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United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
LER 2003-006, Loss of Safety Function and Technical Specification 3.0.3 Entry due to Support System Inoperability

Ladies and Gentlemen:

Enclosed is Licensee Event Report (LER) 2003-006, Loss of Safety Function and Technical Specification 3.0.3 Entry due to Support System Inoperability. The cause evaluation for this event is complete; the results of which are reflected in the LER. The management review of the event is in progress. Should the cause evaluation change significantly, a supplement to this LER will be submitted.

There are no regulatory commitments contained in this letter. Any actions discussed in this document that 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. Vernon K. Higaki, Manager – Regulatory Affairs, at (440) 280-5294.

Very truly yours

for William R. Kanda
Enclosure: LER 2003-006
cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

IE22

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 hrs. 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	05000440	1 OF 6

4. TITLE

Loss of Safety Function and Limiting Condition for Operation 3.0.3 Entry due to Support System Inoperability

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
12	21	2003	2003	006	0	02	19	2004	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	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)	X	50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)	X	50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	X	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Kenneth Russell (Compliance Engineer)	(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	CC	TCV	A609	Y					

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 December 21, 2003, at 1945 hours with the plant operating at 100% power, an emergency closed cooling (ECC) system power loss annunciator was received. Two main line fuses were found to have operated (blown) for the division 1 ECC temperature control valve (TCV). The loss of electrical power caused the TCV to fail in the full cooling position resulting in the inoperability of the division 1 control complex chilled water (CCCW) system chiller. The division 2 CCCW system chiller was already in secured status and inoperable for maintenance. With both division 1 and 2 CCCW system chillers inoperable the heating ventilation and air conditioning (HVAC) systems supported by the chillers were determined to be inoperable. Since the HVAC systems were inoperable, the systems cooled by them, including ac and dc distribution and emergency core cooling systems were determined to be inoperable.

The operation of the TCV fuses was due to shorted windings in the electro-hydraulic actuator motor (hydra-motor). The cause of the event was the failure to identify and implement effective corrective actions to improve reliability of hydra-motor operated equipment. Apparent and root cause evaluations of previous events did not identify organizational, process and management causes that, if resolved, could have prevented failure of additional hydra-motors. Corrective actions include replacement of the fuses and TCV motor. The corrective action program has been revised to improve tracking of corrective actions. Additionally, training of personnel will be conducted to resolve the skill deficit identified.

This event was determined to be of low safety significance.

INTRODUCTION

The purpose of the emergency closed cooling (ECC) [CC] system is to provide nuclear safety related components with a reliable source of cooling water, ensuring proper operation of these components during normal and accident conditions. There are two independent closed-loop ECC subsystems. Each loop consists of a pump, heat exchanger, temperature control valve, surge tank, valves, interconnecting piping, instrumentation and controls. Each ECC heat exchanger is cooled by the emergency service water (ESW) [BI] system that circulates water from Lake Erie. Each ECC pump takes a suction on its loop suction header and discharges to a three-way temperature control valve [TCV] that directs flow through or around the ECC heat exchanger, to maintain the ECC water temperature downstream of the ECC heat exchanger within design limits. The TCV is equipped with an ASCO NH93, Model B-1 hydra-motor actuator that operates at 480 volts ac.

Among the loads cooled by the ECC system are the control complex chilled water (CCCW) chillers [KM - CHU]. The purpose of the CCCW system is to cool the control room and other areas in the control complex by supplying chilled water to the cooling coils of the heating, ventilating, and air conditioning (HVAC) systems which service the control complex. Chilled water is supplied to the cooling coils of the following systems:

- Control room HVAC system [VI] (required to operate during accident conditions)
- MCC, switchgear and miscellaneous electrical equipment area HVAC system [VE] (required to operate during accident conditions)
- Controlled access area HVAC system [VE] (not required to operate during accident conditions)
- Emergency closed cooling pump area cooling system [VE] (required to operate during accident conditions)
- Computer rooms HVAC system [VE] (not required to operate during accident conditions)

The CCCW system has three 100% capacity water chillers and three 100% capacity chilled water pumps. Normally, the two safety related chillers are aligned in standby readiness. The third chiller is not diesel generator backed and therefore is non-safety related. This chiller is normally in service allowing the safety-related chillers to remain in standby. System operating instructions require the CCCW chiller to be declared inoperable when ECC temperature decreases below 55 degrees Fahrenheit. With ECC cooling water temperature less than 55 degrees, the chiller may trip on low refrigerant temperature.

The control room HVAC system provides cooling for control room equipment. With both safety-related CCCW chillers inoperable, both trains of control room HVAC would be inoperable and technical specification (TS) limiting condition for operation (LCO) 3.7.4 Condition B would be entered. This LCO requires the operator to verify control room air temperature < /= 90 degrees once every 4 hours and to restore one control room HVAC subsystem within 7 days.

The MCC, switchgear and miscellaneous electrical equipment area HVAC system provides cooling to the safety-related ac and dc switchgear rooms, high pressure core spray (HPCS) [BG] switchgear rooms [EB], reactor protection electrical equipment rooms [JC], cable spreading areas [FA], and HVAC equipment rooms. Either train of MCC, switchgear and miscellaneous electrical equipment area HVAC system would provide cooling to all three ac and dc electrical divisions (excluding the diesel generator rooms). Each train is in turn cooled by its respective CCCW chiller.

Based on the definition of operability, the loss of both CCCW chillers created a loss of the cooling function for safety-related ac and dc switchgear, batteries and battery chargers. Consequently, LCO 3.8.4 DC Sources - Operating was entered for division 1, 2 and 3 dc electrical subsystems. Since no action is provided for divisions 1 and 2 being inoperable concurrently, LCO 3.0.3 was entered. With division 3 dc electrical subsystem inoperable, the HPCS system was required to be immediately declared inoperable. Likewise, LCO 3.8.7 Distribution Systems - Operating was also entered. With two or more divisions with inoperable distribution systems that resulted in a loss of function, Condition E directed entry into LCO 3.0.3.

The emergency closed cooling pump area cooling system provides cooling to the areas in which the ECC pumps and heat exchangers are located. The ECC pumps supply cooling water to the emergency core cooling systems (ECCS) pump area coolers and ECC pump seal coolers as well as the CCCW chillers. Either train of the ECC pump area cooling is capable of cooling both divisional ECC pump areas. Each train is cooled by its respective CCCW chiller. With both CCCW chillers inoperable, there was a loss of cooling function for the ECC pumps and they were declared inoperable.

LCO 3.7.10, Emergency Closed Cooling Water System, Condition A required that all of the supported systems be declared inoperable. Thus, ECCS and Reactor Core Isolation Cooling must be declared inoperable and LCO 3.5.1, Emergency Core Cooling Systems, and LCO 3.5.3, Reactor Core Isolation Cooling was entered. LCO 3.5.1 Condition H must be entered due to the inoperability of multiple ECCS. This condition required entry into LCO 3.0.3. LCO 3.5.3 Condition A requires HPCS to be verified operable within 1 hour and RCIC to be restored in 14 days. Since HPCS was inoperable (Div. 3 electrical distribution system was inoperable), the plant was required to be placed in MODE 3 within the next 12 hours.

EVENT DESCRIPTION

On December 21, 2003, at 1945 hours with the plant operating at 100% power, the ECC system power loss annunciator was received and an operator was dispatched to investigate. The operator observed that the motor run light for the division 1 ECC heat exchanger TCV was not illuminated at the electrical switchgear as expected and that two main line fuses were found to have operated (blown). The TCV was found to be failed full open. This resulted in the division 1 CCCW chiller being inoperable due to the TCV being unable to prevent ECC temperature from decreasing to less than 55 degrees. The division 2 CCCW system chiller was already in secured status and inoperable for maintenance. With both division 1 and 2 CCCW system chillers inoperable, the HVAC systems supported by the chillers were determined to be inoperable. Since the HVAC systems were inoperable, the systems cooled by them, including ac and dc distribution and ECCS were determined to be inoperable. As a result of the inoperable equipment, LCO 3.0.3 was entered at 2021 hours, as directed by LCOs 3.8.4, 3.8.7 and 3.5.1.

Division 2 CCCW chiller was placed in standby (aligned for automatic start) at 2130 hours in order to perform post maintenance testing to demonstrate operability. The post maintenance testing was satisfactorily completed and thus the safety function of the supported systems cooled by the division 2 CCCW chiller was determined to have been restored 1 hour and 45 minutes after the failure of the division 1 CCCW TCV. The division 2 CCCW chiller was declared operable and LCO 3.0.3 was exited at 0003 hours on December 22, 2003, after 3 hours and 42 minutes.

Since supported systems from division 1, 2 and 3 ac and dc distribution systems and ECCS, were inoperable, as a result of the support systems (ventilation systems) being inoperable, the condition was reported per 10CFR50.72(b)(3)(ii)(B), an unanalyzed condition that significantly degraded plant safety and 10CFR50.72(b)(3)(v)(A, B and D), an event or condition that could have prevented fulfillment of a safety function. The Nuclear Regulatory Commission was notified via the Emergency Notification System (ENS) at 0031 hours on December 22, 2003. Subsequent to the report, an engineering evaluation has determined that the condition was of low safety significance and thus is not reportable under 10CFR50.72(b)(3)(ii)(B). Additionally, since the ability to shutdown the reactor and maintain it shutdown was not impacted, 10CFR50.72(b)(3)(v)(A) does not apply.

This License Event Report (LER) is being submitted in accordance with 10CFR50.73(a)(2)(v)(B and D), an event or condition that could have prevented fulfillment of a safety function to remove decay heat or mitigate the consequences of an accident. This LER was also required due to an entry into LCO 3.0.3 for greater than one hour, which is reportable per 10CFR50.73(a)(2)(i)(B), as an operation or condition prohibited by Technical Specifications.

CAUSE OF EVENT

The loss of safety function and entry into LCO 3.0.3 was the result of both the division 1 and 2 CCCW chillers becoming inoperable at the same time. The division 1 chiller became inoperable due to the loss of power to the TCV. The loss of power was determined to be the result of two main line fuses that were found to have operated. Subsequent troubleshooting determined that the fuses had operated as a result of the failure of the valve electro-hydraulic actuator motor (hydra-motor) due to shorted windings as the result of a defect in the wire insulation within the stator. The division 2 chiller was inoperable due to routine planned maintenance.

The following root causes were identified:

- Hydra-motors can experience unpredictable repetitive failures.
- Lack of effective action tracking in the corrective action program.
  Several modifications were initiated but not prioritized or implemented. No follow on actions were created to track implementation of the proposed modifications. The corrective action process in the 1990s allowed actions to be tracked in other systems / databases. The vendor quality issue and modification priority were never tracked to an effective conclusion. This deficiency was addressed by revision 4 to the "Condition Report Process." The current process requires that actions are tracked to completion for all remedial and preventative corrective actions developed for Conditions Adverse to Quality and Significant Conditions Adverse to Quality.
- Apparent cause and root cause evaluations identified mechanisms but consistently fail to identify organizational, process, and management causes.
  Troubleshooting and failure analysis were generally used to determine the failure mechanism without use of an equipment root cause tool. Personnel responsible for apparent and root cause investigations were not adequately trained to advanced root cause tools.

SAFETY ANALYSIS

In the event of an accident, loss of cooling for the control room HVAC; MCC, switchgear and miscellaneous electrical equipment area HVAC system; and the ECC pump area cooling system could have occurred resulting in the eventual loss of safety functions that could have impacted the mitigation of the accident. As a result of the loss of the ECC pump area cooling system, loss of the ECC safety function could have occurred based on elevated temperatures. Loss of ECC could result in the loss of HPCS, low pressure core spray (LPCS), residual heat removal (RHR) A, B and C (low pressure core injection (LPCI), containment spray and suppression pool cooling modes), RCIC and both hydrogen analyzer channels. The actual loss of function would not have occurred immediately, but would have required the area to heat up, resulting in eventual degradation of the safety equipment, and ultimate failure. Restoration of the division 2 CCCW chiller was completed in 1 hour and 45 minutes from the time of failure of the division 1 CCCW chiller.

An engineering analysis was performed in 1996, (condition report 96-3098), for an event in which both chillers could have become inoperable. The purpose of the evaluation was to determine when the significant supported components would be impacted by loss of cooling. The results were as follows:

If cooling to the control room HVAC safety-related system is lost, a temperature rise in excess of the 90 degree TS limit, would be required to impact equipment qualification. Exceeding the equipment qualification temperature does not result in immediate equipment failure, but the over-all life of the affected components could be shortened. An engineering calculation determined that with both HVAC trains running (without cooling from the chillers) following a loss of offsite power (LOOP) or loss of coolant accident (LOCA), it would take 1 hour 24 minutes to go from 75 to 90 degrees in the control room. The calculation also listed 2 hours 10 minutes to go from 75 to 90 degrees with only one control room HVAC train in operation. Since actual temperature at the time of the event was about 68 degrees, the actual time to reach 90 degrees would have been longer for either case. A linear interpolation of the time using the 68-degree temperature would increase the times to 2 hours 3 minutes and 3 hours 10 minutes respectively.

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

Additionally, plant procedures direct operators to shutdown 1 of the 2 HVAC trains after verifying their operation. Based on the actual time required to restore CCCW B chiller, and the time necessary to exceed the TS temperature limit of the control room equipment, cooling could have been restored during an accident prior to equipment damage as a result of high temperature. Therefore, the control room temperature rise would have had negligible impact on control room equipment qualifications.

For the MCC, switchgear and miscellaneous electrical equipment area HVAC system, the engineering analysis determined that the limiting temperature rise would be in the divisional SWGR area. The analysis indicates that the 104-degree equipment qualification temperature for the SWGR area would not be reached for up to approximately 3 hours 40 minutes following a loss of coolant accident.

The time required to impact the ECC Pump room components' equipment qualifications was determined to be in excess of four hours.

During the short time period when the CCCW chillers were unavailable, the ECC water system and ECCS are considered inoperable; however, during an accident they would continue to be operated and would remain available. The actual time for restoration of the division 2 CCCW chiller and thus restoring cooling to the HVAC systems was one hour and 45 minutes.

Access to the control complex building basement (CC 579' elevation) was required to restore the division 2 CCCW chiller to operation. A review of the post-accident radiological conditions for that area determined that the dose rates would be less than 15 mrem per hour and would not pose an access constraint.

There was not a significant impact to the equipment needed to mitigate the effects of an accident as a result of loss of the control complex chillers. Therefore, this event was determined to be of low safety significance.

CORRECTIVE ACTIONS

The immediate corrective action was to restore the CCCW chiller B to operable following post maintenance retest to permit exiting LCO 3.0.3.

The open fuses and the failed valve actuator were replaced for ECC A TCV.

The First Energy Nuclear Operating Company HVAC component owner will develop a comprehensive plan that effectively resolves the hydra-motor reliability issues for safety related critical functional locations, track the action steps in the plan and the effectiveness of the plan. Additional preventative actions will be created to track the actions identified by the plan. Effectiveness of the plan will also be monitored through the corrective action process. PNPP PES will present the plan to the Plant Health Committee for prioritization.

The condition report process had previously been revised to track actions to completion for all remedial and corrective actions developed for Conditions Adverse to Quality and Significant Conditions Adverse to Quality.

A condition report has been written to identify engineering change requests (potential design modifications) that were not given development priority in the design change process as a result of not being tracked in the corrective action program. These change requests will be ranked and presented to the Plant Health Committee for prioritization in the design change process in accordance with their significance.

Training will be provided for apparent cause and root cause personnel to resolve the identified skill deficit in the identification of process, organizational, and management causes and effective extent of condition evaluations.

Training will be provided to the management team (including Apparent Cause analysts) on effective corrective action program administration to assure apparent cause and root cause evaluations result in timely and effective resolution of the identified issues.

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PREVIOUS SIMILAR EVENTS

There have been no similar events, resulting in licensee event reports (LERs), as a result of hydra-motor failures, lack of effective action tracking or failure to identify organizational, process, and management causes at PNPP within the last five years. Other LERs for LCO 3.0.3 entries were identified, the most recent in 2000, but did not have root causes similar to the hydra-motor failure. The corrective actions from these events would not be expected to prevent the condition that occurred in this LER.

The hydra-motor failure in this event occurred after 19 months of service (previous replacement was due to the preventative maintenance schedule). The failure mechanism was determined to be a shorted connection in the motor windings. Although there is no significant history of this exact failure mechanism, PNPP's corrective action program had documented several hydra-motor failures. Hydra-motor failures were evaluated as described in the Cause of Event section of this report. Corrective actions have been identified for these failures and are listed in the Corrective Action section.

Energy Industry Identification System (EIIS) codes are identified in the text in the format [xx].