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10CFR50.73

June 18, 2001

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

Subject: LER 2-01-002 Loss of ATWS Flow Split Feature

Limerick Generating Station, Unit 2
Facility Operating License No. NPF-85
NRC Docket No. 50-353

This Licensee Event Report (LER) addresses the failure of a relay which prevented the opening of a discharge valve in the Unit 2 High Pressure Coolant Injection (HPCI) flow path through the feedwater system, and its effect upon the plant's response to postulated anticipated transients without scram (ATWS) events. This relay failure was discovered as part of surveillance testing conducted during refueling outage 2R06.

Report Number:	2-01-002
Revision:	00
Event Date:	April 17, 2001
Discovered Date:	April 17, 2001
Report Date:	June 18, 2001
Facility:	Limerick Generating Station P.O. Box 2300, Sanatoga, PA 19464-2300

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

Very truly yours,

Robert C. Braun
Plant Manager

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

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

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

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

Loss of HPCI Injection Flow Split ATWS Mitigation Feature Due To Relay Failure

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 05000
4	17	01	01	0 0 2	00	6	18	01	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 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)		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)
K. W. Gallogly, 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
B	BJ	RLY	T 1 9 8	Y					

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)

On April 17, 2001 at 16:45 hours during refueling outage 2R06, High Pressure Coolant Injection (HPCI) system valve HV-055-2F105 failed to open during a 24-month surveillance test. The cause of the problem was determined to be a position monitor relay whose contacts failed to fully close when the relay was de-energized. The failed relay was replaced and the valve control logic was tested satisfactorily prior to Unit 2 restart. The inability to open valve HV-055-2F105 could have prevented the fulfillment of the safety function of a flow split feature (UFSAR 15.8.3.7) intended to mitigate the consequences of an anticipated transient without scram (ATWS) event. The design basis safety function of the HPCI system to provide emergency core cooling was not affected because adequate injection flow would exist to maintain peak clad temperature below previously analyzed values.

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

Unit Conditions Prior to the Event

Unit 2 was in Operational Condition (OPCON) 5, Refueling, with the sixth refueling outage (2R06) underway. There were no structures, systems or components out of service that contributed to this event.

Description of the Event

On April 17, 2001 at 16:45 hours during refueling outage 2R06, injection valve (EIIS:INV) HV-055-2F105 in the HPCI (EIIS:BJ) flow path to the feedwater system (EIIS:SJ) failed to open during 24-month surveillance test ST-6-055-205-2. The inability of the valve to open was caused by a position monitor relay (EIIS:RLY) (E41A-K57) whose contacts failed to fully close when the relay was de-energized. This relay had been installed two years earlier, as part of preventative maintenance performed during the prior refueling outage (2R05). The relay was last tested, satisfactorily, on May 25,1999.

The HPCI system is provided with two injection paths to the reactor (EIIS:RPV), one through the Core Spray (EIIS:BM) Loop "B" header and the other through the feedwater Loop "A" injection pathway. The flow split is one of a number of diverse ATWS mitigation features, and is intended to limit injection flow inside of the core shroud during an ATWS event to 3000 gallons per minute (gpm) for power and flow considerations. With valve HV-055-2F105 not able to be opened, all available HPCI flow will inject through the Core Spray header. In this configuration the system is capable of injecting 5600 gpm at reactor pressures of 1085 psig or less; injection would decrease as reactor pressure increases, but adequate emergency core cooling injection flow would exist to maintain peak clad temperature (PCT) below previously analyzed values.

The inability to open valve HV-055-2F105 could have prevented the fulfillment of the safety function of a flow split feature (UFSAR 15.8.3.7) intended to mitigate the consequences of an ATWS event. 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 analytical response of Unit 2 to an ATWS was potentially affected because the feedwater injection path to the reactor (EIIS:RCT) was not available, and all HPCI flow would have been directed to the Core Spray "B" sparger.

The design basis safety function of HPCI is described in UFSAR Section 6.3.2.2.1 and Technical Specification 3/4.5.1. HPCI is designed to assure that the reactor core is adequately cooled, limiting fuel clad temperatures in the event of a small break in the reactor coolant system and for a loss of coolant that does not result in rapid depressurization of the reactor vessel. The reduction in the total HPCI system flow due to loss of the injection path through the feedwater line did not invalidate single failure assumptions. Therefore, the loss of the feedwater injection path did not impact the current loss of coolant accident (LOCA) analysis or the ability of HPCI to meet the design bases, because adequate injection flow would exist to maintain PCT below previously analyzed values.

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

The current licensing basis analysis for Limerick plant response to ATWS (NEDC-32265P dated September 1993) was affected by the inability to open the feedwater injection valve. The flow split is intended to limit injection to the Core Spray header to less than 3,000 gpm during an ATWS. The current predicted peak suppression pool temperature for the most limiting ATWS event -- with the flow split present -- is 189.4°F. If HPCI is injecting during an ATWS, and with all injection flow directed to the core spray line, the suppression pool water temperature limit of 190°F would be exceeded thus representing an unanalyzed condition.

Engineering judgment is that the expected increase in suppression pool water temperature would not adversely impact containment (EIIS:NH) performance. The 190°F value is a generic limit, utilized in the original ATWS performance evaluations (NEDE-24222 dated December 1979). With respect to other acceptance criteria, for the limiting ATWS events at Limerick, the peaks in cladding temperature and vessel pressure occur before HPCI initiates. The initial power surge, which generates the peak vessel pressure and cladding temperature from these limiting events, exceeds the power increase from the higher HPCI flow inside the shroud. Therefore the current licensing basis for peak cladding temperature and peak vessel pressure is not impacted by loss of the feedwater injection path.

Also part of the Limerick licensing basis, operators are directed in an ATWS event by emergency operating procedure T-117 to terminate injection to the reactor vessel by securing HPCI along with all other injection to the vessel with the exception of Standby Liquid Control (SLC) (EIIS:BR), Reactor Core Isolation Cooling (RCIC) (EIIS:BN) and Control Rod Drive (CRD) (EIIS:AA). The BWR Owners Group (BWROG) Emergency Procedure Guidelines Contingency #5, Level/Power Control, calls for reactor water level to be lowered to below the ECCS setpoint and for the Automatic Depressurization System (ADS) to be inhibited. Lowering water level has the effect of reducing power, which is judged by the BWROG to be preferable in the actual event.

This condition was not significant with respect to risk, and did not affect the calculated baseline core damage frequency. The frequency of an ATWS in the PRA model is 9E-6/year, and is considered an extremely low probability event. ATWS is not treated as a design basis event; the licensing basis analysis is used to demonstrate adequate plant protection for compliance with the respect to the 10CFR50.62 ATWS Rule. Large injection sources such as HPCI are secured (if running) very early in an ATWS event.

The current LGS Probabilistic Risk Assessment (PRA) model does not credit HPCI in the ATWS response. Further limiting the risk is the fact that the time during which the valve open logic and relay were in a failed state existed for a relatively short period, bounded by the previous 24-month surveillance interval. The flow split to feedwater is one of a number of diverse ATWS mitigation features described in UFSAR Section 15.8. Other features remained reliable during the period in question, including alternate rod insertion (ARI), recirculation pump trip logic, and automatic redundant reactivity control system (RRCS) initiation. The standby liquid control system was also capable of providing flow in excess of the 86 gpm required and assumed in the licensing basis, since three pumps are generally available.

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

Cause of the Event

The inability to open valve HV-055-2F105 was caused by a failed position monitor relay in the valve's opening circuit. During testing and failure analysis performed following the event, the relay repeatedly failed to properly reposition to the de-energized configuration (i.e. contacts closed). The open contact condition was found to be a result of increased friction between the plunger and the relay coil bobbin, combined with insufficient spring force.

The increased friction between the plunger and the coil bobbin is caused by formation of zinc oxide crystals from breakdown of the zinc chromate coating on the plunger and associated parts. The heat generated from being normally energized allows for the zinc oxide formation to create a frictional component too great for the spring return force to adequately overcome.

Corrective Action Completed

The relay (E41A-K57) was replaced for Unit 2 and the surveillance test was conducted successfully.

Subsequent to the discovery of the failed Unit 2 relay, the same relay for Unit 1 HPCI feedwater injection valve HV-055-1F105 was confirmed to function properly. Note that, the relay had been replaced on April 14, 1998, as part of preventative maintenance and its associated logic system functional test was last successfully performed on April 24, 2000.

Corrective Actions Planned

The affected relay will be cycled and monitored on a three-month frequency. Investigation into the broader aspects of the relay failure will continue, including more detailed analysis of the failure mode(s) of normally energized relays, as well as aspects of the manufacturing process.

Previous Similar Occurrences

None

Failed Component Data

Manufacturer: TYCO Electronics, Agastat Relay
Model Number: EGPD004