NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

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.

LICENSEE EVENT REPORT (LER)

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

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TITLE (4)

Feedwater Coolant Injection (FWCI) System Potential Inoperability Upon Failure of S2 DC Power

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
04	11	95	95	008	02	12	19	96	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	[X] 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)	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)
Robert W. Walpole, MP1 Nuclear Licensing Manager	(860) 440-2191

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

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

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

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

On April 11, 1995, with the plant at 100% power, normal temperature and pressure, it was determined that a Feedwater Regulating Valve (FRV) closure interlock was dependent on both the S1 and S2 DC logic trains. This interlock ensures the 'A' & 'B' FRVs are closed after receipt of a Feedwater Coolant Injection (FWCI) initiation and Loss of Normal Power (LNP) signal to enable restart of the selected FWCI train pumps upon restoration of power to their electrical bus by the Gas Turbine Generator. The FWCI system was intended to be independent of the S2 DC logic train such that no single failure of S1 or S2 DC would make both the Isolation Condenser and FWCI inoperable. No safety systems were required to function as a result of this event. The cause of the event was a design error occurring at the time of original plant design. Flow modeling and analysis was performed which demonstrated that for accident mitigation, FWCI would perform its intended design function at all reactor vessel pressures down to and including that corresponding to the 330 degrees F Technical Specification requirements for FWCI operability with the FRVs open due to an S2 DC failure. Analysis has also revealed that the feedwater flow control logic will throttle the FRVs to the flow control setpoint, if a reactor feed pump runout condition is sensed following restoration of power to the FWCI train pumps, regardless of whether the FRVs are initially failed open. This feedwater flow control logic is independent of S2 DC power. Upon further review of the S1/S2 electrical separation issues in conjunction with the LNP logic modifications completed during Refueling Outage 15, it was decided to correct this design error by eliminating the S2 dependency of the FRV Closure Interlock. The physical plant modifications have been completed.

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

I. Description of Event

On April 11, 1995, with the plant at 100% power, normal temperature and pressure, it was determined that a Feedwater Regulating Valve (FRV) closure interlock was dependent on both the S1 and S2 DC logic trains. This interlock ensures the 'A' & 'B' FRVs are closed after receipt of a Feedwater Coolant Injection (FWCI) initiation and Loss of Normal Power (LNP) signal to enable restart of the selected FWCI train pumps upon restoration of power to their electrical bus by the Gas Turbine Generator. The FWCI system was intended to be independent of the S2 DC logic train such that no single failure of S1 or S2 DC would make both the Isolation Condenser and FWCI inoperable.

II. Cause of Event

The cause of the event was determined to be an error that occurred during original plant design. A review of the history of drawing and design changes associated with this control wiring diagram (CWD) revealed that the wiring associated with this condition was part of the original design.

III. Analysis of Event

This event is being reported in accordance with 10CFR50.73(a)(2)(ii)(B), any event or condition that resulted in the nuclear power plant being in a condition that was outside the design basis of the plant.

A failure of the S1 DC logic train would cause inoperability of the Gas Turbine and FWCI system as well as one train each of the Low Pressure Coolant Injection (LPCI) and Core Spray Systems. The isolation Condenser and the other train of the LPCI and Core Spray Systems, powered by the Diesel Generator, in conjunction with the Automatic Depressurization System (ADS), would be available to mitigate a design basis accident scenario.

A failure of the S2 DC logic train would normally cause inoperability of the Diesel Generator and the Isolation Condenser as well as one train each of the Low Pressure Coolant Injection (LPCI) and Core Spray Systems. The FWCI system, and the other train of the LPCI and Core Spray Systems, powered by the Gas Turbine Generator, in conjunction with the Automatic Depressurization System (ADS) would be available to mitigate a design basis accident scenario. However, the failure of the FRV closure interlock could have caused the inoperability of the FWCI system.

The Feedwater Coolant Injection (FWCI) system supplies make-up water to the reactor vessel in the event of a loss-of-coolant accident. The system is independent of the low pressure emergency core cooling systems, and is designed primarily for a small break in the Reactor Coolant System (RCS) that does not cause rapid RCS depressurization. The LPCI/CS systems, in conjunction with the Automatic Depressurization System (ADS) provides redundant methods of event mitigation in the event the FWCI system should fail to operate. The FWCI system, as designed, is a one train system which is not single failure proof.

The FWCI system automatically initiates on low low reactor vessel level (-48") or high Drywell pressure (2 psig). If a Loss of Normal Power (LNP) occurs concurrent with or subsequent to a FWCI initiation signal, the operating feed string pumps will stop until the Gas Turbine Generator can restore power to their

respective electrical buses. When reactor feed pump discharge pressure drops below 300 psig, the FRVs shut. Once the buses are re-energized by the Gas Turbine Generator, the selected FWCI train pumps will start as their suction pressure start permissives are met. The suction pressure start permissive for the reactor feed pump is 335 psig. When feed pump discharge pressure exceeds 300 psig, the FRVs will begin to open to permit vessel injection in the level control mode. If the reactor feed pump level/flow control logic circuitry senses a pump runout condition, the feedwater control system will switch to the flow control mode, throttling the FRVs to the control setpoint.

The FRV interlock functions to bypass the FRV lock-up for 70 seconds and close the 'A' & 'B' FRVs upon receipt of an LNP signal concurrent with or subsequent to an accident signal. A FRV lock-up, which would occur with either a loss of control signal or a loss of air, is not expected to occur during this scenario. The purpose of this FRV closure interlock is to enable the FWCI train pumps to repressurize the Feedwater system at shutoff head following an LNP condition after emergency power is subsequently supplied to the associated bus. The FRVs, which close when feed pump discharge pressure drops below 300 psig, will remain closed until the discharge pressure increases above 300 psig. A failure of this interlock would prevent closure of the FRVs, leaving them in the open or partially open position, which could prevent the feed pump suction pressure from building up to the 335 psig pressure start permissive for restart of the reactor feed pump and subsequent FWCI injection to the vessel.

An evaluation was performed that provided reasonable assurance the FWCI system could perform its intended safety function with an S2 DC system failure that fails this FRV closure interlock. Evaluation showed that the FWCI system remains capable of starting with the FRV fully open for the scenarios where reactor pressure is at elevated values (greater than 600 psig for more than one minute), thereby avoiding reactor blowdown via the Automatic Depressurization System (ADS). For the events where reactor pressure is lower than 600 psig prior to FWCI initiation, it was concluded that even though FWCI is not required to assist the ADS with vessel depressurization, additional computer modeling of the FWCI system has demonstrated that operability of the FWCI system is maintained for all reactor vessel pressures less than 600 psig down to and including that corresponding to the 330 degrees F Technical Specification requirement for FWCI operability. This is based on several considerations. The Condensate Booster Pump suction pressure start permissive will be met initially to enable pump start and will be maintained except for a period of approximately 4-5 seconds when suction pressure may fall below the low suction pressure setpoint of 20 psig. However, the Booster Pump Trip circuitry requires that suction pressure fall below 20 psig for a period not less than 10 sec. Therefore, analysis has shown that the Booster Pump will not trip on low suction pressure. The Reactor Feed Pump is also expected to start and remain operating since suction pressure will initially be above the suction pressure start permissive and will be maintained above the low suction pressure trip setpoint, based on maintaining an operable condensate and booster pump in the selected FWCI string. In addition, these evaluations concluded that, if the FRVs did not close due to a failure of the FRV closure interlock, vessel pressure, coupled with containment check valves, feed pump discharge check valves, and the booster pump discharge check valves, would allow the FWCI train pumps to fill the Feedwater lines, thereby allowing the FWCI train pump suction pressure start permissives to be satisfied while also minimizing the potential for pump runout. Therefore, it was concluded that FWCI would remain operable for all reactor vessel pressures. The potential for reactor feed pump runout is negligible due to the flow control circuitry which would throttle down the FRVs if a runout condition was sensed by the flow control logic. This feedwater flow control logic is independent of S2 DC power.

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

IV. Corrective Action

Based upon further review of the S1/S2 electrical separation issues in conjunction with the LNP logic modifications completed during Refueling Outage 15, it was decided to correct this design error by eliminating the S2 dependency of the FRV Closure Interlock. The physical plant modifications have been completed. The integrated testing will be completed prior to startup for Cycle 16.

The design control process and the design engineering organization have been strengthened, since the time of the original design and implementation of the FRV closure interlock. The design control improvements include a revised Design Control Manual. The current revision to the Design Control Manual became effective for Millstone Unit No. 1 on July 15, 1996.

V. Additional Information

None.