Entergy

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
600 Rocky Hill Road
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Mike Bellamy
Site Vice President

December 2, 2002

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No.: 50-293 License No.: DPR-35

Licensee Event Report 2002-003-00

LETTER NUMBER: 2.02.104

Dear Sir or Madam:

The enclosed Licensee Event Report 2002-003-00, "Loss of Automatic Scram Safety Function due to Age-Related Failure of Recirculation Flow Converter," is submitted in accordance with 10 CFR 50.73.

This letter contains no commitments. Any planned corrective actions will be implemented consistent with the Pilgrim Station corrective action program.

Please feel free to contact Bryan Ford, (508) 830-8403, if you have any questions regarding this subject.

Sincerely,

Mike Bellamy

DWE/dd
Enclosure: LER 2002-003-00
cc:

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INPO Records

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NRC Form 366 U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), 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. If an 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.

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TITLE (4)

Loss of Automatic Scram Safety Function due to Age-Related Failure of Recirculation Flow Converter

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 NAME	DOCKET NUMBER
									N/A	05000
10	03	2002	2002	003	00	12	02	02	FACILITY NAME: N/A	DOCKET NUMBER: 05000

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

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

20.2201(b)		22.2203(a)(3)(i)		50.73(a)(2)(i)(C)	50.73(a)(2)(vii)
22.2202(d)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(A)
20.2203(a)(1)		20.2203(a)(4)		50.73(a)(2)(ii)(B)	50.73(a)(2)(viii)(B)
20.2203(a)(2)(i)		50.36(3)(1)(i)(A)		50.73(a)(2)(iii)	50.73(a)(2)(ix)(A)
20.2203(a)(2)(ii)		50.36(3)(1)(ii)(A)		50.73(a)(2)(iv)(A)	50.73(a)(2)(x)
20.2203(a)(2)(iii)		50.36(c)(2)	X	50.73(a)(2)(v)(A)	73.71(a)(4)
20.2203(a)(2)(iv)		50.46(a)(3)(ii)		50.73(a)(2)(v)(B)	73.71(a)(5)
20.2203(a)(2)(v)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(C)	OTHER
20.2203(a)(2)(vi)	X	50.73(a)(2)(i)(B)		50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Bryan Ford – Licensing Manager	(508) 830-8403

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
E	AD	CNV	G080	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 October 3, 2002, at 0150 hours, reactor protection system (RPS) trip channel 'A' and one of the two rod block channels were manually tripped. These actions were taken because the related average power range monitors (APRMs) were declared inoperable due to non-conservative drift from the recirculation loop 'A' flow converter. The converter provides flow-bias input to the APRMs that are part of the respective RPS trip channel. The APRMs are equipped with the Enhanced Option I-A flow control trip reference feature. Consequently, an automatic scram would not have occurred when entering the Exclusion Region as a result of a runback of both recirculation pumps to the minimum speed as assumed in the Enhanced Option I-A stability solution while RPS trip channel 'A' was not tripped.

The direct cause was the age-related failure of the recirculation system loop 'A' flow converter. The root cause was a lack of a preventive maintenance activity to replace the recirculation flow converters. The flow converter was replaced and calibrated with satisfactory results. Corrective actions planned include creating preventive maintenance activities to periodically replace the flow controllers. The condition posed no threat to public health and safety.

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BACKGROUND

The neutron monitoring system consists of the source range monitors, intermediate range monitors (IRMs), local power range monitors (LPRMs), and average power range monitors (APRMs). The monitors function to detect neutrons in the reactor core and provide input to the reactor protection system and rod block portion of the reactor manual control system.

The six APRMs are flow-biased and receive flow-bias input from the respective recirculation system flow converter. The flow-bias for APRMs 'A', 'C', and 'E' is provided from the recirculation loop 'A' flow converter. The flow-biasing for APRMs 'B', 'D', and 'F' is provided from the recirculation loop 'B' flow converter.

In the late 1998 timeframe, the APRMs were modified by the addition of flow control trip reference (FCTR) features which are part of the features described in NEDO-3239-A, "Reactor Stability Long-Term Solution: Enhanced Option I-A" (Option I-A). In addition to the FCTR feature of the APRMs, the Option I-A features include an instability detection system, referred to as the Period Based Detection System (PBDS), and mandatory licensed operator actions. The PBDS uses input from the LPRMs. The licensed operator actions are described in procedures and the operator training and re-qualification training programs.

APRMs 'A', 'C', and 'E' are part of reactor protection system (RPS) channel 'A' and APRMs 'B', 'D', and 'F' input to RPS trip channel 'B'. Technical Specification Table 3.1.1 (RPS) specifies a minimum of 2 operable APRMs for the high neutron flux (flow-bias) trip function for each RPS trip channel when in the RUN mode. The Table specifies actions to be taken for less than the minimum number of operable instrument channels (APRMs). For the complete loss of the trip function (APRM neutron flux flow-bias), the Table specifies restoration of the trip function within one hour, or initiate the insertion of operable control rods and the complete insertion of all operable rods within four hours or to reduce the reactor power level to the range of the IRMs and place the reactor mode switch in the STARTUP/HOT STANDBY position within eight hours.

On October 2, 2002, at 1227 hours, a procedure was initiated to evaluate reactor core flow and recirculation system flow performance. The procedure is performed periodically as a good practice by reactor engineering.

After completing the procedure, the control room was notified, at about 2100 hours on October 2, 2002, that a comparison of APRM percent drive flow to the calculated percent drive flow for RPS trip channel 'A' did not meet the (+/-) five (5) percent acceptance criteria of the procedure. When averaged, the flow differed from the RPS trip channel 'A' APRM flow indicated value by 5.1 percent. The RPS trip channel 'B' percent drive flow met the acceptance criteria of (+/-) five (5) percent. The difference (5.1 percent) in RPS trip channel 'A' APRM percent drive flow was in the non-conservative direction relative to the APRM flow-biased settings. It was not clear whether the problem was with the RPS trip channel 'A' APRM circuitry or with the instrument providing the input to the calculated value. A priority maintenance work document was initiated to troubleshoot and determine necessary corrective action. A corrective action program document was written to document the finding.

The condition was identified during operation while at 100 percent reactor power. The reactor mode switch was in the RUN position.

On October 2, 2002, at about 2320 hours, a calibration of the recirculation loop 'A' flow converter was initiated to determine whether the flow converter was in calibration.

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EVENT DESCRIPTION

On October 3, 2002, at 0150 hours, APRMs 'A', 'C', and 'E' were declared inoperable for the flow-bias scram and rod block functions. This action was taken because a calibration of the recirculation loop 'A' flow converter found the flow converter to be out of calibration. RPS trip channel 'A' was manually tripped and a rod block was manually initiated at 0150 hours on October 3, 2002. These actions were taken in accordance with Technical Specifications Tables 3.1.1 and 3.2.C.1 (Rod Blocks) because the flow converter provides flow-bias signals to APRMs for the rod block function and RPS trip channel 'A' scram function. Technical Specifications limiting conditions for operation were entered as a result of APRMs 'A', 'C', and 'E' being inoperable.

Although RPS trip channel 'A' was manually tripped within the timeframe specified in Technical Specifications Table 3.1.1 from the time the inoperable condition became known to the on-shift licensed operators, subsequent evaluation conservatively determined the condition existed longer than the timeframes in Table 3.1.1. The subsequent evaluation determined the recirculation loop 'A' flow converter was inoperable from the time when the core flow evaluation procedure was initiated, at 1227 hours on October 2, 2002. During the timeframe of October 2, 2002 (beginning at 1227 hours) to October 3, 2002 (until 0150 hours), the licensed operators did not have sufficient information to determine the flow converter was inoperable. This additional time exceeded the timeframes specified in Table 3.1.1.

The NRC Operations Center was notified in accordance with 10 CFR 50.72(b)(3)(v)(A) at 0800 hours on October 3, 2002. The notification was made because the results of surveillance testing (calibrations) of recirculation loop 'A' flow converter, initiated on October 2, 2002 at 2320 hours, determined the flow converter was out of tolerance and could not be calibrated and was declared inoperable.

A re-calibration of the recirculation loop 'A' flow converter was completed by 0833 hour on October 3, 2002. The calibration results were satisfactory. The flow converter was returned to service, RPS trip channel 'A' was reset and the rod block was reset by 1248 hours on October 3, 2002.

On October 3, 2002 at 1746 hours, the main control room alarm, "Recirc Flow Converter Failure," annunciated. The alarm is initiated if a difference (mismatch) of greater than six (6) percent occurs between the recirculation loops 'A' and 'B' flow converters. Investigation of the cause of the alarm identified a step change in the output signal of the loop 'A' flow converter. The recirculation loop 'A' flow converter was declared inoperable, the RPS trip channel 'A' was manually tripped, and a rod block was manually initiated. A priority maintenance work document was initiated to replace the flow converter and the flow converter was subsequently replaced. A corrective action program document was written to document the failure of the flow converter (at 1746 hours).

CAUSE

The direct cause for the loss of the RPS trip channel 'A' APRM flow-bias neutron flux trip function was the age-related failure of the recirculation loop 'A' flow converter. The failed flow converter was the original flow converter and was installed in circa 1971, near the end of plant construction. The failed flow converter was a General Electric model number 135B8303G002; serial number 6,342,222. The component in the flow converter that caused the failure was a vacuum tube (V1).

The root cause of the failure of the recirculation loop 'A' flow converter was less than adequate preventive maintenance (PM) for the recirculation flow controllers. Specifically, there was no PM activity established to replace the recirculation flow controllers due to age.

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CORRECTIVE ACTION

Corrective actions taken included the following:

- The RPS trip channel 'A' was manually tripped and a rod block was manually initiated at 0150 hours and 1750 hours on October 3, 2002.

- The failed flow converter was replaced with a new flow converter and the new flow converter was calibrated with satisfactory results. After the replacement and a period of satisfactory operation of the new flow converter, the RPS trip channel 'A' trip circuit was reset and the rod block circuit was reset. These actions were completed by 0919 hours on October 4, 2002.

The recirculation loop 'B' flow converter was previously replaced with a new converter as a result of its failure in 1997. Since the replacement of the recirculation loop 'B' flow converter, the corrective action program that existed in 1997 has been replaced with a new corrective action process. For an equipment failure, the new process includes an equipment failure analysis that includes an extent review and action(s) to preclude recurrence.

Corrective actions planned include the following:

- Creating preventive maintenance activities to replace the recirculation flow converters. An in-service time of 12 years has been selected as the initial replacement frequency, based on discussions with the equipment vendor. The frequency may be modified based on experience and/or change in the flow converter design.

- Performing a review to identify electronic components in selected systems, which if failed, would have potential to challenge Technical Specifications and/or power generation. The focus of the review is to determine the adequacy of equipment trending and performance, subcomponents susceptible to age-related failure and the related PM frequency for replacement, and adequacy of data obtained during the calibration process for trending. Changes to applicable procedures and/or processes may be initiated as a result of the review and may be further modified based on experience or process changes.

- Additional actions are being evaluated or performed as part of the corrective action program.

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SAFETY CONSEQUENCES

The condition posed no threat to public health and safety.

The problem with the recirculation loop 'A' flow converter did not affect the local power range monitors (LPRMs) because the LPRMs are not flow-biased. Moreover, the problem with the flow converter would not have prevented the rod block function provided by APRMs 'B', 'D', and 'F' because any one of the six APRMs is capable of initiating the rod block function.

The recirculation loop 'A' flow converter provides input to the Flow Control Trip Reference (FCTR) circuitry of APRMs 'A', 'C', and 'E'. The impact of the flow converter failure was that the RPS trip channel 'A' APRM flow-biased trip function was non-conservative (inoperable) for the neutron flux (flow-bias) trip function for about 13 hours on October 2 (beginning at 1227 hours) to October 3, 2002 (until 0150 hours), while RPS trip channel 'A' was not tripped. The problem with the recirculation loop 'A' flow converter did not affect the operability of the RPS trip channel 'B' APRMs for the neutron flux (flow-bias) trip function.

The APRM flow-biased scram defines the boundary of the Exclusion Region for reactor core stability purposes. The safety function of the Exclusion Region (scram region boundary) of the reactor core power-flow map is to prevent operation where it is possible for thermal-hydraulic instability events to occur. The basis and methodology for this safety function is documented in NEDO-32339-A Rev. 1, Long-Term Stability Solution, Enhanced Option 1-A. The following assessment addresses transients that could have challenged the safety function.

There are 3 types of transients that can affect reactor core thermal-hydraulic stability: reactor power increases, feedwater temperature reductions, and flow reductions. Because the condition existed when the plant was operating at rated conditions (100% reactor power, 83% core flow) and the APRM scram clamp setting (120%) is not flow-biased, the first 2 transients are not applicable. The flow reduction events that could have occurred during the October 2, 2002 (1227 hours) – October 3, 2002 (0150 hours) timeframe while RPS trip channel 'A' was not in a tripped condition are: a trip of one or both recirculation pumps or a runback of both recirculation pumps.

- For a trip of one recirculation pump, the reactor power and core flow end state would have been in the Restricted Region of the reactor power-flow map. The APRM flow-biased scram safety function would not have been challenged for this transient.

- For a trip of both recirculation pumps, the reactor core flow would decrease to natural circulation flow conditions. The RPS trip channel 'A' APRM flow-bias trip function would have been delayed but the RPS trip channel 'B' APRM flow-bias trip function was not affected and therefore, the trip of both recirculation pumps would actuate the RPS trip channel 'B' scram function at 40% core flow. Based on the information in the Enhanced Option I-A Methodology, instability develops after termination of the flow reduction and feedwater temperature equalizes at a lower value, in about 5 – 7 minutes. An automatic scram (RPS trip channels 'A' and 'B') would occur before the lower feedwater temperatures were achieved.

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- For a runback of both recirculation pumps, the Pilgrim Station recirculation MG sets/pumps each have two speed limiters (Speed Limiter #2 and Speed Limiter #1). Speed Limiter #2 has a setting of 44% rated recirculation pump speed. A runback of both recirculation pumps to 44% speed would have terminated in the Restricted Region of the reactor power-flow map, but would not have challenged the scram safety function. Speed Limiter #1 has a setting of 26% of rated recirculation pump speed, which is the minimum recirculation pump speed. For this assessment, it was assumed that a runback of both recirculation pumps to 26% (minimum speed) would have terminated in the Exclusion Region of the reactor power-flow map and consequently, may not have resulted in an automatic scram (RPS trip channels 'A' and 'B' tripped) at the Exclusion Region boundary before achieving lower feedwater temperature.

The safety consequences of the non-conservative flow-biased scram function of APRMs 'A', 'C', and 'E', resulting from the failure of the recirculation loop 'A' flow converter, is low due to the defense-in-depth features of the Enhanced Option 1-A Stability Solution. The flow reduction transients that terminate in the Restricted Region of the reactor power-flow map would have actuated the Restricted Region entry alarm because the RPS trip channel 'B' APRMs were not affected. The alarm would alert the licensed operators to follow approved procedures to exit the Restricted Region.

Defense-in-depth features could also have terminated a minimum speed flow reduction transient before an instability event occurred. For a runback of both recirculation pumps to the minimum speed (Speed Limiter #1 setting), the Restricted Region Entry alarm would also alert licensed operators that the reactor was in an operating state where manual actions are required to exit the Restricted Region. RPS trip channel 'A' might not have tripped due to the impact of the recirculation loop 'A' flow converter on APRMs 'A', 'C', and 'E'. The FCTR (APRM flow-biased scram) setting, however, has a linear slope section above the highest rod line above the Restricted Region. This section of the linear flow-biased setting is set closer to the highest power-flow control line to initiate a scram in the event of a power transient in the Restricted Region. Thus, if core conditions were changing such that unstable core conditions were to be approached, the resulting reactor power increase would likely cause APRMs 'A', 'C', and 'E' to trip and result in an automatic scram (RPS trip channels 'A' and 'B' tripped). If unstable core conditions were approached and APRMs 'A', 'C', and 'E' did not trip, RPS trip channel 'B' would have initiated a scram signal (half-scram tripped condition) alarm when core flow decreased below 40%. This alarm would alert operators that an automatic scram (RPS trip channels 'A' and 'B' tripped) should have occurred and the licensed operators would have initiated a manual scram in accordance with training and approved procedures. Finally, the LPRMs are spatially located throughout the reactor core to detect neutron conditions. The LPRMs are not flow-biased and were not affected by the recirculation loop 'A' flow converter. The LPRMs input to the PBDS. The PBDS would be operable and if instability conditions were to develop and actuate the PBDS HI-HI alarm, the licensed operators would have initiated a manual scram in accordance with training and approved operating procedures.

Therefore, the safety consequences of the non-conservative (inoperable) flow-bias settings for APRMs 'A', 'C', and 'E' are considered to have been low. For all cases of flow reduction events, defense-in-depth features were available and would increase the likelihood a flow reduction event would have been terminated manually or automatically, prior to the occurrence of an instability event.

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REPORTABILITY

This report was submitted in accordance with 10 CFR 50.73(a)(2)(i)(B) because the timeframes for taking the actions specified in Technical Specifications Table 3.1.1 were exceeded.

This report is also submitted in accordance with 10 CFR 50.73(a)(2)(v)(A) because the inoperable recirculation loop 'A' flow converter caused the RPS trip channel 'A' APRMs (flow-bias) to be inoperable. Consequently, an automatic scram would not have occurred as a result of entering the Exclusion Region as assumed in the Enhanced Option I-A stability solution while RPS trip channel 'A' was not tripped.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted for similarity that involved the recirculation flow converters. The review identified LER 92-012-00, Failure to Perform Calibration Test of Neutron Monitoring System Recirculation Flow Converters." The cause was not similar to the cause(s) described in this report.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS	CODES
Alarm	ALM
Converter	CNV
Monitor (APRMs, LPRMs)	MON

SYSTEMS

Incore/Excore Monitoring System	IG
Plant Protection System (RPS)	JC
Reactor Core System	AC
Reactor Recirculation System	AD