ATTACHMENT 1
Response to Request for Additional Information

NRC Request 1

Describe how the Unit 2 Cycle 19 (U2C19) core loading pattern is established for the mixed core configuration as shown in Figure 1 of Attachment 5 with respect to:

a) meeting the cycle energy requirements;

b) satisfying all licensing requirements;

c) providing adequate thermal margins and operational flexibility; and

d) meeting other design and manufacturing criteria established by EGC and Westinghouse.

Response

The Quad Cities Nuclear Power Station (QCNPS) Unit 2 Cycle 19 (Q2C19) Optima2 bundles and core loading pattern were developed via a design collaboration between Exelon Generation Company, LLC (EGC) and Westinghouse. Both Westinghouse and EGC used NRC-approved lattice physics codes and three-dimensional simulator codes to perform bundle and core design calculations, respectively. The Westinghouse core reload design group performed design calculations using the PHOENIX lattice physics code and the POLCA7 three-dimensional simulator code, while the EGC Nuclear Fuels (NF) core reload design group used the CASMO4 lattice physics code and MICROBURN-B2 three-dimensional simulator code.

The core loading pattern was developed, reviewed, and approved in accordance with the EGC core reload design process and procedures. Consistent with this, NF worked with QCNPS to develop and document the design goals, constraints, and requirements for the reload cycle. Westinghouse design and manufacturing requirements were also incorporated. The Q2C19 design criteria were approved by QCNPS and NF management prior to the development and finalization of the core loading pattern.

Using the approved design criteria, Westinghouse and NF core reload design engineers performed numerous iterations on proposed Optima2 bundle designs and core loading patterns. Designs were modeled and evaluated in both the Westinghouse POLCA7 core model and the NF MICROBURN-B2 core model. Engineers in both organizations reviewed proposed designs and collectively revised designs until the design criteria were met. Based on a comparison of the results from both core models to the design criteria, the final core design was determined to ensure that cycle energy requirements, operating thermal margin goals, licensing requirements, and other design criteria were satisfied. In addition, the final bundle designs were reviewed to ensure that they comply with the Westinghouse Optima2 fuel manufacturing criteria.

Since this is the first reload of Westinghouse Optima2 fuel at QCNPS, and as yet there is no operating data from a QCNPS core that contains Optima2 fuel, there may be a relatively higher than normal uncertainty in the current prediction of the core reactivity and/or power distribution throughout the cycle. To account for this, the design goals for thermal margins and cold shutdown margin were increased relative to recent QCNPS cycles. In addition, in order to ensure that there will be sufficient operational flexibility, the final core loading pattern was required to comply with the design thermal margin goals even if the core reactivity and operating control rod patterns are somewhat different than those that were developed based on the nominal hot core reactivity assumptions. This approach helped to ensure that the core loading pattern was not too aggressive, such that Q2C19 can be expected to operate at the targeted core thermal power levels with adequate thermal margins even if the actual core reactivity and/or power distribution is somewhat different than predicted. In this way, sufficient operational flexibility and flexible control rod patterns were built into the final design.

Regarding the cycle energy capability, the prediction of the cycle energy capability for a given core design is dependent on the hot reactivity bias (i.e., hot target eigenvalue) that is assumed for the design cycle. This reactivity bias is also dependent on the given three-dimensional core simulator code used to perform the design. Since the Q2C19 core design was developed in collaboration between Westinghouse and NF using both the POLCA7 and MICROBURN-B2 core models, separate reactivity biases were established for use with each model. For POLCA7, Westinghouse used historical plant, bundle, and cycle operational data provided by NF to develop POLCA7 core models of recent QCNPS cycles. Then, Westinghouse and NF reviewed the results of this POLCA7 benchmark and determined appropriate POLCA7 reactivity biases (i.e., hot and cold target eigenvalues) for use with the Q2C19 core design. In a similar manner, MICROBURN-B2 eigenvalue trends from recent QCNPS cycles were reviewed to determine appropriate MICROBURN-B2 hot and cold target eigenvalues.

The evaluations EGC performed to generate the Q2C19 core loading pattern is documented within Fuel Change Package 354483, "Quad Cities Unit 2 Cycle 19 Core Reload Design." Supporting information is documented within Design Change Package 349583, "Implement Westinghouse Optima2 Nuclear Fuel (Quad Cities Unit 2)."

<u>NRC Request 2</u>

On Page 5 of 24 in Attachment 5, clarify that the USAG14 correlation does sufficiently address the Global Nuclear Fuel (GNF) 10 CFR Part 21 issue with respect to Critical Power Determination since the USAG14 correlation was generated based on GEXL14 critical power ratio (CPR) data. If the correlation does not sufficiently address the GNF 10 CFR Part 21 issue, provide the corrective actions including any penalty factor. Also, identify whether the USAG14 correlation was reviewed and approved by the staff, and if not reviewed, provide a copy of the USAG14 for staff review.

<u>Response</u>

The USAG14 correlation does sufficiently address the GNF Part 21 issue with respect to critical power determination. The USAG14 correlation was generated based on GEXL14 CPR data that already reflect the GNF corrections to the GEXL14 CPR correlation that were made in response to the GNF Part 21 issue. Therefore, CPRs calculated with the USAG14 correlation match the values from the Part 21 corrected GEXL14 correlation (i.e., the GEXL14 correlation data revised by GNF to address the Part 21 issue).

The USAG14 correlation was developed using the NRC-approved methodology described in Reference 1. Although the NRC has approved the methodology used to develop the correlation, the NRC has not specifically approved the USAG14 correlation itself.

The USAG14 correlation, along with a description of the process in generating USAG14, is documented in Reference 2. A copy of USAG14, including a detailed description of the methodology used to develop the correlation, was previously submitted to the NRC in response to a request for additional information (i.e., response to NRC Request 8 in Attachment 2 of Reference 3).

In Attachment 7 of Reference 4, EGC submitted information to the NRC to address the measures taken to ensure compliance with the limitations and conditions discussed in the NRC's safety evaluation for CENPD-300-P-A. Attachment 7 of Reference 4 also included a description of the methodology used to derive the conservative adder to the operating limit minimum critical power ratio (OLMCPR), as required by Condition/Limitation 7 of the NRC safety evaluation for CENPD-300-P-A.

NRC Request 3

Justify that the adjustment (multiplication) factor in Section 4 of Attachment 5 of the submittal that is applied when using the USAG14 correlation is conservative.

Response

The adjustment (multiplication) factor applying to the USAG14 correlation is conservative. The adjustment factor is specifically applied to establish the GE14 fuel OLMCPR that satisfies the 95/95 statistical criterion. A description of the process in generating USAG14 was previously provided to the NRC in response to NRC Request 8 in Attachment 2 of Reference 3.

NRC Request 4

Provide clarification that the calculated SLMCPR in Table 1 of Attachment 5 for GE14 fuel for Cycle 19 is the same as that in Cycle 18 for dual-loop operation and single-loop operation since the Cycle 19 is an aggressive mixed core operation and the once burned fuel may still dominate.

Response

Response is provided in Attachment 2.

NRC Request 5

It appears that there is no effect on the SLMCPR calculation due to the fuel channel bow. Provide information for mean and standard deviation for both Westinghouse SVEA 96 Optima 2 and GNF GE14 fuel channel bow as shown in Table 2 of Attachment 5 and describe their impact on the Cycle 19 SLMCPR values.

Response

Response is provided in Attachment 2.

NRC Request 6

Describe the process to determine the total core flow uncertainty for dual-loop operation and single-loop operation for Cycle 19 operation and justify that the core flow uncertainty in Section 3 of Attachment 5 of the submittal is conservative for the Cycle 19 SLMCPR calculation, or justify an increase in core flow uncertainty.

Response

The total core flow uncertainty values for dual-loop and single-loop operations that were applied for the Q2C19 safety limit minimum critical power ratio (SLMCPR) calculation are the same as those used in SLMCPR calculations for recent QCNPS cycles. These uncertainties are consistent with values provided in General Electric (GE) Nuclear Energy topical report NEDC-32601P-A (i.e., Reference 5), in which GE updated their methodology and the inputs to be used in SLMCPR evaluations. Reference 5 concluded that these core flow uncertainty values, which had also been previously approved for General Electric BWR Thermal Analysis Basis (GETAB) analyses, continued to be applicable and conservative. In Reference 6, the NRC approved NEDC-32601P.

In addition, EGC calculations of the loop accuracy of the instrument loops that monitor the reactor core flow for dual-loop operation were used to demonstrate that these uncertainty values are conservative. This evaluation is documented within EGC Technical Evaluation EC 357691, "Evaluation of Appropriate Uncertainties for Use by Westinghouse in Safety Limit MCPR Analyses."

The total core flow uncertainty values are based on system performance. There is no impact on the total core flow uncertainty values as a result of the mixed core, since the GE14 and Optima2 fuel are hydraulically compatible.

NRC Request 7

The proposed TS changes involve two sets of SLMCPR for two fuel types from two different vendors. Describe the procedures to apply these two sets of safety limits to the real Cycle 19 operation with respect to display, alarm, monitoring systems and actions taken if the CPR margin is challenged.

Response

Consistent with the Westinghouse reload licensing methodology described in Reference 1, unique SLMCPR values have been established for each fuel product line present in the Q2C19 core. Specifically, one set of SLMCPR values will be applied to the Optima2 fuel, and another set will be applied to the co-resident GE14 fuel.

The SLMCPR values are applied via the determination and application of the OLMCPR. The OLMCPR values are established based on the SLMCPR and the results of the Westinghouse cycle-specific reload licensing analyses. From these analyses, unique sets of OLMCPR values are established for the Optima2 and GE14 fuel. The OLMCPR values for each fuel type are then documented in the Core Operating Limits Report (COLR).

In order to monitor operation to the limits in the COLR, the OLMCPR sets are specified in the core monitoring system input deck. QCNPS currently monitors operation with the POWERPLEX-III core monitoring system, which has flexible inputs and monitoring capabilities, such that the OLMCPR sets can be input and applied to each fuel type.

Technical Specification 3.2.2, "Minimum Critical Power Ratio (MCPR)," requires all MCPRs to be greater than or equal to the MCPR operating limits specified in the COLR. Surveillance Requirement 3.2.2.1 requires verification of all MCPR limits every 24 hours. The core monitoring system calculates the MCPR of every fuel assembly, and the limiting results are displayed in the control room using the appropriate OLMCPR for each fuel type. Action to reduce the limiting MCPR is taken if the core approaches the limits. For Q2C19, the differences in the GE14 and Optima2 SLMCPR values will be accounted for by the core monitoring system when it determines the limiting MCPR values based on the appropriate GE14 or Optima2 OLMCPR set.

GE14 fuel will be monitored with the Global Nuclear Fuel GEXL14 correlation, while Westinghouse will use their USAG14 correlation for GE14 fuel to determine the appropriate GE14 OLMCPR in the cycle-specific reload licensing analyses. The application of these two CPR correlations for GE14 fuel in this way is consistent with Reference 1.

For Optima2 fuel, the approach is simpler in that the same Westinghouse CPR correlation used by Westinghouse in the reload licensing analyses will be installed into the core monitoring system. As a result, the Optima2 fuel will be licensed and monitored with the same Westinghouse CPR correlation.

References

1. CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel," dated July 1996

2. NF-BEX-05-10, Revision 1, "Task Report for TSD DQW04-020, CPR Correlation for Design," dated October 21, 2005

3. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Transition to Westinghouse Fuel," dated January 26, 2006

4. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendment Regarding Transition to Westinghouse Fuel," dated June 15, 2005

5. NEDC-32601P-A, "Methodology and Uncertainties for Safety Limit MCPR Evaluations," dated August 1999

6. Letter from F. Akstulewicz (U. S. NRC) to G. A. Watford (General Electric Company), "Acceptance for Referencing of Licensing Topical Reports NEDC-32601P, Methodology and Uncertainties for Safety Limit MCPR Evaluations; NEDC-32694P, Power Distribution Uncertainties for Safety Limit MCPR Evaluation; and Amendment 25 to NEDE-24011-P-A on Cycle-Specific Safety Limit MCPR (TAC Nos. M97490, M99069 and M97491)," dated March 11, 1999