency conditions. The plant's four SW pumps comprise two SW headers. The north SW header includes the 'A' and 'B' SW pumps and the south SW header includes the 'C' and 'D' pumps. Technical Specification 3.7.3 requires two SW headers to be operable in Modes 1, 2, 3 and 4. The source of water for the SW system is the Connecticut River which is also the Haddam Neck Plant's ultimate heat sink. A single SW line supplies flow to two Spent Fuel Pool (SFP) heat exchangers (HXs), one of which is normally in service.

The Haddam Neck Plant is currently in a defueled condition and has notified the NRC of its decision to permanently cease power operation and permanently remove fuel from the reactor vessel. Therefore, all reference to operation in Modes 1, 2, 3 and 4 is no longer applicable to the SW system. In the defueled state, SW provides cooling to the SFP HXs, the emergency diesel generators and to a small number of secondary plant components.

Technical Specification 3.9.15 requires at least one SFP cooling pump and the plate heat exchanger be in operation and the SFP temperature to be less than 150 degrees F for the SFP cooling system to be operable in Mode 6, during transfer and storage of irradiated fuel from the reactor vessel to the spent fuel pool for a full core offload. If these conditions are not met, corrective action is to be initiated to restore the SFP cooling system to operable status as soon as possible. Although not required in the defueled state, Haddam Neck currently implements the requirements of the Technical Specification action statement.

EVENT DESCRIPTION

On March 11, 1997, at approximately 1730 hours, with the plant defueled, a reportability evaluation determined that the service water supply line to the spent fuel pool heat exchangers was inoperable. This line is located quite high relative to the rest of the system and is susceptible to drain down when SW is stopped due to a loss of normal power (LNP) event. A potential then exists for water column separation and subsequent water hammer in the SW line to the SFP HXs upon restart of a SW pump.

CAUSE OF EVENT

The apparent cause of this event was that the original design of the plant and other earlier analyses did not identify the potential for water hammer. An analysis was performed in-house in 1992 and was independently verified by a vendor. Both of these reviews concluded that the SW piping was not susceptible to significant water hammer forces associated with water column rejoining following water column separation.

SAFETY ASSESSMENT

This condition is reportable under 10CFR50.73 (a)(ii)(B) since it resulted in a condition outside the design basis of the plant. It is also reportable under 10CFR50.73(a)(2)(i)(B) as a condition prohibited by the plant's Technical Specifications since this condition existed when the SFP cooling system was required to be operable.

At present, only one SW pump is in operation due to the reduced demand for SW in the plant.

On an LNP, the SW pumps will trip and the system will lose pressure rapidly. This was shown to occur within approximately 2 seconds this past summer during the performance of a simulated LNP test. On an LNP, the SW air operated isolation valve (AOV) in the SFP HX return line will fail closed, which will limit draindown. Per quarterly surveillances over the past year, this valve closes in 3.5 to 4.2 seconds. Therefore, the time between loss of flow and AOV closure is approximately 2 seconds, during which time the SW velocity is low (decreasing from the initial 2.2 ft/sec) and the AOV is partially closed. Based on this, it was concluded that there is little chance for draindown on the SFP SW discharge line. Therefore, it was concluded that the SW return line to the SFP HX remained operable for this postulated event. Under current conditions, even if the AOV fails to close as designed, the return side is not expected to create a column void. Due to the low flow rates more of the pipes will be partly full of water enabling penetration of atmospheric air and entrapped air bubbles to decrease the effective elevations and dramatically reduce the potential for column separation.

The SFP SW supply line, on the other hand, could drain down to some extent during the time between the LNP and the SW pump restart which occurs 48 seconds later. Flow cannot drain back through the SW pumps because of pump discharge check valves. However, since the SFP supply and return lines are the high point of the SW system (El 63 ft and 64 ft, respectively), some draindown could occur through other branches of the SW supply header, such as the emergency diesel generator lines which automatically open 15 seconds after an LNP. These system conditions meet one of the criteria for inducing a column separation in a piping system, i.e., piping located at elevations high enough to result in pressures at the top of the column that fall below vapor pressure while the bottom of the column is open to the atmosphere. Therefore, because of the potential for draindown, column separation could not be ruled out in the SFP SW supply line. Once a vapor space is postulated to form, a water hammer load results from pump restart which causes the vapor column to rejoin.

The effects of the potential water hammer condition in the SW supply line to the SFP HX were reviewed to assess the impact on the structural integrity of the piping and supports. A preliminary review concluded that the pipe stress levels would be unacceptable for the anticipated transient. This was concluded following a segmented review of the piping stress analysis and considering the potential reduction in wall section properties as a result of corrosion (based on past inspections). Additionally, the support loads increased substantially and qualification of the supports was

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Haddam Neck	05000213	97	--	007	--	00	4 of 5

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

questionable even with detailed analysis. As a result, it was concluded that the water hammer transient could potentially fail the piping pressure boundary.

Based on this, the SW supply line to the SFP HX could not be shown to remain operable.

However, assuming the worst case scenario of a failure in the SW SFP supply line, compensatory measures could be taken to reestablish flow to the SFP before the Tech Spec pool temperature limit of 150 degrees F is reached. Preliminary SFP heatup rates (assuming no credit for evaporative losses) indicate a present heatup rate of 1.763 degrees F per hour with no cooling water flow to the SFP HX. During the recent installation of fire hoses, to provide temporary cooling, actual heatup rates were shown to be less than 1.5 degrees F per hour. Assuming a starting temperature of 90 degrees F, which conservatively reflects conditions at the time of discovery, the pool would not reach its design temperature of 150 degrees F for 34 hours. This time frame is sufficient to install a temporary cooling water supply hose, if needed.

Based on the above evaluations, it was concluded that the safety significance of this event is low.

CORRECTIVE ACTION

Short term corrective action consisted of revising a plant procedure to allow installation of a temporary cooling line using fire hose in the event of the failure of the SW supply line to the SFP HX. In addition, all materials required for a temporary cooling water supply line were staged to allow for immediate installation in the unlikely event of a failure of the SW supply line. Based on the preliminary SFP heatup calculations which indicated that the pool would not reach its design temperature of 150 degrees F for 34 hours, it was concluded that there would be adequate time to install this temporary cooling water supply line, if needed.

Long term corrective action is to install a 6-in check valve in the single SW supply line to the SFP HXs which will hold the line full of water until pump restart following the LNP. This will preclude column separation and subsequent rejoining with associated water hammer forces.

The system design for this check valve assumes a maximum permissible leakage of 2 gpm. This amount of leakage accomodates a service water flow interruption of 48 seconds, which corresponds to the time that is required for a diesel to start and load a service water pump after a loss of offsite power. For extended loss of power events, emergency operating procedure EOP 3.1-10, "Partial Loss of AC" is being revised so that the restart of a SW pump after a prolonged loss of flow, coupled with slight leakage of the new check valve, will not result in the sudden pressurization of a section of voided SW piping and the potential for water hammer.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Haddam Neck	05000213	97	--	007	--	00	5 of 5

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

ADDITIONAL INFORMATION

The following are commitments made within this report. All other statements are for information only.

CY 97-029-1 A 6-in check valve will be installed in the single SW supply line to the SFP Hxs.

CY 97-029-2 Emergency operating procedure EOP 3.1-10, "Partial Loss of AC" will be revised.

PREVIOUS SIMILAR EVENTS

LER 96-013-00, CAR Fan Service Water Piping Susceptible to Water Hammer