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

Report Nos.: 50-369/84-40 and 50-370/84-35

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-369 and 50-370 License No.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: November 27 - December 11, 1984

Inspector: C. W. Burger, for 2/26/85
R. Pierson Date Signed

Approved by: H C Dance 2/26/85
H. Dance, Section Chief Date Signed
Division of Reactor Projects

SUMMARY

Scope: This special, unannounced inspection entailed 52 inspector-hours in the areas of licensee event followup.

Results: Three violations were identified (Operation with a Degraded Safety Circuit, failure to adequately install and test safety-related equipment and failure to perform an adequate post trip review).

REPORT DETAILS

1. Licensee Employees Contacted

*M. McIntosh, Station Manager
*D. Rains, Superintendent of Maintenance
*T. McConnell, Superintendent of Tech Service
*N. McCraw, Compliance Engineer
*D. Marquis, Performance Engineer
*M. Weiner, McGuire Safety Review Group
*T. Cline, McGuire Safety Review Group
*R. White, IAE Engineer
*S. Carter, IAE Engineer
*D. Simmons, IAE Engineer
*J. Freeze, IAE Engineer
M. Kitlan, Reactor Engineer

Other licensee employees contacted included technicians and operators.

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on December 7, 1984, with those persons indicated in paragraph 1 above. The licensee expressed cognizance of the items of concern relayed during the exit. Violations are summarized in paragraph 10. The licensee disagreed with the inspector on one violation and felt that the post trip review following the reactor trip on November 24, 1984, was adequate. The event, corrective actions, and safety significance were discussed in a conference call by DPC, Region II and NRR on December 11, 1984. Subsequent to this call, J. A. Olshinski (RII) discussed with H. L. Tucker (DPC) additional reviews being conducted by DPC relative to reactor protective system verifications.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items were not identified during this inspection.

5. Inoperable Overpressure Delta Temperature Sequence of Event

On November 24, 1984, at 3:55 p.m. the Unit 2 reactor tripped on an Over-temperature ΔT signal. At the time of the reactor trip Power Range N41 was inoperable due to noise problems encountered earlier. As a result Channel 1 positive and negative rate, Overpressure ΔT, Overtemperature ΔT, and steam generator level were in the trip position. This resulted in one out of

three logic being in effect for these reactor trip protective functions. One out of three logic for Overtemperature ΔT was completed by a spurious signal on channel 4 and resulted in the reactor trip.

Following the reactor trip the Overtemperature ΔT signal was evaluated by the reactor engineer and judged to be related to the ongoing noise problems on Unit 2. Power Range N41 was placed in service and a reactor startup was initiated. During the investigation of the Overtemperature ΔT initiated reactor trip it was observed that Channel I (Loop A) and Channel IV (Loop D) experienced spikes on the Overpressure ΔT setpoint at the time of the trip. Review of the spikes on the Overpower ΔT setpoint was noted in the Post Trip Review Report of November 24, 1984, for follow-up and evaluation following reactor startup.

On Monday, November 26, 1984, Instrumentation and Electrical technicians determined that the Overpower ΔT trip setpoint was increasing to approximately 119% reactor power with a decreasing Tavg signal. This signal is normally clamped such that the setpoint remains at 108.75% with a decreasing Tavg input to the Overpower ΔT protective circuit. Circuit analysis revealed that the JA jumpers on Channels I and IV were missing. They are required to be installed on the NLL Tavg derivative line card in the overpower subsystem of the Overpower ΔT protective circuit.

A review of previous trip data, which was available from computer generated data, revealed that the JA jumpers have been missing from the Channels I and IV Overpower ΔT NLL derivative cards since at least the first reactor trip from power which took place June 6, 1983. Initial criticality occurred on May 8, 1983.

The JA jumpers were installed on Overpower ΔT NLL derivative cards Channel IV at 8:30 p.m. and Channel I at 11:05 p.m. on November 26, 1984. At no time were two channels of Overpower ΔT considered inoperable by plant operations personnel. The matter was then referred to licensee design engineering staff for review. On Tuesday evening, November 27, 1984, design engineering reported that the increasing setpoint for Overpower ΔT during a decreasing Tavg may have been nonconservative during a main steam line break accident. The licensee then reported the incident to the Nuclear Regulatory Commission. The two inoperable channels of the Overpressure ΔT circuit is a violation (370/84-35-02) discussed in paragraph 10.a of this report.

6. Card Verification, Installation and Surveillance

Card verification of a Lead/Lag Amplifier (NLL) card consists of a bench calibration performed in accordance with procedure IP/0/A/3200/13, Process 7300 Series Lead/Lag Amplifier (NLL) Card Calibration. This was performed on Unit 2 in January of 1981. All the process 7300 cards were pulled and bench tested at this time for general functional verification: lead/lag, derivative, lag and gain. Following this functional verification the cards were modified to reflect the desired process demand and were reinstalled in the 7300 cabinets. The last step of procedure IP/0/A/3200/13, step 10.6,

reflects this in that it states "Install proper JA jumpers that correspond to process demand." However, the procedure is not specific in what jumpers are required for a particular process demand. The specific jumpers required for a Tavg NLL-1 (Derivative) card process demand are addressed in Enclosure 11.2 of procedure IP/0/A/3000/05 C, "ΔT/Tavg Protection Calibration". The jumpers specified by part (h) of Enclosure 11.2, Tavg NLL-1 (Derivative) Card, included a lead and variable jumper but did not include the required JA jumpers.

The channel calibration surveillance, ΔT/Tavg Protection Calibration Procedure, IP/0/A/3000/05/C, is required to be performed once each 18 months per Technical Specification 4.3.1.1, Table 4.3.1. This procedure was performed in January 1983 prior to initial criticality. Step 10.25.3 of Section 10.25 of this procedure, Dynamics check - Tavg (Derivative), requires that the NLL Derivative Card output be recorded with both a step input of 7.127± .002 VDC and then after thirty seconds a step decrease back to .375± .002 VDC. The same step further states that "the curve shall resemble the curve in Figure 11.3.4 of Enclosures." This curve does not show the step decrease, but only the step increase and subsequent decay. The technicians in performing this step were not monitoring the step decrease. As a result the absence of the JA jumpers and resultant increase in the Overpower ΔT setpoint for Channels I and IV following a decrease in Tavg would not have been noted during surveillance testing, nor was it detected during Preoperational Testing which utilized this procedure.

Preoperational testing also utilized procedure TP/2/A/2600/09, Reactor Protection System Trip Circuits Test, which was performed in February 1983. Step 12.21.6, Section C, which provides for verification of the K5 parameter refers to a curve on Enclosure 13.16 of the same procedure. This curve again does not provide for monitoring the output of the setpoint of the Overpower ΔT protective circuit following a step decrease on the Tavg input. Similarly PT/2A/4601/01-04, Protective System Channel I-IV Functional Tests, which are the monthly surveillance checks, do not monitor the Overpower ΔT protective circuit following a step decrease on the Tavg input. Again the figure used for comparison does not include a step decrease on the Tavg input. Failure to adequately test the Overpower ΔT circuit is a violation (370/84-35-01) summarized in paragraph 10.b.

McGuire Quality Assurance in performing SUR MC-84-35 during the period June 5-28, 1984, evaluated the ΔT/Tavg Protection Calibration Procedure, IP/0/A/3000/05/C. They stated at that time that the procedure was in compliance with Technical Specification requirements.

Review of circuit cards in similar applications, following discovery of the missing JA jumper on the Overpower ΔT Reactor Protection circuitry, was performed by the licensee. The licensee verified that the other circuit cards with potential JA jumper installation problems would be within the Overtemperature ΔT, pressurizer pressure, steam generator pressure and steam generator low low level reactor trip protective circuits. These circuits were evaluated and in each case it was determined that the presence or absence of JA jumpers would make no difference on the protective circuits

function. Evaluation of this analysis in conjunction with a determination of the adequacy of the scope of this effort will be left as an inspector followup item (370/84-36-04).

7. Post Trip Review

McGuire Nuclear Station Directive 3.1.10 defines the action to be taken in investigating reactor trips to ensure full understanding of the cause of the trip; the plant transient behavior before and after the trip; the trip's impact on nuclear safety, power production and performance; and to identify necessary corrective action. In addition, this directive prescribes the criteria that must be satisfied in order to restart the unit.

A post-trip review is performed immediately following a reactor trip and completed prior to restart of the unit.

The purpose of the Post-Trip Review is to:

a. Determine the immediate cause of the reactor trip. It is not required that the root cause (e.g., the cause of a component failure leading to a trip) be determined at this time.

b. Identify other-than-expected performance of operators, systems, and equipment and assess its impact on safe plant operation.

Key parameters reviewed include:

Primary	Secondary
RCS Tave, each loop	SG Pressure
Pressurizer Level	SG Level
RCS Pressure	
RCS Cooldown Limit	
Reactor Power	

In addition any deviations from expected behavior are to be investigated in-depth as appropriate.

The Post-Trip Review is performed by the Reactor Engineer with assistance as needed from other personnel. The results of the review are documented and provided to personnel performing a subsequent investigation.

Written guidelines are used in performing the Post-Trip Review. These guidelines describe the various aspects of the trip event that should be considered in order to ensure that any impact on safe operation is identified and resolved. It also provides criteria and guidelines defining the range of expected plant responses.

Prior to restart of the unit, Operations ensures that the following criteria are met:

a) The immediate cause of the reactor trip is known or has been investigated to the fullest extent possible while remaining in the shutdown condition.

b) The plant transient behavior, immediately proceeding and until stabilization following the trip, does not identify any unresolved problems that impact the ability of the unit to be safely restarted and operated.

c) Any malfunctions or failure in equipment or components subject to technical specification LCO requirements are evaluated and corrected as required prior to restart.

Operations further ensures that the Reactor Engineer's recommendations are resolved prior to restart and obtains his or her concurrence with restart. This concurrence is indicated by the Reactor Engineer's signature on the trip recovery operating procedure.

Additionally, Station Directive 3.1.10 requires that a review of performance of safety systems including the Reactor Protection System be performed in order to identify other than expected performance. Abnormal behavior requires in-depth evaluation and resolution prior to restart. If performance in all areas was as expected, the unit may be safely restarted.

In the Post-Trip Review conducted on November 24-25, 1984, for the reactor trip from Overtemperature ΔT, the Reactor Engineer investigating chose to evaluate the Overpower ΔT response during this trip to further his understanding of plant parameter behavior utilized on the Overtemperature ΔT inputs. Evaluation of the Overpower ΔT response would not have normally been investigated in a Post Trip Review involving a trip such as that encountered, since it is not included in the key parameters evaluated and there is usually no reason to expect abnormal behavior on the Overpower ΔT protective circuit.

The transient plot for the Overpower ΔT setpoint showed two spikes to approximately 119% for channels I and IV. The Reactor Engineer performing the Post Trip review did not judge that these were indications of abnormal response for the channels I and IV Overpower ΔT requiring resolution prior to restart.

Voltage spikes are sometimes encountered on plant parameter inputs during a plant transient and are typically noise related. However, these voltage spikes are of significantly less width than the spikes observed for the Overpower ΔT setpoints. The Reactor Engineer misinterpreted the Overpower ΔT setpoint spikes to be voltage spikes. Consequently, the Reactor Engineer concurred with the decision to startup the plant and the Unit 2 reactor reached criticality and subsequently 100% power later in the day on November 25, 1984. However, the Reactor Engineer did recommend that

following restart the Overpower ΔT voltage spikes for Channel I and Channel IV be evaluated. When instrumentation and electronic technicians evaluated the Overpower ΔT transient they determined that the Overpower ΔT response was in error as discussed earlier in the report.

Although it is clear that the personnel involved with the Post Trip review and the subsequent decision to restart the unit did not feel at the time that there was any question that the Unit could be safely restarted and operated, it is the intent of a Post Trip Review to identify potential problems and ensure that personnel involved with the evaluation have the necessary expertise to make an informed decision. In this particular instance the fact that the Overpressure ΔT setpoint was going in the non conservation direction and the duration of the voltage spike should have prompted further investigation prior to reactor startup. Consequently during this Post Trip Review, Station Directive 3.1.10 was not fully implemented and an adequate Post Reactor Trip Review was not conducted. This is a violation (370/84-35-03) as summarized in paragraph 10.c of this report.

8. Procedures

Unit 1

Procedure IP/0/A/3200/13, Process 7300 Series Lead/Lag Amplifier (NLL) Card Calibration, and IP/0/A/3000/05/C, ΔT/Tavg Protection Calibration, are used for Unit 1 as well as Unit 2. In addition, TP/1/A/2600/09, Reactor Protection System Trip Circuits Test, which was used for Preoperational Testing of Unit 1, and PT/1/A/4601/01-04, Protective System Channel I-IV Functional Tests, which are the Unit 1 monthly surveillance checks, do not monitor the Overpower ΔT protective circuit following a step decrease in the Tavg input. As a result, the Preoperational Testing and the surveillance program for Unit 1 are also deficient. However, since the Unit 1 JA jumpers were installed, the protective function of the Overpower ΔT reactor trip system did not appear to be degraded. Inadequate procedure violation is described in paragraph 10.b of this report.

9. Safety Significance

The Overpower ΔT reactor trip provides protection for intermediate steam line breaks, approximately .5 ft^2 to 1.0 ft^2, while the reactor is at power. Alternate reactor trips exist which will provide core protection. These reactor trips include: low pressurizer pressure; low-low steam generator level; power range neutron flux high setting; Overtemperature ΔT; safety injection and the resulting reactor trip on low steam line pressure and for steam line breaks inside containment, the safety injection and resulting reactor trip on high containment pressure.

A licensee evaluation has concluded that center line fuel melt is not a problem on any scenario. In addition, the departure from nucleate boiling (DNB) ratio remains above 1.3. Since two channels, Channels II and III, were not affected, the Overpower ΔT circuit would have functioned barring a malfunction in Channels II and III. Additionally, considering the

redundancy of the reactor protection system with respect to the Overpower ΔT circuit, the safety significance of this specific incident is minimal. A Region II review group agreed with this assessment.

10. Violations

A review of this incident revealed the following violations.

a. Technical Specification 3.3-1 requires that the Overpower ΔT Reactor Trip System Instrumentation Channels of Table 3.3-1 shall be operable when the reactor is operated in modes 1 and 2 and states that a minimum of three channels are required for startup and low power operation.

Technical specification 3.0.3 requires that when a Limiting Condition for Operation is not met, except as provided in the associated ACTION requirements, within 1 hour action shall be initiated to place the unit in a MODE in which the specification does not apply by placing it, as applicable, in: (a) at least HOT STANDBY within the next 6 hours, (b) at least HOT SHUTDOWN within the following 6 hours, and (c) at least COLD SHUTDOWN within the subsequent 24 hours.

From May 8, 1983, (initial criticality) to November 26, 1984, the licensee operated Unit 2 in the applicable modes with Channels I and IV of the Overpower ΔT Reactor Trip System Instrumentation inoperable, resulting in operation with less than the minimum three channels required. The inoperability of channels I and IV involved a setpoint which would have resulted in a setpoint change for these two channels of Overpower ΔT which was non conservative for a main steam line break accident. This is a violation (370/84-35-02).

b. 10 CFR 50, Appendix B, Criterion V requires that activities affecting quality be prescribed by documented instructions, procedures, or drawings which shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

10 CFR 50, Appendix B, Criterion XI requires that testing be performed to demonstrate that structures, systems and components will perform satisfactorily in service.

The licensee failed to provide an adequate procedure necessary to ensure that the Overpower ΔT NLL Derivative Cards were correctly installed and tested. This resulted in two channels of Overpower ΔT Reactor Trip System Instrumentation channels, Channels I and IV of Unit 2, being installed without a JA jumper and would have resulted in an incorrect and nonconservative setpoint change for a main steam line break accident. The functional tests performed did not include evaluation of a step decrease input for Tavg during testing of the Overpower ΔT Reactor Protective Circuit.

As a result of the missing JA jumper and deficient test procedures the unsatisfactory state of Channels I and IV of the Overpower ΔT Reactor Trip System Instrumentation were not detected. This is a violation (369/370/84-35-01).

c. Technical Specification 6.8.1 requires that written procedures shall be established, implemented, and maintained covering the activities referenced in Appendix A of Regulatory Guide 1.33, Revision 2, February 1978. Section 2 of this Appendix requires that General Plant Operating Procedures be implemented and used for recovery from Reactor Trip. McGuire Nuclear Plant Operations Procedure OP/1/A/6100/05, Unit Fast Recovery, specifies that an engineering evaluation be performed prior to entering Mode 2. This engineering evaluation is the Post Trip Review Report performed in accordance with Station Directive 3.1.10 which states that prior to restart of Unit 1, Operations shall ensure specific criteria including the following are met:

(1) The plant transient behavior immediately preceding and until stabilization following the trip, does not identify any unresolved problems that impact the ability of the unit to be safely restarted and operated.

(2) Any malfunctions or failures in equipment or components subject to Technical Specification LCO requirements are evaluated and corrected as required prior to restart.

It further requires, in Enclosure 4.1, that a review of performance of safety systems, including Reactor Protection System be performed to identify other than expected performance. Abnormal behavior requires in-depth evaluation and resolution prior to restart. The post trip review preceding the reactor startup of November 25, 1984, did not evaluate and resolve the abnormal behavior noted on Channels I and IV of the Overpower ΔT Reactor Trip System prior to restart. This is a violation (370/84-35-03).