Application of Reactor Analysis Methods for BWR Design and Analysis

PL-NF-90-001

Supplement 1

Loss of Feedwater Heating Changes & Use of RETRAN MOD 5.1

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Abstract

PP&L is currently performing reload licensing analyses to establish MCPR operating limits using NRC approved methods. This supplement to PP&L's NRC approved methodology documents two minor changes to our methodology. First, PP&L intends to begin using RETRAN-02 MOD005.1 (which has been NRC approved for licensing applications) in place of RETRAN-02 MOD004. Second, a generic loss of feedwater heating methodology is proposed.

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1.0 INTRODUCTION

PP&L is currently performing reload licensing analyses to establish MCPR operating limits using NRC approved methods (References 1 through 5). These methods have been used for calculating the operating limits for Unit 1 Cycle 7, Unit 1 Cycle 8, Unit 2 Cycle 6, and Unit 2 Cycle 7 (first power uprate cycle). A great deal of additional analysis was performed during the development of these methods. The result of these extensive analyses is a significant increase in our experience and knowledge.

It is PP&L's intent to use the experience gained to simplify our licensing methods, where applicable, in order to reduce the resources required to perform reload licensing analyses. The desired result of this approach is to improve PP&L's competitive position with no loss of safety assurance. In addition, PP&L desires to upgrade our analytical methods to use state-of-the-art methods, when such changes are justifiable.

This supplement to PP&L's NRC approved methodology (Reference 1) documents two minor changes to our methodology. First, PP&L intends to begin using RETRAN-02 MOD005.1 (which has been NRC approved for licensing applications) in place of RETRAN-02 MOD004. Second, a generic loss of feedwater heating methodology is proposed.

2.0 Use of RETRAN MOD005.1

PP&L's NRC approved licensing methods described in References 1 and 2 utilize RETRAN MOD004 with minor modifications as described. PP&L intends to use MOD005.1 in place of MOD004 for future licensing analyses (with the same modifications described in References 1 and 2). Reference 6 contains NRC's acceptance of MOD005.1 for licensing applications. In addition to the extensive testing of MOD005.1 performed by EPRI, PP&L performed a comparison of MOD004 and MOD005.1 for the four licensing transients which use the RETRAN code. The four events analyzed were: Generator Load Rejection w/o Bypass, Feedwater Controller Failure, Recirculation Flow Controller Failure, and the MSIV closure (ASME Overpressure event). Results (peak powers, peak pressures, and trip timing) were virtually identical for the two code versions. Therefore, substituting MOD005.1 for MOD004 in PP&L's licensing methodology is justified.

3.0 Generic Loss of Feedwater Heating

3.1 Discussion

PP&L's current NRC approved Loss of Feedwater Heating (LOFWH) analysis methodology is described in Section 2.3 of Reference 1. It consists primarily of a small number of SIMULATE-E calculations to confirm the applicability of a generic correlation. This generic correlation of final MCPR (post-LOFWH) and initial MCPR was expected to be applicable for future cycles. The fact that the LOFWH is an event that can be

represented by a generic correlation has been approved by the NRC for Siemens Power Corporation (Reference 7). The addition of the SIMULATE-E confirmation analyses was considered desirable by PP&L since the correlation was based on only two cycles of data.

Since Reference 1 was written, however, PP&L has performed LOFWH analyses on four additional cycles, including a power uprate cycle. Results of all these analyses confirm the validity of the generic correlation. Figure 1 shows the results of LOFWH analyses for Unit 1 (Cycles 2, 3, 7, and 8) and Unit 2 (Cycles 6 and 7). The results of all six reload analyses also demonstrated that transient fuel LHGR limits would not be violated for a LOFWH.

Two additional aspects of the Susquehanna Steam Electric Station (SSES) units are noteworthy. First, a single failure in the feedwater heater system would be expected to produce a feedwater temperature decrease significantly less than the $100^{o}F$ assumed in the NRC approved methodology. The second aspect of the SSES units is that the LOFWH is not the limiting event for establishing MCPR operating limits. The Generator Load Rejection Without Bypass typically produces a ΔCPR which is at least 0.10 greater than the LOFWH. Therefore, for SSES, the LOFWH is not expected to impact the MCPR operating limit.

3.2 Proposed Change

For future reload analyses, PP&L will continue to use the conservative generic correlation given in Section 2.3 of Reference 1 to calculate ΔCPR for the LOFWH. However, the cycle specific confirmation cases will not be performed. In the event of a significant change to PP&L's operating strategy (e.g., introduction of reload quantities of a new fuel type), either the validity of the generic correlation will be confirmed or the correlation will be adjusted to be conservative.

4.0 Conclusions

The substitution of RETRAN-02 MOD005.1 for MOD004 in PP&L's licensing analysis methods (References 1, 2, and 4) is technically justifiable. Also, the revised approach for the LOFWH event described in Section 3 of this report is technically correct and will not impact the MCPR operating limit for the SSES units.

5.0 References

1. "Application of Reactor Analysis Methods for BWR Design and Analysis", PL-NF-90-001-A, July 1992.

2. "Qualification of Transient Analysis Methods for BWR Design and Analysis", PL-NF-89-005-A, July 1992.

3. "Qualification of Steady State Core Physics Methods for BWR Design and Analysis", PL-NF-87-001-A, July 1988.

4. "Licensing Topical Report for Power Uprate with Increased Core Flow", NE-092-001.

5. "Licensing Topical Report for Power Uprate with Increased Core Flow, Revision 0, Susquehanna Steam Electric Station, Units 1 and 2 (PLA-3788) (TAC NOS. M83426 and M83427)", Letter from Thomas E. Murley (NRC) to Robert G. Byram (PP&L), November 30, 1993.

6. "Acceptance for Referencing of the RETRAN-02 MOD005.1 Code", Letter from Martin J. Virgilio (NRC) to C. R. Lehmann (Chairman - RETRAN Maintenance Group) April 12, 1994.

7. "The Loss of Feedwater Heating Transient in Boiling Water Reactors", Siemens Power Corporation Report ANF-1358(P)(A), September 1992.

FIGURE 1

Summary of LOFWH Analysis Results