CONNECTICUT YANKEE ATOMIC POWER COMPANY

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

October 22, 1996
Re: 10CFR50.73(a)(2)(i)
B15955

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 50-213/96-024-00

This letter forwards the Licensee Event Report 96-024-00, required to be submitted, pursuant to the requirements of the Haddam Neck Plant's Technical Specifications.

Very truly yours,

J. J. LaPlatney
Unit Director

JJL/eda

Attachment: LER 50-213/96-024-00

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 (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)
Haddam Neck	05000 -213	1 OF 6

TITLE (4)
'B' Residual Heat Removal Pump Found Inoperable in Mode 5 (Cold Shutdown)

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
09	01	96	96	-- 024 --	00	10	22	96	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	5
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	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)		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)
William M. Forrestt, Technical Support	(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
B	BP	P	P025	Y						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		12	31	96

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

On September 1, 1996, at 1419 hours, with the plant in Mode 5 (cold shutdown) for the cycle 19 refueling and maintenance outage, an attempt to start the 'B' residual heat removal (RHR) pump resulted in pegged motor current indication, indicative of a locked rotor. The pump start failure resulted from a previous, undetected shaft rub which displaced a stationary stuffing box bushing, eventually seizing the pump once stopped. Since the 'B' RHR pump was last run, and subsequently shut down, on August 19, 1996 it is assumed that the pump was inoperable since that date. The root cause was determined to be the combination of original manufacturing defects coupled with a marginal pump design. Initial corrective action consisted of replacing the pump's rotating element. The pump was returned to service on September 25, 1996 at 2144 hours. Additional corrective action includes a manufacturer's design analysis and inspection/overhaul on the 'A' RHR pump during reactor core offload. Implementation of the corrective action is contingent upon resumption of operation of the Haddam Neck Plant. A supplemental report will be submitted detailing the extent of the corrective actions taken. The root cause investigation was completed on September 23, 1996 and this event was determined to be reportable on September 24, 1996 with the plant in Mode 5.

REQUIRED NUMBER OF DIGITS/CHARACTERS
FOR EACH BLOCK

BLOCK NUMBER	NUMBER OF DIGITS/CHARACTERS	TITLE
1	UP TO 46	FACILITY NAME
2	8 TOTAL 3 IN ADDITION TO 05000	DOCKET NUMBER
3	VARIES	PAGE NUMBER
4	UP TO 76	TITLE
5	6 TOTAL 2 PER BLOCK	EVENT DATE
6	7 TOTAL 2 FOR YEAR 3 FOR SEQUENTIAL NUMBER 2 FOR REVISION NUMBER	LER NUMBER
7	6 TOTAL 2 PER BLOCK	REPORT DATE
8	UP TO 18 -- FACILITY NAME 8 TOTAL -- DOCKET NUMBER 3 IN ADDITION TO 05000	OTHER FACILITIES INVOLVED
9	1	OPERATING MODE
10	3	POWER LEVEL
11	1 CHECK BOX THAT APPLIES	REQUIREMENTS OF 10 CFR
12	UP TO 50 FOR NAME 14 FOR TELEPHONE	LICENSEE CONTACT
13	CAUSE VARIES 2 FOR SYSTEM 4 FOR COMPONENT 4 FOR MANUFACTURER NPRDS VARIES	EACH COMPONENT FAILURE
14	1 CHECK BOX THAT APPLIES	SUPPLEMENTAL REPORT EXPECTED
15	6 TOTAL 2 PER BLOCK	EXPECTED SUBMISSION DATE

BACKGROUND INFORMATION

During COLD SHUTDOWN and refueling operations the residual heat removal (RHR) system (EIIS Code:BP) maintains the reactor coolant system (RCS) (EIIS Code: AB) at the appropriate temperature and also ensures that the boron concentration in the RCS will remain equalized. In this mode of operation one of two parallel RHR pumps takes a common suction from the RCS loop 1 hot leg and discharges reactor coolant, via a common discharge line, to one of two full capacity tube and shell heat exchangers. The coolant is then returned to the RCS loop 2 cold leg.

The RHR system is also used for post accident sump recirculation. When sufficient water is injected from the RWST to fill the containment sump, short term recirculation is entered. In this alignment, one residual heat removal (RHR) pump (EIIS Code: P) takes suction from the sump and supplies water to the suction of one HPSI pump, which delivers water to two of the four cold legs. After a predetermined time has elapsed, two path recirculation is initiated. In this alignment, one RHR pump takes suction from the sump and supplies water to the suction of one charging pump, which delivers water at high pressure to the loop two cold leg. The RHR pump also supplies low pressure water directly to the upper reactor vessel head (core deluge).

The RHR pumps are original plant equipment which have been completely overhauled several times over the past 28 years. The 'B' RHR pump was last overhauled in 1987. The pump re-assembly had provided running clearances that, while within manufacturer's design specifications, were relatively tight. The 'B' RHR pump had since been operating as required, with no significant abnormalities identified up to pump failure.

EVENT DESCRIPTION

On September 1, 1996 at 1419 hours, with the plant in Mode 5 (cold shutdown) for the cycle 19 refueling and maintenance outage, an attempt to start the 'B' residual heat removal (RHR) pump resulted in a pegged motor current, indicative of a locked rotor. The pump start failure resulted from a previous, undetected shaft rub which displaced a stationary stuffing box bushing, eventually seizing the pump once

stopped. Since the 'B' RHR pump was last run, and subsequently shut down, on August 19, 1996, it is assumed that the pump was inoperable since that date.

The pump overhaul took approximately 24 days to complete, including post maintenance testing. The fundamental reason for the prolonged repair effort involved defective parts on the new, spare back pullout assembly coupled with original manufacturing defects on the existing unit. As a result, many new spare parts were reworked off site. Additional restoration delays are attributed to pump venting problems, special test procedure creation and revisions, questions on motor performance signatures, a constant level oiler defect and the failure to identify oil baffle seal clearance problems during the overhaul.

The pump was returned to service on September 25, 1996 at 2144 hours.

CAUSE OF THE EVENT

The root cause investigation was completed on September 23, 1996 and this event was determined to be reportable on September 24, 1996 with the plant in Mode 5.

The root cause of this event was determined to be the combination of original manufacturing defects coupled with a marginal pump design.

The main cause of the pump failure is attributed to numerous design defects found with various pump components. These discrepancies included casing head concentricity problems, pump head to casing loose rabbit fit and an eccentric pump casing. These deficiencies coupled with anticipated shaft deflection caused wear ring rubbing during pump starts. The rubbing and wear ring wear worsened over time resulting in increased shaft deflection and eventual rubbing in the stuffing box area. This pump has a 316 stainless steel shaft sleeve running in a stainless steel stuffing box bushing with minimal running clearances. In time, the shaft sleeve contacted the stationary stuffing box bushing. The intermittent contact of the shaft sleeve on the stuffing box bushing, eventually broke the tack welds which held the throttle bushing to the head. Continued intermittent contacts worked the stuffing box bushing out of its pressed fit into the stuffing box bore. Eventually, the bushing traveled down the shaft, became cocked and anchored in the stuffing box sometime during the August 19, 1996 run. Once the pump was secured, cooling and subsequent fusing occurred causing pump seizure.

The RHR pumps are assembled with many stacked fits (e.g. loose fit parts which fit inside of one another, otherwise known as a rabbit fit). These stacked fits may be relatively loose, per the original design specification or may lack proper concentricity or perpendicularity. The net effect of stacked, out of tolerance fits is to reduce running clearances increasing the likelihood of running contact. Additionally, the pump has many running fits which have 316 stainless steel on both the rotating and stationary parts, thereby creating a potential for galling. This design is relatively intolerant of disturbances.

SAFETY ASSESSMENT

This event is reportable under 10CFR50.73(a)(2)(i)(B) as any operation or condition prohibited by the plant's Technical Specifications.

Technical Specification 3.4.1.4.2 requires that two residual heat removal loops shall be operable and one RHR loop in operation in Mode 5. The action statement requires that with less than two RHR loops operable, immediately initiate corrective action to return the required loop(s) to operable status.

Since it was unknown that the 'B' RHR pump was inoperable since August 19, 1996, immediate corrective action to return it to service was not taken resulting in a condition prohibited by the Technical Specifications.

By itself, the safety significance of this event is low since the 'A' RHR pump was operable and in operation. One train of RHR is sufficient to remove decay heat from the core. However, during the period August 28,1996 to September 1, 1996 the unit was experiencing nitrogen intrusion into the reactor vessel, through a closed leaking valve, which further reduced the margin of safety due to the potential for losing RHR cooling. The nitrogen intrusion event was reported in LER 96-021-00, dated October 11, 1996.

In the event of a loss of the RHR pumps operators would enter Abnormal Operating Procedure AOP 3.2-12, "Loss of Residual Heat Removal System". This procedure provides guidance for aligning an alternate cooling method or for aligning a makeup water source to the reactor vessel when an alternate cooling method is not available to increase the time to

boiling in the core. Inventory could have been added using the low pressure safety injection system. At the time of the event all four reactor coolant loops were available for natural circulation upon opening the loop stop valves.

CORRECTIVE ACTION

The 'B' RHR pump's rotating element was replaced and the pump was restored to operable status on September 25, 1996 at 2144 hours.

The new spare 'B' RHR pump element had running clearances increased, individual parts restored to manufacturer's design tolerances and critical fits corrected. Subsequent post maintenance testing verified satisfactory pump operation.

In order to assess material questions and thermal cycling effects which may be experienced during post accident service, the manufacturer will perform a design analysis of the RHR pumps. In addition to assessing material compatibility, running clearances, shaft deflection and thermal growth, the design analysis will consider service conditions, maintenance history and pump overhaul inspection results. The RHR pumps will not be credited for Mode 4 operability until the design review is complete and all subsequent corrective actions are implemented.

Additionally, a complete inspection/overhaul will be performed on the 'A' RHR pump after the core is off-loaded.

All stored RHR pump parts are being returned to the manufacturer for dimensional verification and rework, as necessary.

Implementation of the above corrective action is contingent upon resumption of operation of the Haddam Neck Plant.

A supplemental report will be submitted detailing the extent of the corrective actions taken.

ADDITIONAL INFORMATION

Component	Manufacturer	Model No.
'B' RHR pump	Pacific Pumps	8" LX, type SVCR

Commitments

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

B15955-1 A design analysis of the RHR pumps will be performed.

B15955-2 The RHR pumps will not be credited for Mode 4 operability until the design review is complete and all subsequent corrective actions are implemented.

B15955-3 A complete inspection/overhaul will be performed on the 'A' RHR pump after the core is off-loaded.

Implementation of the above corrective action is contingent upon resumption of operation of the Haddam Neck Plant.

B15955-4 A supplemental report will be submitted detailing the extent of the corrective actions taken.

PREVIOUS SIMILAR EVENTS

There have been two previous pump seizures (1967 and 1968). Both failures were attributed to tight wear ring clearances and excessive thermal cycling (i.e. initiating RHR at 380 degrees F versus 300 degrees currently).