**FENOC**

FirstEnergy Nuclear Operating Company

Perry Nuclear Power Plant
10 Center Road
Perry, Ohio 44081

Richard Anderson
Vice President-Nuclear

440-280-5579
Fax: 440-280-8029

February 21, 2005
PY-CEI/NRR-2863L

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

Perry Nuclear Power Plant
Docket No. 50-440
LER 2004-002-00 and 2005-001-00

Ladies and Gentlemen:

Attached are Licensee Event Reports (LER) 2004-002-00, "Unplanned Automatic Oscillation Power Range Monitor SCRAM" and 2005-001-00, "Manual Reactor SCRAM Following Unexpected Reactor Recirculation Pump Trip." Any actions discussed within these LERs are described for information only and are not regulatory commitments.

If you have questions or require additional information, please contact Mr. Jeffrey J Lausberg, Manager - Regulatory Compliance, at (440) 280-5940.

Very truly yours,

Richard Anderson

Attachments

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

IE22

| NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007 |
|---|---|
| **LICENSEE EVENT REPORT (LER)**<br>(See reverse for required number of digits/characters for each block) | Estimated burden per response to comply with this mandatory collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 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. |

| 1. FACILITY NAME | 2. DOCKET NUMBER | 3. PAGE |
|---|---|---|
| Perry Nuclear Power Plant | 05000440 | 1 OF 6 |

**4. TITLE**
Unplanned Automatic Oscillation Power Range Monitor SCRAM

| 5. EVENT DATE | | | 6. LER NUMBER | | | 7. REPORT DATE | | | 8. OTHER FACILITIES INVOLVED | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO. | MONTH | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| 12 | 23 | 2004 | 2004 - | 002 - | 00 | 02 | 21 | 2005 | FACILITY NAME | DOCKET NUMBER |

| 9. OPERATING MODE | 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)* | | | |
|---|---|---|---|---|
| Mode 1 | ☐ 20.2201(b) | ☐ 20.2203(a)(3)(i) | ☐ 50.73(a)(2)(i)(C) | ☐ 50.73(a)(2)(vii) |
| | ☐ 20.2201(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(c)(1)(i)(A) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) |
| 10. POWER LEVEL | ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☒ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| 55 percent | ☐ 20.2203(a)(2)(iii) | ☐ 50.36(c)(2) | ☐ 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<br>Specify in Abstract below or in NRC Form 366A |
| | ☐ 20.2203(a)(2)(vi) | ☐ 50.73(a)(2)(i)(B) | ☐ 50.73(a)(2)(v)(D) | |

**12. LICENSEE CONTACT FOR THIS LER**

| NAME | TELEPHONE NUMBER *(Include Area Code)* |
|---|---|
| Kenneth Russell, Compliance Engineer, Regulatory Compliance | (440) 280- 5580 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| B | AD | OB | GE | Y | | | | | |

| 14. SUPPLEMENTAL REPORT EXPECTED | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|
| ☐ YES *(If yes, complete EXPECTED SUBMISSION DATE).* ☒ NO | | | | |


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

On December 23, 2004, at 2345 hours, both reactor recirculation system (RRC) pumps at the Perry Nuclear Power Plant (PNPP) unexpectedly downshifted from fast to slow speed. At the time of RRC pump speed downshift, the plant was stable in Operational Condition 1 at 100 percent rated thermal power. Reactor power decreased to about 44 percent and then gradually increased to 55 percent rated thermal power. The power and flow reduction placed the plant in the immediate exit region of the power-flow map. At 2354 hours a reactor scram occurred due to core oscillations being detected by the oscillation power range monitor (OPRM). All control rods fully inserted.

The cause of the scram was determined to be a reactor protection system scram signal initiated from the OPRM per design and appropriate for the plant conditions. Troubleshooting of the RRC system pump speed downshift initially identified the probable cause to be a faulty card in the RRC pump control circuit. However, following a subsequent similar RRC pump downshift on January 6, 2005, the cause was determined to be an optical isolator intermittent failure as a result of an inadequate surge suppression network in the control circuit for the RRC pumps (See PNPP LER 2005-001).

This event is being reported under requirements of 10 CFR 50.73(a)(2)(iv), any event or condition that resulted in manual or automatic actuation of any of the specified systems.

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2004 | -- 002 -- | 00 | 2 OF 6 |

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

## I. INTRODUCTION

On December 23, 2004, at 2345 hours, both reactor recirculation system (RRC) pumps [AD] at the Perry Nuclear Power Plant (PNPP) unexpectedly downshifted from fast to slow speed. Prior to the RRC pump speed downshift, the plant was stable in Operational Condition 1 at 100 percent rated thermal power. The reactor pressure vessel (RPV) was at 1020 psig and saturated conditions. Following the downshift, at 2354 hours a reactor scram occurred due to core oscillations being detected by the Oscillation Power Range Monitor (OPRM)[JC]. At the time of the scram, the plant was at approximately 55 percent rated thermal power. All control rods fully inserted as a result of the scram signal.

The primary purpose of the RRC system is to provide forced circulation through the reactor core to achieve full power operation and permit variations in power level without control rod movement. Control interlocks are provided for RRC pumps to automatically downshift the pump from fast to slow speed. These controls are provided to prevent cavitation in RRC system components and mitigate the effects of various operational transients on reactor water level and reactivity. The OPRMs are designed to detect reactor core power oscillations and suppress the oscillations by providing a trip signal to the reactor protection system, which results in a reactor scram.

On December 24, 2004, at 0307 hours, the required non-emergency four-hour notification was made to the NRC pursuant to the requirements of 10CFR50.72(b)(2)(iv)(B), reactor protection system actuation while critical (NRC Event Number 41290). This event is being reported under the requirements of 10CFR50.73(a)(2)(iv), any event or condition that resulted in manual or automatic actuation of any of the specified systems.

## II. EVENT DESCRIPTION

At 2345 hours on December 23, 2004, both RRC pumps A and B unexpectedly transferred from fast to slow speed. At the time of RRC pump speed downshift, the plant was stable in Operational Condition 1 at 100 percent rated thermal power. After the downshift, reactor power stabilized at about 44 percent and then gradually increased to about 55 percent rated thermal power. The power and flow reduction placed the plant in the immediate exit region of the power-flow map. In this region, the reactor core is susceptible to power oscillations. At 2346 hours, off-normal instruction, "Unplanned Change in Reactor Power or Reactivity," was entered. At 2348 hours the first OPRM alarm was annunciated and subsequently cleared. The magnitude of the core power oscillations detected by the OPRM instrumentation was not observable to operators monitoring reactor power on the control room instrumentation. The OPRM alarm came in three additional times at 2351, 2352 and 2354 hours also with no observable power oscillations.

At 2354 hours a reactor scram occurred due to OPRM trip signals. All control rods fully inserted. The operators properly entered, off-normal instruction, "Reactor SCRAM". The operators also correctly entered plant emergency instruction, "Reactor Pressure Vessel Control" when the reactor vessel level momentarily decreased as expected below Level 3 (178 inches above the top of active fuel) due to void collapse. Level was restored by the

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2004 | -- 002 -- | 00 | 3 OF 6 |

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

feedwater control system operating in automatic mode. Reactor water level continued to increase to about 230 inches at which time the feedwater pump turbines tripped as designed. Subsequent level control was with the motor driven feedwater pump.

All control rods inserted, no safety relief valves were opened, no automatic ECCS response occurred, and no ECCS system was used for level control. The reactor water cleanup (RWCU) system [CE] was not available due to the RWCU trip during the scram transient. The RWCU pumps have non-safety electrical power supplies that underwent a voltage transient during the scram and caused the RWCU pumps to trip.

Pressure control was maintained by the turbine bypass valves [SB-V] throughout the transient. The valves and their control system functioned as designed. The safety relief valves [SB-RV] were not required to automatically respond and were not opened manually.

III. CAUSE OF EVENT

The cause of the SCRAM was determined to be a Reactor Protection System (RPS) scram signal from OPRM Channels A/E, B/F and C/G following the RRC pump downshift. The setpoint for Channels D/H was not exceeded. The data review from the OPRMs determined that the OPRMs response during the event was per design with no deficiencies noted. The scram signal was appropriate for the plant conditions.

Although the operating crew was determined to have performed no inappropriate actions, appropriate mitigating strategies (inserting control rods) were not adequate to promptly exit the region of potential instability. The delay in inserting control rods in this event was caused by organizational and programmatic issues, including inadequate training and procedures resulting from a lack of rigor in the management of changes when the OPRM was made operable.

The engineering change process (ECP) was followed when the OPRM modification was implemented, but the change in the operable status of the system was delayed for over 3 years for technical reasons. When the change was finally made to transition to the "OPRMs Operable" status, the ECP process was already completed and therefore there was no process mechanism that re-initiated the assessment of training or procedures.

Because of this, the appropriate training needs analysis was not performed and the operators were not provided with adequate training or procedures that would have provided the basis for more timely actions that could have prevented an automatic scram under the conditions experienced on December 23, 2004.

Troubleshooting of the RRC system pump speed downshift was initiated to identify the cause. These investigations focused on the RRC pump fast to slow speed downshift logic circuitry. Three of the five RRC pump downshift signals were eliminated as a potential cause since a scram would have initiated simultaneously with the downshift from those signals.

Since the other sources of pump downshift signals were eliminated, the alarm cards for Low Feedwater Flow and Low Reactor Level were replaced prior to plant restart. These cards

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

were considered the highest probability to have caused the RRC pump downshift based on historical failure trends. Since the RRC pump downshift signal was intermittent and could not definitively be confirmed, temporary recorders were installed to monitor the power supply and input voltage to the two replaced alarm cards and other points in the RRC circuitry.

Subsequent to this event, on January 6, 2005, the RRC pumps again unexpectedly downshifted to slow speed. The cause of the downshift was determined to be an optical isolator intermittent failure as a result of an inadequate surge suppression network in the end-of-cycle reactor recirculation pump trip (EOC/RPT) control circuit for the RRC pumps (Reference PNPP LER 2005-001 for further information). This cause was also subsequently determined to be the reason for the RRC pump downshift on December 23, 2004.

IV. EVENT ANALYSIS

The primary purpose of the RRC system is to provide forced circulation through the reactor core to achieve full power operation and permit variations in power level without control rod movement. Control interlocks are provided for the RRC pumps to automatically downshift the pump from fast to slow speed. These controls are provided to prevent cavitation in RRC system components and mitigate the effects of various operational transients.

Analysis of plant conditions at the time of the RRC pump fast to slow speed downshift confirmed that no process parameters or transients required to initiate the above interlocks were present. With the reactor at full power, the RRC pump downshift brought the reactor into the region of potential instability of the power to flow map. Power following the downshift stabilized at approximately 55 percent. The reactor scrammed as a result of exceeding the trip setpoints of the OPRMS. Evaluation of the OPRM event buffer data concluded that reactor core wide oscillations occurred following the RRC pump downshift. The OPRMs did suppress the oscillations by initiating a scram and the minimum critical power ratio (MCPR) safety limit was not exceeded.

The plant response was consistent with and bounded by the Updated Safety Analysis Report (USAR) event analyses for "Decrease in Reactor Recirculation Flow" in Chapter 15.3 which shows that a downshift of both RRC pumps event is bounded by the trip of both RRC pumps event. The plant response following the scram was bounded by USAR Section 15.2.3 for a turbine trip. Thus, this event was determined to be within design evaluation limits

A risk assessment was also performed. The computed results were that the probability of core damage for the December 23, 2004 scram was 3.7E-07 and the probability of a large early release was computed to be 4.6E-09. Transients with a core damage probability less that 1.0E-06 and a large early release probability less than 1.0E-07 are not considered to be risk significant events.

Based upon the above information, this event is considered to be of very low safety significance.

# LICENSEE EVENT REPORT (LER)

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2004 | -- 002 | -- 00 | 5 OF 6 |

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

## V. CORRECTIVE ACTIONS

Interim action to address inadequate training was completed prior to restart including training on the significance and pattern of the OPRM alarms and the urgency for exiting the immediate exit region of the power to flow map.

Following the January 6, 2005 RRC pump downshift, the failed optical isolator was replaced and a diode was installed across the downstream logic trip relay for surge suppression. Similar optical isolators, that could have been damaged by relay inductive surges, were also replaced.

Additional corrective actions that have been completed or are in progress:

1. Off-normal operating instruction, ONI-C51 "Unplanned Change in Reactor Power or Reactivity" was revised so that the operators can go immediately to the required actions.

2. The alarm response instruction was revised to indicate that a reactor scram was possible and to evaluate the need to enter off-normal operating instruction, ONI-C51 "Unplanned Change in Reactor Power or Reactivity.

3. Simulator training time will be reviewed to increase off-normal event training including events that have a higher probability to occur.

4. Procedures will be revised to consider training needs when incorporating changes to operational methods and to ensure that training precedes significant changes in operational methods.

5. Analysis of industry BWR power oscillation events will be performed and incorporated into simulator training sessions.

The above actions have been entered in the corrective action program.

## VI. SIMILAR EVENTS

Manual Scram due to unexpected Reactor Recirculation Pump downshift, LER 1993-015. This manual scram was initiated in accordance with procedures in effect at that time when entering the power-to-flow region of core instability. The cause of the downshift was a failure of both RRP suction resistance thermal detectors, which is not similar to the December 23, 2004 event. Optical isolators were specifically evaluated as not being the cause.

Manual scram due to unexpected Reactor Recirculation Pump downshift, LER 1994-002. This manual scram was initiated in accordance with procedures in effect at that time when entering the power-to-flow region of core instability. The cause of the downshift was a failure of a K1 relay on an alarm card, which is not similar to the December 23, 2004 event.

Automatic scram following unexpected Reactor Recirculation Pump downshift, LER 2001-005.

# LICENSEE EVENT REPORT (LER)

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2004 | -- 002 | -- 00 | 6 OF 6 |

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

This automatic scram occurred following a high Reactor Pressure Vessel water level that was initiated by a Reactor Recirculation Pump downshift. The cause of the downshift was a failure of a feedwater system level summer card, which is not similar to the December 23, 2004 event.

The corrective actions from the events above would not have precluded occurrence of this event.

Manual scram due to unexpected Reactor Recirculation Pump downshift and subsequent pump trip to off, LER 2005-001. This scram occurred following the December 23, 2004 scram. This manual scram was correctly initiated based upon multiple unexpected plant responses while in the immediate exit region of the power-to-flow map. The cause of the downshift was a failure of an optical isolator, which was subsequently determined to also be the cause of the December 23, 2004 pump downshift.

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

| NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007 |
|---|---|
| **LICENSEE EVENT REPORT (LER)**<br>(See reverse for required number of digits/characters for each block) | Estimated burden per response to comply with this mandatory collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 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. |

| 1. FACILITY NAME | 2. DOCKET NUMBER | 3. PAGE |
|---|---|---|
| Perry Nuclear Power Plant | 05000440 | 1 of 6 |

**4. TITLE**
Manual Reactor SCRAM Following Unexpected Reactor Recirculation Pump Trip

| 5. EVENT DATE | | | 6. LER NUMBER | | | 7. REPORT DATE | | | 8. OTHER FACILITIES INVOLVED | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REV NO. | MONTH | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| 01 | 06 | 2005 | 2005 | - 001 - | 00 | 02 | 21 | 2005 | FACILITY NAME | DOCKET NUMBER |

**9. OPERATING MODE:** Mode 1

**10. POWER LEVEL:** 44 percent

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

| | | | |
|---|---|---|---|
| ☐ 20.2201(b) | ☐ 20.2203(a)(3)(i) | ☐ 50.73(a)(2)(i)(C) | ☐ 50.73(a)(2)(vii) |
| ☐ 20.2201(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(c)(1)(i)(A) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) |
| ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☒ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| ☐ 20.2203(a)(2)(iii) | ☐ 50.36(c)(2) | ☐ 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 Specify in Abstract below or in NRC Form 366A |
| ☐ 20.2203(a)(2)(vi) | ☐ 50.73(a)(2)(i)(B) | ☐ 50.73(a)(2)(v)(D) | |

**12. LICENSEE CONTACT FOR THIS LER**

| NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Kenneth Russell, Compliance Engineer, Regulatory Compliance | (440) 280- 5580 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| B | AD | OB | GE | Y | B | AD | EC | Basler | Y |

| 14. SUPPLEMENTAL REPORT EXPECTED | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|
| ☐ YES *(If yes, complete EXPECTED SUBMISSION DATE).* ☒ NO | | | | |


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

On January 6, 2005, at 0106 hours, while operating at approximately 100 percent rated thermal power, the Perry Nuclear Power Plant (PNPP) reactor recirculation system (RRC) pumps A and B unexpectedly downshifted from fast to slow speed. Reactor power decreased to approximately 44 percent power. This power and flow reduction placed the plant in the immediate exit region of the power-flow map. While operators were inserting control rods in accordance with the applicable off normal operating instructions, RRC pump A unexpectedly tripped from slow speed to off at 0110 hours. At 0112 hours, a manual reactor scram was initiated by the control room crew. All control rods fully inserted. At 0119 hours, following reactor level reduction below level 8 (219 inches above top of active fuel), the motor feedwater pump could not be manually started. At 0122 hours, a reactor core isolation cooling (RCIC) pump was started for injection to the reactor vessel and continued to provide reactor level control.

It was determined that the RRC pumps downshift originated from a degraded optical isolator in the RRC logic circuitry. The installed resistor/capacitor surge suppression network on the optical isolator was insufficient to protect the output transistors from the inductive kick experienced during normal operation, allowing intermittent malfunctioning output. To minimize this kick, diodes were installed across applicable optical isolators, downstream trip logic relays to limit the inductive loads on the optical isolator card transistors.

This event is being reported under requirements of 10 CFR 50.73(a)(2)(iv)(A), any event or condition that resulted in manual or automatic actuation of any of the specified systems.

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2005 | -- 001 | -- 00 | 2 of 6 |

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

## I. INTRODUCTION

On January 6, 2005, at 0106 hours, while operating at approximately 100 percent rated thermal power with stable conditions, the Perry Nuclear Power Plant (PNPP) reactor recirculation system (RRC) [AD] pumps A and B unexpectedly downshifted from fast to slow speed. Reactor power decreased to approximately 44 percent power. This power and flow reduction placed the plant in the immediate exit region of the power-flow map. A similar unexpected downshift from fast to slow speed of both RRC pumps occurred on December 23, 2004, which was reported in PNPP Licensee Event Report (LER) 2004-002.

At 0110 hours, while operators were inserting control rods in accordance with off normal operating instruction ONI-C51, "Unplanned Change in Reactor Power or Reactivity", RRC pump A unexpectedly tripped from slow speed to off. At 0112 hours, a manual reactor scram was initiated by the control room crew. All control rods [AA] fully inserted.

The RRC system consists of two independent piping loops, each with a two speed recirculation pump, a flow control valve (FCV), and associated piping and instrumentation external to the vessel, and jet pumps internal to the vessel. The primary purpose of the RRC system is to provide forced circulation through the reactor core to achieve full power operation and permit variations in power level without control rod movement. Control interlocks are provided for the RRC pumps to automatically downshift the pump from fast to slow speed.

## II. EVENT DESCRIPTION

On January 6, 2005, at 0106 hours, while operating at approximately 100 percent power, the Perry Nuclear Power Plant (PNPP) RRC pumps A and B unexpectedly downshifted from fast to slow speed. Reactor power decreased to approximately 44 percent power. This power and flow reduction placed the plant in the immediate exit region of the power-flow map. In this region, the reactor core is susceptible to power oscillations due to higher power relative to core flow. Control room operators entered off normal operating instruction ONI-C51, "Unplanned Change in Reactor Power or Reactivity" and began to insert the specified control rods.

At 0110 hours, while operators were inserting control rods, RRC pump A unexpectedly tripped from slow speed to off, resulting in single loop RRC operation. At 0112 hours, the reactor operator, with the concurrence of the control room Senior Reactor Operator (SRO), inserted a manual reactor scram, based upon conservative plant operations by the control room crew. All control rods fully inserted.

As anticipated, reactor water level decreased to Level 3 (178 inches above top of active fuel) immediately following the scram. Level was restored by the feedwater system [SJ] operating in automatic on the master level controller. Reactor level increased to Level 8 (219 inches above top of active fuel). At Level 8, the non-safety related reactor feedwater pump turbines tripped as designed to terminate feedwater addition to the reactor. Level continued to increase due to control rod drive hydraulic water addition and swell until level reached 226 inches.

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

At 0114 hours, the turbine generator was manually tripped. At 0119 hours, following reactor level reduction below Level 8, operators attempted to manually start the non-safety related motor feedwater pump (MFP) [SJ-P] to control level. The pump failed to start when taken to start following two attempts. At 0122 hours, a reactor core isolation cooling (RCIC) pump [BN] was started for injection to the reactor vessel and continued to provide reactor level control.

Pressure control was maintained by the turbine bypass valves [SB-V] until 0210 hours, when the main steam isolation valves (MSIVs) were closed to limit reactor vessel cooldown. Once the MSIVs were closed, the RCIC System, which was being used for level control, was also utilized for pressure control. The safety relief valves [SB-RV], were not required to automatically respond and were not opened manually. No automatic Emergency Core Cooling System (ECCS) response was required.

There were no other structures, systems or components that were inoperable at the start of the event (other than the MFP as described above) that contributed to the event.

On January 6, 2005, at 0401 hours, the required non-emergency four-hour notification was made to the NRC pursuant to the requirements of 10 CFR 50.72(b)(2)(iv)(B), reactor protection system actuation while critical (NRC Event Number 41310). This event is being reported under requirements of 10 CFR 50.73(a)(2)(iv), any event or condition that resulted in manual or automatic actuation of any of the specified systems.

III. CAUSE OF EVENT

The cause of the reactor scram was a manual initiation by the reactor operator. The operator actions to initiate this manual scram were appropriate considering the plant conditions and within management expectations.

Troubleshooting of the RRC pump speed downshift instrument loops was initiated to identify potential component failures. A similar unexpected RRC downshift event occurred approximately two weeks earlier on December 23, 2004 [See PNPP LER 2004-002].

It was determined that the downshift originated from an optical isolator in the end-of-cycle RRC pump trip (EOC/RPT) circuitry for the B logic. An optical isolator is used for physical separation of safety and non-safety circuits.

The EOC/RPT trip is a safety supplement to the reactor protection system [JC], which will automatically initiate a RRC pump downshift to slow speed after a main turbine trip. A relay was found to have 40 VDC across its coil supplied from an optical isolator output, when voltage should have been 0 VDC. The sequence of events recorded during both the December 23, 2004 and the January 6, 2005 RRC high to slow speed downshift events could be duplicated during testing with 40 VDC being applied from the output of the subject optical isolator. The failure mechanism for the optical isolator was overvoltage stress, which caused the output transistor on the optical isolator to fail. The installed resistor/capacitor surge suppression network was insufficient to protect the output transistors from the inductive kick experienced during normal operation, thus providing the source for electrically overstressing

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

of the optical isolator card. This inadequate suppression design made the optical isolator sensitive to normal high level electrical fast transient noise, which allowed an intermittent malfunctioning output.

The cause of the RRC A tripping from slow speed to off was a failure of an amplifier circuit on the voltage regulator card [EC] in the low frequency motor generator (LFMG) which supplies electrical power to the RRC pump A at slow speed. The failure caused a momentarily loss of voltage from the LFMG A generator followed by a rapid recovery to near rated voltage seven seconds later. The ensuing attempt of the LFMG A to restore voltage to the RRC pump motor resulted in a generator over-current relay trip and lock out the LFMG A generator output breaker.

The cause of the motor feedwater pump failure to start was due to the closing springs in the 15 KV electrical supply breaker not being charged. With the breaker closing springs not charged, it is not possible to close the breaker and start the pump from the control switch. The breaker's charging springs were not charged due to the closing spring charging link arm striking the cubicle floor-mounted interference plate (also known as a rejection plate) used within 15 KV non-safety related 15 HK ABB electrical supply breaker cubicles. This interference plate, which was in its design location, is positioned to ensure that a breaker with a different electrical current rating can not be installed in its cubicle. Additionally, misalignment of the racking rails contributed to the contact of the spring charging link arm with the interference plate. The physical contact dissipates some kinetic energy to the operating mechanism and can intermittently result in the breaker timing cam failing to rotate sufficiently to actuate the control device and energize the closing spring charging motor. This is a legacy design deficiency.

A lack of full organizational commitment for the program implementation of the Problem Solving and Decision Making Process contributed to the ineffectiveness in determining the cause of the December 23, 2004 RRC pump downshifting event and is a contributing cause of the January 6, 2005 RRC pump downshifting event.

## IV. EVENT ANALYSIS

The primary purpose of the RRC system is to provide forced circulation through the reactor core to achieve full power operation and permit variations in power level without control rod movement. Control interlocks are provided for the RRC pumps to automatically downshift the pump from fast to slow speed. These controls are provided to prevent cavitation in RRC system components and mitigate the effects of various operational transients.

Analysis of plant conditions at the time of the RRC pump fast to slow speed downshift confirmed that no process parameters or transients requiring initiation of the above interlocks were present. With the reactor at full power, the pump speed downshift placed the reactor in a region of potential instability on the power-flow map, although no power oscillations were observed. Actual power after the downshift transient was determined to be approximately 44 percent. Following off normal operating instructions, the control room crew began inserting control rods. However, the reactor was subsequently manually scrammed as a conservative decision by the control room crew given both the unexpected downshift of both RRC pumps and the subsequent unexpected tripping of one RRC pump to off. All control rods inserted, no safety relief valves were opened, no automatic ECCS response occurred, and no ECCS system was used for level control.

The plant response was consistent with and bounded by the Updated Safety Analysis Report (USAR) event analyses for "Decrease in Reactor Recirculation Flow" in Chapter 15.3 which shows that a downshift of both RRC pumps event is bounded by the trip of both RRC pumps event. The plant response was also consistent with and bounded by the USAR event analysis for "Recirculation System Single Loop Operation" in Chapter 15.0.5.3 and in Appendix 15F. The recirculation system single loop operation evaluation indicates that PNPP can safely operate with a single recirculation loop out-of-service at up to approximately 67 percent of rated thermal power. The plant response following the manual scram was bounded by USAR Section 15.2.3 for a turbine trip. Thus, this event was determined to be within design evaluation limits.

A risk assessment was also performed. The computed results were that the probability of core damage for the January 6, 2005, scram was 8.7E-07 and the probability of a large early release was computed to be 4.9E-09. Transients with a core damage probability less that 1.0E-06 and a large early release probability less than 1.0E-07 are not considered to be risk significant events.

Based upon the above information, this event is very low safety significance.

## V. CORRECTIVE ACTIONS

The failed optical isolator in the RRC logic was replaced with a modified card using diodes in place of the resistor/capacitor surge suppression network. Additional optical isolator cards that had been subjected to similar conditions as the failed card were replaced with the modified cards.

The LFMG A voltage regulator was replaced. Actions were initiated to identify and correct degrading LFMG voltage regulator trends prior to equipment failure.

The interference plate was removed from the floor of the motor feedwater pump's 15 KV electrical supply cubicle. Interference plates in other 15 KV breakers that exhibited wear were also removed.

Training will be provided to the appropriate site personnel on the Problem Solving and Decision Making process "NOP-ER-3001", their roles and responsibilities in the process, management's expectations and the standards required to be followed to ensure the process is implemented as written.

The above events and corrective actions have been entered in the plant corrective action program.

# LICENSEE EVENT REPORT (LER)

| 1. FACILITY NAME | 2. DOCKET | 6. LER NUMBER | | | 3. PAGE |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| Perry Nuclear Power Plant | 05000440 | 2005 | -- 001 -- | 00 | 6 of 6 |

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

## VI. PREVIOUS SIMILAR EVENTS

Manual Scram due to unexpected Reactor Recirculation Pump downshift, LER 1993-015. This manual scram was initiated in accordance with procedures in effect at that time when entering the power-to-flow region of core instability. The cause of the downshift was a failure of both RRC pump suction resistance thermal detectors, which is not similar to the January 6, 2005 event. Optical isolators were specifically evaluated as not being the cause.

Manual Scram due to unexpected Reactor Recirculation Pump downshift, LER 1994-002. This manual scram was initiated in accordance with procedures in effect at that time when entering the power-to-flow region of core instability. The cause of the downshift was a failure of a K1 relay on an alarm card, which is not similar to the January 6, 2005 event.

Automatic Scram following unexpected Reactor Recirculation Pump downshift, LER 2001-005. This automatic scram occurred following a high reactor pressure vessel water level that was initiated by a RRC pump downshift. The cause of the downshift was a failure of a feedwater system level summer card, which is not similar to the January 6, 2005 event.

The corrective actions from the above events would not have precluded occurrence of this event.

Automatic Scram following unexpected Reactor Recirculation Pump downshift, LER 2004-002. This automatic scram occurred due to an oscillation power range monitor (OPRM ) actuation. The cause of the downshift was thought to be a failed low feedwater flow or low reactor water level sensing card. The subsequent pump downshift, which occurred on January 6, 2005, was determined to be due to a failed optical isolator, which was also subsequently determined to be the cause for the prior pump downshift on December 23, 2004. Although the cause of the downshift was the same, the corrective actions for the OPRM scram were judged effective since the correct operator actions were in progress to exit the immediate exit region of the power to flow map. No OPRM alarms were received indicating that an automatic scram was unlikely to have reoccurred. The RRC pump tripped to off, causing the control room crew to manually scram the reactor in this event.

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