Omaha Public Power District
1623 Harney Omaha, Nebraska 68102-2247
402/536-4000

February 1, 1990
LIC-89-1155

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Gentlemen:

Subject: Licensee Event Report 89-021 for the Fort Calhoun Station

Please find attached Licensee Event Report 89-021 dated February 1, 1990. This report is being submitted as a voluntary LER.

If you should have any questions, please contact me.

Sincerely,

W. G. Gates
Division Manager
Nuclear Operations

WGG/tcm

Attachment

c: R. D. Martin, NRC Regional Administrator
A. Bournia, NRC Project Manager
P. H. Harrell, NRC Senior Resident Inspector
INPO Records Center
American Nuclear Insurers

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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fort Calhoun Station Unit No. 1	0 5 0 0 0 2 8 5	1 OF 0 6

TITLE (4)
Potential Nonconservative RPS Thermal Margin/Low Pressure Setpoints

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 0	8 9	8 9	0 2 1	0 0	0 2	0 1	9 0	N	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	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)	Voluntary Report
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)
Keith Voss, Shift Technical Advisor	4 0 2 5 3 3 - 6 9 3 1

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)

Combustion Engineering (CE) was requested by Omaha Public Power District (OPPD) to review the Cycle 12 Excess Load Transient Analysis for Fort Calhoun Station. The DNB Limiting Safety System Setting (LSSS) Setpoint Analysis was also reviewed. On October 10, 1989 OPPD was formally informed of the possibility of having a non-conservative setpoint in the Reactor Protective System (RPS) Thermal Margin/Low Pressure (TM/LP) trip unit due to an error in the incorporation of the Transient Power Decalibration (TPD) in the setpoint analyses. The potential safety impact on the plant was assessed by reviewing the Cycle 12 Excess Load Transient analysis and Departure from Nucleate Boiling Limiting Safety System Setting analysis to verify that the plant has been operating conservatively. The results of the review concluded that the plant had been operating within the design basis and would continue to do so for the remainder of Cycle 12 based on a comparison between predicted and observed core parameters. Corrective actions include development of improved administrative controls and training for the reload analysis process. This report is submitted as a voluntary LER.

The Thermal Margin/Low Pressure (TM/LP) trip protects the core from violating the allowable Departure from Nucleate Boiling Ratio (DNBR) limit. Technical Specifications require that the minimum DNBR be maintained above 1.18. This ensures fuel cladding integrity by maintaining adequate heat transfer from the cladding to the coolant. The TM/LP Trip function provides this protection through the calculation of a variable setpoint using an equation (Pvar) defined in Figure 1-3 of the Technical Specifications. The Pvar equation yields a reactor trip setpoint that is a function of the core power, the core inlet temperature, and the Axial Shape Index. The core power used is the greater of the thermal (delta-T) power or the nuclear (excore detector) power. The calculated trip setpoint is compared with the measured pressurizer pressure. If the measured pressurizer pressure value is less than or equal to the setpoint, then the TM/LP trip unit in the Reactor Protection System (RPS) will initiate a reactor trip.

The Integrated Radial Peaking Factor (Fr) is the ratio of the peak pin power to the average integrated pin power in the core, excluding the tilt. The Total Integrated Radial Peaking Factor (Frt) is the radial peaking factor multiplied by a correction factor that accounts for the tilt. The limits on Frt assure that the assumptions made in the setpoint analysis remain valid during operation at the various Control Element Assembly (CEA) group insertion limits. The peaking factors assumed in the safety analysis are limiting assumptions chosen to provide the most conservative setpoint analysis.

The setpoint analysis utilizes inputs from a number of different analyses, including the Thermal Hydraulics, the Transient Safety, and the Axial Shape Index analyses, and calculates the RPS trip unit setpoints. One of the variables that must be included in the reload analysis is the Transient Power Decalibration (TPD) term. The TPD term accounts for the temperature shadowing and rod shadowing effects on the excore detector indicated power level and RTD response time for the delta-T power calculation. Temperature shadowing occurs when changes in the core inlet temperature take place. The result is a change in the reactor vessel downcomer coolant density which produces an increase or decrease in the moderation of the neutrons normally detected by the excore detectors. The result is a mismatch between the actual core power and the excore detectors' indicated power. The rod shadowing effect is caused by CEA movement resulting in shielding of the excore detectors, which also results in a mismatch between actual core power and the indicated power. The setpoint methodology allows the personnel performing the analysis to account for the TPD in either the Excess Load transient analysis or the Limiting Safety System Setting (LSSS) setpoint analyses.

During the preparation of the Cycle 10 setpoints, Omaha Public Power District (OPPD) used an updated version of the CESEC computer code that contained explicit modeling of the excore detector and RCS temperature responses, which is used in the determination of the core nuclear power and delta-T power levels, respectively. The new modeling allowed a better approximation of the magnitude of the TPD term that must be used in the setpoint analysis. On March 1, 1984 OPPD contacted Combustion Engineering (CE) proposing the removal of the nonzero TPD term to take advantage of the new computer modeling. On April 17, 1984 CE informed OPPD that the TPD term could either be reduced in the Excess Load Transient analysis or removed from the setpoint analysis. However, there was apparently some misunderstanding by OPPD personnel as to the intent of the guidance in this correspondence. During the Cycle 10 reload analysis the TPD term was reduced by OPPD in both the transient analysis and the setpoint analysis.

Prior to the start of the Cycle 11 reload analysis there was a large turnover of personnel within the OPPD department that performs the analyses. This resulted in increased reliance on the assumptions used for the methodology in Cycle 10. The Cycle 11 analysis was the first at OPPD to employ a computer-aided method to perform the setpoint analysis. The preparation of the Cycle 11 analysis used the Cycle 10 analysis as a guideline. Since the analyst performing the Cycle 11 setpoint analysis was not as experienced as the previous analyst, the TPD term error of Cycle 10 was undetected and propagated into the Cycle 11 analysis.

In April of 1988, CE was contracted by OPPD to perform the Cycle 12 setpoint analysis because at that time there were no qualified OPPD personnel available to complete the analysis. The Cycle 12 setpoint analysis was also to be used as a training exercise that would aid OPPD personnel in becoming qualified to perform the analysis. OPPD personnel performed the transient analyses for Cycle 12 that were used as inputs for the setpoint analysis. The TPD error again was undetected and propagated into the Cycle 12 analysis.

During the performance of the Cycle 12 setpoint analysis, errors leading to non-conservative Cycle 11 TM/LP trip setpoints were discovered and reported to NRC as LER 88-16. CE determined that there were no additional errors in the setpoint analysis for Cycle 11. On August 11, 1988, as a result of NRC Violation 88-22-01 and an enforcement conference on the events detailed in LER 88-16, OPPD further committed to have all the Cycle 12 reload analyses reviewed by CE. Prior to the start of Cycle 12, CE was contracted by OPPD to review the Cycle 12 reload application and the supporting analyses. No errors, including the TPD term error, were found by CE during this review. CE also performed a review of the Cycle 10 setpoint analysis which revealed no problems.

The TPD term error was subsequently found during another review performed by CE at the request of OPPD. This review was conducted as part of the follow-up for a delta-T power flow stratification event that occurred at Fort Calhoun Station on September 13, 1989 during Cycle 12. The purpose of this review was to verify that the Excess Load Transient analysis was conservative and to assess the margin in the Departure from Nucleate Boiling Limiting Safety System Setting (DNB LSSS) portion of the setpoint analysis.

On September 29, 1989 OPPD was verbally informed by CE of a potential discrepancy in the Cycle 12 Transient and Setpoint analyses. There was a potential non-conservatism in the RPS TM/LP trip unit setpoint due to an error in the incorporation of the TPD term in the setpoint analysis. OPPD Nuclear Engineering department performed a preliminary assessment which indicated the plant was operating within design basis. It was concluded that further discussions with CE were required.

On October 10, 1989, while the plant was operating in mode 1 at 100 percent power, OPPD was informed by a letter from CE that the Pvar equation used in the TM/LP trip units of the RPS could, under certain conditions, be non-conservative. The Pvar equation would be non-conservative when Frt was greater than 1.77 and core inlet temperature was 543 degrees Fahrenheit. The Technical Specification limit for Frt is 1.80 and for core inlet temperature is 543 degrees Fahrenheit. As noted previously, the TPD term is required to be accounted for in either the Excess Load Transient analysis or the setpoint analysis. OPPD set the term to zero in the Excess Load Transient analysis and CE also set it to zero in the DNB LSSS setpoint analysis.

On October 10, 1989 it was determined that the existing RPS TM/LP setpoints would be conservative for Frt values below 1.77. A review of the actual full power peaking factors for Cycle 12 showed that Frt had not exceeded the value of 1.65. Also, the predicted values for Frt were not expected to exceed 1.73 for the remainder of Cycle 12. Therefore, the TM/LP trip function had not been and would not be outside of the design basis for the plant during Cycle 12 operation. Furthermore, normal operating practice at Fort Calhoun is to maintain the core inlet temperature approximately 2 degrees Fahrenheit below the Technical Specification limit. This practice provides additional conservatism. It was concluded that the plant was currently operating in a safe configuration and had been in a safe configuration since Cycle 12 startup. The TM/LP reactor trip protects the core from exceeding the DNBR limit. Only if the value of Frt had been higher than 1.77 during Cycle 12 with the core inlet temperature at the Technical Specification limit of 543 degrees Fahrenheit would it have been possible for the DNBR limit to be violated for an event that required TM/LP protection, such as the Excess Load Event.

This event is reported as a voluntary LER for information.

The root cause for this event was the failure to maintain adequate administrative controls and oversight to ensure that the reload analysis remained conservative overall for the Cycle 10 and subsequent reload analyses. There were several contributing causes: lack of overall design process guidelines for the reload analyses which would have allowed the analysts to verify that all the appropriate variables were included, lack of experience for some personnel involved in the Cycle 11 reload analysis, marginal quality of documentation for previous reload analyses, and inadequate communications between CE and OPPD and within the OPPD Nuclear Engineering Department.

The following corrective actions have been completed:

1. The RPS was verified to be operating within the design basis by the Supervisor of Reactor Performance Analysis by reviewing the DNB LSSS and the LHR LSSS setpoint calculations.

2. An Operations Memorandum was issued on October 13, 1989 notifying operations personnel of an administrative change in the maximum limit for Frt to a value of 1.75. This Operations Memorandum provided required corrective actions in the event that Frt exceeds 1.75. The Shift Technical Advisors periodically verify the peaking factor limits are not exceeded in accordance with the existing Technical Specifications requirements.

3. The procedure governing how the calculations are prepared was changed to require a higher level of documentation and review.

4. A formal root cause analysis was completed by the Nuclear Safety Review Group.

5. Additional training for appropriate personnel has been completed on setpoint generation.

6. The Cycle 10 and 11 peaking factors were reviewed to assure the plant was operating within the design basis for those cycles.

7. To enhance the quality verification process, an overview of the entire reload process, including inputs to the setpoint analyses, has been conducted. This review included the applicable procedures to be followed and the transfer of information between the affected groups.

The following longer term corrective actions are planned:

1. A design process document will be implemented, by September 30, 1990, to provide the necessary instructions that will be followed during a reload analysis.

2. OPPD will evaluate the feasibility of an oversight committee to provide guidance for the entire reload process for subsequent cycles. This evaluation will be completed prior to initial reactor criticality for Cycle 13.

There has been one previous LER (LER 88-016) written on errors in generation of RPS setpoints.