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April 7, 1993

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
Licensee Event Report 370/85/24

Gentlemen:

The purpose of this letter is to provide the basis for relief/amendment of the McGuire Nuclear Station LER commitment for adjusting ΔT 1 percent conservative prior to unit start-up. This document will detail the new ΔT evaluation process, which will begin during 1EOC8, and demonstrate that this process is more comprehensive than the existing process as required by LER 370/85-24.

Very truly yours,

T.C. McMeekin

TLP/bcb

Attachment 1
Attachment 2

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IE22
1/1

ATTACHMENT 1

SUBJECT: 1 Percent Conservative ΔT LER Commitment Relief/Amendment

Existing ΔT Evaluation Process:

Outage/Startup ΔT Adjustments:

- ΔT is adjusted 1 percent conservative prior to unit start-up (based upon ΔT value at unit shutdown).
- ΔT is adjusted to linearized 100% value, as determined by NC System flow balance, typically within 14 days after unit start-up.

On-line ΔT Adjustments:

- No on-line ΔT evaluations are performed.

New ΔT Evaluation Process:

Outage/Startup ΔT Adjustments:

- PT/0/A/4150/21 (Reactor Group's controlling procedure for unit start-up) has a hold point at 90% power level, where a preliminary evaluation of ΔT values is performed. Based upon this evaluation, new ΔT data will be placed in the Plant Data Book and ΔT will be adjusted as needed prior to proceeding Unit start-up.
- PT/0/A/4150/40 (Reactor groups ΔT, etc. analysis) will be performed shortly after unit start-up (after Venturi fouling constants are removed) to analyze 100% ΔT values. Based upon this evaluation, new ΔT will be placed in the Plant Data Book and ΔT will be adjusted as necessary.
- IP/1,2/A/3000/05C, D, E, and F (ΔT/Tavg Loop Calibration Procedures) will be revised to use Plant Data Book data for loop calibrations.

On-line ΔT Adjustments:

- PT/0/A/4150/40 will be implemented quarterly and will determine actual ΔT values. If the new ΔT data differs from the 'old' ΔT data by greater than 0.5 degrees F, the new data will be placed in the Plant Data Book.
- The 7300 Monthly calibration procedures (PT/1,2/A/4601/01,02,03, and 04) will be revised to calibrate ΔT loops per values per data in Plant Data Book. This will result in quarterly ΔT adjustments where necessary.

There are three major advantages of the new ΔT evaluation process over the existing process:

1. ΔT values will be evaluated prior to start-up (@90% hold point) and adjusted as necessary prior to continued start-up.

2. Actual 100% ΔT values will be known and the need for loop calibration determined more closely following full power operation.

3. ΔT values will be evaluated, and possibly adjusted quarterly during fuel cycles.

Based upon the arguments presented above, the requirement for the 1 degree conservative ΔT adjustments prior to start-up will be revised to take credit for the new process adopted at McGuire Nuclear Station.

ATTACHMENT 2

NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO 3150-0104
EXPIRES 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
McGuire Nuclear Station - Unit 2	0 5 0 0 0 3 7 0	1 OF 0 5

TITLE (4)

Gradual Decrease in Indicated Full Power Delta-T

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
1 0	1 4	8 5	8 5	0 2 4	0 0	1 1	1 3	8 5		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
1	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
1 0 0	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
Jerry B. Day - Licensing	7 0 4 3 7 3 - 7 0 3 3

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 DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

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

Following the startup of Unit 2 Cycle 2 in May 1985, a gradual decrease in the indicated value of the full power Delta-T was identified. The indicated Delta-T decreased linearly in each loop by approximately 1 degree-F. Delta-T is used as a measure of reactor power for both the overpower and overtemperature Delta-T reactor trip setpoints. The decrease in Delta-T has caused these dynamic reactor trip functions to be improperly scaled in a non-conservative direction.

Two potential causes for the decrease have been identified: a change in hot leg temperature streaming patterns which supply coolant samples to the temperature sensors; a reduction in thermal power, possibly caused by fouling of the feedwater flow venturi meters.

The channel errors have been analyzed to determine the impact on FSAR accident analyses. The results of this evaluation indicate that only a narrow range of steam line break accidents may have exceeded the design basis during this incident. Calibration procedures will be developed to set Delta-T values for each new fuel cycle; and the possible feedwater venturi fouling will be investigated.

NRC Form 366
(9-83)

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
McGuire Nuclear Station - Unit 2	0 5 0 0 0 3 7 0	8 5	— 0 2 4	— 0 0	0 2 OF 0 5

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Following the startup of Unit 2 Cycle 2, a gradual decrease in the indicated value of the full-power reactor coolant temperature difference was identified. During the eight weeks of full-power operation following the cycle 2 refueling, the indicated Delta-T had decreased linearly in each of the four loops by approximately 1 degree-F. Delta-T is used as a measure of reactor power for both the over-temperature and overpower Delta-T reactor trip setpoints. The decrease in Delta-T had caused these dynamic reactor trip functions to be improperly scaled in a non-conservative direction. The Delta-T channels were underpredicting full core power by as much as 5%.

In evaluation which followed the discovery, two potential causes for the Delta-T decrease were identified:

- a change in the hot leg temperature streaming patterns which supply coolant samples to the temperature sensors.
- a reduction in thermal power, possibly caused by fouling of the feedwater flow venturi meters.

The Delta-T channel errors have been analyzed to determine the impact on the Final Safety Analysis Report accidents which take credit for the overtemperature and overpower trip functions. The results of this safety evaluation indicate that only a narrow range of steam line break accidents (0.4 to 0.9 square feat breaks) may have exceeded the design basis during this decreasing Delta-T incident.

Background

Delta-T is used as a measure of reactor power and is calibrated (scaled) to read 100% as determined by the precision secondary system calorimetric measurements. The scaled value is used in the overtemperature and overpower Delta T core protection circuits.

The overtemperature Delta-T trip actuation circuit loops automatically vary with: 1) coolant average temperature, 2) pressurizer pressure, and 3) axial power distribution to protect the reactor core from departure from nucleate boiling (DNB) during certain design transiests.

The overpower Delta-T trip circuit loops automatically vary with: 1) coolant temperature, 2) rate of change of average temperature, and 3) axial power distribution to protect the fuel from excessive heat generation rates (KW/ft).

The overtemperature and overpower Delta-T trip setpoints are detailed in Technical Specification Table 2.2-1.

Description of Event

The results of the evaluation have identified the two possible causes of decreased Delta-T as: 1) changes in the hot leg streaming patterns, and 2) fouling of the feedwater flow venturi nozzles.

The hot leg streaming patterns are results of fuel assembly exit temperature difference. The high flow rates and differences in individual fuel assembly outlet temperatures cause temperature stratification within the Reactor Coolant system piping. A special device is installed in the hot leg piping which samples the reactor coolant at different areas within the piping. These samples mix and pass by the hot leg temperature sensor to provide an average hot leg temperature.

The fuel assembly exit temperatures did change during the period when the Delta-T was decreasing. This is an indication that the temperature streaming patterns in the piping also changed. The evaluation states that it is possible for a 0.5 degree-F decrease in Delta-T on Unit 2 based on the data provided. This would account for about half of the total decrease.

The venturi nozzle fouling is a result of a crud buildup on the feedwater flow sensing device. The buildup affects the flow readings obtained for the heat balance measurements. The venturi is a device which develops a differential pressure when flow is passed through it. This differential pressure can be accurately scaled to indicate flow as long as the venturi dimensions are not altered. The crud buildup inside the venturi affects the accuracy of the developed pressure across the venturi. Venturi fouling has possibly caused a Delta-T decrease of approximately 0.5 degree-F at McGuire.

The total 1.0 degree-F Delta-T drift caused by hot leg streaming and venturi nozzle fouling was within the uncertainty allowances assumed in the safety analysis. The additional errors associated with not calibrating the circuits during the cycle 2 startup caused the total Delta-T uncertainty to exceed the uncertainty allowances assumed in the safety analysis. The actual error for each loop in units of percent full power was:

Loop A	Loop B	Loop C	Loop D
2.5% F.P.	5.3% F.P	5.5% F.P	3.4% F.P

These errors have been evaluated for their impact on certain Final Safety Analysis Report accidents. The evaluation results indicate that only a narrow range of steam line break accidents (0.4 to 0.9 square feet) may have been in violation of the design basis.

The hot leg streaming patterns have been identified to the industry as early as 1968. The RTD Bypass System, which is installed at McGuire, was developed to reduce the effects of the temperature gradients in the piping. Westinghouse reports that no significant problems have arisen in the industry pertaining to the streaming patterns although some variations of 0.5 degree-F or less have been r. orted.

The feedwater flow venturi nozzles have been reported by several nuclear plants as indicating a fouling condition. The stations affected by this condition have taken measures to compensate for the errors and are monitoring the plant parameters.

The omission of the calibration of the Delta-T channels during power escalation has affected both Unit 1 and Unit 2. Although the decreasing Delta-T in Unit 2 brought the problem into view, the Unit 1 channels had not been calibrated during the startup of each fuel cycle. This requirement was not clearly defined to the station personnel. The channel calibration was being performed on an 18 month basis without regard to the cycle startup requirements.

CORRECTIVE ACTIONS:

Immediate: None

Subsequent:

1. The results of the reactor coolant flow test and how it affected the Delta-T circuits have been reviewed.
2. A work request to recalibrate the Delta-T circuits was initiated.
3. Westinghouse reviewed the key plant parameters to evaluate the Delta-T drift and submitted a report to Duke Power.

Planned:

1. A calibration procedure to set the Delta-T to a conservative value prior to reactor startup at the beginning of each cycle will be established. Necessary controls will be implemented to ensure the work is completed prior to reactor startup.
2. A calibration procedure to set the Delta-T values for the new fuel cycle based on final measured Delta-T values will be established. Testing will determine the actual 100% power level.
3. A program to monitor the full power Delta-T during the entire fuel cycle and to report significant temperature drifts to the Reactor Safety group for analysis will be developed. Data has already begun regarding this program.
4. Measures will be taken to identify the extent of the venturi fouling and initiate actions to compensate for the apparent loss of power. Alternate tests have been initiated to determine the extent of error.

SAFETY ANALYSIS

The evaluation stated that the approximately 1 degree-F drift associated with the Delta-T channels is within the uncertainty allowances assumed in the safety analysis. Therefore, the precision heat balance performed in June may be considered valid. In addition, since the error associated with the calculated flow is within the uncertainty allowance assumed in the safety analyses, there are no flow related Tech Spec violations associated with the Delta-T drift incident. However, when the 1 degree-F drift is added to the errors associated with not calibrating the Delta-T channels during startup, the total error associated with the Delta-T channels is greater than the uncertainty allowances assumed in the safety analyses.

The Delta-T channel errors can potentially impact the FSAR accidents which take credit for a reactor trip on the overtemperature or overpower Delta-T trip functions. There is sufficient margin included in the overtemperature Delta-T setpoint calculation to account for the channel errors. Therefore, the accident analyses which take credit for a reactor trip on overtemperature Delta-T (RCCA Withdrawal at Power, RCCA Misalignment, and Boron Dilution) remain valid. However, for the overpower trip function, there is not sufficient margin in the setpoint calculation to account for the channel errors.

It should be noted that credit is not explicitly taken for the overpower Delta-T trip function in any of the accidents analyzed in Chapter 15 of the McGuire FSAR. However, WCAP-9226, "Reactor Core Response to Excessive Secondary Steam Releases", shows that the overpower Delta-T trip function may be relied upon to provide DNB protection for some steam line breaks at power.

Plant-specific analyses have been performed for a spectrum of intermediate steam line breaks at power. It was determined that, for break sizes equal to or greater than 0.9 square feet, reactor trip occurred on SI actuation on low steam line pressure. For break sizes less than 0.4 square feet, either no trip was necessary, or a trip occurred on low-low steam generator level. For breaks inside containment in the size range of interest, reactor trip occurs on SI actuation on high containment pressure. Thus, the overpower Delta-T trip function provides the reactor trip only for breaks between 0.4 square feet and 0.9 square feet outside containment.

There were no pipe break events during the period which would have affected the health and safety of the public. It is also possible that other trip functions such as the high flux trip, or trading off available analytical margin may have revealed acceptable results for the narrow range of affected steam line breaks.