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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 96-006-00

Gentlemen:

Enclosed is Licensee Event Report 96-006-00, Motor-Operated Valve Control Circuitry Design Deficiency Results in Fire Protection Program Violation.

If you have questions or require additional information, please contact Mr. James D. Kloosterman, Manager - Regulatory Affairs at (216) 280-5833.

Very truly yours,

E Worley
for

CRE:sc

Enclosure: LER 96-006-00

cc: NRC Region III Administrator
NRC Resident Inspector
NRC Project Manager

JE22 1/1

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 04/30/98
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND 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.

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TITLE (4)
Motor-Operated Valve Control Circuitry Design Deficiency Results in Fire Protection Program Violation

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAME	DOCKET NUMBER
										05000
07	18	96	96	-- 006 --	00	08	19	96	FACILITY NAME	05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
			20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
POWER LEVEL (10)	100		20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)	X	OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Keith R. Jury, Supervisor-Compliance	(216) 280-5594

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE).		NO		12	01	96

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

On July 18, 1996, at approximately 1655 hours, it was determined that a design deficiency associated with motor-operated valve (MOV) control circuitry constituted a fire protection program concern which could adversely affect the ability to achieve and maintain safe shutdown of the plant in the event of a fire. A fire impairment was issued for the control room fire protection features to reduce the probability of fire induced circuit faults adversely affecting alternate shutdown capability. This event is being reported in accordance with Technical Specification reporting requirement 5.6.6.a.

The cause of this issue is a design deficiency. Typical MOV control circuitry design configuration is such that the control room and remote shutdown control wiring and switch contacts are electrically located between the torque/limit switch contacts and the motor contactors. This design configuration makes the plant vulnerable to the scenario delineated in NRC Information Notice 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," for safe shutdown MOVs that have stall thrust high enough to cause internal valve damage. Identification and implementation of additional permanent actions to resolve valve safe shutdown capability issues will be based upon the results of further evaluation. The details and schedule for these actions will be included in a supplement to this LER which is scheduled for completion by December 1, 1996.

I. Introduction

On July 18, 1996, at approximately 1655 hours, it was determined that a design deficiency associated with motor-operated valve (MOV) control circuitry constituted a fire protection program concern which could adversely affect the ability to achieve and maintain safe shutdown of the plant in the event of a fire. At 1830 hours, a fire impairment was issued for the control room fire protection features to reduce the probability of fire induced circuit faults adversely affecting alternate shutdown capability. This event is being reported in accordance with Technical Specification reporting requirement 5.6.6.a.

At the time of the event, the plant was in Mode 1 at 100 percent of rated thermal power. The reactor pressure vessel pressure was at approximately 1024 psig with reactor coolant at saturated conditions.

II. Event Description

On February 28, 1992, the NRC issued Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire," to alert addressees to conditions found at several commercial reactors that could result in the loss of capability to maintain the reactor in a safe shutdown condition in the unlikely event that a control room fire forced reactor operators to evacuate the control room. IN 92-18 identified a scenario in which a control room fire could result in the energization of MOVs to a stalled condition since MOV protective features might be bypassed during the scenario. As delineated in the IN, degradation of the valve and/or actuator could result in the loss of the ability to achieve and maintain safe shutdown in the event of a fire.

The Perry Nuclear Power Plant (PNPP) initially evaluated IN 92-18 in April 1992, and concluded that engineering efforts would be focused on fuse sizing issues, and that the structural integrity of the valves was acceptable based on the use of stall thrust values in the respective seismic qualification reports for the affected valves. The stall thrust values were based on standard calculation methods in effect at the time and utilized the design values for stem coefficient of friction. Since that time, industry testing of MOVs in response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," has demonstrated that motors are more efficient and stem coefficients of friction are lower than initially assumed, which could result in higher stall thrust being applied to the valve through the actuator, if the MOV control circuitry is subjected to the IN 92-18 scenario.

Due to recent events at Palisades Nuclear Plant (LER 95-015) and Davis-Besse Nuclear Power Station (LER 96-002), IN 92-18 was reviewed to confirm the initial PNPP assessment. Stall thrusts were calculated for the associated MOVs utilizing the more current and conservative assumptions of motor efficiencies and stem coefficients of friction. As a conservative first screening, these stall thrust values were compared to the valve structural abnormal (weak link) limit values

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used for GL 89-10 evaluation purposes. The stress limits used to determine the weak link limit values were conservatively based on not exceeding material yield limits. The weak link limit values are conservative torque and thrust values that contain design margin. Exceeding the weak link limit values does not, by definition, cause loss of valve function. Use of the conservative first screening method resulted in a list of twenty-one valves which have stall thrust values greater than their weak link limit values. Further evaluation was required to ensure the valves would not degrade under a stall condition, to the extent that loss of safe shutdown function could occur.

On July 18, 1996, at 1655 hours, it was determined that reasonable assurance existed that some of the screened valves could degrade, if subjected to the IN 92-18 scenario, to the extent that they could not be relied upon to perform their safe shutdown related functions. This condition could adversely affect the ability to achieve and maintain safe shutdown in the event of a fire. A fire impairment was issued for the control room fire protection features to reduce the probability of fire induced circuit faults adversely affecting alternate shutdown capability. Further screening has been used to determine that the following twelve valves are most susceptible to not being able to perform their safe shutdown related function when subjected to fire induced circuit faults:

1B21-F0019	Main Steam Isolation Valve Before Seat Drain
1E12-F0003A	Residual Heat Removal (RHR) Heat Exchanger Outlet Flow Control Valve
1E12-F0023	RHR Isolation to Reactor Vessel Head Spray Valve
1E12-F0024A	Return to Suppression Pool Isolation Valve
1E12-F0048A	RHR Heat Exchanger Shell Side Bypass Valve
1E51-F0019	Reactor Core Isolation Cooling (RCIC) Pump Low Flow Bypass Valve
1E51-F0045	RCIC Turbine Steam Isolation Valve
1E51-F0063	RCIC Steam Supply Containment Isolation Valve
1E51-F0064	RCIC Steam Supply Containment Isolation Valve
1G33-F0004	Reactor Water Cleanup Suction Containment Isolation Valve
1P57-F0015A	Safety Related Instrument Air Containment Isolation Valve
1P57-F0020A	Safety Related Instrument Air Containment Isolation Valve

An evaluation of the valves affected by the postulated fire scenario has determined that although the valves may be damaged to the extent that they cannot be relied upon to perform their safe shutdown related functions, pressure boundary integrity will be maintained. Valve pressure boundary parts such as the body, bonnet, and body to bonnet connection are typically stronger than actuator bolting, valve stem, and actuator to stem connections. This assertion has been confirmed through consultation with valve vendors and peer industry contacts.

III. Cause of Event

The cause of this issue is a design deficiency. Typical MOV control circuitry design configuration at PNPP is such that the control room and remote shutdown control wiring and switch contacts are electrically located between the

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torque/limit switch contacts and the motor contactors. This design configuration can allow the postulated fire in the control room, and the associated "hot short," to result in the spurious actuation of the affected valve(s) without the protective features limiting the travel of the valve actuator(s). This postulated scenario could cause the motor to go to a locked rotor condition, resulting in valve damage that could adversely affect the ability to achieve and maintain safe shutdown of the plant.

Since the PNPP initial evaluation of IN 92-18, and through the implementation of GL 89-10 related activities, the industry has evolved in its methodology of dynamic MOV testing and valve capability determination methods. As a result, actual stem coefficient of friction values have been shown through testing to be lower than the design stem factor values originally used, which generally increased the calculated stall thrust capability of the MOVs. Re-evaluation of the IN 92-18 scenario with current valve capability information has resulted in different conclusions as to the adequacy of some safe shutdown MOV control circuit designs.

IV. Safety Analysis

As part of the fire protection program, PNPP committed to conform to the technical requirements in Appendix R to 10CFR50. Appendix R, Section III, paragraphs G.2. and G.3., require in part, that if cables or equipment that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located in the same fire area outside of containment, one train must be protected or an alternative or dedicated shutdown capability and its associated circuits, independent of cables, systems, or components in the area, room or zone under consideration, shall be provided.

The requirements for the alternative means are described in Appendix R, Section III, paragraph L. Clarification of these requirements is given in GL 86-10, "Implementation of Fire Protection Requirements," which delineates the following assumptions that should be considered in the design of the alternative or dedicated shutdown systems:

a. The safe shutdown capability should not be adversely affected by any one spurious actuation or signal resulting in any plant area; and

b. The safe shutdown capability should not be adversely affected by a fire in any plant area which results in the loss of all automatic function (signals, logic) from the circuits located in the area in conjunction with one worst case spurious actuation or signal resulting from the fire; and

c. The safe shutdown capability should not be adversely affected by a fire in any plant area which results in spurious actuation of the redundant valves in any high-low pressure interface line."

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There are two situations where equipment is required to operate in order to support Appendix R safe shutdown after the control circuits are subjected to fire induced faults:

Control Room Remote Shutdown Panel - The PNPP design for fire protection of redundant trains for safe shutdown equipment and circuits in the control room, provides an alternate means of control comprised primarily of Division 1 components required for the shutdown train. The fire protection features are designed as part of the control circuitry and allow for the operation of valves to the required positions from the alternative shutdown locations. The power and control of these components are electrically isolated from the effects of the control room fire at the remote shutdown panel, or other locations separated from the control room by fire barriers. After the equipment is isolated from the control room, any fire induced faults in the control room have no impact on the equipment. The valves required for hot shutdown and cold shutdown are identified in the Safe Shutdown Capabilities Report, Table 3.5-1.

Cold Shutdown Actions - Manual operation is required for some valves required for cold shutdown in those areas where circuits for these valves and equipment of the redundant train are located. Any fire induced faults on the circuits must have no adverse impact on the ability to manually align the valve. These valves are identified in Off-Normal Instruction (ONI)-P54, "Fire."

Both of the above situations were considered during the re-evaluation of IN 92-18. No valves associated with Cold Shutdown Actions were identified as adversely affecting the ability to achieve and maintain safe shutdown in the event of a fire.

The scenario described in IN 92-18 involves the impact of the fire induced faults in the control room on equipment, prior to isolation from the control room. The limit/torque switches that stop the movement of the MOVs by interrupting electrical power to the open and close circuitry are located at the MOVs. The circuitry from these limit/torque switches are routed from the MOVs, through the control room, to the control logic circuitry in the motor control centers. For the postulated control room fire scenario, a spurious actuation involves a single 120 volt energized wire coming in electrical contact with either the open or close circuitry in a manner which in effect, electrically removes the limit/torque switch from the circuit. It was determined that there are valves that have the potential for a spurious actuation caused by fire induced hot shorts which bypass valve protection features and adversely impact the ability of the valve to be repositioned after electrical isolation from the control room, due to damage caused by stall thrust.

If the impact of the spurious actuation on the designated safe shutdown valves is determined to cause the valves to fail to operate as required for safe shutdown, protection from the effects of a control room fire is required. With redundant systems in close proximity, installation of a fire rated barrier inside the control room is not practical. The fire protection of the safe shutdown

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capability for the control room fire involves isolation design features that eliminate the adverse impact of the fire induced faults in the control room. These features include fuse sizing, isolation switches, and control logic design.

The lack of fire protection features that ensure the ability to restore any one of the affected valves to the position required for achieving and maintaining safe shutdown after a fire in the control room, could without mitigating actions, have resulted in the postulated fire disabling both trains of safe shutdown systems analyzed in the Safe Shutdown Capabilities Report. This condition does not conform to 10CFR50 Appendix R, which delineates that at least one train of safe shutdown equipment and circuits be free from fire damage. Technical Specification reporting requirements 5.6.6.a references compliance with the Fire Protection Program as described in the Updated Safety Analysis Report (USAR). The USAR concludes that for a fire in the control room, Division 1 could be used for safe shutdown. The Safe Shutdown Capabilities Report, Table 3.5-1, describes the components for the Division 1 systems needed and the manner provided to isolate them from the effects of a control room fire in order to protect the ability to achieve safe shutdown. The fire protection program requires that if fire protection features are not in service, compensatory measures shall be in place. This requirement was apparently not met until the condition was discovered and the fire impairment issued on July 18, 1996.

The basis of the Fire Protection Program is to provide a defense in depth principle by achieving an adequate balance in:

1) Preventing a fire from starting.

2) Quickly detecting and extinguishing fires that do occur, thus limiting fire damage.

3) Designing safety-related systems so that a fire that occurs and burns out of control for a considerable length of time, despite the fire protection activities, will not prevent safe shutdown.

Since not one of the above can always be assumed to be achieved, the fire protection Program is based on the interaction between them, thus ensuring that weaknesses in one area are compensated for by strengths in another.

First, control of combustibles, fire loading, and ignition sources in the control room and other critical areas of the plant is addressed by the fire protection program. Also the Tefzel material used in cabling for the control room design would not be susceptible to rapid fire propagation.

Second, the fire protection program places special emphasis on detecting and suppressing fires which would endanger systems required f... safe shutdown. The control room is equipped with both ionization (smoke)and he.. detectors covering the floor section modules and smoke detectors in the control room proper. This coverage includes the wireways in the modules and the cabinets and panels on top of the modules. The fire suppression system consists of manually initiated carbon

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dioxide total flooding system for the wireways in the floor section modules. Should a fire occur in one of these main sections, the wireways in the entire section are flooded simultaneously. Manual water type hose stations and appropriate fire extinguishers are provided as backup. The Control Room Heating Ventilation and Air Conditioning (CRHVAC) system is provided with smoke clear mode which has a high volume flow capability to clear smoke from the control room.

To address the third defense in depth principle of the Fire Protection Program, capability to transfer control and operation of the components to the remote shutdown panel was designed. This transfer capability is an integral part of the overall Fire Protection Program for an unmitigated fire in the control room.

The control room is continuously occupied, and is equipped with fire detection and suppression systems as well as smoke clearing capabilities of the CRHVAC system (as discussed above), supporting the consideration that an unmitigated control room fire and subsequent control room evacuation (the scenario described in IN 92-18) has a low probability of occurring. Electrical divisional separation is in accordance with Institute of Electrical and Electronics Engineers (IEEE) separation criteria. Redundant divisions of cabling are not located in common wireways within the floor sections. Fire spreading capability within floor section testing indicated that a fire in one wireway will not affect cabling in adjacent wireways. Fires in the control room have a high probability of early detection and suppression before the adverse effects described in IN 92-18 could occur; therefore, the condition reported by this LER is not considered to be safety significant.

V. Similar Events

Previous violations of the fire protection program which would have adversely affected the ability to achieve and maintain safe shutdown of the reactor in the event of a fire, are documented in LERs 88-044, 91-020-01, 92-018, 93-008, and 93-020. LERs 88-044 and 91-020-01 addressed fire barrier design deficiencies. LERs 92-018 and 93-020 addressed missed hourly fire watches. LER 93-008 addressed a design deficiency in the self checking feature of the Fire and Security Monitoring system which resulted in an undetected malfunction of the "Fire" side computer. None of the corrective actions associated with these previous LERs could reasonably be expected to have prevented the condition documented by LER 96-006.

VI. Corrective Actions

The following corrective actions have been taken or are in progress:

1. On July 18, 1996, a fire impairment was issued for the control room fire protection features. This impairment takes credit for continuous control room occupancy and also heightens the control room operators awareness of the situation to further reduce the probability of fire induced circuit faults adversely affecting alternate shutdown capability.

2. Completion of the remote shutdown Appendix R MOV weak link evaluation to determine valve safe shutdown capability effects is scheduled for November 1, 1996.

3. Identification and implementation of actions to resolve valve safe shutdown capability issues will be based upon the results of the evaluation. The details and schedule for these actions will be included in a supplement to this LER which is scheduled for completion by December 1, 1996.

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

The following table identifies those actions committed to by the Perry Nuclear Power Plant in this document. Any other actions discussed in the submittal represent intended or planned actions by the Perry Nuclear Power Plant. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Manager-Regulatory Affairs at the Perry Nuclear Power Plant of any questions regarding this document or any associated regulatory commitments.

Commitments
1. Completion of the remote shutdown Appendix R MOV weak link evaluation to determine valve safe shutdown capability effects is scheduled for November 1, 1996.
2. Identification and implementation of actions to resolve valve safe shutdown capability issues will be based upon the results of the evaluation. The details and schedule for these actions will be included in a supplement to this LER which is scheduled for completion by December 1, 1996.