March 11, 2004

Mr. Bryce L. Shriver
Senior Vice President
and Chief Nuclear Officer
PPL Susquehanna, LLC
769 Salem Boulevard, NUCSB3
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 1 - CORRECTION OF SAFETY EVALUATION SUPPORTING AMENDMENT NO. 216 - MINIMUM CRITICAL POWER RATIO SAFETY LIMITS AND REFERENCE CHANGES (TAC NO. MB9902)

Dear Mr. Shriver:

On March 9, 2004, the Nuclear Regulatory Commission staff issued the subject amendment in response to your application transmitted by letter dated July 1, 2003, as supplemented by letters dated November 17 and December 22, 2003. The amendment revised the values of the Safety Limit for Minimum Critical Power Ratio, clarified fuel design features, and updated the references used to determine core operating limits.

Subsequent to the issuance, Mr. Duane Filchner of your staff pointed out a number of errors in the safety evaluation (SE) supporting the amendment. We agree that administrative errors had been inadvertently made, resulting in several inaccurate statements in the SE. Enclosed please find the corrected pages 2, 4, and 5 of the SE, with side bars highlighting the areas of correction. We apologize if these errors caused you any inconvenience.

Sincerely,

/RA/

Richard V. Guzman, Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-387

Enclosure: Corrected SE Pages 2, 4, and 5

cc w/encl: See next page

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3. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," provides guidance on the acceptability of the reactivity control systems, the reactor core and fuel system design. Specifically, Section 4.2, "Fuel System Design," specifies the criteria for evaluation of fuel design limits such that there be at least 95% probability at a 95% confidence level that the hot fuel rod in the core does not experience a departure from nucleate boiling or transition condition during normal operation or anticipated operational occurrence (AOO). Section 4.4, "Thermal Hydraulic Design," provides guidance on the review of thermal-hydraulic design in meeting the requirement of GDC-10 and the fuel design criteria established in Section 4.2.

3.0 TECHNICAL EVALUATION

3.1 PPL/Framatome SLMCPR Methodology

Framatome is the current fuel vendor for PPL's U1C14. However, PPL performs the reload core design and analysis, including generating the lattice neutronic data and simulating the cycle steady state core-wide neutronic and thermal-hydraulic response. PPL is currently licensed to generate the lattice neutronic data using CASMO-3G and to model the reactor steady state core response for the cycle, using CASMO-3G/SIMULATE-E (References 6 and 8). PPL uses the CASMO-3G/SIMULATE-E code system and provides to Framatome the cycle neutronic and thermal-hydraulic response data, the core reactivity, flow, and nodal power distribution. Framatome determines the cycle SLMCPR limit that ensures 99.9% of the fuel rods will avoid boiling transition during steady state and transient event.

The NRC staff previously approved the critical power correlations applicable to the ATRIUM-10 fuel loaded for U1C14 (Reference 5). The NRC staff also approved Framatome's analytical method for calculating the SLMCPR (Reference 7). Framatome is currently licensed to use CASMO-4, a lattice spectrum/depletion code, and MICROBURN-B2, a core simulator code, to perform neutronic and thermal-hydraulic analysis for boiling water reactors (Reference 5). Framatome also uses the upgraded CASMO-4/MICROBURN-B2 code systems in the new POWERPLEX III core monitoring system, while POWERPLEX II core monitoring system uses the earlier NRC-approved lattice depletion code (CASMO-3) and core simulator code (MICROBURN-B). In the current Framatome SLMCPR licensing method, the CASMO-4/MICROBURN-B2 code system is used for generating the lattice neutronic data, simulating the core cycle neutronic and thermal-hydraulic response, and monitoring the core.

The approved SLMCPR calculation methodology for both Framatome and PPL are based on compatible use of code systems both in simulating the cycle core response and in monitoring the core. This provides consistency in fuel related uncertainties in the code systems used to generate the lattice neutronic design parameters and simulating the core conditions used in the core monitoring system. The NRC approval of the code systems used to simulate the reactor core conditions for the cycle includes review of the calculational uncertainties associated with the given code system. In establishing these calculational uncertainties, PPL benchmarks the code predictions of key calculated parameters and the predicted transversing incore probe readings against statistically generated data, reactor measured data, and the fuel assembly gamma scan. The uncertainties of each key predicted and measured parameters are included in the SLMCPR calculation methodology, by statistically perturbing each parameter according to

3.2.2 Reduction in the Power Distribution Uncertainties

For U1C13, PPL used the POWERPLEX-II code system. Therefore, the power distribution uncertainties included in the SLMCPR calculation for U1C13 correspond to the CASMO-3/MICROBURN-B power distribution uncertainties. For U1C14, PPL proposes to use the POWERPLEX-III core monitoring system which utilizes the CASMO-4/MICROBURN-B2 code system (EMF-2158(p)(A), revision 0). Due to advanced features implemented in MICROBURN-B2 (core simulator code), the calculated nodal and pin power distributions are more accurate relative to the earlier version of CASMO-3/MICROBURN-B. PPL states the CASMO4/MICROBURN-B2 core simulator implemented in the POWERPLEX-III core monitoring system and the associated radial and local power distribution uncertainties decrease for U1C14. The plant, fuel, and critical power ratio correlation uncertainties are incorporated into the NRC-approved Framatome-ANP SLMCPR calculations method, and the lower uncertainties contribute to the lower SLMCPR value for U1C14 as compared to U1C13.

The NRC staff determined that for U1C14, PPL used CASMO-3G to generate the lattice neutronic data. In addition, SIMULATE-E was also used to perform the steady state cycle simulation and to establish the base reactor condition and the corresponding bundle power distributions for a given burnup and rod pattern. The core monitoring system would employ the upgraded CASMO-4/MICROBURN-B2 code system. Moreover, in performing the SLMCPR calculation, Framatome used the upgraded code systems' lower power distribution uncertainties in perturbing the key parameters from the base case for a given rod pattern and burnup state. The smaller perturbation of the key power distribution parameters yields the reduction in the SLMCPR limit for U1C14. The NRC staff found that the use of different code systems results in inconsistencies in the power distribution uncertainties and could potentially lead to the calculation of nonconservative SLMCPR values for the cycle. The NRC staff requested PPL to demonstrate why the use of the core monitoring systems' lower power distribution uncertainties, instead of the uncertainties corresponding to the code system used to generate the actual bundle pin radial and axial power distribution, yield a conservative SLMCPR value.

In a February 26, 2004, meeting (ADAMS accession nos. ML040630331 and ML040640525), PPL addressed the NRC staff's above concerns. PPL demonstrated that for a given SSES-1 core design, rod pattern, and burnup condition, CASMO-3G/SIMULATE-E predicted a flatter radial power distribution than MICROBURN-B2, despite the code system's lower radial power distribution uncertainty. In addition, PPL stated that since the high powered bundles that contribute to the SLMCPR are assumed to be operating at the SLMCPR value initially selected, the differences in the radial power distribution between the codes have a much lower influence on the SLMCPR calculation. Therefore, the PPL presentation to the NRC staff demonstrated that for U1C14, the power distribution uncertainty associated with those generated with CASMO-3G/SIMULATE-E, although slightly larger than those uncertainties associated with CASMO-4/MICROBURN-B2, had very small effect on the overall U1C14 safety limit. That is, the SLMCPR calculation, which is in general deterministic with some statistical component in the process, was found to be insensitive to minor variations arising from small differences that are due to computer code changes. The end result of determining the number of rods contributing to the boiling transition remained the same.

Approval of PPL's use of different code systems is limited to the upcoming U1C14, in which PPL demonstrated in the February 26, 2004, meeting that the calculated SLMCPR limit is conservative. For future cycles, PPL has stated that it would transition to using consistent code systems to generate the lattice spectrum depletion calculations and in simulating the core steady state conditions; and in the event of upgrading the code system, PPL will submit the appropriate request prior to implementation of the new methodology.

In its November 17, 2003, submittal (Reference 2), PPL provided a revised core composition for U1C14. These changes were necessary to address design changes related to control cell friction mitigation. Four twice-burned ATRIUM-10 fuel assemblies were discharged and replaced with 4 fresh fuel assemblies in order to maintain full power energy targets as a result of the rod pattern adjustments needed to address the control cell friction issues. PPL states the resulting SLO and TLO SLMCPR values remain unchanged from the values reported in their July 1, 2003, submittal and that at least 99.9% of the fuel rods are expected to avoid boiling transition during normal operation or AOOs. The NRC staff notes that this item is controlled by PPL's Core Operating Limits Report and does not require a TS amendment.

In its December 22, 2003, submittal (Reference 3), PPL states that based on previous safety limit evaluations performed by Framatome for SSES, the reduction in the U1C14 SLMCPR values are attributed to the following:

4. Deleting the factor of 2 based on ANFB-10 correlation results in a decrease of -0.01 to -0.02 for both TLO and SLO.

5. The reduction in the power distribution uncertainties yields approximately a -0.02 to -0.03 reduction in the SLMCPR for both TLO and SLO.

6. Cycle-to-cycle variability contributes +0.01 to -0.01 for both TLO and SLO.

In addition, PPL states the U1C14 reload and SLMCPR analyses for TLO and SLO was performed within the applicability range of the ANFB-10 correlation, including the additional uncertainty for local peaking greater than 1.5 as specified in the NRC-approved ANFB-10 correlation safety evaluation, dated July 17, 1998. PPL states that the fuel will be operated within the ANFB-10 correlation range of applicability during U1C14 operation.

The NRC staff has evaluated PPL's submittals (References 1, 2, and 3) to determine whether the proposed changes to the SLMCPR values are justified and are acceptable. Based on the results of the review, the NRC staff finds the U1C14 SLMCPR values acceptable. The proposed U1C14 SLMCPR values will ensure that 99.9% of the fuel rods in the core will not experience boiling transition. The requirements of GDC-10 are met with respect to acceptable fuel design limits. The NRC staff also concludes that the justification for analyzing and determining the SLMCPR value of 1.08 for TLO and 1.10 for SLO is acceptable, because PPL used appropriate cycle-specific parameters and NRC-approved licensing methodologies, analytical methods, and codes. Therefore, the NRC staff finds the proposed changes in TS 2.1.1.2 acceptable.

3.3 TS 4.2.1 Fuel Assemblies

PPL proposed a change to TS 4.2.1 to indicate the use of a small amount of depleted uranium ("tails") in the fuel rods, in addition to natural and slightly enriched uranium dioxide (UO_2).

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