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ENERGY

DOD

PERRY NUCLEAR POWER PLANT

10 CENTER ROAD  
PERRY, OHIO 44081  
(216) 259-3737

Mail Address:  
PO. BOX 97  
PERRY, OHIO 44081

Michael D. Lyster  
VICE PRESIDENT - NUCLEAR

June 10, 1991  
PY-CEI/NRR-1363 L

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

Perry Nuclear Power Plant  
Docket No. 50-440  
LER 90-022-01

Dear Sir:

Enclosed is Licensee Event Report 90-022-01 for the Perry Nuclear Power Plant. In addition, previously submitted Licensee Event Report 91-011-00 is attached for reference.

Sincerely,

Michael D. Lyster

MDL:NJL:njc

Enclosures: LER 90-022-01  
LER 91-011-00

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

Operating Companies  
Cleveland Electric Illuminating  
Toledo Edison

1400  
9106180304 910610  
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## LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATES TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20540, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1) Perry Nuclear Power Plant, Unit 1										DOCKET NUMBER (2) 0 5 0 0 0 4 4 0										PAGE 13	
TITLE (4) Two Reactor Water Cleanup Containment Isolations Occur During Plant Shutdown Due to High Differential Flow																					
EVENT DATE (5) 0 9 0 7 9 0				LER NUMBER (6) 0 2 2				REPORT DATE (7) 0 1 0 6 1 0 9 1				OTHER FACILITIES INVOLVED (8)									
OPERATING MODE (9) 3				THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5. (Check one or more of the following) (11)																	
POWER LEVEL (10) 0 0 0				20.402(a)				20.406(a)				50.73(a)(2)(i)				73.71(a)					
				20.406(a)(1)(i)				50.73(a)(1)				50.73(a)(2)(ii)				73.71(a)					
				20.406(a)(1)(ii)				50.73(a)(2)				50.73(a)(2)(iii)				OTHER (Specify in Abstract Section and in Text NRC Form 350A)					
				20.406(a)(1)(iii)				50.73(a)(2)(ii)				50.73(a)(2)(iv)(A)									
				20.406(a)(1)(iv)				50.73(a)(2)(iii)				50.73(a)(2)(iv)(B)									
				20.406(a)(1)(v)				50.73(a)(2)(iv)				50.73(a)(2)(v)									
LICENSEE CONTACT FOR THIS LER (12)																					
NAME Henry L. Hegrat, Compliance Engineer, Extension 5185										TELEPHONE NUMBER 7 1 6 2 6 9 - 3 7 3 7											
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)																					
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC DS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC DS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC DS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC DS		
SUPPLEMENTAL REPORT EXPECTED (14)															EXPECTED SUBMISSION DATE (15)		MONTH DAY YEAR				
YES (If yes, date of expected submission date)															X NO						

ABSTRACT (Enter no. 1409 unless, i.e., appropriate NRC staff member requires) (16)

On September 7, 1990 at 0633 and 1422, two Reactor Water Cleanup (RWCU) System containment isolations occurred due to high differential flow. The first isolation occurred following a planned, manual shutdown of the plant. The second event occurred during the subsequent RWCU system restoration. In response to the isolations, plant operators verified that no actual system leakage existed, completed securing the RWCU system, and returned the RWCU system to service at approximately 1500. These events were due to a design deficiency. During periods of reduced feedwater temperature, feedwater piping configuration requires the RWCU system return flow to be aligned to bypass the regenerative heat exchangers to minimize the return temperature. Although this lineup minimizes thermal stress in the feedwater piping, the potential is introduced for flashing within the RWCU regenerative heat exchangers and the resultant isolation as the system refills.

As a result of these isolations, an engineering evaluation was performed and system operating instructions were changed to add steps to minimize flashing during reduced feedwater temperature operations and to clarify startup requirements of the system. These events were discussed with all Licensed Operators during continuing training. With these actions implemented, however, an additional RWCU isolation occurred on April 16, 1991. Additional analysis and corrective actions are provided in LER 91-011.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 300 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-430), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20546, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (3)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
Perry Nuclear Power Plant, Unit 1	0 5 0 0 0 4 4 0	9 0	0 2 2	0 1 0 2	OF 0 4		

TEXT (if more space is required, use additional NRC Form 305A's) (7)

## I. INTRODUCTION

On September 7, 1990 at 0633 and at 1422 hours, two Reactor Water Cleanup (RWCU) [CE] system containment isolations occurred due to high differential flow. The first isolation followed a planned, manual shutdown of the plant. The second isolation occurred later during an attempt to return the RWCU system to service. At the time of the first event the plant was subcritical in Operational Condition 3 (HOT SHUTDOWN) with all control rods inserted and pressure decreasing following a planned, manual, reactor scram. The reactor vessel [RPV] pressure was approximately 395 psig with reactor coolant at saturated conditions. At the time of the second event, the RPV pressure was less than 100 psig and reactor coolant temperature was approximately 225 degrees Fahrenheit (F).

## II. DESCRIPTION OF EVENT

A planned, manual reactor scram was initiated on September 7, 1990 at 0558 from 10 percent of rated power. The plant was shutdown with all control rods inserted and the main steam lines were isolated to reduce the cooldown rate. The RWCU system was operating in the reduced feedwater temperature mode with one pump [P] running and a system suction flow of about 220 gpm. One filter/demineralizer [FDM] was in service. In accordance with approved operating instructions, two valves [V] that control return flow through the regenerative heat exchangers (RHXs) [HE] back to the feedwater lines were throttled to reduce return temperature and minimize thermal stratification in the feedwater piping while the reactor was cooling down. At 0600, a significant flow increase in the return to feedwater line occurred along with a 250 degree F increase in the outlet temperature of the RWCU RHXs. At 0633, the RWCU discharge flow dropped off from 170 gpm to zero with a simultaneous increase in suction flow from 220 gpm to 240 gpm. Both divisions of the RWCU received a containment isolation signal from the Nuclear Steam Supply Shutoff system [JM] when the Leak Detection system [IJ] measured high differential flow for 45 seconds. After the Licensed Operator verified that no actual leakage existed, the RWCU system was secured at 0700.

On September 7, 1990 at 1421 during an attempt to return the RWCU system to service, the Licensed Operator received an "RWCU Delta Flow High Timer Run" alarm immediately after opening the containment isolation valves in accordance with approved operating instructions. The Licensed Operator performing the RWCU system hot startup evolution had assumed that the system was solid with water; however, opening the divisional containment isolation valves aligned RPV pressure to a partially voided system. The resultant inrush of water filled the RWCU system causing the second isolation due to high differential flow at 1422. After reviewing the isolation with an oncoming Licensed Operator, the attendant Operator performed additional steps specified for a depressurized system. This approach was successful and the RWCU system was returned to service at approximately 1500 hours with no further difficulty. The NRC Operations Center was informed of these events via the Emergency Notification System at 0857 and 1500 hours in accordance with reportability requirements identified in 10CFR50.72.

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 (F-630), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20548, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (3)

PAGE (3)

Perry Nuclear Power Plant, Unit 1

0500044090

-022-01

03 OF 04

TEXT (If more space is required, use additional NRC Form 380A's) (17)

## III. CAUSE ANALYSIS

The first event was attributed to the unexpected formation of a steam void in the RHXs while operating in the reduced feedwater temperature mode of operation. In this mode, the flow rate through the RHXs is reduced in order to reduce RWCU return temperature and thereby minimize thermal stresses in the feedwater piping. During this event, reduction in RHX flow along with the reactor pressure decrease allowed water on the shell side of the RHXs (at reactor temperature and very close to saturation conditions) to flash into steam causing a void. A 250 degree F increase in the outlet temperature of the RWCU RHXs occurred along with a significant increase in return to feedwater flow. As cooldown progressed sometime later, the void collapsed and return flow refilled the RHXs instead of returning to the RPV via the feedwater injection line. The high differential flow was sensed by the Leak Detection system and resulted in a RWCU containment isolation.

The second event was also attributed to the steam void formation described above. The system operating instruction (SOI-G33) "Reactor Water Cleanup System (Unit 1)" for hot startup to normal recirculation mode was written for normal RWCU system behavior under pressurized conditions without steam void anomalies. The instruction had been previously changed on December 28, 1989 to minimize RWCU delta flow problems by instructing the Operator to close the RWCU pump suction isolation valves if the system is not pressurized. The assumption behind the procedure change was that pressure indication would provide positive assurance that the RWCU system was solid with water. However, the procedural change provided no guidance to the Licensed Operator in the event of steam voiding. After divisional containment isolation valves were opened, an influx of water filled the RWCU system and caused the second isolation to occur due to 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. Although no actual leak existed during this event, RWCU high differential flow did exist due to the formation and subsequent collapse of steam voids in the RWCU RHXs. The Leak Detection system responded as designed and initiated containment isolation. The reactor was already manually scrammed and remained in hot shutdown throughout this transient with all control rods fully inserted. All other plant systems responded as designed. Therefore, this event is not considered to be safety significant.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-430), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20549, AND TO THE PAPERWORK REDUCTION PROJECT (3190-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (8)

PAGE (3)

VER. SEQUENTIAL REVISION  
NUMBER NUMBER NUMBER

Perry Nuclear Power Plant, Unit 1 0 5 0 0 0 4 4 D 9 0 - 0 2 2 - 0 1 1 d 4 OF 0 4

TEXT (If change reported in subsequent LER, add additional NRC Form 388A's) (17)

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 these RWCU isolations, 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.

## VI. CORRECTIVE ACTIONS

As the result of this event, 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 (Unit 1)" was changed on April 11, 1991 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 minimize voiding and the associated isolations from occurring while operating in the reduced feedwater temperature mode. However, on April 16, 1991, another RWCU isolation occurred due to high differential flow while operating in the reduced feedwater temperature mode. Refer to LER 91-011. The April 16 event demonstrates that these measures were not fully effective; however, the operational data gathered from the recent event has greatly increased the understanding of the physical system changes which may be causing the isolations.

As part of the Licensed Operator Requalification training program, these events were discussed with all Licensed Operators. With these actions implemented, however, an additional RWCU isolation occurred on April 16, 1991 while operating in the reduced feedwater temperature mode. Additional analysis and corrective actions are provided in LER 91-011.

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

## LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 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)

Perry Nuclear Power Plant, Unit 1

DOCKET NUMBER (2)

050004401 OF 05

PAGE (3)

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

EVENT DATE (6)			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)
04	16	91	91	011	00	05	16	91			050004401

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 1.101 (Check one or more of the responses) (11)									
POWER LEVEL (10) 01010	3	70.4021a)	70.4051a)	X	50.735a21a)	73.710a)					
		70.405a111a)	50.735a111)		50.735a21a)	73.711a)					
		70.405a111a)	50.735a112)		50.735a21a)	OTHER (Specify in Remarks section and on back of this form) (66a)					
		70.405a111a)	50.735a211a)		50.735a21a)						
		70.405a111a)	50.735a212a)		50.735a21a)						

LICENSEE CONTACT FOR THIS LER (12)

NAME

Henry L. Hegrat, Compliance Engineer, Extension 5185

TELEPHONE NUMBER

AREA CODE

21116 215191-13171317

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

SUPPLEMENTAL REPORT EXPECTED (14)

EXPECTED SUBMISSION DATE (15)

MONTH DAY YEAR

YES (If yes, expected submission date)

NO

05 15 91

ABSTRACT (Limit to 1,000 words; i.e., approximately fifteen single-spaced typewritten lines) (16)

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

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 560 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-308), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20548, AND TO THE PAPERWORK REDUCTION PROJECT (J150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (3)

PAGE (3)

YEAR	SEQUENTIAL NUMBER	REVISION NUMBER
91	011	010

Perry Nuclear Power Plant, Unit 1 0 5 0 0 0 4 4 0 9 1 — 0 1 1 — 0 1 0 0 2 OF 0 5

TEXT (If space needed in preceding, use additional NRC Form 288A-1 (17))

## 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 [LJ] 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.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 560 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-330) U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20548, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104) OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)		PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER
Perry Nuclear Power Plant, Unit 1	0500044091	0111	0001	OF 05

TEXT (IF NEEDED) SHOULD BE PREPARED, WITH ADDITIONAL NRC FORM 3886's (17)

However, the necessity of the reduced feedwater temperature mode of operation introduced the potential for an unforeseen RWCU system event. While operating RWCU in the reduced feedwater temperature mode, the system flow bypasses the regenerative heat exchangers to closely match the RWCU return water temperature with feedwater to minimize thermal deflections in the feedwater piping. Water on the shell side of the regenerative heat exchanger is stagnant at reactor temperature and very close to saturation conditions. As cooldown progresses, slight pressure transients can occur enabling this water to flash to steam. If such flashing occurs, Licensed Operators have no indication that the RWCU system has partially voided 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.



LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 30.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-430), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20548, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (3)		PAGE (3)
		YEAR	SEQUENTIAL NUMBER	
		REVISION NUMBER		
Perry Nuclear Power Plant, Unit 1	0 5 0 0 0 4 4 0	9 1	0 1 1	0 0 0 4 OF 0 5

TEXT (if any) should be included, and shall be NRC Form 308A (17)

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.

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 (F-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20548, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DOCKET NUMBER (2)

LER NUMBER (8)

PAGE (3)

YEAR SEQUENTIAL REVISION  
NUMBER NUMBER NUMBER

Perry Nuclear Power Plant, Unit 1

0 5 0 0 0 4 4 0 9 1 — 0 1 1 — 0 0 0 5 OF 0 5

TEXT (If more space is required, use additional NRC Form 305A's) (7)

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].