UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos. 50-369/96-02 and 50-370/96-02

Licensee: Duke Power Company
422 South Church Street

Docket Nos.: 50-369 and 50-370

License Nos.: NPF-9 and NPF-17

Facility Name: McGuire Nuclear Station 1 and 2

Inspection Conducted: March 11, 1996 - April 1, 1996

Inspectors: D. B. Rudisail 4/3/96
for G. Maxwell, Sr. Resident Inspector per telcon — Date Signed

M. Sykes, Resident Inspector
G. Harris, Resident Inspector
S. Rudisail, Project Engineer

Approved by: R. V. Crlenjak 4/4/96
R. V. Crlenjak, Chief, Branch 1 — Date Signed
Division of Reactor Projects

SUMMARY

Scope: This special inspection was conducted to review the circumstances surrounding the inoperability of Unit 2 refueling water storage tank level instrumentation due to freezing conditions from February 2-6, 1996, and the valid failure of the Unit 2B emergency diesel generator on February 6, 1996.

Results: Two apparent violations were identified. The first apparent violation involved inadequate procedural guidance for level instrumentation panel thermostat settings which resulted in the loss of control room annunciators and the automatic ECCS swapover from the RWST to the containment ECCS sump feature (paragraph 2).

The second apparent violation involved the failure to comply with TS action requirements for the onsite emergency power system. Ineffective corrective action is identified as the cause for the failure to comply with the requirements (paragraph 3).

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REPORT DETAILS

Acronyms used in this report are defined in paragraph 5.

1.0 **Persons Contacted**

Licensee Employees

*Cross, R., Regulatory Compliance Technical Specialist
*Dolan, B., Safety Assurance Manager
*Efird, E., Electrical Systems Engineering Supervisor
*Geddie, E., Station Manager
*Herran, P., Engineering Manager
Hashim, K., Safety Assurance
*Hatley, M., Civil Equipment Manager
*Houser, D., Electrical Systems Engineer
*Jones, R., Operations Superintendent
*Kennedy, M., Electrical Systems Engineer
Kisner, J., I&E Supervisor
*Kunkel, N., Civil Equipment Engineer
*Matthews, B., Nuclear Generation Engineer
*McMeekin, T., Vice President, McGuire Station
*Nazar, M., Maintenance Superintendent
*Roberts, R., Secondary Systems Engineer
*Small, G., Safety Review Group
*Snyder, J., Regulatory Compliance Manager

Other licensee employees contacted included operations, engineering, maintenance, chemistry/radiation, and corporate personnel.

NRC Personnel

*G. Maxwell, Senior Resident Inspector
*M. Sykes, Resident Inspector
G. Harris, Resident Inspector
S. Rudisail, Project Engineer
*R. Crlenjak, Branch Chief

*Attended exit meeting on March 27, 1996

2.0 Inoperable Refueling Water Storage Tank Level Transmitters (62703, 92703, 37551, and 93702)

2.1 Background

McGuire Units 1 and 2 have separate refueling water storage tanks (RWST). The RWST provides a source of borated water during the injection mode of operation of the emergency core cooling system (ECCS) following a postulated loss of coolant accident (LOCA). Upon an engineered safety feature (ESF) signal, the centrifugal charging pump, the safety injection pump, and the residual heat removal pumps start and take suction from the RWST. Also, under certain conditions the

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containment spray pumps start on an ESF signal. Safety related level transmitters 2FWLT5000, 2FWLT5010, and 2FWLT5020, provide narrow range tank level indication in the main control room and control signals for the automatic residual heat removal (RHR) system suction realignment from the RWST to the containment emergency core cooling system sump.

The Unit 2 RWST level instrumentation consists of the following:

- One non-safety related wide range level transmitter, 2FWLT5340, and one non-safety related narrow range level transmitter, 2FWLT5341, that provide control room level indication but do not provide inputs to any control circuitry. Both transmitters are located in a single thermostatically controlled and insulated enclosure. The non-safety related transmitters are used to verify RWST water volume in compliance with TS. The non-safety related transmitters also provide make-up and high level alarms.

- Three safety related narrow range transmitters (2FWLP5000, 2FWLP5010, and 2FWLP5020) that provide narrow range RWST level indication, alarms and annunciators in the control room, provide inputs for the automatic RHR pump suction realignment from the RWST to the ECCS sump on low RWST level (150 inches). The alarm and automatic swapover operate on a 2 out of 3 coincident logic. Each safety related transmitter is installed in separate thermostatically controlled and insulated enclosures. The temperature of each enclosure is controlled by a strip heater and thermostat located within the enclosure.

2.2 Frozen Refueling Water Storage Tank Level Transmitters and Related Issues

On February 6, 1996, with Unit 2 operating at 100 percent power, maintenance technicians were performing an operability verification of the RWST level transmitters 2FWLT5000, 2FWLT5010 and 2FWLT5020 in accordance with IP/0/A/3050/13B, RWST Class 1E Level Transmitter Operability Verification. The procedure was required to be performed on a 6 month frequency. The technicians completed the operability verification for 2FWLT5000 (Channel 4), verifying operability. The technicians then tested 2FWLT5020 (Channel 2) and found the transmitter inoperable. The technicians determined that the inoperability of the transmitter was due to freezing. The enclosure box thermostat was not properly adjusted to maintain enclosure box temperatures above freezing. The technicians measured the enclosure box temperature for transmitter 2FWLT5010 (Channel 1) and found the temperature near freezing.

The technicians notified the operations shift manager (OSM) and requested guidance. The OSM responded by directing that Channel 2 be placed in the tripped condition and the thermostat setting be increased for Channel 2. The operability of the Channel 1 level transmitter was not known, but technicians suspected that the transmitter was frozen.

The technicians could not determine whether the transmitter was operable unless the test was conducted. The OSM directed the technician to increase the thermostat setting; deciding to test the transmitter later. If testing the Channel 1 transmitter resulted in it being declared inoperable and placed in the trip position with Channel 2 already in the trip position, a safety injection signal could result in alignment to a dry sump. This was determined by the licensee to be a non-conservative action. This would cause the RHR system suction to realign to a dry containment sump and result in RHR pump degradation/failure. Approximately four hours from the time of discovery, both Channel 2 and Channel 1 were tested and verified operable. The Channel 1 enclosure box heater had been on for approximately one hour.

On February 8, 1996, following the February 6 failure of Channel 2 RWST level transmitter and a detailed engineering evaluation of the Channel 1 RWST level transmitter, Channel 1 was also determined to have been inoperable. Therefore, 2 of 3 safety-related RWST level transmitters were inoperable when instrumentation became frozen sometime after outside ambient temperatures decreased below freezing. With 2 of 3 RWST level transmitters inoperable, the RWST Low and Low-Low level main control room annunciators and the automatic residual heat removal swapover feature from the RWST to the ECCS sump would not function.

Prior to the freezing of the safety-related transmitters, the licensee determined that the Unit 2 non-safety related transmitters were frozen and the Unit 1 non-safety related reactor makeup water level indication was frozen. A PIP report generated by the licensee questioned the integrity of the RWST level indication transmitter enclosures.

2.3 Corrective Action

On February 7 the licensee verified proper operation of the Unit 1 RWST level transmitters and verified that enclosure box thermostats settings were above freezing. Station management established a task force to determine actions needed to assure all equipment requiring cold weather protection is adequately protected.

2.4 Significance of Event

The licensee determined that the Channel 1 and Channel 2 RWST level transmitters were inoperable when they became frozen sometime after ambient temperatures decreased below freezing. The RHR system suction path automatic realignment from the RWST to the containment sump operates on a 2 out of 3 coincident logic. With two channels unresponsive, the automatic realignment of both ECCS trains would not have occurred.

According to the licensee probabilistic risk assessment (PRA), multiple failures of the safety-related RWST level transmitters will fail the low level RWST alarm and the automatic realignment for the recirculation

mode of ECCS. This will fail both high pressure and low pressure recirculation since the RHR pumps and Containment Spray pumps could cavitate and eventually fail. The failure of multiple RWST level transmitters is a dominant contributor to LOCA initiated core melt frequency. The failure of multiple RWST level transmitters by freezing would be undetectable during normal operation and the initial phases of a large break LOCA since the control level indicators are scaled to provide indication of the lower 160 inches of RWST volume. When these transmitters froze, their indicators failed high. Therefore, the signals that call for the automatic swapover from the RWST to ECCS sump would not have occurred. Based on pump flow rates during a LOCA, pump degradation could occur.

The PRA does not give credit for operator action following multiple RWST level transmitter failures in conjunction with a large break LOCA. Some credit is given for operator action during small or medium size LOCA. The licensee's safety analysis showed that for small and for some medium size LOCAs, the emergency operating procedures and control room alarms and indications remain adequate for a successful manual swapover to the ECCS sump.

2.5 Root Cause

The licensee determined the root cause of the RWST level transmitter inoperability was due to insufficient monitoring of freeze protection equipment. The RWST level transmitters enclosure boxes were inspected during the performance of the 18 month calibration in accordance with IP/0/A/3050/13, RWST Class IE Level Transmitter Calibration. However, the procedure did not provide any requirement to confirm proper operation of the strip heaters or thermostat settings. Also, the inspectors verified that neither of the licensee's cold weather protection procedures, IP/0/B/3250/59, Preventive Maintenance and Operational Check of Freeze Protection or PT/0/B/4700/38, Verification of Freeze Protection Equipment and Systems, contained specific guidance necessary to ensure proper operation of the strip heaters or thermostats for the refueling water storage tank level transmitters.

2.6 Conclusion

The inspectors concluded that the licensee failed to provide detailed procedures for verification of freeze protection for the RWST level transmitters. This failure resulted in the inoperability of 2 of 3 RWST level transmitters during cold weather conditions and is considered to be an apparent violation of Technical Specification 6.8.1. This violation will be identified as Apparent Violation 50-369,370/96-02-01, Inadequate freeze protection procedures causing inoperability of RWST level transmitters.

3.0 Valid Failure of the Unit 2 Train B Emergency Diesel Generator (92703, 37551)

3.1 Background

McGuire Units 1 and 2 have two separate and independent emergency diesel generators as part of the onsite A.C. power source to ensure that sufficient power is available to supply the safety-related equipment for the safe shutdown of the facility and the mitigation and control of accident conditions within the facility. The EDGs are designed to provide power to the essential auxiliary power system following the loss of normal offsite power supplies. Each EDG is rated for continuous operation at 4000 kW.

The following trips are provided to protect the diesel-electric generating units at all times and are not bypassed during starting of the diesel generator by an engineered safeguard signal (manual reset of these trips is required):

1. Low Lube Oil Pressure
2. Engine Overspeed
3. Generator Differential Protection
4. Generator Time (Voltage Controlled) Overcurrent Protection

3.2 Valid Failure of Unit 2 Train B Emergency Diesel-Electric Generator

On February 6, 1996, during the performance of PT/2/A/4350/02B, 2B Diesel Generator Operability Test, a valid failure of the Unit 2 Train B EDG occurred due to low lube oil pressure when the EDG tripped after 39 seconds. The trip delay includes 9 seconds for the EDG to reach 95 percent speed and 30 seconds for lube oil pressure to exceed the trip setpoint. If lube oil pressure does not reach the setpoint of 33 psig within 30 seconds, then a trip signal is generated.

The licensee performed a review of the low lube oil pressure trip and determined that actual engine lube oil pressure was adequate to provide proper engine lubrication. The licensee checked the lube oil pressure instrumentation including the speed switch, time delay relay, and pressure switches (2LDPS5130 and 2LDPS5133). All operated properly and were confirmed to be within tolerances. After additional evaluations of sensing line performance, the licensee determined that the cause of the valid failure of the 2B EDG was a marginal design of the lube oil pressure sensing line. Because of the length of the tubing, venting was difficult. Entrapped air slowed lube oil pressure response. At lower room temperatures, these response times increased because of increased lube oil viscosity.

Both Unit 2 EDG room temperatures were above the design limit of 55°F specified in FSAR, Section 9.4. According to the licensee's operator aid computer (OAC) data point, the lowest recorded temperature in the 2B EDG room during the winter months was 62°F.

3.3 Corrective Action

The licensee increased EDG room temperatures in the Unit 1 and Unit 2 EDG rooms to greater than 75 F and increased lube oil temperature to 115°F. The licensee established compensatory measures to monitor EDG room and lube oil temperatures to ensure EDG operability. The licensee conducted an investigation into the past operability of the diesel generators to determine the effect of temperatures on lube oil pressure. Room temperatures were varied and the EDG lube oil pressure instrumentation was tested. Based on the test results, the licensee determined that the marginal design coupled with room temperatures below 71°F will cause the 2B EDG to become inoperable.

The pressure sensing line response of the other EDGs was examined and the effect of the low room temperatures and lube oil pressure indication response determined. The Unit 1 EDGs pressure sensing instrumentation responded within the acceptable period and have not experienced any low lube oil pressure trips due to slow pressure response. Overall, the Unit 1 EDGs were not considered to be as susceptible during periods of low room temperature and were confirmed to have been operable.

3.4 Operability Evaluation

The inspectors reviewed the licensee emergency diesel generator information for the time period between December 1995 and March 1996 and determined, on one occasion, both of the Unit 2 diesels were inoperable for approximately five hours. The five hour inoperability of both EDGs is within the TS allowed outage time. However, the TS requirement for one inoperable EDG was violated on several instances. Initial determination by the licensee identified four time periods when the EDG-2B would have been considered inoperable for periods greater than 72 hours based on room temperature. These times were:

12/22/95, 2200 to 12/26/95, 1500 - 89 hours
12/26/95, 2300 to 12/30/95, 1700 - 90 hours
01/06/96, 1500 to 01/15/96, 1400 - 215 hours
02/01/96, 0200 to 02/07/96, 0400 - 146 hours.

On April 2, 1996, the licensee issued Licensee Event Report (LER) 50/370/96-02. The licensee reported that due to the Before and After (B & A) Lube Oil Pump running 15 minutes each hour, the diesel was not continuously inoperable during this period. The licensee only considered the diesel inoperable 45 minutes of each hour with the room temperature below 71°F.

The inspectors noted that previous low lube oil pressure trips on the Unit 2 diesels had occurred with the B & A lube oil pump running and that the operation of this pump did not provide complete assurance that a diesel failure would be prevented in a degraded temperature condition. Testing to substantiate the licensee conclusion that the diesel would be operable with the B & A lube oil pump running and room temperature less than 71°F was not performed on EDG-2B. Testing was performed with the room temperature at approximately 73°F with the B & A pump not running. Additional testing was performed with the B & A pump running but with room temperatures at or above 75°F. The inspectors did not consider extrapolation of these separate testing results sufficiently conclusive to determine diesel operability. Testing of EDG-2B with the B & A pump running and room temperatures below 71° F was not performed.

3.5 History of Unit 2 EDG Low Lube Oil Pressure Valid Failures

Valid Unit 2 EDG failures due to low lube oil pressure have been a recurring problem. From May 1985 to February 1994 the Unit 2 EDGs have experienced several low lube oil pressure trips. In each case, the low pressure trip was due to low sensing line pressure and not due to actual low engine lube oil pressure. Corrective actions included flushing the sensing lines and venting the system to remove any air that may have been present.

Following a February 15, 1994, valid failure of the Unit 2 Train A EDG because of low lube oil pressure, the licensee determined that the marginal design of the sensing line tubing, an insufficient timer delay for the low lube oil pressure switch, and poor venting of the sensing line were contributors to the diesel generator trip. This combination resulted in a slow pressure response.

Minor Modifications MM-5429 and MM-5430 were implemented to increase the lube oil trip time delay settings from 15 seconds to the current value of 30 seconds to accommodate the slow pressure response. The licensee recognized that this modification did not eliminate the cause of the low pressure trips, but would provide additional time for lube oil pressure to rise above the low lube oil pressure trip setpoint. This was initially documented in NRC Inspection Report 50-369,370/94-06. Additional action included a proposal to modify the sensing line length. These modifications were identified as Minor Modification MM-7203 for Unit 1 but were not implemented. Modifications of the Unit 2 diesels were not scheduled. The licensee rescheduled these modifications for Unit 1 and 2 after the failure of EDG-2B on February 6, 1996.

3.6 Conclusion

The inspectors concluded that the licensee's failure to correct this design deficiency was contrary to the requirements of 10 CFR 50 Appendix B and resulted in an apparent violation of Technical Specification (TS) 3.8.1. Technical Specification 3.8.1 requires that two independent

diesel generators shall be operable while in Mode 1 or otherwise restore the inoperable diesel generator to operable status within 72 hours or be in at least hot standby within the next 6 hours and in cold shutdown within the following thirty hours. This violation will be identified as Apparent Violation 50-369,370/96-02-02, Failure to correct long term deficiencies results in valid failures of the EDGs.

4.0 Exit Interview

The inspection scope and findings were summarized on March 27, 1996, with those persons indicated by an asterisk in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results. A listing of inspection findings is provided. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

Item Number	Status	Description and Reference
Apparent Violation 50-369,370/96-02-01	OPEN	Inadequate freeze protection procedures causing inoperability of RWST level transmitters (paragraph 2.6)
Apparent Violation 50-369,370/96-02-02	OPEN	Failure to correct long term deficiencies results in valid failures of EDGs (paragraph 3.6)

5.0 Acronyms

ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
ESF	Engineered Safety Feature
FSAR	Final Safety Analysis Report
LCO	Limiting conditions for operation
LD	Diesel Generator Lube Oil
LOCA	Loss of Coolant Accident
ND	Residual Heat Removal System
NS	Containment Spray System
OAC	Operator Aided Computer
OSM	Operations Shift Manager
PORC	Plant Operations Review Committee
PRA	Probabilistic Risk Assessment
psig	pounds per square inch gauge
RWST	Refueling Water Storage Tank
SRO	Senior Reactor Operator
TS	Technical Specification