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New York Power Authority

Michael J. Colomb
Site Executive Officer

April 6, 2000
JAFP-00-0081

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

Subject: **Docket No. 50-333**
LICENSEE EVENT REPORT: LER-99-014-01 (DER-99-02908)

Non-Conservative APRM-Flow Referenced Neutron Flux Scram Line

Dear Sir:

This report is submitted in accordance with 10 CFR 50.73(a) (2) (ii), "a condition outside the design basis of the plant."

There are no commitments contained in this report.

Questions concerning this report may be addressed to Mr. Abramski at (315) 349-6305.

Very truly yours,

MICHAEL J. COLOMB

MJC:MA:las
Enclosure

cc: USNRC, Region 1
USNRC, Project Directorate
USNRC Resident Inspector
INPO Records Center

IE22

NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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TITLE (4)

Non-Conservative APRM-Flow Referenced Neutron Flux Scram Line

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 NAME	DOCKET NUMBER
									N/A	05000
12	09	99	99	014	01	04	06	00	N/A	05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	X 50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mr. Mark Abramski, Sr. Licensing Engineer	315-349-6305

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO		04	06	00

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) **(16)**

Reactor power before, during and after this event was 100%. On 12/9/99, through one engineering analysis it was determined that the actual slope of the Average Power Range Monitor (APRM) flow referenced scram line was non-conservative relative to the functional relationship established in the Core Operating Limits Report (COLR). The Technical Specifications state that the APRM Flow Referenced Neutron Flux Scram setting shall be less than or equal to the limit specified in the COLR. The Average Power Range Monitor (APRM) Flow Referenced Neutron Flux Trip Function of the Reactor Protection System (RPS) was declared inoperable at 2230 on 12/9/99. The discrepancy between the actual slope of the APRM flow referenced scram line and the functional relationship established in the COLR was caused by an apparent reduction in the core to drive flow ratio. At 2315 the APRM gains were adjusted to bring the APRM flow referenced neutron flux scram line into agreement with the functional relationship established in the COLR. The APRM Flow Referenced Neutron Flux Trip Function of the RPS was then declared operable. Corrective actions include an investigation into the cause of the apparent reduction in the core to drive flow ratio, and the cause of the breakdown in the administrative control processes used for verifying compliance with assumptions in the COLR and evaluation of how the APRM Flow Reference Neutron Flux Scram was credited in the operating limit MCPR.

EIIS Codes in [ ]

Event Description

Reactor power before, during and after this event was 100 percent. On December 9, 1999, engineering analysis determined that the actual slope of the APRM flow referenced neutron flux scram line was non-conservative relative to the functional relationship established in the Core Operating Limits Report (COLR). The Technical Specifications state that the APRM Flow Referenced Neutron Flux Scram setting shall be less than or equal to the limit specified in the COLR.

The Technical Specifications require that, if this Limiting Condition for Operation (LCO) cannot be satisfied:

1. All operable control rods be inserted within four hours or,

2. Reactor power level be reduced to the Intermediate Range Monitor (IRM) range and the Mode Switch placed in the Startup position within eight hours.

The Average Power Range Monitor (APRM) Flow Referenced Neutron Flux Trip Function of the Reactor Protection System (RPS) [AA] was declared inoperable at 2230. This condition was reported under 10CFR50.72(b)(1)(i)(A), The initiation of a nuclear plant shutdown required by the plant's Technical Specifications and 10CFR50.72(b)(1)(ii)(B), In a condition that is outside the design basis of the plant.

At 2315 the APRM gains were adjusted to bring the APRM flow referenced neutron flux scram line into agreement with the functional relationship established in the COLR and the APRM Flow Referenced Neutron Flux Trip Function of the RPS was declared operable.

Cause

The COLR develops a functional relationship between Reactor Power and Reactor Water Recirculation (RWR) [AD] mass flow rate (expressed in percent of rated drive flow) for the APRM flow referenced neutron flux scram line.

Scram ≤ % Rated Drive Flow (0.66) + 54%

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Cause (cont'd.)

In-situ plant data indicates that core flow to drive flow ratio has decreased relative to previous cycles and perhaps relative to the beginning of the current fuel cycle. An investigation was conducted to determine the mechanistic cause for this apparent reduction in the core flow to drive flow ratio. This investigation determined there were three principal factors contributing to the apparent reduction in the core flow to drive flow ratio.

1. The Core Flow Measurement System (CFMS) [AD] had been recalibrated. This recalibration reduced indicated core flow by approximately 3%. Reactor Water Recirculation [AD] pump speed was therefore increased approximately 3% to compensate for the indicated reduction in core flow.

2. Jet Pump Performance Decreased. The plant had recently completed a Noble Chemical Addition modification to help inhibit intergrannular stress corrosion cracking (IGSCC) on reactor internals. The Noble Chemical application restructured the pre-existing crud layer in the Jet Pumps causing a reduction in Jet Pump performance. Reactor Water Recirculation pump speed was increased approximately 1% to compensate for the reduction in Jet Pump performance.

3. Reduced uncertainty in feedwater flow measurement resulted in an increase in reactor power. The plant had recently installed an ultrasonic feedwater flow measurement system. This system removed the bias inherent in the venturi flow elements it replaced allowing the plant to operate closer to the maximum licensed power limit. The net increase in reactor power was approximately 1.6%. Reactor Water Recirculation pump speed was increased approximately .33% to achieve this higher power level.

The discrepancy between the actual slope of the APRM flow referenced scram line and the functional relationship established in the COLR was caused by this apparent reduction in the core to drive flow ratio.

The value of Drive Flow that results in Rated Core Flow varies with fuel design, the thermo-hydraulic conditions in the Reactor Core and performance of the Reactor Jet Pumps. Figure 1 illustrates how a change in the Core Flow to Drive Flow relationship results in new value for 100 percent drive flow ($W_{D(100\%)}$). Points A and A' represent two arbitrary operating points. Over time, the Core Flow to Drive Flow relationship changes based on the factors identified above. These changes manifest themselves in a different slope for the correction factor as well as different operating points. In

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Cause (cont'd.)

both cases, a value for $W_{D(100\%)}$ is developed based on an operating point and a correction factor (both of which are based on measured values) which are used to extrapolate $W_{D(100\%)}$ for 100 percent Rated Core Flow ($W_{T(Rated)}$). Note that, in practice, the slope of the correction factor line is relatively constant and therefore, the value for $W_{D(100\%)}$ is predominately a function of the operating point (W_T and W_T' are approximately equal).

Figure 2 illustrates how the gradual transition from Operating Point A to A' changes the slope of the Flow Referenced APRM Scram Line required to maintain the functional relationship between Reactor Power and percent rated Drive Flow established in the COLR. $W_{D(100\%)}$ moves to $W_D'_{(100\%)}$ and the required slope is reduced accordingly. This change in operating point had an analogous effect on the APRM Control Rod Block Trip Setting as well.

Since the change in operating point results in a lower required slope, instrument gains must be adjusted to ensure a conservative actual slope.

Reactor Analyst Procedure (RAP) 7.3.30, "Cycle Startup Physics Test Report" directs the performance of RAP 7.3.7, "Core Flow Evaluation and Indication Calibration" and RAP 7.3.29, "Determination of Rated Recirculation Flow." RAP 7.3.7 establishes values for $W_{D(Measured)}$ and $W_{T(Measured)}$. RAP 7.3.29 determines the value of $W_{D(100\%)}$ based on the results of RAP 7.3.7.

No procedural guidance was in place to review the new value for rated drive flow ($W_D'_{(100\%)}$) against the value used to develop APRM/RWR system gains which maintain compliance with the COLR. This lack of guidance constitutes a breakdown in the administrative control processes used for verifying the assumptions in the COLR (Cause Code E).

A root cause investigation was conducted to determine the cause and extent of condition for the breakdown in administrative controls, which lead to the event described in this report. This investigation concluded the cause was poor change management. This investigation evaluated the programmatic balance between procedural detail, staff experience levels, supervision and training within the Reactor Engineering group from 1983 to present. The investigation concluded that, over this time frame, the level of procedural detail and the balance between supervision and training did not effectively compensate for staff turnover and resulting reduction in experience level within the Reactor Engineering group.

Other root cause analyses recently performed at the station also identified weaknesses in the management of Technical Services Department turnover. A comprehensive review of the station's Technical Services program is being conducted to identify ways to formalize the turnover of key technical staff.

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Analysis

The reduction in the slope of the Flow Referenced APRM Scram Line required to maintain the functional relationship between Reactor Power and percent rated Drive Flow established in the COLR resulted in a non-conservative APRM Flow Referenced Neutron Flux input to the RPS.

The Bases for JAF Technical Specifications (Bases Section 2.1.A.1.c, APRM Flux Scram Trip Setting [Run Mode]) states that the flow-referenced trip will result in a significantly earlier scram during slow thermal transients such as the loss of 80 degrees F feedwater heating event, than would result from the 120 percent fixed high neutron flux scram.

This bases section also states that the lower flow referenced-scram setpoint therefore decreases the severity (in terms of change in Critical Power Ratio) of a slow thermal transient and allows lower Minimum Critical Power Ratio (MCPR) Operating Limits if such a transient is the limiting abnormal operational transient during a certain exposure interval in the cycle. The flow-referenced trip also provides protection for power oscillations, which may result from reactor thermal hydraulic instability.

The analysis of limiting plant transients, pressurization events, does not consider the flow-biased APRM Rod Block and Scram functions. These events credit the fixed APRM Scram which is unaffected by the change in core flow characteristics.

The JAF COLR specifies that, for Core Flows less than 59.9 percent of rated, the Operating Limit MCPR shall be increased by a factor inversely proportional to the percent of rated Core Flow.

A post-event evaluation determined the APRM Flow Referenced Neutron Flux scram is not credited in developing the cycle Operating Limit MCPR. In addition, the detect and suppress protection provided by the flow-biased APRM was not affected by this event.

This condition does not constitute a Safety System Functional Failure as defined by NEI 99-02 (Draft Rev. D) because it alone would not have prevented a reactor scram. Rather, this condition would have resulted in a higher Neutron flux scram setpoint for certain combinations of drive flow and reactor power.

Corrective Actions

1. The APRM/RWR system gains have been adjusted to bring the APRM Flow-Referenced Neutron Flux Scram Trip setting in agreement with the COLR. **(Complete)**

2. RAP-7.3.7, Core Flow Evaluation and Indication Calibration and IMP-2-3.2, Single Tap Jet Pump Flow Summer Recorder & Indicator Calibration and ISP-63-1, APRM Flow Bias Signal Instrument Calibration have been revised to ensure that changes in indicated core flow are appropriately evaluated and accounted for in RWR system gain settings. **(Complete)**

3. Corrective action to prevent abrupt changes in indicated core flow during calibration of the CFMS has been taken. The sample size used when collecting data required to calibrate the CFMS was increased to reduce the impact of normal signal variation due to bistable flow. Also, a calibration of entire jet pump instrumentation, including single tap, double tap jet pumps and associated instrumentation was completed. A subsequent CFMS calibration revealed core flow indication was slightly higher than actual, meaning the flow biased setpoints were more conservative than originally thought. **(Complete)**

4. Corrective action to compensate for both reduction in jet pump performance, and net increase in reactor power due to installation of an ultrasonic feedwater flow measurement system, was to perform an adjustment of the Reactor Water Recirculation (RWR) pump stops. This adjustment allows the RWR pumps to operate at a higher speed. **(Complete)**

5. An investigation was conducted to determine the mechanistic cause for this apparent reduction in the core flow to drive flow ratio. The results of this investigation are presented in this supplemental report. **(Completed)**

6. A post-event evaluation determined the APRM Flow Referenced Neutron Flux scram is not credited in developing the cycle Operating Limit MCPR. **(Completed)**

7. A root cause investigation was conducted to determine the cause and extent of condition for the breakdown in administrative controls, which lead to the event described in this report. The results of this investigation are presented in this supplemental report. **(Complete)**

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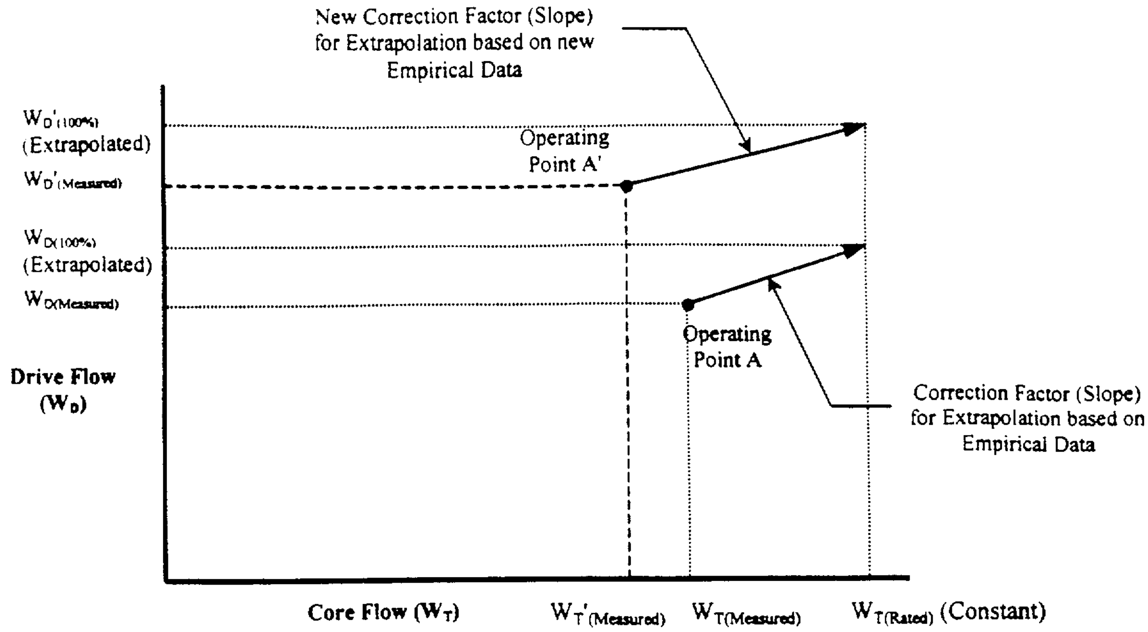
Corrective Actions (cont'd.)

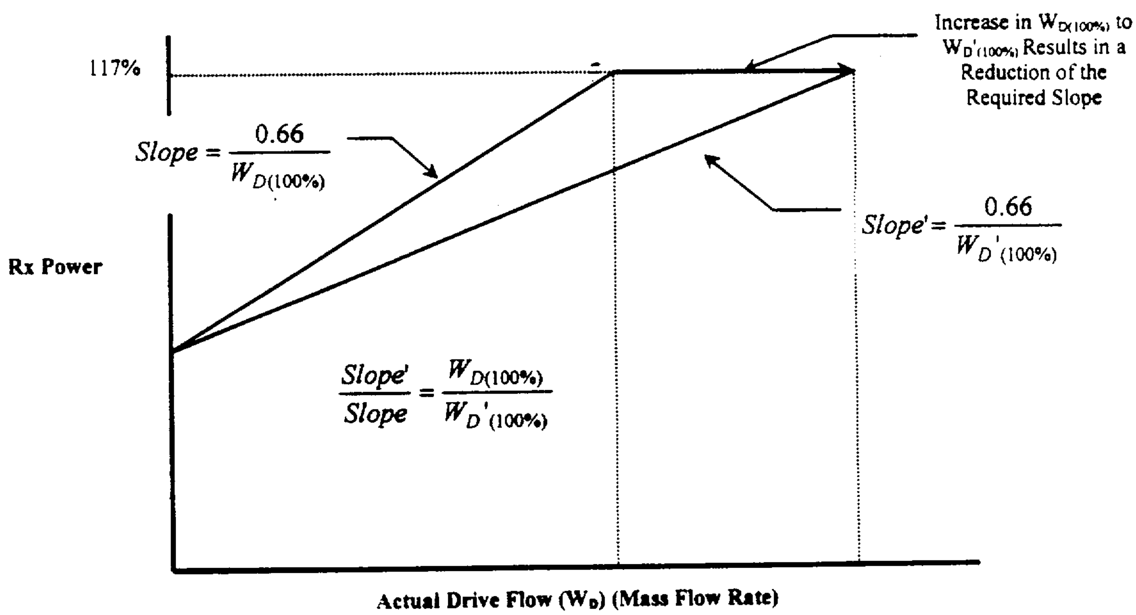
8. An improvement plan for Reactor Engineering will be developed to address the deficiencies identified in the Root Cause Analysis performed for this event. **(Scheduled Completion Date: July 1, 2000)**

Additional Information

Previous Similar Events: None



LER 99-014 Figure 1
Extrapolation of 100% Drive Flow



LER 99-014 Figure 2
Change in APRM Flow Referenced SCRAM Line Slope
Required to Maintain $S \leq .66(\frac{W_D}{W_{D(100\%)}}) + 54\%$