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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 2
Docket No. 50-412, License No. NPF-73
Cycle 7 Reload and Core Operating Limits Report

Beaver Valley Power Station, Unit No. 2 completed the sixth cycle of operation on August 30, 1996, with a burnup of 16,621 MWD/MTU. This letter describes the Cycle 7 reload design, documents our review in accordance with 10 CFR 50.59 including our determination that no unreviewed safety question is involved, and provides a copy of the Core Operating Limits Report (COLR) in accordance with Technical Specification 6.9.1.12.

No technical specification change is required. However, boration requirements for Cycle 7 will require an increase in the 58,965 gallons currently required for the refueling water storage tank (RWST) volume requirements. This requirement is stipulated in Bases Section 3/4.1.2, "Boration Systems." The new volume requirement will be bounded by the minimum volume requirements provided in Technical Specification 3.1.2.8 which requires at least 859,248 gallons in the RWST. The Bases change will be forwarded by separate letter following Engineering verification of the appropriate value.

The new core configuration is arranged in a low leakage loading pattern and involves replacing one (1) Region 5B, twenty (20) Region 6A and 6B, forty (40) Region 7A and four (4) Region 8B fuel assemblies with twenty (20) fresh Region 9A ZIRLO fuel assemblies enriched to 4.0 weight percent, forty-four (44) fresh Region 9B ZIRLO fuel assemblies enriched to 4.4 weight percent, and one (1) Region 5B fuel assembly reinserted from Cycle 4. One (1) fuel assembly that was new last cycle has been reconstituted for this cycle by replacing one (1) fuel rod with a stainless steel rod. WCAP-13060-P-A, "Westinghouse Fuel Assembly Reconstitution Evaluation Methodology," which provided the NRC approved codes and methods was used for evaluating the effects of the reconstituted fuel assemblies on the operation of the core in compliance with Technical Specification Design Feature 5.3.1.

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The mechanical design of the new Region 9A and 9B fuel assemblies is similar to the previous reload fuel except for the following features:

(1) Westinghouse has developed a new zirconium based alloy, known as ZIRLO, to improve fuel assembly corrosion resistance and dimensional stability under irradiation. For the Beaver Valley Unit 2 Cycle 7 fuel assemblies, the fuel rod cladding will be ZIRLO and the fuel assembly skeleton will be fabricated with ZIRLO guide thimble tubes, ZIRLO instrument tubes and ZIRLO mid grids. The use of ZIRLO is supported by WCAP-12610-P-A and was approved for use by Technical Specification Amendment No. 82.

The chemical composition of the fuel rods and core components fabricated with ZIRLO alloy in the Beaver Valley Unit 2 Cycle 7 fuel assemblies is similar to the Region 8 Zircaloy-4 fuel assemblies except for a slight reduction in the content of Tin (Sn), Iron (Fe) and the elimination of Chromium (Cr). The ZIRLO alloy also contains a nominal amount of Niobium (Nb). These composition changes, although small, are responsible for the improved corrosion resistance of ZIRLO compared to Zircaloy-4.

Due to the longer fuel rod end plugs in the protective bottom grid described below, the Region 9 ZIRLO fuel rod length is longer than the Zircaloy-4 clad fuel rods used in Region 8. The Region 9 plenum spring is a variable pitch spring but is similar to the previous Zircaloy-4 design and provides a comparable holddown force. The variable pitch design provides additional space for gas release and retains sufficient plenum volume while not sacrificing performance.

(2) The design of the Beaver Valley Unit 2 Cycle 7 Region 9 fuel assemblies incorporates debris mitigating features that include one additional grid (protective bottom grid), modified fuel rod end plugs and a protective oxide coating along the bottom section of the fuel rod clad.

The protective bottom grid is a partial height grid similar in configuration to the mid grid, but fabricated of Inconel without mixing vanes. It is positioned on the top plate of the bottom nozzle. The fuel rod end plug positioned within the protective bottom grid is an elongated version of the current fuel rod end plug design. In conjunction with the protective bottom grid and the new elongated bottom end plug, the fuel rod top end plug was elongated and fitted with an external gripper to assist in repositioning the fuel rod during fabrication and also to facilitate fuel rod removal during reconstitution. The bottom inconel grid was raised and the first ZIRLO grid was lowered to reduce the lowermost span in the fuel assembly. This resulted in Span No. 1 being shortened and Span No. 2 being lengthened. These

changes increase the resistance of the fuel assembly to flow induced fuel rod vibration to preclude excessive clad wear. The protective bottom grid retains the original function as a debris mitigation feature and also its benefit of increased support to the fuel rod end. All other grid elevations remain the same as the previous region.

The hydraulic effects of the protective bottom grid are minimized by positioning the fuel rods 0.085 inch above the bottom nozzle in a manner that reduces the pressure drop at the fuel rod ends. Component testing indicated that the design of the protective bottom grid and the elongated end plug causes no significant effect on fuel assembly hydraulic performance. The combination of the lowered fuel rod position and the longer fuel rod end plug results in no change to the axial fuel stack height from the previous fuel region.

As an additional level of debris defense, a hardened coating of zirconium oxide shields the bottom section of the fuel rod clad, increasing wear resistance by more than a factor of ten over the current design. Formed by exposing rods and end plugs to heating in an induction furnace, this zirconium oxide layer is at least twice as hard as the most common type of debris. Should debris pass through the bottom nozzle, and progress past the lower dimples of the bottom grid, this coating provides an added measure of protection.

The above changes do not compromise either the performance of any safety-related system or result in any adverse effect on any analyses, since the changes do not affect the plant operating parameters, the safeguard system actuation or the assumptions and input parameters used in those analyses.

These modifications meet fuel assembly/rod design criteria and will not adversely affect reactor core safety considerations. Fuel rod design evaluations for the new fuel were performed using NRC approved methodology to demonstrate that the fuel rod design bases are satisfied.

Duquesne Light Company has performed a review of this reload core design including a review of the core characteristics to determine those parameters affecting the postulated accidents described in the Updated Final Safety Analysis Report (UFSAR). The consequences of those accidents described in the UFSAR which could potentially be affected by the reload core characteristics were evaluated in accordance with the NRC approved methodology described in WCAP-9272-P-A "Westinghouse Reload Safety Evaluation Methodology." The effect of the reload design was accommodated within the conservatisms of the assumptions used in the current analysis design basis, or it was

demonstrated through evaluation that the reload parameters would not change the conclusions in the UFSAR.

The NRC approved dropped rod methodology (WCAP-10298-A [non-proprietary], June 1983) was used for this design evaluation and confirmed that the peaking factors will not exceed the safety analyses limits.

The reload core design will be verified by performing the standard Westinghouse reload core physics startup tests. The results of the following startup tests will be submitted in accordance with Technical Specification 6.9.1.3:

1. Control rod drive tests and rod drop time measurements.

2. Critical boron concentration measurements.

3. Control rod bank worth measurements.

4. Moderator temperature coefficient measurements.

5. Startup power distribution measurements using the incore flux mapping system.

The COLR (enclosed) has been updated for this cycle to replace reference to Technical Specification 6.9.1.14 with 6.9.1.12 in accordance with Amendment No. 70 and to include new radial peaking factor at rated thermal power [F_{xy} (RTP)] limits for unrodded core planes. Figure 3 and Figure 4 have been replaced with new figures to address the new radial peaking factor limits.

The Beaver Valley Onsite Safety Committee and the Duquesne Light Company Offsite Review Committee have reviewed the Reload Safety Evaluation and Core Operating Limits Report and determined that this reload design will not adversely affect the safety of the plant and does not involve an unreviewed safety question.

Sincerely,

Sushil C. Jain

Enclosure

c: Mr. D. M. Kern, Sr. Resident Inspector
Mr. H. J. Miller, NRC Region I Administrator
Mr. D. S. Brinkman, Sr. Project Manager