



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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DESIGNATED ORIGINAL

Certified By Patricia J. Moore

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING THE THERMAL HYDRAULIC MARGINS FOR EXXON TOPROD

FOR PRAIRIE ISLAND NUCLEAR GENERATING PLANT UNIT 1, CYCLE 7

DOCKET NO. 50-282

In XN-NF-80-56 (P), Exxon Nuclear Company (ENC) presented a description of their TOPROD fuel design which would be used in two loop Westinghouse reactors having 14x14 fuel assemblies. The thermal-hydraulic aspects of mixing ENC TOPROD fuel, OD = 0.417" with ENC standard fuel, OD = 0.424", was addressed by Exxon in Supplement Number 1 to XN-NF-80-56.

TOPROD fuel was used for the first time in Prairie Island Unit 1 Cycle 7. Although the staff had not completed our review of XN-NF-80-56, Supplement Number 1, the thermal margin existing for Prairie Island Unit 1 was more than enough to compensate for uncertainties in the ENC mixed core analysis methods. Therefore, the staff concluded that Cycle 7 operation was acceptable (Berlinger, October 20, 1981).

As a result of the above review, Exxon submitted XN-NF-82-21 which describes in detail the application of their thermal margin design methodology to mixed core reloads. The first application of this methodology was Prairie Island Unit 2 Cycle 7. The staff has reviewed the methodology described in XN-NF-82-21(P) and identified a number of concerns on ENC's approach to calculating the location and value of the minimum departure from nucleate boiling ratio (DNBR). In particular, ENC lacked the ability to store crossflow boundary conditions on the hot assembly for use in their sub-channel DNBR calculations. Hence, Exxon used an average flow factor in their subchannel analysis which accounted for the radially-averaged mass velocity and enthalpy rise at the MDNBR location.

The staff requested that Exxon perform calculations using the minimum axial flow obtained for the hot assembly as the flow factor for the subchannel calculations. In response to this request, ENC submitted a sensitivity study for a full TOPROD core, which is the most limiting core configuration, using

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an average flow factor of 0.98 and a minimum flow factor of 0.95. The power distribution used in the analysis was for a representative core loading for Prairie Island, which is 2/3 TOPROD and 1/3 standard, and the transient that was analyzed was the loss of two-pump flow coastdown. Decreasing the flow factor by 0.03 resulted in a 1.5% decrease in the minimum DNBR, (MDNBR). The staff has performed an independent audit using the W-3 critical heat flux correlation sensitivity factors reported in FATE-79-101. The results of this review showed that the 1.5% change in DNBR reported by ENC is conservative. Based on this independent audit, the staff concludes that the use of a minimum flow factor of 0.95 is acceptable and conservative.

When this 1.5% change is accounted for in the MDNBR of 1.46 reported for the limiting two pump coastdown transient for Prairie Island Unit 1 Cycle 7, the result is a new MDNBR of 1.44. Based on the fact that the calculations reported in XN-NF-80-56, Supplement Number 1 for Prairie Island Unit 1 Cycle 7 are also applicable to Prairie Island Unit 2 Cycle 7 and the fact that there is sufficient margin between the 1.44 MDNBR and the W-3 DNBR limit of 1.30, the staff concludes that Cycle 7 operation of Prairie Island Unit 2 is acceptable.

July 9, 1982

## References

XN-NF-80-56 (P), Supplement 1, "Generic Mechanical, Thermal-Hydraulic, and Neutronic Design for Exxon Nuclear TOPROD Reload Fuel Assemblies for Pressurized Water Reactors Thermal Margin Analysis," Exxon Nuclear Company October 1981.

XN-NF-82-21 (P), "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations," Exxon Nuclear Company, March 1982.

FATE-79-101, "Analysis of the Sensitivity of Calculated MDNBR to Eight Selected DNB Parameters," Battelle Pacific Northwest Laboratories, March 1979.

Memorandum, Carl H. Berlinger to Robert A. Clark, Subject: "Thermal-Hydraulic Evaluation for the Use of ENC TOPROD Fuel in Prairie Island 1, Cycle 7," October 20, 1979.