ATTACHMENT 2

Proposed Alternate Analysis Method for Unit 1 Cycle 7

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1.0 INTRODUCTION

Reference 1 describes the NRC approved steady state core physics methods used by PP&L for BWR core analysis and provides qualification of the analytical methods which will be used to perform safety related licensing analyses. Reference 2 describes PP&L's transient analysis methods for the analysis of a GE BWR-4 reactor. PP&L's steady state core physics and transient analysis methods are based on the Electric Power Research Institute (EPRI) code package. Reference 3 describes the application of PP&L's steady state core physics and transient analysis methods to licensing analyses, including the assumptions, methods, and application of uncertainties used to calculate conservative results.

Reference 4 contains the responses to NRC questions arising from their review of the transient analysis methods report PL-NF-89-005 (Reference 2). References 5 and 6 contain responses to NRC questions arising from their review of the applications topical report PL-NF-90-001 (Reference 3).

This attachment describes alternate methods of calculating MCPR operating limits for the Rod Withdrawal Error (RWE) and for pressurization transients such as the Generator Load Rejection (GLR) and the Feedwater Controller Failure (FWCF). The alternate methods described in this supplement can be used in place of the Statistical Combination of Uncertainties (SCU) methodology described in Appendix B of PL-NF-90-001 to produce conservative MCPR operating limits. The PP&L alternate methods use a "deterministic" calculation of ΔCPR. The MCPR operating limit is determined by adding the calculated ΔCPR to a separately calculated MCPR safety limit value to assure that greater than or equal to 99.9% of the fuel rods are expected to avoid boiling transition for these transients. The alternate methods described herein are similar to the NRC approved methods utilized by the Philadelphia Electric Company and the Siemens Nuclear Power Corporation (SNP), formerly the Advanced Nuclear Fuels Corporation (ANF).

The RWE alternate method involves the selection of a conservative rod pattern with respect to expected operational rod patterns and conservative assumptions regarding the availability of LPRM strings in the Rod Block Monitor. The alternate method for pressurization events deterministically accounts for code uncertainty by applying a 10% penalty on integral power in the same manner as SNP (PP&L's current fuel vendor) in their approved licensing methodology (Reference 7).

Sample calculations of the ΔCPRs for the RWE and GLRWOB events using the methods described in this supplement are also provided.

2.0 ALTERNATE LICENSING METHOD: ROD WITHDRAWAL ERROR

2.1 Licensing Analysis Method

The RWE analysis will be performed using the methodology described in Section 2.1.3 of PL-NF-90-001, with the exception that the SCU method and the statistical treatment of applicable uncertainties will be replaced with a deterministic ΔCPR calculation which assumes a conservative LPRM failure configuration and uses the strongest worth rod as the error rod. The two principal codes used to perform the alternate licensing approach are the SIMULATE-E and RBM codes. The SIMULATE-E code provides detailed neutronic and thermal hydraulic feedback data during the event. The RBM code will then process the SIMULATE-E predicted detector readings to generate RBM responses for different LPRM string failure combinations. The most conservative RBM response of the different LPRM string failure combinations is chosen to determine when the rod block occurs and, hence, the ΔCPR. The MCPR operating limit will be determined for this event by adding the calculated ΔCPR to a MCPR safety limit value (calculated with SNP's NRC approved safety limit methodology) to assure that greater than or equal to 99.9% of the fuel rods are not expected to experience boiling transition.

The following conservative assumptions are used for the alternate RWE licensing analysis method:

1) The RWE event is initiated at rated power and flow (same as Reference 8 method).

2) A control rod pattern that: a) forces the limiting core MCPR location to be within one control cell of the error rod; b) forces the fuel bundles near their MCPR and LHGR operating limits; and c) results in the core being near critical. This is the same approach as used in the Philadelphia Electric Company method described in Reference 8.

3) The error rod is the maximum worth rod (same as the Reference 8 method).

4) The error rod is initially fully inserted (same as the Reference 8 method).

5) Zero xenon is assumed as the xenon concentration for 100% power rod line cases (same as the Reference 8 method).

6) A conservative RBM response is chosen. Of the four possible LPRM strings nearest to the control rod being withdrawn, the worst case of 0, 1, or 2 LPRM string failures will be chosen. In addition, of the two possible RBM channels, the more conservative RBM channel response (i.e., least sensitive) will be used to determine the RBM response. This approach is the same as that used in the NRC approved Philadelphia Electric Company methodology described in Reference 8.

7) Analyses will be performed for both BOC and peak hot excess reactivity.

The above conservative assumptions provide a high degree of assurance that the analyzed event will bound all RWE events that are expected to occur.

2.2 Sample Analysis

A sample analysis was performed for Unit 2 Cycle 5 using the alternate method of calculating MCPR operating limits described above. The calculated ΔCPR which is based on a 108% rod block trip setpoint at 100% flow is 0.23. Using a MCPR safety limit of 1.06, this ΔCPR value corresponds to a MCPR operating limit of 1.29.

3.0 ALTERNATE LICENSING METHOD: PRESSURIZATION EVENTS

3.1 Code Uncertainty Penalty on Integral Power

The analyses presented in Sections 5, 6, and 8 of PL-NF-89-005 demonstrate that the RETRAN system models set up using PP&L methodology accurately model plant behavior with a slight conservative bias for pressurization events. Of particular interest are the analyses of the Peach Bottom 2 Turbine Trip Tests, since they are representative of licensing basis pressurization transients. Since the change in critical power ratio is largely determined by the core power transient, the integral power during the event is an appropriate parameter to use to determine the conservatism of the PP&L RETRAN models.

As discussed in Section 6 of PL-NF-90-001, there are significant differences between the Peach Bottom 2 and Susquehanna SES steam lines. In addition, the steam line uncertainties do not contribute significantly to the total code uncertainty. Thus, in order to evaluate the ability of the PP&L RETRAN model to calculate integral power for pressurization events, the Peach Bottom RETRAN model described in Section 6 of PL-NF-89-005 was modified to use measured steam dome pressure as a boundary condition. Analyses of the three turbine trip tests were performed using this "dome forced" system model. Table 3-1 provides a comparison of calculated and measured peak and integral powers for the three turbine trip tests.

Another demonstration of the ability of PP&L's RETRAN model to calculate integral power is provided by the inadvertent end of cycle generator load rejection event used for benchmarking the Susquehanna SES RETRAN model described in Section 5.6 of PL-NF-89-005. Table 3-2 provides the calculated and measured integral powers for this event.

As demonstrated by the Table 3-1 and Table 3-2 results, the calculated values of integral power are conservative with respect to their measured values. It should be noted that the calculated integral powers range from 8% to 18% conservative. In addition to the inherent conservatism of the PP&L RETRAN model, PP&L will apply a 10% integral power penalty for licensing analyses of pressurization transients using the alternate method as discussed in Section 3.2. The application of a 10% integral power penalty is consistent with SNP's NRC approved methodology (Reference 7).

3.2 Licensing Analysis Method

Analyses of licensing basis pressurization transients (i.e., GLR and FWCF) will be performed using the methodologies described in Sections 3.1.3 and 3.2.3 of PL-NF-90-001, with the exception that the SCU method and code uncertainty treatment would be replaced by the deterministic ΔCPR calculation with the 10% integral power penalty. The MCPR operating limit will be determined for these events by adding the calculated ΔCPR to a MCPR safety limit value (calculated with SNP's NRC approved safety limit methodology) to assure that greater than or equal to 99.9% of the fuel rods are not expected to experience boiling transition.

PP&L also intends to use the above described methodology to define scram speed dependent MCPR operating limits. The analyses at scram speeds faster than those corresponding to the Technical Specification maximum allowed average insertion times will be performed using the same method except for the use of a different scram insertion versus time curve.

3.3 Sample Analysis

A sample analysis was performed for the limiting Unit 2 Cycle 5 GLRWOB using the alternate method of calculating MCPR operating limits described above. The calculated ΔCPR which assumed a scram speed of 4.2 ft/second is 0.27. This value yields a MCPR operating limit of 1.33.

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TABLE 3-1

Peach Bottom Turbine Trip Test RETRAN Analyses
Peak and Integral Power Comparisons

Test or	Peak Normalized Power		Integral Power (%-sec)		
Event	Measured	Calc'd	Measured	Calc'd	Meas/Calc
TT1	4.83	5.31	42.11	46.02	.92
TT2	4.53	5.56	46.16	53.56	.86
TT3	4.94	6.23	46.30	56.43	.82

TABLE 3-2

Susquehanna SES End of Cycle 1, Unit 1, Generator Load Rejection
Integral Power Comparison

	Integral Power (%-sec)		
Event	Measured	Calc'd	Meas/Calc
EOC GLR	7.78	9.05	0.86

4.0 REFERENCES

1. "Qualification of Steady-State Core Physics Methods for BWR Design and Analysis", PL-NF-87-001-A, Pennsylvania Power & Light, July 1988.

2. "Qualification of Transient Analysis Methods for BWR Design and Analysis", PL-NF-89-005, Pennsylvania Power & Light, December 1989.

3. "Application of Reactor Analysis Methods for BWR Design and Analysis", PL-NF-90-001, August 1990.

4. "Response to RAI on PL-NF-89-005", PP&L Letter PLA-3542, March 13, 1991.

5. "Initial Response to RAI on PL-NF-90-001 (SCU Questions)", PP&L Letter PLA-3566, April 23, 1991.

6. "Final Response to RAI on PL-NF-90-001", PP&L Letter PLA-3578, June 4, 1991.

7. "Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors", XN-NF-79-71(P) (A), Revision 2, Supplements 1,2, & 3, March 1986.

8. "Philadelphia Electric Company Methods for Performing BWR Steady State Reactor Physics Analyses", Volume 1, November 9,1989.

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