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MILLER,C.L. Project Directorate I-2

SUBJECT: Forwards info re recently discovered error that impacts validity of TS limit issued in 920507 Cycle 7 reload amend. Proceeding above 25% rated thermal power on 920517 is safe & justified.

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May 15; 1992

Harold W. Keiser
Senior Vice President-Nuclear
215/774-4194

Director of Nuclear Reactor Regulation
Attention: Mr. C.L. Miller, Project Director
Project Directorate I-2
Division of Reactor Projects
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
ADMINISTRATIVE CONTROL OF FLOW DEPENDENT
MCPR OPERATING LIMITS FOR U1C7 OPERATION
PLA-3778 FILES A17-2, R41-2 Docket No. 50-387

Reference: Letter, J.J. Raleigh to H.W. Keiser, "Cycle 7 Reload Amendment, Susquehanna Steam Electric Station, Unit 1 (TAC No. M82356)", dated May 7, 1992.

Dear Mr. Miller:

The purpose of this letter is to provide information to you regarding a recently discovered error that impacts the validity of a Technical Specification limit as issued in the referenced reload amendment which supports cycle 7 operation of Susquehanna Unit 1.

BACKGROUND:

On May 6, 1992, during final independent review of the Unit 2 Cycle 6 (U2C6) reload licensing analysis packages, an error was discovered in the calculation of the Technical Specification flow-dependent MCPR operating limit curve (*Figure 3.2.3-1*). This error will be corrected for U2C6 prior to submitting the proposed reload amendment to the NRC. The flow-dependent MCPR operating limits curve derived for U1C7 was subsequently checked and found to contain the same error. The following paragraphs describe the basis for the flow-dependent MCPR operating limit curve, the nature of the calculational error, an assessment of safety impact, and PP&L's proposed corrective actions (including compensatory actions) to resolve this problem.

BASIS FOR THE FLOW-DEPENDENT MCPR OPERATING LIMIT:

The flow-dependent MCPR operating limit curve is derived based on the analysis of the design basis Recirculation Flow Controller Failure (RFCF) event. An inadvertent reactor recirculation pump runup would result in a power increase, due to void reactivity feedback, and a consequential decrease in MCPR margin.

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Because this event can cause a larger decrease in MCPR at lower initial flows than other limiting events at full power (e.g., Generator Load Rejection), higher MCPR operating limits are required at reduced core flow conditions. The licensing analysis of the RFCF event requires numerous parametric calculations in order to determine the limiting pump runup rate. The analyses are performed using PP&L's NRC-approved licensing analysis methods. The reactor system response to the RFCF is calculated with the RETRAN code, and the resultant delta-CPR is determined based on hot bundle RETRAN analyses and hand calculations.

NATURE OF THE CALCULATIONAL ERROR:

The analyses of the RFCF for U1C7 were performed using the methodology described in PP&L's NRC-approved licensing topical reports. An error was discovered in the calculation of the flow-dependent MCPR operating limit curve. More specifically, the error involves the equation used to compute the delta-CPR from which the MCPR operating limit is derived. The transient hot bundle delta-CPR is calculated based on reaching a minimum CPR equal to 1.0. PP&L's methodology requires that a 4% uncertainty (i.e., 1.04 factor) be applied to the relative change in CPR (RCPR = delta CPR/initial CPR). From the adjusted RCPR, the final delta-CPR is calculated and added to the MCPR Safety Limit (equal to 1.06). However, analyses show that a transient initiated from a higher initial MCPR results in a higher value of calculated delta-CPR, compared to the identical transient initiated from a lower initial MCPR. This aspect of the delta-CPR calculation was omitted in the calculation for U1C7. Therefore, relative to PP&L's defined methodology, the flow-dependent MCPR operating limit for U1C7 was calculated incorrectly, and resulted in an incorrect Technical Specification *Figure 3.2.3-1* being transmitted to and subsequently approved by the NRC. Pertinent portions of the hand calculation found to be in error are attached for your information.

IMPACT OF THE CALCULATIONAL ERROR ON SAFETY:

The calculational error was found prior to SSES Unit 1 operation above 25% Rated Thermal Power, where the Technical Specifications require the MCPR operating limit curve to be enforced. Therefore, the calculational error has had no direct impact on safety. Upon recognizing the problem, PP&L placed an administrative control on exceeding 25% Rated Thermal Power until this error was completely resolved and proper limits were in place.

PROPOSED CORRECTIVE AND COMPENSATORY ACTIONS:

A new flow-dependent MCPR operating limit curve has been prepared, based on correcting the described error such that the new curve is what PP&L should have originally supplied to the NRC, and what the NRC believed they approved via the reference. Copies of the new curve, the old and new curve together, and the numbers that form the basis for the old and new curves are attached.

The new curve has been entered into PP&L's Powerplex core monitoring system, and as such will be enforced as the proper Technical Specification operating limits. PP&L will operate under these limits administratively until such time as a formal Technical Specification change can be processed. PP&L will submit this change by May 22, 1992, but it is understood that our commitment to the above administrative controls will serve to safely control plant operation until such time as the NRC formally approves the change.

This action is justified for the following reasons:

1. PP&L has corrected the single calculational error and the new curve is consistent with what the NRC believed they approved in the reference.

2. PP&L's methodology for the RFCF event contains several significant conservatisms:

   - o No credit is taken for the simulated thermal power monitor trip.
   - o The failure assumed is a two recirculation pump runup. A two pump runup as a result of a single failure can only occur when the recirculation system is in master-manual control mode. This mode of operation is prohibited below 45% recirculation pump speed (corresponding to 55% core flow). The RFCF event is not limiting above approximately 72% core flow (this is shown on the figure of old vs. new curves where the two curves merge). Thus, the region of concern is limited to a window of between approximately 55% and 72% core flow.
   - o The worst case runup rate is assumed. This rate is extemely slow (on the order of ten minutes), and no operator action is assumed.
   - o Uncertainties in trip setpoints and code uncertainties are included.
   - o No credit is taken for the operability of the turbine bypass system.

3. PP&L proposes an additional compensatory action for conservatism until receipt of the formal change to the Technical Specifications. Based on our determination that the existing Technical Specification figure is valid as long as the turbine bypass system is operable, PP&L commits to reducing power below 25% (the applicability of the MCPR operating limit Technical Specification) if the turbine bypass system becomes inoperable.

In effect, the current Action of Technical Specification 3.7.8 will be replaced by the following action:

"With the main turbine bypass system inoperable, restore the system to OPERABLE status within 2 hours, or be below 25% RATED THERMAL POWER within the next 4 hours."

4. The Susquehanna Plant Operations Review Committee has reviewed this proposed action and approved it.

Based on the above, PP&L believes that proceeding above 25% Rated Thermal Power is safe and justified. The U1C7 startup schedule currently projects that we will reach this limit on Sunday, May 17. Any questions on this request should be directed to Mr. R. Sgarro at (215) 774-7914.

Very truly yours,

H.W. Keiser

Attachments

cc: NRC Document Control Desk (original)
NRC Region I
Mr. G. S. Barber, NRC Sr. Resident Inspector - SSES
Mr. J. J. Raleigh, NRC Project Manager - OWFN
Mr. J. Stone, NRC - OWFN

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pla3778.rrs

ORIGINAL CALCULATION

To account for the RETRAN code uncertainty, the RCPR is multiplied by 1.04 (Reference 2) as follows;

$$RCPR_f = 1.04 * RCPR$$

where: $RCPR_f$ = the final RCPR for the event adjusted for code uncertainty,
$RCPR$ = the RCPR for the event based on the values calculated by the DELTACPR runs.

To determine the corrected delta-CPR (delta-CPR_f) for the event, the equation for $RCPR_f$ can be rearranged as follows;

$$RCPR_f = \frac{\text{delta-}CPR_f}{1 + \text{delta-}CPR_f}$$

$$RCPR_f*(1 + \text{delta-}CPR_f) = \text{delta-}CPR_f$$

Therefore,

$$\text{delta-}CPR_f = \frac{RCPR_f}{1 - RCPR_f}$$

Once the delta-CPR_f is determined, the estimated MCPR operating limit (MCPROL) for each power/flow condition is determined as follows;

$$MCPROL = \text{Safety Limit} + \text{delta-}CPR_f$$

$$MCPROL = 1.06^* + \text{delta-}CPR_f.$$

* assuming a 1.06 Safety Limit

Table 3.4 presents the RCPR, $RCPR_f$, delta-CPR_f, MCPROL values for the three explicit U1C7 RFCF calculations. The information in Table 3.4 will be used to develop detailed values for the Core Flow dependent MCPR operating limits.

The following curve fit was used to determine the MCPR operating limit value for the 30% core flow case;

initial guess on bundle power which was then iterated upon until the calculated CPR is within 0.0005 of 1.0. The 54/37 condition required a 60 second null transient to be run because of instabilities in the Hot Bundle Model while trying to reach a steady state at these power/flow conditions. The 54/37 case still was not capable of reaching a steady state even after 60 seconds. Therefore CPR calculations were performed at 0.5 second intervals over the last 1 second of the 60 second null and the maximum CPR was used as the initial CPR.

Tables D.3.2 and D.3.3 present the results of the CPRITER runs including the RCPRs. These RCPRs are defined below and are not corrected for code uncertainty. Section D.3.3 will provide the adjusted RCPRs and the estimated MCPR operating limits.

$$RCPR = \frac{(\text{Initial CPR} - 1.0)}{\text{Initial CPR}}$$

(Initial CPR = 1.0 + delta-CPR for the RFCF event)

D.3.3 MCPR Operating Limits

To determine the MCPR vs Core Flow operating limits that the new analyses produce, the RCPR values must first be corrected for the RETRAN code uncertainty and then a MCPR operating limit can be 'back-calculated'. This MCPR operating limit will be based on a MCPR safety limit of 1.06 for this calculation. The original U1C7 RFCF analysis did not correctly calculate the MCPR operating limits. Revision 1 of this package shows that the safety limit must be used when back calculating a delta-CPR or MCPR operating limit from the value of RCPR with the code uncertainty applied to it. The procedure that follows correctly accounts for the safety limit when calculating the MCPR operating limit and is used to calculate operating limits for the new U1C7 RFCF analysis.

REVISED CALCULATION

To account for the RETRAN code uncertainty, the RCPR defined in Section D.3.2 is multiplied by 1.04 (Reference 2) as follows;

$$RCPR_f = 1.04 * RCPR$$

where: $RCPR_f$ = the final RCPR for the event adjusted for code uncertainty,
RCPR = the RCPR for the event based on the values calculated by the CPRITER runs.

To determine the MCPR operating limit (MCPROL) for the event, the equation for $RCPR_f$ can be rearranged as follows;

$$RCPR_f = \frac{MCPROL - SL}{MCPROL} \quad ;(SL = Safety\ Limit)$$

$$MCPROL*(1 - RCPR_f) = SL$$

Therefore,

$$MCPROL = \frac{SL}{1 - RCPR_f}$$

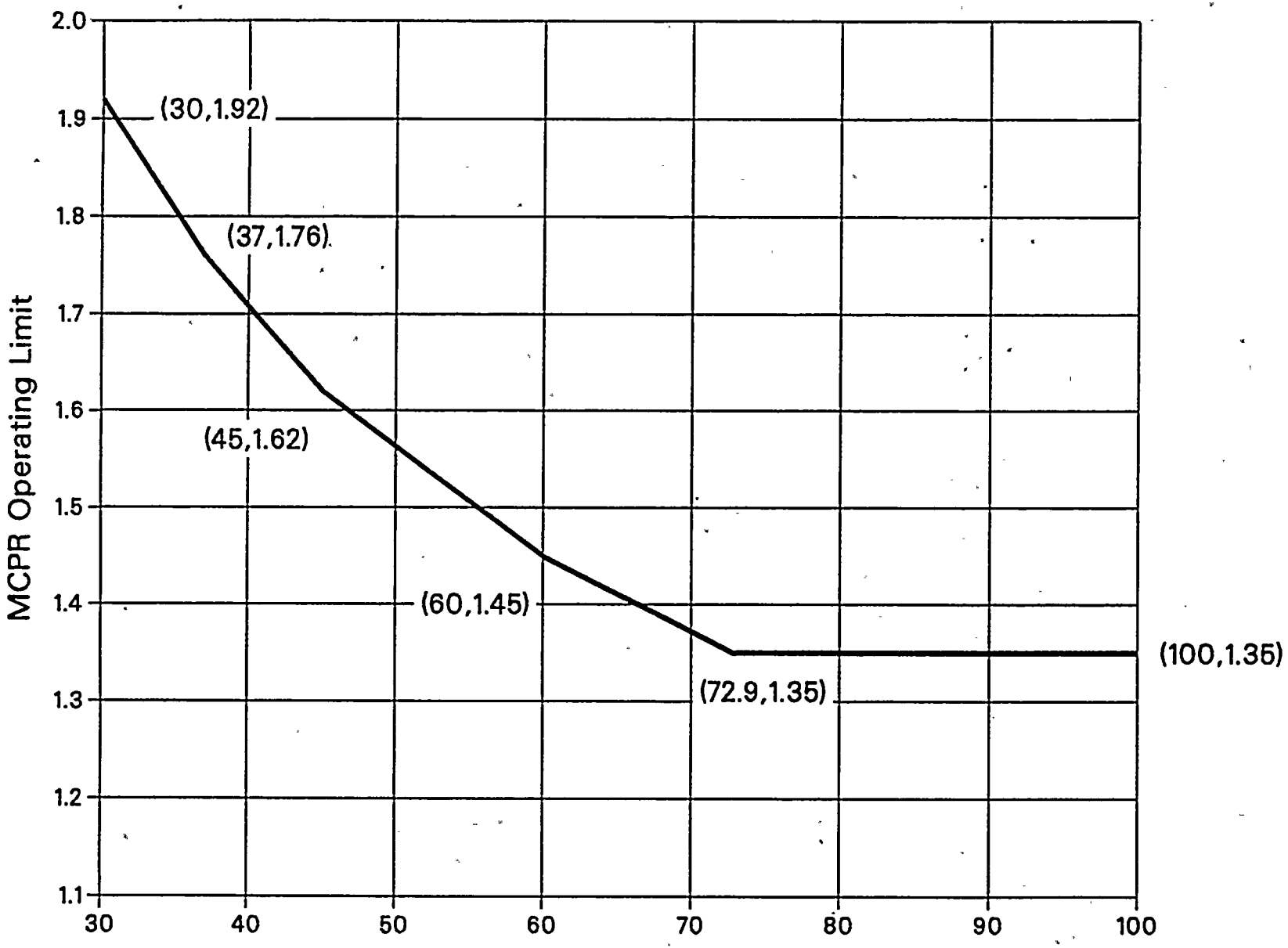
Assuming a 1.06 Safety Limit

$$MCPROL = \frac{1.06}{1 - RCPR_f}$$

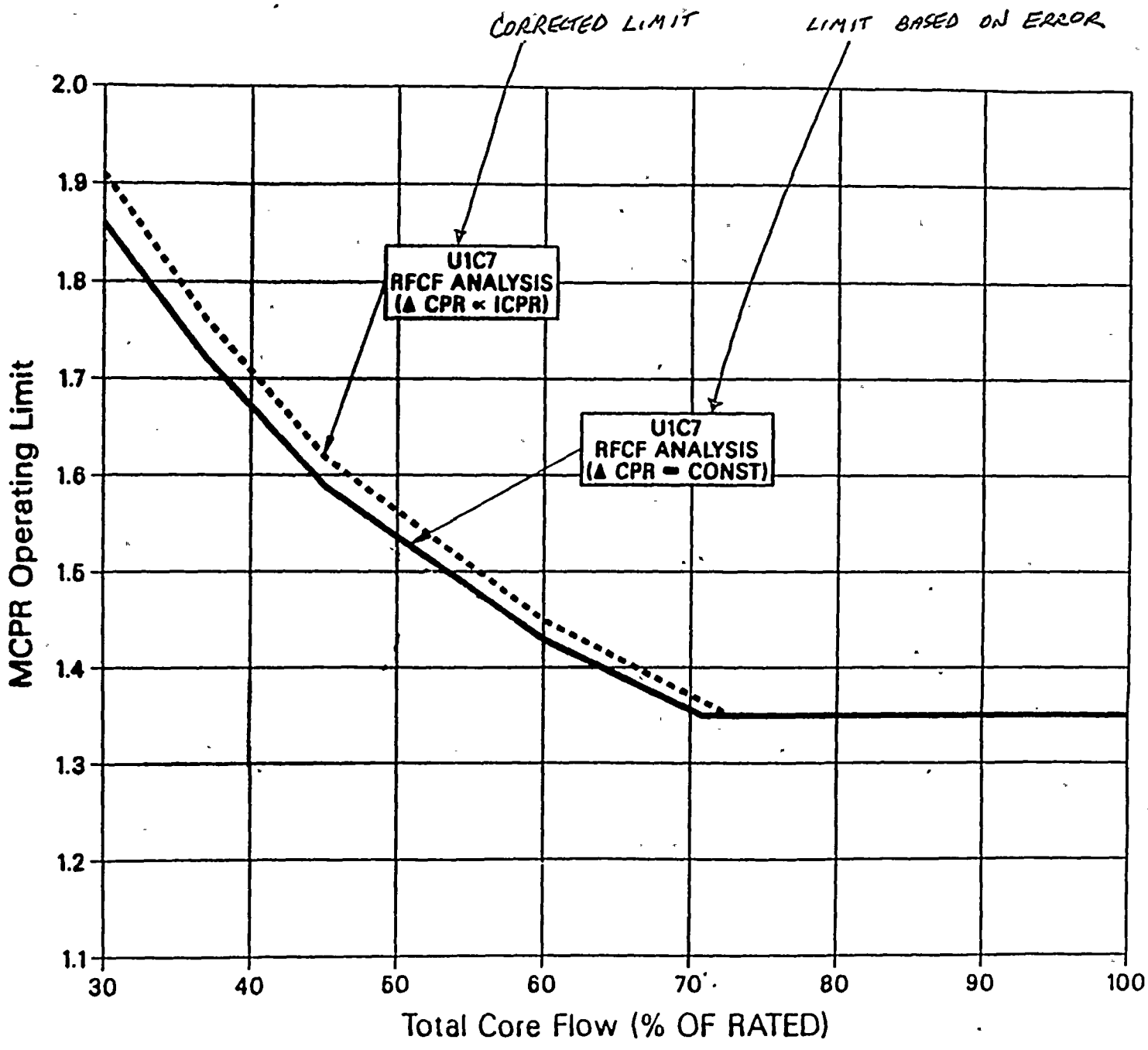
Table D.3.4 presents the RCPR, $RCPR_f$, MCPROL values for the three explicit U1C7 RFCF calculations. The information in Table D.3.4 will be used to develop detailed values for the Core Flow dependent MCPR operating limits.

The following curve fit was used to determine the MCPR operating limit value for the 30% core flow case;

CORRECTED FIGURE



FLOW DEPENDENT MCPR OPERATING LIMIT
FIGURE 3.2.3-1



FLOW DEPENDENT MCPR OPERATING LIMIT

DATA BASED ON CALCULATIONAL ERROR

Table 3.1

U1C7 Core Flow Dependent MCPR Operating Limits Based on the U1C7 Recirculation Flow Controller Failure Analysis

Core Flow (% Rated)	delta-CPR	MCPROL
30.0	0.80	1.86
37.0	0.66	1.72
45.0	0.53	1.59
60.0	0.37	1.43
70.9	0.29	1.35*
100.0	0.29	1.35*

* MCPROL value for 100% Power/100% Flow operation based on the U1C7 Licensing Analyses.

CORRECTED DATA

Table 3.1A

U1C7 Core Flow Dependent MCPR Operating Limits Based on the U1C7 Recirculation Flow Controller Failure Analysis

Core Flow (% Rated)	delta-CPR	MCPROL
30.0	0.86	1.92
37.0	0.70	1.76
45.0	0.56	1.62
60.0	0.39	1.45
72.9	0.29	1.35*
100.0	0.29	1.35*

* MCPROL value for 100% Power/100% Flow operation based on the U1C7 Licensing Analyses.