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Exelon Nuclear

10CFR50.73

June 21, 2004

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Unit 1 and Unit 2
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket No. 50-352 and 50-353

Subject: LER 1-04-001, Unplanned Potential Inoperability of RCIC and HPCI Due To Air In Suction Lines

This Licensee Event Report (LER) addresses a 32-day period of unplanned inoperability of Unit 1 reactor core isolation cooling (RCIC) system. Coincident with the Unit 1 RCIC inoperability there was a 34-hour period during which Unit 1 high pressure coolant injection (HPCI) system was inoperable for maintenance. In addition over the three year reporting period there were brief periods when the associated unit's HPCI system was potentially inoperable during unit restart following refueling outages prior to the 920-psig HPCI surveillance test. The potential inoperability of these systems was due to design and procedure deficiencies that resulted in air in the pump suction lines. The periods when HPCI was potentially inoperable during unit restart also represented brief periods when a condition existed (i.e., air in the suction lines) that could have prevented the fulfillment of the safety function of Unit 1 and Unit 2 HPCI if a transfer from the CST to the suppression pool suction path was required during an accident. The air has been vented from the Unit 1 and Unit 2 RCIC pump suction lines and the Unit 1 and Unit 2 HPCI pump suppression pool suction lines. Also procedures have been revised to include venting of the affected suction line sections.

Report Number:	1-04-001
Revision:	00
Event Date:	April 20, 2004
Discovered Date:	April 20, 2004
Report Date:	June 21, 2004

This LER is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(i)(B) and 10CFR50.73(a)(2)(v).

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If you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

Ron J. DeGregorio
Vice President - Limerick

cc: H. J. Miller, Administrator Region I, USNRC
A. L. Burritt, USNRC Senior Resident Inspector, LGS

SUMMARY OF EXELON NUCLEAR COMMITMENTS
LS-AA-117-1003 Rev.1

The following table identifies commitments made in this document by Exelon Nuclear. (Any other actions discussed in the submittal represent intended or planned actions by Exelon Nuclear. They are described to the NRC for the NRC's information and are not regulatory commitments.)

Commitment #1 Committed date (or "outage"): 8/2/04

Unit 2 RCIC suction pressure transmitters will have damping added. This will be complete by 8/2/04.

Commitment #2 Committed date (or "outage"): Outage

A modification will be implemented to address the section of RCIC pump suction line without a vent path associated with the abandoned RHR steam-condensing mode on Unit 1 and Unit 2. This will be complete by the next refueling outage. Unit 2 refueling outage (2R08) is scheduled for March 2005. Unit 1 refueling outage (1R11) is scheduled for March 2006.

Commitment #3 Committed date (or "outage"): Outage

A modification will be implemented to address the lack of a vent on the HPCI pump suppression pool suction check valve bonnets. This will be complete by the next refueling outage. Unit 2 refueling outage (2R08) is scheduled for March 2005. Unit 1 refueling outage (1R11) is scheduled for March 2006.

Commitment #4 Committed date (or "outage"): 9/1/04

A validation of Unit 1 and Unit 2 ECCS fill and vent procedure effectiveness will be conducted. This will be complete by 9/1/04.

NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Limerick Generating Station, Unit 1	05000 352	1 OF 7

TITLE (4)

Unplanned Inoperability Of RCIC and HPCI Due To Air In Suction Lines

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									Limerick Unit 2	05000353
04	20	2004	2004	- 001 -	00	06	21	2004	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)

20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)	
20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)	
20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)	
20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)	
20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A	
20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)			
20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)	x	50.73(a)(2)(v)(D)			
20.2203(a)(2)(v)	x	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)			
20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)			
20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)			

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Keith S. Kemper, Manager – Experience Assessment	(610) 718-3400

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	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)

Air was discovered in the pump suction lines of Unit 1 and Unit 2 reactor core isolation cooling (RCIC) and high pressure coolant injection (HPCI) systems. The condition was identified during an investigation of an actuation of the Unit 1 RCIC pump low suction pressure turbine trip that occurred with RCIC in the standby mode during performance of the ECCS - Condensate Storage Tank Level Functional Test. The air was present due to a combination of design deficiencies and procedural deficiencies. The RCIC pump suction piping design, associated with the abandoned RHR steam-condensing mode, was deficient in that a vent valve was not provided. The procedures for filling and venting of the HPCI pump suction lines following maintenance did not include venting between the suppression pool suction check valve and the pump. The air has been vented from the Unit 1 and Unit 2 RCIC pump suction lines and the HPCI pump suppression pool suction lines. Also procedures have been revised to include venting of the affected suction line sections.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	2 OF 7

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

Unit Conditions Prior to the Event

Unit 1 was in Operational Condition (OPCON) 1 (Power Operation) at approximately 100% power. Unit 2 was in Operational Condition (OPCON) 1 (Power Operation) at approximately 100% power. There were no structures, systems or components out of service that contributed to this event.

Description of the Event

On April 20, 2004, at 02:45 hours, instrumentation and control (I&C) technicians were performing surveillance (ST-2-055-601-1) on the Unit 1 condensate storage tank (CST) low-level instrumentation with the high pressure coolant injection (HPCI) (EIIS:BJ) and reactor core isolation cooling (RCIC) (EIIS:BN) systems in the standby mode. The test actuated the HPCI system automatic pump suction transfer from the CST to the suppression pool as planned.

A RCIC pump (EIIS:P) low suction pressure turbine trip occurred when the HPCI suppression pool suction valves (EIIS:V) opened. The RCIC pump low and high suction pressure alarms (EIIS:PA) also annunciated. No HPCI alarms or trips were observed. RCIC was declared inoperable. At 02:51 hours the RCIC turbine trip was reset and RCIC was declared operable.

At 21:29 hours the surveillance was repeated with additional instrumentation installed. No abnormalities were noted during the test. On April 21, 2004, at 00:53 hours, Unit 1 HPCI suction was aligned to the suppression pool to eliminate the hydraulic interaction on the common CST suction line.

Between April 20 and May 21, 2004 air was vented from Unit 1 and Unit 2 HPCI and RCIC suction piping and testing was performed on Unit 1 to confirm the mitigating effect of the venting activities. Air was vented from the HPCI suppression pool suction piping between the check valve and the outboard suction valve, the bonnets of the HPCI pump suppression pool suction check valves, and the RCIC pump suction piping associated with the abandoned RHR steam-condensing mode. Unit 1 testing confirmed that the pressure perturbation was reduced in magnitude after each venting activity. On May 6, 2004 damping was added to the Unit 1 RCIC pump suction pressure instruments. On May 19, 2004 Unit 1 HPCI suction was realigned to the CST.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	3 OF 7

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

Prior to the event, on February 12, 2004, maintenance was conducted on the RCIC pump that drained the pump suction piping. The restoration from this maintenance did not vent a section of the RCIC suction piping associated with the abandoned RHR steam-condensing mode due to lack of an adequate vent path. The RCIC pump suction pressure instruments are located on this section of suction piping. The CST low-level surveillance was performed on several occasions during the interval between this maintenance and the March 2004 refueling outage. These tests did not cause a RCIC turbine trip or the high and low pump suction pressure alarms.

The HPCI pump suction was drained during the refueling outage in March 2004. HPCI fill and vent was completed on March 14, 2004 but the fill and vent procedure did not include venting the suppression pool suction line section between the check valve and the pump. This resulted in an air volume being present in the HPCI suppression pool suction during unit restart until reduced by the 920-psig surveillance. The 200-psig HPCI pump flow surveillance is run with a suction from the CST and returned to the CST. The 920-psig surveillance is also run from the CST but includes running HPCI with a suction from the suppression pool, returning to the suppression pool through the pump minimum flow line.

RCIC was operable when reactor pressure exceeded 150 psig on March 18, 2004 at 04:43 hours and remained operable until completion of the HPCI 920-psig surveillance on March 19, 2004 at 14:08 hours. The HPCI alignment to the suppression pool suction path in the minimum flow mode during the 920-psig surveillance likely resulted in the HPCI suppression pool suction check valve being not fully seated at the conclusion of the test due to normal hinge pin friction. RCIC was inoperable from this time until the event on April 20, 2004. This resulted in exceeding the TS 3.7.3 RCIC 14-day allowable outage time (AOT) for RCIC inoperability. The RCIC turbine trip was reset at 02:51 hours and RCIC remained operable from this point.

Unit 1 HPCI was potentially not operable when reactor pressure exceeded 200 psig on March 18, 2004 at 07:24 hours. TS 3.0.4 does not permit exceeding 200 psig in OPCON 2 with HPCI inoperable. The 920-psig surveillance was completed on March 19, 2004 at 14:08 hours at which time HPCI was removed from service to perform maintenance on a degraded handswitch. HPCI remained inoperable until restoration from the maintenance activity was complete on March 21, 2004 at 00:36 hours.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	4 OF 7

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

The potential for air binding of the HPCI pump due to air in the suction piping was present on two additional occasions during the three-year reporting period. Unit 2 HPCI was potentially not operable for a similar brief period during restart from the last Unit 2 refueling in March 2003. Unit 1 HPCI was also potentially not operable for a similar brief period during restart from the Unit 1 refueling in March 2002.

Unit 1 RCIC was inoperable during the 34-hour period that Unit 1 HPCI was inoperable for repair of the degraded handswitch. Therefore, the AOTs for TS 3.5.1 ECCS and TS 3.7.3 RCIC were both exceeded.

This event involved conditions that were prohibited by the plant's Technical Specifications. Therefore, this LER is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(i)(B).

This event involved three occasions in the three-year reporting period during which for a brief period during unit restart a condition that could have prevented the fulfillment of the safety function for the HPCI system existed on the unit being restarted. The failure to use a vent valve (EIIS:VTV) during system restoration resulted in air remaining in the HPCI suppression pool suction line. It is possible that the air could have resulted in air binding the HPCI pump during a transfer to the suppression pool suction path. Therefore, this LER is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(v)(D).

Analysis of the Event

There were no actual safety consequences associated with this event. The potential safety consequences of this event were minimal. It is possible that RCIC would have tripped if aligned to the CST when HPCI automatically transferred to the suppression pool suction path on low CST level or high suppression pool level. The operators would have restored RCIC by procedure using main control room operator actions directed by control room annunciator response procedure actions.

During Unit 1 restart, for a 31-hour period between exceeding 200 psig reactor pressure and the 920 psig surveillance, there was the potential that the HPCI pump would have become air bound following a transfer to the suppression pool suction path. A transfer to the suppression pool suction at full flow would potentially draw the air into the pump and may have caused air binding to occur.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	5 OF 7

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

Prior to the refueling outage on February 12, 2004, the RCIC pump was removed from service for maintenance. The suction was drained and refilled which introduced air into the abandoned RHR steam condensing mode section of the RCIC pump suction piping. A vent is not provided in this section of piping.

During the last Unit 1 refueling outage a design change was implemented that replaced the motor operator and gear set on the HPCI inboard suppression pool suction valve and the valve position was changed to normally open. The valve stroke time was reduced by this modification.

Based on review of system performance it is likely that the HPCI suppression pool check valve may not fully close after opening under low flow conditions (e.g., during the 920-psig surveillance or during venting activities). If the check valve is open when the transfer to the suppression pool occurs a reverse flow to the suppression pool is briefly present until the check valve closes. When the check valve closes a pressure wave is created in the associated piping including the shared CST suction line. The magnitude of the reverse flow and the resultant pressure wave are exacerbated by the reduced stroke time of the HPCI inboard suppression pool suction valve. After the check valve closes the momentum of the water causes compression of the air voids in the HPCI suppression pool suction line and the RCIC pump suction line section associated with the abandoned RHR steam condensing mode. It is believed that the conditions required for the transient were established during the HPCI system testing during restart from the refueling outage on March 19, 2004.

The major portion of the air in the HPCI suppression pool suction line is believed to have migrated through the open check valve upper seating surface and entered the suppression pool during the period of low flow operation with the pump suction aligned to the suppression pool on March 19, 2004. The volume of air that was remaining in the suppression pool suction line following the 920 psig surveillance was determined to be insufficient to cause air binding of the pump.

A computer model of the HPCI and RCIC pump suction hydraulic interactions is currently under development.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	6 OF 7

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

Cause of the Event

The root cause of the Unit 1 RCIC inoperability was a design deficiency. The design deficiency resulted in portions of the RCIC pump suction associated with the abandoned RHR steam-condensing mode piping to not have provisions for venting. Also fill and vent procedure deficiencies allowed for an air volume in the HPCI and RCIC systems suction piping. These air voids allowed fluid motion and pressure waves, causing receipt of the Unit 1 RCIC low suction pressure alarm and turbine trip.

There were two contributing factors for the RCIC inoperability. The first contributing factor was the design change installed during the March 2004 Unit 1 refueling outage that reduced the stroke time of the HPCI pump inboard suppression pool suction valve. This design change increased the magnitude of the pressure wave to a point that exceeded the RCIC pump low suction pressure trip setpoint. The second contributing factor was the HPCI suppression pool suction check valve failure to fully close when securing from low flow operation.

The cause of Unit 1 and Unit 2 HPCI system potential inoperabilities was a procedure deficiency that resulted in a failure to vent the section of HPCI pump suction between the suppression pool suction check valve and the pump. A contributing factor was a design deficiency related to the lack of vent paths in the HPCI suppression pool suction check valve bonnets.

Corrective Action Completed

Air was vented from the Unit 1 and Unit 2 HPCI suppression pool suction lines including the check valve bonnets.

Air was vented from the Unit 1 and Unit 2 RCIC suction line sections associated with the abandoned RHR steam-condensing mode.

The vent valve (Unit 1 055-1041 and Unit 2 055-2041) on the HPCI suppression pool suction line was added to the HPCI fill and vent procedure (S55.3.A) on Unit 1 and Unit 2.

Venting of the HPCI suppression pool suction check valve bonnets has been added to the HPCI fill and vent procedure (S55.3.A).

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Limerick Generating Station, Unit 1	05000352	2004	- 001 -	00	7 OF 7

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

Venting of the RCIC suction steam condensing mode line has been added to the RCIC fill and vent procedure (S49.3.A).

Unit 1 RCIC suction pressure transmitter damping has been added.

Corrective Action Planned

Unit 2 RCIC suction pressure transmitters will have damping added. This will be complete by 8/2/04.

A modification will be implemented to address the section of RCIC pump suction line without a vent path associated with the abandoned RHR steam-condensing mode on Unit 1 and Unit 2. This will be complete by the next refueling outage. Unit 2 refueling outage (2R08) is scheduled for March 2005. Unit 1 refueling outage (1R11) is scheduled for March 2006.

A modification will be implemented to address the lack of a vent on the HPCI pump suppression pool suction check valve bonnets. This will be complete by the next refueling outage. Unit 2 refueling outage (2R08) is scheduled for March 2005. Unit 1 refueling outage (1R11) is scheduled for March 2006.

A validation of Unit 1 and Unit 2 ECCS fill and vent procedure effectiveness will be conducted. This will be complete by 9/1/04.

Previous Similar Occurrences

None

Component data:

System:	BN	(Reactor Core Isolation Cooling)
Component:	P	(Pump)
Manufacturer:	B260	(Sulzer Pumps)
Model:	6X6X10-1/2 CP TYP	

Attachment:
Simplified drawing of HPCI and RCIC suction

Attachment 1