CENTERIOR ENERGY

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VICE PRESIDENT - NUCLEAR

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PY-CEI/NRR-1356 L

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

Perry Nuclear Power Plant
Docket No. 50-440
LER 91-011

Dear Sir:

Enclosed is Licensee Event Report 91-011 for the Perry Nuclear Power Plant.

Sincerely,

Michael D. Lyster

MDL:NJL:sec

Enclosure: LER 91-011

cc: NRC Project Manager
NRC Sr. Resident Inspector
NRC Region III

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NRC FORM 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

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)	DOCKET NUMBER (2)	PAGE (3)
Perry Nuclear Power Plant, Unit 1	0 5 0 0 0 4 4 0	1 OF 0 5

TITLE (4): Reactor Water Cleanup Containment Isolation Occurred During Plant Shutdown Due to High Differential Flow

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 NAMES	DOCKET NUMBER(S)
0 4	1 6	9 1	9 1	— 0 1 1	— 0 0	0 5	1 6	9 1		0 5 0 0 0
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OPERATING MODE (9)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
3	0 0 0	20.402(b)	20.405(c)	X 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 (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		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
	AREA CODE
Henry L. Hegrat, Compliance Engineer, Extension 5185	2 1 6 2 5 9 - 3 7 3 7

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
X YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		0 5	1 5	9 2

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

On April 16, 1991 at 0706 hours during a manual plant shutdown, a Reactor Water Cleanup (RWCU) System containment isolation occurred due to high differential flow. Immediate corrective action was taken to verify that no actual system leakage had occurred. The RWCU system was secured and subsequently returned to service.

The root cause of this event was due to a design deficiency associated with the reduced feedwater temperature mode of operation. The RWCU system was not originally intended to be operated in a reduced feedwater temperature mode of operation but was added by plant personnel after initial construction began in order to minimize the potential for feedwater system thermal stratification and stress. However, the necessity of the reduced feedwater temperature mode of operation introduced the potential for an unforeseen RWCU system event. In order to minimize future isolations, an on-going engineering evaluation will continue to investigate several concerns. In addition, a vendor evaluation was initiated to determine if there are any deleterious long-term effects resulting from flashing within the RWCU regenerative heat exchangers or possible waterhammer concerns. The outcome of these evaluations will provide appropriate corrective actions to minimize the recurrence of events similar to this isolation. A supplement to this LER will be provided upon completion of these corrective actions.

I. INTRODUCTION

On April 16, 1991 at 0706 hours during a manual plant shutdown, a Reactor Water Cleanup (RWCU) [CE] System containment isolation occurred due to high differential flow. At the time of the event, the plant was in Operational Condition 3 (HOT SHUTDOWN) with a reactor cooldown in progress. The reactor vessel [RPV] pressure was approximately 60 psig with reactor coolant temperature at 307 degrees Fahrenheit. The RWCU system was operating in the reduced feedwater temperature mode with one pump and one filter demineralizer in service.

II. DESCRIPTION OF EVENT

On April 16, 1991 at 0415 during startup following a 17 day maintenance outage, a leak was discovered inside the drywell from the Reactor Core Isolation Cooling head spray line. The startup evolution was stopped, and it was decided to place the plant in Operational Condition 4 (COLD SHUTDOWN) to repair the leak. At 0425, plant shutdown was initiated. As cooldown progressed, the RWCU system was operating in the reduced feedwater temperature mode with one pump [P] running and a suction flow of about 200 gpm. One filter/demineralizer [FDM] was in service. In accordance with approved operating instructions, return flow to the feedwater piping was bypassed around the shell side of the regenerative heat exchanger [HE]. This lineup returns flow to the feedwater system without reheating to minimize thermal stratification in the feedwater piping while feedwater heating is unavailable. At 0612, the RWCU system was briefly aligned to radwaste to discharge excess reactor water. At 0705 the attendant Licensed Operator received an "RWCU Delta Flow High Timer Run" alarm in the control room. The Licensed Operator unsuccessfully attempted to prevent the imminent isolation by throttling system flow control valves. With only 10 seconds remaining on the timer, the RWCU pump was manually tripped, in an attempt to avoid automatic closure of the divisional containment isolation valves. However at 0706, the RWCU system received a containment isolation signal from the Leak Detection system [IJ] and the Nuclear Steam Supply Shutoff system [JM] on high differential flow. After Licensed Operators verified that no actual leakage existed, the RWCU system was secured. The NRC Operations Center was informed of the event via the Emergency Notification System at 1006 hours in accordance with reportability requirements identified in 10CFR50.72. After reviewing the isolation with the oncoming shift, the RWCU system was returned to service at approximately 1100 hours without further incident.

III. CAUSE ANALYSIS

The root cause of the event is considered to be design deficiency. The RWCU system was not originally intended to be operated in a reduced feedwater temperature mode of operation, which was added by plant personnel after initial construction began in order to minimize the potential for feedwater system thermal stratification and stress. This mode of operation was a recommendation from NRC Information Notice No. 84-87: Piping Thermal Deflection Induced By Stratified Flow.

However, the necessity of the reduced f[illegible]ature mode of operation introduced the potential for an unfor[illegible]vent. While operating RWCU in the reduced feedwater temperature mo[illegible] bypasses the regenenative heat exchangers to closely match the RWC[illegible]re with feedwater to minimize thermal deflections in the f[illegible]er on the shell side of the regenerative heat exchanger is stagna[illegible]ure and very close to saturation conditions. As cooldown pro[illegible] ure transients can occur enabling this water to flash to steam. [illegible]ccurs, Licensed Operators have no indication that the RWCU system has p[illegible]oided until the void collapses sometime later. The collapse of this void results in a significant decrease in system return flow while system inlet flow is maintained constant. The differential flow conditions, if not halted, result in a system isolation.

During this event, the RWCU system return flow was aligned to the feedwater system in the reduced feedwater temperature mode of operation. Briefly at 0612, the RWCU system was partially aligned to Radwaste via the bypass blowdown line to drain excess reactor water. Opening of the blowdown line to Radwaste (at 60 psig) is believed to have introduced a pressure transient that reduced pressure within the regenerative heat exchangers below saturation conditions. At the time, no unusual operating conditions were noted by Licensed Operators. However, water inside the regenerative heat exchangers near reactor temperature (320 degrees F.) flashed to steam and caused a steam bubble or void to form. At 0705, the suspected void collapsed and RWCU filtered water refilled the low pressure void instead of returning to the RPV by way of the pressurized feedwater injection line. The refilling of the void resulted in a reduction of return flow to the feedwater line. The loss of return flow to feedwater was detected by the Leak Detection flow instrumentation and the Nuclear Steam Supply Shutoff system as designed. At 0706, the 45 second timer expired before the RWCU flow returned to normal values and caused the RWCU Containment Isolation to occur on high differential flow.

IV. SAFETY ANALYSIS

The Leak Detection System compares RWCU suction flow to discharge flows (return flow to the reactor vessel through the feedwater line and blowdown flows to the main condenser and radwaste). All three discharge flows are summed to generate a total discharge flow value. A RWCU high differential flow signal is generated from the Leak Detection System when RWCU suction flow exceeds discharge flow by 68 gpm. If this differential flow signal continues for 45 seconds, an RWCU system containment isolation will occur. This could occur as the result of a line break in the RWCU system. The 45 second time delay is intended to allow for system flow transients when operational configurations change. During this event, although no actual leak existed, an RWCU high differential flow did exist due to the apparent formation and subsequent collapse of a steam void in the regenerative heat exchangers, and the Leak Detection system responded as designed to indicate high differential flow and initiate containment isolation. All other plant systems responded as designed. Therefore, this event is not considered to be safety significant.

Following an RWCU containment isolation, the loss of the RWCU system may cause reactor coolant conductivity to slowly increase until the system is returned to service. In addition, during shutdown with little or no internal recirculation flow, reactor vessel thermal stratification may occur. However, since the out-of-service time was short during this RWCU isolation, the effects were minimal.

V. SIMILAR EVENTS

Other RWCU containment isolations have been reported in LERs 87-074, 88-002, 88-013, 88-039, 89-025, and 89-031. Corrective actions previously completed as a result of these events are described in their respective LERs. Previous root cause analyses did not identify the problem of potential voiding in the heat exchangers and therefore, the corresponding corrective actions taken would not have been effective in eliminating the voiding problem.

As the result of a recent event (LER 90-022), initial root cause determination indicated the potential for flashing. An engineering evaluation was initiated to verify the root cause of these isolations and recommend appropriate corrective action. As a result of this evaluation, the system operating instruction (SOI-G33) "Reactor Water Cleanup System" was recently changed to direct Licensed Operators to fully open the regenerative heat exchanger bypass throttle valve and to fully close the regenerative heat exchanger outlet throttle valve. This procedural change was intended to maintain regenerative heat exchanger pressure above saturation conditions, to prevent voiding and the associated isolations from occurring while operating in the reduced feedwater temperature mode. The April 16 event demonstrates that these measures were not fully effective; however, the operational data gathered from these two recent events has greatly increased the understanding of the physical system changes which may be causing the isolations.

VI. CORRECTIVE ACTION

Currently, the RWCU/Feedwater system interface is being evaluated for other system configurations that would provide RWCU backpressure control in all operating conditions. In order to prevent future isolations, an on-going engineering evaluation will continue to investigate several concerns. Some of these concerns include the following issues:

(1) review of the design basis for the Leak Detection differential flow timer
(2) feasibility of installing a bypass loop around the regenerative heat exchangers or other means of preventing flashing
(3) RWCU operational limitations when in the reduced feedwater temperature mode
(4) alternatives and operational ramifications if a fix for flashing is not feasible
(5) safety evaluation for a Technical Specification change request to permit longer flow transients if the condition is tolerable, and analysis provides no other means of preventing it.

In addition, a vendor evaluation was initiated to determine if there are any deleterious long-term effects resulting from flashing within the RWCU regenerative heat exchangers or possible waterhammer concerns. The outcome of these evaluations will provide appropriate corrective actions to minimize the recurrence of events similar to this isolation. A supplement to this LER will be provided upon completion of these corrective actions.

Energy Industry Identification System Codes are identified in the text as [XX].