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

Report Nos.: 50-369/91-18 and 50-366/91-18

Licensee: Duke Power Company
P.O. Box 1007
Charlotte, NC 28201-1007

Docket Nos.: 50-369 and 50-370 License Nos.: NPF-9 and NPF-17

Facility Name: McGuire Nuclear Station Units 1 and 2

Inspection Conducted: July 5 - August 12, 1991

Inspectors: W. H. Miller, Jr. 8-16-91
P. K. VanDoorn, Senior Resident Inspector Date Signed

W. H. Miller, Jr. 8-16-91
T. A. Cooper, Resident Inspector Date Signed

Accompanying Personnel: W. M. Sartor

Approved by: G. A. Belisle 8/16/91
G. A. Belisle, Chief, Reactor Projects Date Signed
Section 3A, Division of Reactor Projects

SUMMARY

Scope: This routine resident inspection was conducted onsite in the area of calculating the overtemperature delta-temperature (OTDT) trip setpoints.

Results: In the areas inspected, one apparent violation was identified involving the improper [illegible]ain settings used in calculating the OTDT trip setpoints.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

J. Freeze, Production Specialist III, Maintenance Engineering Services (MES)
A. Hinson, Supervisor, MES
*T. McConnell, Station Manager
D. Pazzula, Production Specialist III, MES

Other licensee employees contacted during this inspection included engineers, operators, technicians, and administrative personnel.

NRC Resident Inspector

*T. Cooper

*Attended exit interview

2. Review of Overtemperature Delta-Temperature Trip Setpoint (93702)

The overtemperature delta-temperature (OTDT) trip is designed to protect against a departure from nucleate boiling (DNB), which causes a large decrease in the heat transfer coefficient between the fuel rods and the reactor coolant, resulting in high fuel clad temperatures and possible fuel damage.

The indicated loop delta-T is used as a measure of reactor power and is compared with a setpoint that is automatically calculated as a function of Tavg, pressurizer pressure, and axial flux difference.

If the indicated delta-T exceeds the calculated setpoint, the affected channel will be tripped. If two or more channels are simultaneously tripped, the reactor will be automatically tripped. The Tavg input acts to lower the trip point above normal full power Tavg. This is necessary because the increased average temperature reduces the margin to DNB.

On July 17, 1991, the licensee notified the NRC of a potential problem with the OTDT reactor trip circuit, which may have prevented the system from operating correctly over its entire operating range for reactor coolant loop average temperature (Tavg). The problem was discovered while engineers were attempting to rescale their OTDT setpoints for the upcoming new fuel load. It was found that the K2 gain applied to the lead/lag amplifier for the Tavg portion of the OTDT circuit was set too high, based on the current scaling of the hardware. This caused the Tavg input to saturate at approximately 597 degrees F, resulting in the OTDT circuit not

applying a reduction to the OTDT setpoint as Tavg increased above these saturation values. The required input temperature range for Tavg is 530 degrees F to 630 degrees F. Therefore, the OTDT setpoint calculation was in error above the saturation temperatures.

The OTDT setpoint equation and associated input parameters are specified in the licensee's Technical Specifications Table 2.2-1 and in the Precautions, Limitations, and Setpoints (PLS) manual supplied by Westinghouse Electric Corporation. The current value for K2 is 0.0222/degrees F. The Corresponding Tavg voltage gain associated with this K2 value, based on the OTDT hardware scaling factors used by the licensee, was 1.48 v/v. Since the Tavg input signal is scaled such that its range (530 degrees F to 630 degrees F) is represented by a 0 to 10 volt span, the Tavg output voltage (gain times input voltage) from the lead/lag amplifier could exceed 10 volts. However, the maximum output voltage that can be obtained from the lead/lag amplifier is 10 volts, which results in the Tavg input signal becoming effectively "saturated" at voltages exceeding 6.76 volts (597 degrees F). For input voltages (temperatures) exceeding these values, no additional Tavg penalty would be added to the OTDT setpoint, resulting in a higher OTDT setpoint than required.

The licensee indicated that the OTDT hardware had operated in this degraded condition since 1983. The original K2 value, provided by Westinghouse via the PLS, was 0.0133/degrees F. The hardware was scaled by Westinghouse such that the lead/lag amplifier gain corresponding to this K2 was less than 1.0. with a gain setting of less than 1.0, the amplifier does not overrange since the gain output voltage cannot exceed 10 volts.

The degraded condition was introduced when the licensee rescaled the OTDT trip hardware as a function of performing a core reload analysis to allow for the use of Westinghouse "optimized" fuel. As part of this change to the OTDT parameters, K2 was increased to its current value of 0.0222/degrees F. Using the Westinghouse scaling methodology, however, the licensee scaled the OTDT hardware such that the output gain on the Tavg lead/lag amplifier was greater than 1.0.

On July 23, 1991, the licensee notified the NRC, per 10 CFR 50.72, that the OTDT input to the reactor protection system had the potential for being listed as inoperable. The licensee's final safety analysis for the OTDT circuitry has not been completed.

Following discussions with Westinghouse Electric Corporation, the licensee corrected the problem by redistributing the gain associated with the K2 parameters. This was accomplished by replacing resistors in the lead/lag circuit to ensure that the gain was not high enough to cause saturation of its output over the entire input range. The modification to both unit's OTDT instrumentation were completed July 18, 1991.

The licensee program to calculate the gains, based on the scaling factors did not take into consideration the hardware limitations of the OTDT circuitry. The procedures for calibrating the Tavg input to the OTDT circuitry calls for higher voltages, corresponding to temperatures, above 597 degrees F requires that the as-left voltage be greater than 10 volts. These procedures were revised following the identification of the gain problems, but the original procedures required that the voltage be adjusted greater than the range of the amplifier.

Technical Specification 3.3.1 requires that at least 3 channels of the OTDT trip circuitry be operable in Modes 1 and 2. With the number of operable channels one less than the total number of channels, startup and/or power operation may continue provided the inoperable channel is placed in the tripped condition within six hours.

Contrary to the above, for a period from approximately 1983 to July 1991, all four RPS channels of OTDT were degraded, with the circuitry not functioning as analyzed. This apparent violation is 369,370/91-20-01: Failure of Overtemperature Delta-Temperature Trip Circuitry to Function as Analyzed.

3. Exit Interview

The inspection scope and results were summarized on August 12, 1991, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results listed below.

Apparent Violation 369,370/91-20-01: Failure of Overtemperature Delta-Temperature Trip Circuitry to Function as Analyzed (paragraph 2).