FENOC
FirstEnergy Nuclear Operating Company

Perry Nuclear Power Plant
10 Center Road
Perry, Ohio 44081

John K. Wood
Vice President, Nuclear

440-280-5224
Fax: 440-280-8029

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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Perry Nuclear Power Plant
Docket No. 50-440
Subject: Submittal of Licensee Event Report 2001-004

Ladies and Gentlemen:

Enclosed is Licensee Event Report 2001-004, "Potential to Have Exceeded Licensed Maximum Power Level." There are no regulatory commitments contained in this letter or its attachments. Any actions discussed in this document represent intended or planned actions, are described for the NRC's information, and are not regulatory commitments.

If you have questions or require additional information, please contact Mr. Gregory A. Dunn, Manager - Regulatory Affairs, at (440) 280-5305.

Very truly yours,

John K. Wood

Enclosure

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

IE22

Rec'd 11/1/01

NRC FORM 366 (7-2001)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

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)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
PERRY NUCLEAR POWER PLANT	05000-440	1 OF 4

4. TITLE

Licensed Power Limit Exceeded Due to a Non-conservative Moisture Carryover Fraction

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
10	01	2001	2001	– 004	– 00	10	30	2001	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	1
10. POWER LEVEL	100

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

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)	X 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)	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)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Todd A. Henderson, Regulatory Issues	(440) 280-5889

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

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

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On October 1, 2001, it was determined that a non-conservative assumption for the steam carryover fraction of main steam has been applied in the General Electric methodology for calculating reactor core thermal power at the Perry Nuclear Power Plant (PNPP). This was documented in a General Electric Report entitled, "Impact of Steam Carryover Fraction on Process Computer Heat Balance Calculations, September 2001." This report states that the assumed carryover fraction in later model Boiling Water Reactors is non-conservative with respect to heat balance calculations. The potential effect of this non-conservative assumption is that the calculated core thermal power could be as much as approximately 0.082% lower than the actual core thermal power. Consequently, it is assumed that the plant has operated at reactor core power levels in excess of the licensed power level by approximately 0.082%, or approximately 3 megawatts thermal (MWth).

Due to the small magnitude of the carryover fraction input and the conservatism present in the core thermal power levels used for the safety analyses, the use of the non-conservative steam carryover fraction does not represent a safety issue. As a measure of conservatism, however, an administrative reactor power reduction of 4 MWth was implemented until the process computer thermal power calculation was modified to reflect the revised moisture carryover fraction.

This issue was reported to the NRC Operations Center via the Emergency Notification System at 1914 on October 1, 2001 (Notification number 38337). This written report is being submitted in accordance with PNPP Operating License Condition 2.F., as a potential violation of the Maximum Power Level specified in PNPP Operating License Condition 2.C.1.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
PERRY NUCLEAR POWER PLANT	05000-440	2001	- 004 -	00	2 OF 4

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

I. Introduction

On October 1, 2001, it was determined that a non-conservative assumption for the steam carryover fraction of main steam has been applied in the General Electric methodology for calculating reactor core thermal power at the Perry Nuclear Power Plant (PNPP). This was documented in a General Electric (GE) Report entitled, "Impact of Steam Carryover Fraction on Process Computer Heat Balance Calculations, September 2001." This report states that the assumed carryover fraction in later model Boiling Water Reactors (BWRs) is non-conservative with respect to heat balance calculations. The process computer determines reactor thermal power using a heat balance calculation. This calculation is based on a summation of all heat sources raising the inlet feedwater, and other cold water sources, to steam exiting the reactor pressure vessel. The effect of this non-conservative carryover fraction assumption is that the calculated core thermal power could be as much as approximately 0.082% lower than the actual core thermal power. Consequently, the plant has potentially operated at reactor core power levels in excess of the licensed power level by approximately 0.082%, or approximately 3 megawatts thermal (MWth).

Condition 2.F of the PNPP Operating License requires that violations of the operating license be reported to the NRC with a 24-hour Emergency Notification System call and a written follow-up report within 30 days. This issue was reported to the NRC Operations Center via the Emergency Notification System at 1914 on October 1, 2001 (Notification number 38337).

At the time of the event, the plant was operating in Mode 1 at 100% power, at normal operating temperature and pressure.

II. Event Description

Through an industry questionnaire, a question was raised about how plants determine main steam [SB] moisture content. During the evaluation of the question by PNPP staff, it was noted that the moisture content, or steam carryover fraction, for PNPP had been measured during the startup test program in 1987. The primary purpose of this startup test was to demonstrate compliance with warranty requirements, and was not a verification of heat balance calculation input parameters. The measured value was determined to satisfy the acceptance criteria at that time. However, the carryover fraction used in the core thermal power calculation was higher than this measured value, which results in an under-calculation of core thermal power. As the investigation progressed, an administrative 8-hour average power limit of 3754 MWth (a reduction of 4 MWth from the licensed maximum power level) was implemented as a conservative measure. On October 1, it was determined that the potential to have exceeded the licensed maximum power level existed.

III. Cause of Event

During the GE development of the core thermal power calculations (heat balance), a value for the steam carryover fraction was established based on steam dryer specifications. This value corresponded to the performance requirements specified for most BWR steam dryers. Recent moisture carryover measurements in BWRs have generated questions about steam dryer performance and the resulting impact on process computer core thermal power calculations. Data also indicates differences in steam dryer/steam separator performance between the various BWR models, with newer models reporting smaller carryover fractions. GE has indicated that the difference in dryer performance between older and newer model plants is likely due to evolutionary design improvements made to the steam dryers installed in the later designs. This has resulted in a carryover fraction of essentially zero for the newer design plants, which means the calculated core thermal power is approximately 0.082% lower than actual core thermal power. Although the steam carryover fraction had been measured during the startup test program in 1987, the primary purpose of this startup test was to demonstrate compliance with warranty requirements, and was not a verification of heat balance calculation input parameters. Actual plant testing data was not incorporated into the core thermal power calculation.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
PERRY NUCLEAR POWER PLANT	05000-440	2001	- 004 -	00	3 OF 4

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

IV. Safety Analysis

The PNPP licensed power level of 3758 MWth is the analysis basis for the Cycle 9 core (the current operating cycle). This power level was used for the initial conditions for the design basis accident and transient analyses performed. Most design basis accident and transient analyses are performed at 102% of rated thermal power. As discussed in the GE report, "Impact of Steam Carryover Fraction on Process Computer Heat Balance Calculations, September 2001", most reactor thermal heat balances have an uncertainty value of 1.8%. The uncertainty value of 1.8% coupled with the moisture fraction carryover bias of 0.082% would still be bounded by the 102% rated thermal power assumed in various design basis accidents and transients analyses. Use of the original carryover fraction, while non-conservative, does not represent a safety issue, however. The change in core thermal power is an order of magnitude less than the precision of the Maximum Critical Power Ratio (MCPR) safety limit evaluation process. Further, the change in core thermal power is a factor of 18 less than the precision of the process computer core thermal power estimate. Applying the change as a carryover fraction bias of 0.1% in the core thermal power evaluation represents a small increase (less than 1%) in the probability that the core thermal power will exceed the nominal rated power by more than 2%. If reactor power would be in excess of 102% at the start of a transient or accident, then the consequences of the accident may exceed the results estimated by the analysis. Although the thermal power potentially exceeded the maximum power level specified in the operating license, it is not likely that thermal power ever exceeded analyzed limits (102%). The Updated Safety Analysis Report (USAR) Chapter 15 contains bounding analyses for power levels of 102%.

The recent PNPP power uprate project (License Amendment 112, issued May 3, 2000) resulted in a power uprate to 105% of original rated thermal power. The carryover fraction issue also existed prior to the power uprate. It is not expected that power uprate improved the moisture carryover fraction, but instead degraded it towards the assumed value of 0.1%. If the power uprate improved the moisture fraction carryover, however, this improvement would be bounded by assuming no carryover. With no assumed carryover, calculated thermal power would be 0.082% less than actual reactor thermal power. The power uprate analysis basis maintained the 102% analysis basis discussed above (i.e., 102% of 105% of original rated thermal power). This power uprate analysis demonstrated all relevant acceptance criteria were satisfied. It should be noted the 102% analysis basis was also applied to the pre-power uprate analysis.

The Anticipated Transient Without Scram (ATWS) is a non-design basis accident and as such its analysis is performed at rated conditions. The recent 105% power uprate ATWS analysis was reviewed. Based on the change resulting in uprating the reactor to 105%, the increase in reactor power of 0.082% would not cause any acceptance criteria to be exceeded.

Thermal power distribution limits are established within PNPP Technical Specifications and are identified within the Core Operating Limits Report. These ensure that the reactor fuel is operated within design limits for both normal power operations as well as transient situations. Review of reactor parameters during Cycle 9 indicated that there was still margin to actual thermal power distribution limits. By maintaining margin to real thermal power distribution limits despite the reactor thermal power calculation error, operation of the fuel stayed within fuel design limits, and did not exceed Technical Specification limits.

Reactor power is also monitored using Average Power Range Monitors (APRMs) [IG]. The surveillance requirements for these nuclear instruments use calculated thermal power. The bias introduced by the non-conservative carryover fraction should not have resulted in any APRM inoperability. Surveillance procedures which verify APRM operability ensure the APRM readings are within 2% of the indicated percent core thermal power, or adjustment of the APRM is required to restore operability. For APRM readings that differ from the indicated power level by 1% to 1.9%, the APRMs are operable but the surveillance instruction states that the APRMs should be adjusted, and that is the standard operating practice. Therefore, there are no periods of time where the carryover fraction bias should have resulted in APRM inoperability.

Based on the above, this event had no safety significance.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
PERRY NUCLEAR POWER PLANT	05000-440	2001	- 004 -	00	4 OF 4

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

V. Similar Events

A search of licensee event reports from PNPP over the past five years found one event where exceeding operating license thermal power limits was reported (LER 1999-007, and LER 1999-007-01). In that event, a modification to a database within a software code providing input to thermal power calculations set specific constants to zero, which impacted the calculation of core thermal power when feedwater temperature was less than 420 degrees Fahrenheit. As a result, a historical review of operating data identified that the plant had reached a maximum power level that exceeded licensed reactor thermal power limits. That event had no safety significance because the thermal power levels did not exceed limits in the accident analyses. The cause of that event was a weakness in the administrative controls in place for the review of the software revision. Although similar consequences occurred, the current event was not the result of a change to the software.

As discussed previously, the non-conservative carryover fraction affects reactor power calculations at other plants, and several plants have reported potential operating license violations to the NRC.

VI. Corrective Actions

Core thermal power was administratively restricted to 3754 MWth (a reduction of 4 MWth) until the value of the moisture fraction in the process computer was changed based on GE input and industry performance through a software change in accordance with plant procedures. Corresponding changes will also be made to the program used for manual heat balance calculations.

A design basis document will be generated for the reactor heat balance to identify source documents for each term in the heat balance equation.

This event has been documented in the PNPP corrective action program. The corrective actions will be tracked and implemented in accordance with processes and requirements of the corrective action program.

NOTE: Energy Industry Identification System Codes are identified in the text by square brackets (e.g., [XX]).