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SUBJECT: Documents info on KEW-19 fuel & Cycle 23 reload design changes,per 970701 telcon.

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September 5, 1997

U. S. Nuclear Regulatory Commission
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Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
KEW-19 Fuel and Cycle 23 Reload Design Changes

Reference: Telephone conference between R.P. Pulec, et al. (WPSC) and R. Laufer, et al. (NRC), dated July 1, 1997.

In the reference telephone conference, Wisconsin Public Service Corporation (WPSC) discussed fuel and reload design changes related to the KEW-19 fuel and the Cycle 23 reload with the Nuclear Regulatory Commission (NRC). Based on the results of the telephone conference, WPSC is docketing information on the KEW-19 fuel and Cycle 23 reload design changes.

The Kewaunee Nuclear Power Plant (KNPP) is currently operating in Cycle 22 with feed fuel assemblies designated as KEW-18. Cycle 22 is currently expected to shut down for refueling in the fall of 1998. Cycle 23 is currently expected to start up in November or December of 1998. The feed fuel for Cycle 23 will be designated as KEW-19.

The KEW-19 fuel design incorporates various changes, several of which allow an increase in the amount of Uranium loaded in the assembly. Additional fuel design changes unrelated to the increased Uranium loading are also utilized in the KEW-19 fuel. These include FUELGUARD$_{TM}$ lower tie plates, high thermal performance (HTP) spacers, and the use of Gadolinia as a burnable absorber. The fuel design changes are discussed in the attachment and have all been part of an ongoing Lead Fuel Assembly (LFA) program at Kewaunee.

Reload design changes for Cycle 23 include increased peaking factors (F_q and $F_{\Delta H}$) and the use of SPC's HTP critical heat flux correlation. The reload design changes are also discussed in the attachment. In addition, a schedule intended to support the Cycle 23 startup in November or December of 1998 is proposed in the attachment.

9709100174 970905
PDR ADOCK 05000305
P PDR

WPSC is willing to meet with the NRC staff to review these fuel and reload design changes at your convenience. If you should desire a meeting or have any questions with regard to this letter, please contact me or a member of my staff.

Sincerely,

Mark L. Marchi
Manager-Nuclear Business Group

djw

Attachment

cc: US NRC Senior Resident Inspector
US NRC Region III

ATTACHMENT

Letter from M. L. Marchi (WPSC)

To

Document Control Desk (NRC)

Dated

September 5, 1997

KEW-19 Fuel and Cycle 23 Reload Design Changes

KEW-19 FUEL DESIGN CHANGES AND LEAD FUEL ASSEMBLY PROGRAM

The KEW-19 fuel incorporates several fuel rod and fuel assembly design changes. The fuel rod design changes improve the neutronics design of the fuel. The fuel assembly design changes improve the debris resistance and thermal hydraulic performance of the fuel. Fuel assemblies incorporating these changes have been irradiated during a Lead Fuel Assembly (LFA) program performed using the guidelines of Reference 1. The purpose of the LFA program was to demonstrate the compatibility of the design changes with KNPP's equipment and analytic methodology. The LFA program had two parts. The first part of the LFA program was 8 assemblies inserted in Cycle 21 as part of the KEW-17 fuel. The second part of the LFA program was 8 assemblies inserted in Cycle 22 as part of the KEW-18 fuel.

The KEW-17 and KEW-18 LFA differences from the standard (non-LFA) KEW-17 fuel loaded in Cycle 21 coincident with the start of the LFA program are as follows:

1) A 10.5 mil larger pellet diameter to allow more Uranium to be loaded in the fuel rod;
2) A 5 mil thinner cladding wall and a 0.5 mil smaller diametral pellet/cladding gap to accommodate the larger diameter pellet while retaining the standard cladding outer diameter;
3) A 75 psi increase in fill pressure to mitigate cladding creep with the thinner cladding;
4) A FUELGUARD$_{TM}$ lower tie plate to increase debris resistance;
5) A 1% (KEW-17) and 1.35% (KEW-18) increase in fuel pellet percent of theoretical density to allow more Uranium to be loaded in the fuel rod;
6) High Thermal Performance (HTP) spacers to improve the DNBR performance of the assemblies by allowing better mixing of coolant within a fuel assembly; and
7) The use of Gadolinia as a burnable absorber to improve neutron economy (KEW-18 only).

The KEW-19 fuel design has the same features as the KEW-18 LFA's. The KEW-18 standard (non-LFA) fuel incorporated the FUELGUARD$_{TM}$ lower tie plate and the HTP spacers in Cycle 22 based on the results of the KEW-17 LFA's in Cycle 21. However, no credit for the improved thermal hydraulic performance of the HTP spacers was taken in the safety analysis of Cycles 21 and 22.

LFA PROGRAM RESULTS

The KEW-17 LFA's have performed as expected. There have been no fuel failures in the KEW-17 LFA's. An end of Cycle 21 inspection of LFA A98 revealed no abnormal conditions. In-core monitoring measurements of the KEW-17 LFA's in Cycle 21 and Cycle 22 agree with

predicted neutronic performance within normal uncertainties. The KEW-17 LFA's are currently at approximately 17.5 GWD/MTU and are expected to reach approximately 31 GWD/MTU by the end of Cycle 22.

The KEW-18 LFA's have performed as expected throughout their brief irradiation. There have been no fuel failures in the KEW-18 LFA's. A primary objective of the KEW-18 LFA's is to validate the WPSC neutronics methodology for fuel rods containing Gadolinia. In-core monitoring measurements of the KEW-18 LFA's in Cycle 22 agree with predicted neutronic performance within normal uncertainties. The KEW-18 LFA's are currently at approximately 2.5 GWD/MTU and are expected to reach approximately 17.5 GWD/MTU by the end of Cycle 22.

MECHANICAL DESIGN

The LFA's have been analyzed by SPC using SPC's NRC approved mechanical design methodology (References 2, 3, and 4). This methodology will also be applied to the KEW-19 fuel. The Cycle 23 analysis of the KEW-19 fuel will cover:

1) Exposures to a peak rod burnup of 62 GWD/MTU; and
2) $Fq=2.40$ and $F\Delta H=1.70$, which will bound the maximum expected values for these peaking factor limits for Cycle 23.

Based on a comparison of the existing analyses of the KEW-18 standard fuel (Reference 5) and the KEW-18 LFA's (Reference 6), the primary impact of the fuel rod design changes is an increase in the end of life internal rod pressure. The maximum KEW-18 standard fuel assembly design internal pressure was 2557 psia, whereas the maximum KEW-18 LFA design internal pressure was 2732 psia. The design limit of 3050 psia was met in both cases. The KEW-19 internal rod pressure results will be slightly different due to differences in peaking factor limits and exposure compared to KEW-18. However, the design limit of 3050 psia will be shown to be met for KEW-19.

Other mechanical design parameters remained similar between standard fuel assemblies and LFA's for KEW-18. This is expected to be the case for the KEW-19 fuel as well.

A seismic evaluation will also be performed for the KEW-19 fuel. The seismic results will be documented with the other mechanical design calculations in the SPC mechanical design report and must show compliance with the criteria previously used for SPC mechanical design calculations.

SPC FUEL DESIGN EXPERIENCE

The KEW-19 fuel design is well within the range of SPC's design experience:

1) The KEW-19 pellet diameter is 0.3670 inches and SPC has provided reloads with pellet diameters between 0.3030 and 0.3770 inches;
2) The KEW-19 pellet/clad gap is 0.0070 inches and SPC has provided reloads with pellet/clad gaps between 0.0065 and 0.0080 inches;
3) The KEW-19 initial fill pressure is 380 psia and SPC has provided PWR reloads with fill pressures between 305 and 380 psia;
4) The KEW-19 pellet density is 95.35% TD and SPC has provided reloads between 93.50% TD and 95.35% TD;
5) HTP spacers have been used in more than 27 reloads, including KEW-18;
6) FUELGUARD$_{TM}$ lower tie plates have been used in more than 21 reloads, including KEW-18;
7) Gadolinia rods have been used in over 205 PWR and BWR reloads, with up to 8 w/o Gadolinia having been used;
8) The KEW-19 cladding outer diameter is 0.424 inches and SPC has provided reloads between 0.360 and 0.426 inches;
9) The KEW-19 cladding inner diameter is 0.374 inches and SPC has provided reloads between 0.310 and 0.374 inches; and
10) The KEW-19 cladding wall thickness is 0.025 inches and SPC has provided reloads between 0.024 and 0.031 inches.

The cladding wall thickness to average diameter ratio for KEW-19 is 0.063 which is slightly outside the 0.068 to 0.076 range of SPC experience. However, the KEW-18 LFA cladding had the same ratio of 0.063 and met all pertinent design criteria using SPC's NRC approved methods. This is expected to be the case for the KEW-19 fuel as well.

RELOAD DESIGN CHANGES

In addition to the fuel design changes, WPSC intends to implement several reload design changes for Cycle 23. Peaking factor limits will be increased for Cycle 23. The F_q limit will be raised from 2.28 to about 2.40, with the exact value dependent on the results of a Westinghouse UPI SECY model LBLOCA analysis that will be completed in the first quarter of 1998. The LBLOCA analysis will use the same methodology that WPS used for the Cycle 22 analysis. It will include the KEW-19 fuel design and transition cores. The $F_{\Delta H}$ limit will be increased from 1.55 to about 1.70, with the exact value dependent on the results of both LBLOCA and non-LOCA safety analyses. A Westinghouse SBLOCA evaluation for the KEW-19 fuel based on the Cycle 22 Westinghouse SBLOCA analysis has already been completed and bounds the peaking factors proposed for Cycle 23. The non-LOCA and LOCA safety analysis results will be documented in the Cycle 23 RSE.

In order to support the $F_{\Delta H}$ limit increase in non-LOCA safety analysis, WPSC will utilize SPC's approved HTP DNBR correlation. The HTP correlation allows the improved thermal hydraulic performance of the HTP spacers to be included in WPSC's non-LOCA safety analysis. WPSC has recently submitted a report to the NRC qualifying the use of the SPC HTP CHF correlation by WPSC (Reference 7). WPSC has requested NRC review and approval of the qualification report by February of 1998. WPSC will use the HTP correlation for the Cycle 23 non-LOCA safety analysis, documenting the results in the Cycle 23 Reload Safety Evaluation (RSE).

Cycle 23 is the first KNPP reload which will rely primarily on Gadolinia as a burnable absorber. WPSC has benchmarked its neutronics methods for Gadolinia to SPC results for a typical full Gadolinia reload core. In addition, SPC will perform an independent set of neutronics calculations for Cycle 23. In-core monitoring measurements to date on the KEW-18 LFA's with Gadolinia in Cycle 22 show measured to predicted agreement within normal uncertainties. The neutronics analysis of record will be performed by WPSC and will be documented in the Cycle 23 RSE.

SUBMITTAL SCHEDULE

The anticipated schedule for submittals and other key milestones related to the KEW-19 fuel and the Cycle 23 reload design is as follows:

Milestone	**Responsible Party**	**Schedule Date**
Submittal of HTP Correlation Qualification Report	WPSC	September 1997
Approval of HTP Correlation Qualification Report	NRC	February 1998
Completion of Westinghouse LBLOCA Analysis	WPSC/ Westinghouse	March 1998
Submittal of Technical Specification Proposed Amendment	WPSC	March 1998
Approval of Technical Specification Amendment	NRC	September 1998
Cycle 23 RSE Completed (submitted to NRC for information only)	WPSC	September 1998
Cycle 23 Startup	WPSC	November 1998

SUPPORTING DOCUMENTS

In addition to the submitted documents, various documents have been or will be developed to support NRC submittals and 50.59 evaluations for the KEW-19 fuel and the Cycle 23 reload design:

1) The Westinghouse SBLOCA evaluation report;
2) The Westinghouse LBLOCA analysis report;
3) The SPC KEW-19 Fuel Design Mechanical report;
4) The WPSC KEW-17 and KEW-18 LFA monitoring reports;
5) The WPSC Gadolinia neutronics benchmark report; and
6) The WPSC KEW-19 fuel design safety evaluation.

SUMMARY

The KEW-19 fuel design and Cycle 23 reload design changes are within the SPC reload experience. The LFA program has demonstrated the compatibility of the KEW-19 fuel design with the KNPP equipment and the WPSC reload analysis methodologies. WPSC will perform a 50.59 evaluation of the KEW-19 fuel design. No unreviewed safety questions are expected due to the acceptable mechanical design results. WPSC will perform a 50.59 evaluation of the Cycle 23 reload design based on the Cycle 23 RSE. No unreviewed safety questions are expected to be caused by the reload design, since approvals of the HTP correlation and the Technical Specification amendment are anticipated prior to the completion of the Cycle 23 RSE.

REFERENCES

1) "Core Reloads of Advanced Design Fuel Assemblies," WPSC letter NRC-91-084 from K.H. Evers to USNRC, dated June 19, 1991.

2) Qualification of Exxon Nuclear Fuel for Extended Burnup, XN-NF-82-06(A) Revision 1 and Supplements 2, 4, and 5, Exxon Nuclear Company, Richland, WA 99352, October 1986.

3) Qualification of Advanced Nuclear Fuels' PWR Design Methodology for Rod Burnup to 62 GWd/MTU, ANF-88-133(A) and Supplement 1, Advanced Nuclear Fuels Corporation, Richland, WA 99352, October 1986.

4) Generic Mechanical Design Report High Thermal Performance Spacer and Intermediate Flow Mixer, ANF-88-060(A) and Supplement 1, Advanced Nuclear Fuels Corporation, Richland, WA 99352, May 1991.

5) Mechanical Design Evaluation for Kewaunee Reload KEW-18 Standard Fuel Assemblies, EMF-96-126, Revision 1, SPC report dated September 1996.

6) Mechanical Design Evaluation for Kewaunee Reload KEW-18 Lead Fuel Assemblies, EMF-96-127, Revision 1, SPC report dated September 1996.

7) "Justification For the Use of the High Thermal Performance (HTP) Critical Heat Flux (CHF) Correlation in the Kewaunee Reload Safety Evaluation Methods," WPSC letter from J.T. Holly to USNRC, dated September 4, 1997.