UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO TOPICAL REPORT EMF-96-021(P), REVISION 1

COMMONWEALTH EDISON COMPANY

LASALLE COUNTY STATION, UNIT 2

DOCKET NO. 50-374

1.0 BACKGROUND

By letter dated March 8, 1996, (Reference 1) Commonwealth Edison Company (ComEd) requested the review of the submittal EMF-96-021(P), Revision 1. The submittal describes the application of the ANFB Critical Power Correlation to the coresident GE9 fuel for LaSalle County Station, Unit 2, cycle 8. In the upcoming cycle (cycle 8), ComEd will utilize previously exposed GE9 fuel as well as fresh ANFB fuel assemblies at LaSalle, Unit 2. ComEd will use the NRC-approved ANFB critical power correlation to establish and monitor the Minimum Critical Power Ratio (MCPR) limits for both the Siemens Power Corporation (SPC) fuel and the coresident GE9 fuel.

The ANFB correlation is based on assembly hydraulic conditions and on local peaking factors around each rod. The local power peaking relies heavily on the local peaking function (F_{eff}) parameters which include a component SPC refers to as the "Additive Constant." The additive constant addresses the effects on the critical power ratio due to different fuel design features (primarily steel spacers) between assembly types. The constants are determined based on fuel test data according to procedures described in (Reference 2). The calculational uncertainties associated with these additive constants are, in turn, used in the NRC-approved methodology for calculating the MCPR safety limit as described in (Reference 3).

The ANFB critical power correlation includes test results for many different fuel designs in its data base, including fuel test data from various other vendors. In a transition cycle, the licensee is typically switching from one fuel design to another fuel design manufactured by a different vendor. In such cases when the coresident fuel in a transient cycle is not part of the existing database, the ANFB critical power correlation utilizes an alternative process to establish the additive constants and their associated uncertainty. This alternate process for determining the additive constants for coresident fuel that is not included in the ANFB database is described in Reference 4, and is currently being reviewed by the staff. In the alternative process, the additive constants for the coresident fuel types are established using critical power ratio (CPR) data provided by the utility. This conservative method of developing additive constants and additive constants uncertainties for the coresident fuel, is intended to ensure that the coresident fuel will

be nonlimiting relative to the SPC fuel (i.e., the coresident GE fuel will have more margin to boiling transition during potential transients). This safety evaluation only covers the staff's review of the ComEd submittal for LaSalle, Unit 2, upcoming cycle 8 reload.

2.0 TECHNICAL EVALUATION

2.1 Additive Constants

The additive constants pertaining to the ANFB database are determined by comparing ANFB correlation predictions to actual ANFB fuel test data. The additive constants for the coresident fuel that are not part of the ANFB database are developed based on calculated critical power data provided by the utility.

Some early critical power data for GE9 designs already exists in the ANFB database, however, SPC does not consider this data to be sufficient to justify additive constants appropriate for the current GE9 fuel design. Consequently, additive constants were developed for the GE9 fuel based on calculated critical power data provided by ComEd.

2.2 Development of Coresident (GE9) Additive Constants for LaSalle, Unit 2, Cycle 8

Additive constants specifically for LaSalle coresident (GE9) fuel were developed based on comparisons between the ANFB and the GEXL correlations CPR predictions. The process involved comparing analytical results for the CPR performance of the coresident fuel to establish the ANFB CPR additive constants, and associated uncertainties for use in the safety limit analyses for the coresident fuel. The SPC safety limit methodology uses these additive constants and associated uncertainties for the coresident fuel along with the CPR uncertainties for the SPC fuel to determine the number of rods in each bundle that could go through boiling transition for specific cycle design.

The initial set of additive constants were used to determine the nodal F_{eff} values for use with the ANFB correlation. Single assembly CPR calculations using the SPC plant simulator code MICBURN-B were performed for fuel assemblies with power, exposure, inlet enthalpy, pressure, and active channel flow conditions consistent with the calculated data provided by the licensee. The results of the analyses indicate that the ANFB calculated CPR is lower than the coresident fuel calculated CPR, which indicates that applying the ANFB correlation is conservative since the ANFB correlation would put the fuel assembly closer to the MCPR limit.

The ANFB method for defining additive constants for the GE9 coresident fuel is described in Reference 2. Two constraints were imposed on the analyses: (1) the same set of additive constants were used for each of the GE9 neutronic designs analyzed, and (2) within the same additive constant domain, the same additive constant was used at the various rod positions that are in similar locations relative to the channel wall, water rod, and other fuel rods.

Results of the analyses showed that several of the characteristic rod groups were never limiting. Consequently, adjustments were made in the nonlimiting rod groups to ensure that future coresident fuel (such as GE9) neutronic designs do not reduce the conservative nature of the additive constants selected. The licensee developed the additive constants for the nonlimiting rod positions to force the rods in the nonlimiting rod positions to the point where they are nearly limiting. This has the effect of insuring that the resulting F_{eff} will be conservative in nuclear design/analyses that have different limiting rod positions.

The above stated analyses were conducted for fuel assemblies with a wide range of operating conditions. The calculations included length of exposure, power, and flow conditions. The initial input conditions used in the analyses by the licensee covered the entire range of expected operating and accident conditions.

Tabulated data provided by the licensee summarizes the ANFB additive constants and uncertainty developed for the GE9 fuel. The GE9 additive constants were calculated at rated conditions and over an exposure range where the coresident fuel had the potential to be limiting or near limiting. The tabulated results also showed that the use of additive constants in conjunction with the ANFB critical power correlation, will result in a conservative CPR prediction for the coresident (GE9) fuel assemblies relative to the CPR predicted by the GEXL.

2.3 The Uncertainty Associated with the Additive Constant

The calculation of the additive constants leads to an associated standard deviation or uncertainty. This uncertainty is required to establish the MCPR limits. For the resident fuel, the additive constant uncertainty is determined directly by comparing ANFB correlation predictions to ANFB fuel test data.

The additive constants used by SPC for the coresident fuel are based on the approved correlation for the coresident fuel; in this case the GEXL correlation. However, because measured data is not always available for use in establishing these additive constants, an additional conservatism is added to the calculated additive constant uncertainty to assure that the CPR performance of the coresident fuel is conservatively restrictive for the safety limit determination. This restriction provides additional margin for the coresident fuel between the safety limit and the actual boiling transition that would occur if the measured data were used to establish the additive constants uncertainties. The procedure for determining the additional uncertainty is described in Reference 3.

The total ANFB additive constant uncertainty for use with the coresident fuel (GE9) is determined by converting the total CPR standard deviation into the additive constant standard deviation for use in the approved safety limit methodology as described in Reference 3. For the ANFB, the CPR standard deviation is described and calculated in Reference 4.

The determination of the standard deviation uncertainty in this way will lead to an uncertainty value larger than would be obtained if the ANFB correlation were compared directly to the critical power fuel test data for the coresident GE9 fuel. Consequently, standard deviation when used as described in Reference 4, will result in the coresident fuel treated in a manner that results in a conservative prediction of the safety margin to actual boiling transition.

3.0 IMPACT OF THE ADDITIVE CONSTANT ON THE MCPR SAFETY LIMIT

The licensee will use the additive constants described above to perform the safety analyses to establish the MCPR operating limit for the GE9 coresident fuel present in the LaSalle, Unit 2, transition cycle.

The MCPR operating limit for the coresident fuel is established by adding the delta CPR for the limiting event to the MCPR safety limit for the given cycle. The licensee indicated that the delta CPR is relatively insensitive to the value of the additive constants, and that the additive constant is considered in the MCPR safety limit even though it does not effect the delta CPR calculation methodology.

When performing the MCPR safety limit analysis, the core power is typically increased until the MCPR safety limit is reached for the limiting fuel assembly. Next, Monte Carlo calculations are performed to assess the impact of the uncertainties of various plant and analysis parameters. The Monte Carlo calculations establish the MCPR safety limit at which 99.9 percent of the fuel rods are expected to avoid boiling transition. Analyses by the licensee shows that because the limiting fuel assembly is forced to the safety limit, the contribution of the additive constant is relatively insignificant in the overall determination of the safety limit.

The licensee pointed out in its submittal that the determined additive constants will be applied to the coresident fuel (GE9) that is or will be in its second cycle of exposure. Also, the MCPR safety limit will be performed at various exposures through out the cycle to ensure a bounding safety limit for the cycle. Analysis shows that the MCPR safety limit is primarily controlled by high power first cycle fuel (especially at the end-of-cycle conditions where the safety limit is normally limiting). The analysis indicated that the LaSalle, Unit 2, cycle 8 core design safety limit, is expected to be relatively insensitive to the additive constant uncertainty used for GE9 fuel, and that in many cases the additive constants will not have any effect on the safety limit. That is, the coresident fuel (GE9) in its second or higher cycle of operation will not contribute to the number of rods in boiling transition. Preliminary safety analysis performed by the licensee for LaSalle, Unit 2, cycle 8 indicated that at the limiting exposure, the GE9 fuel does not contribute to the number of rods calculated to be in boiling transition.

4.0 MCPR MARGIN FOR GE9 FUEL AT THE LASALLE, UNIT 2, CYCLE 8

Analyses by the licensee shows that, the coresident fuel (GE9) will have significant MCPR margin when compared to the fresh SPC fuel due to the lower power of the once or twice burned GE fuel. This is particularly true at end-of-cycle (EOC) where the transients are expected to be most limiting. Preliminary core loading data shows that significant steady-state MCPR differences between SPC and GE9 fuel based on the approved correlation for each fuel type. MCPR differences (GE9 fuel MCPR/SPC fuel MCPR) range from approximately 12 percent (at the beginning-of-cycle) to approximately 31 percent (at EOC) of the expected delta CPR for the fresh SPC fuel.

Submitted data also indicates that through out the cycle and especially at EOC, the coresident GE9 fuel will have significantly greater initial MCPR margin to the safety limit than for the SPC fuel. Consequently, the fact that the coresident fuel has undergone at least one cycle of burning, combined with the conservative method of developing additive constant uncertainties, ensures that the coresident GE9 fuel will be nonlimiting relative to the SPC fuel. The staff agrees with the licensee's submitted analyses and responses to the requested additional information conclusion.

5.0 CONCLUSION

Based on the above evaluation, the NRC staff has concluded that the licensee's cycle 8 core reload design submittal regarding application of the ANFB Critical Power Correlation to coresident GE9 fuel is acceptable. The staff has concluded that (1) the application to cycle 8 of the method of developing additive constants for ANFB correlation application to GE9 fuel is conservative, and (2) analyses, based on this application, show a substantially greater CPR margin for the coresident GE9 fuel in the cycle 8 reload core with fresh SPC fuel. Consequently, the NRC staff has concluded that the greater MCPR margin combined with the conservative method of developing additive constants and additive constants uncertainties for the coresident fuel, ensures that the coresident fuel will be nonlimiting relative to SPC fuel and is, thus, acceptable.

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6.0 REFERENCES

1. Letter from Gary G. Benes to the U.S. Nuclear Regulatory Commission, "Application of Siemens Power Corporation ANFB Critical Power Correlation to Coresident General Electric Fuel for LaSalle Unit 2, Cycle 8," dated March 8, 1996, with attachment: EMF-96-021(P), Revision 1.

2. Advanced Nuclear Fuels Corporation, "ANFB Critical Power Correlation," ANF-1125(P)(A) with Supplements 1 and 2, dated April 1990.

3. Advanced Nuclear Fuels Corporation, "Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors: Methodology for Analysis of Assembly Channel Bowing Effects," ANF-524(P)(A), Revision 2 and Supplement 2, dated November 1990.

4. Siemens Power Corporation, "ANFB Critical Power Correlation Application to Co-Resident Fuel," EMF-1125(P), Supplement 1, Appendix C, dated November 1995.

5. Letter from A.C. Thadani (NRC) to J.S. Charnley (GE), "Acceptance for Referencing of Amendment 18 to General Electric Licensing Topical Report NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel," dated May 12, 1988.