Docket No. 50-305

June 20, 1985

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Mr. D. C. Hintz
Manager - Nuclear Power
Wisconsin Public Service Corporation
Post Office Box 19002
Green Bay, Wisconsin 54307-9002

Dear Mr. Hintz:

The Commission has issued the enclosed Amendment No. 62 to Facility Operating License No. DPR-43 for the Kewaunee Nuclear Power Plant. The amendment consists of changes to the Technical Specifications in response to your application transmitted by letter dated November 30, 1984. This review was conducted under our TAC No. 56425.

The amendment consists of changes to the nuclear peaking factor limits as a result of analyses of the impact of using higher burnup fuel, and the effect of increased steam generator tube plugging. Among the changes is Technical Specification (TS) 3.10 which defines hot channel factors for Exxon fuel as a function of both the peaking factor (FQ) and the K(z) curve. Our letter of April 5, 1985, written pursuant to 10 CFR 50.54(f), required you to submit a reevaluation of ECCS cooling performance and in particular to establish the validity of the K(z) curve for Exxon fuel. You responded by letter dated May 3, 1985, wherein you committed to operate the Kewaunee Nuclear Power Plant at a maximum FQ value of 2.23 until the reanalysis of your ECCS cooling performance is found acceptable by the NRC. Our enclosed Safety Evaluation finds an FQ of 2.23 to be acceptable and provides a detailed basis for the finding.

A copy of the related Safety Evaluation is enclosed. A Notice of Issuance will be included in the Commission's next regular monthly Federal Register notice.

Sincerely,

/s/MFairtile

Morton B. Fairtile, Project Manager
Operating Reactors Branch #1
Division of Licensing

see proposed changes MBF

Enclosures:
1. Amendment No. 62 to DPR-43
2. Safety Evaluation

cc: w/enclosures
See next page

ORB#1:DL	ORB#1:DL	BC-ORB#1:DL	OELD	AD-OR:DL
CParrish	MFairtile	SVarga	L. Dewey	GLainas
6/12/85	6/12/85	6/ /85	6/18/85	6/19/85

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Mr. D. C. Hintz
Wisconsin Public Service Corporation   Kewaunee Nuclear Power Plant

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER AND LIGHT COMPANY
MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

KEWAUNEE NUCLEAR PLANT

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 62
License No. DPR-43

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Wisconsin Public Service Corporation, Wisconsin Power and Light Company, and Madison Gas and Electric Company (the licensee) dated November 30, 1984, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-43 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 62 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing

Attachment:
Changes to the Technical
Specifications

Date of Issuance: June 20, 1985

ATTACHMENT TO LICENSE AMENDMENT

AMENDMENT NO. 62 TO FACILITY OPERATING LICENSE NO. DPR-43

DOCKET NO. 50-305

Revise Appendix A as follows:

Remove Pages	Insert Pages
TS 3.10-1	TS 3.10-1
TS 3.10-2	TS 3.10-2
TS 3.10-3	TS 3.10-3
TS 3.10-10	TS 3.10-10
TS 3.10-11	TS 3.10-11
TS 3.10-12	TS 3.10-12
TS 3.10-21	TS 3.10-21
Figure TS 3.10-2	Figure TS 3.10-2
Figure TS 3.10-6	Figure TS 3.10-6
Figure TS 3.10-7	----------

3.10 CONTROL ROD AND POWER DISTRIBUTION LIMITS

Applicability

Applies to the limits on core fission power distributions and to the limits on control rod operations.

Objective

To ensure 1) core subcriticality after reactor trip, 2) acceptable core power distribution during power operation in order to maintain fuel integrity in normal operation transients associated with faults of moderate frequency, supplemented by automatic protection and by administrative procedures, and to maintain the design basis initial conditions for limiting faults, and 3) limited potential reactivity insertions caused by hypothetical control rod ejection.

Specification

a. Shutdown Reactivity

When the reactor is subcritical prior to reactor startup, the hot shutdown margin shall be at least that shown in Figure TS 3.10-1. Shutdown margin as used here is defined as the amount by which the reactor core would be subcritical at hot shutdown conditions if all control rods were tripped, assuming that the highest worth control rod remained fully withdrawn, and assuming no changes in xenon, boron, or part length rod position.

b. Power Distribution Limits

1. At all times, except during low power physics tests, the hot channel factors defined in the basis must meet the following limits:

A. $F_Q^N(Z)$ Limits:

(i) Westinghouse Electric Corporation Fuel

$F_Q^N(Z) \times 1.03 \times 1.05 \leq (2.14)/P \times K(Z)$ for $P > .5$

$F_Q^N(Z) \times 1.03 \times 1.05 \leq (4.28) \times K(Z)$ for $P \leq .5$

(ii) Exxon Nuclear Company Fuel

$F_Q^N(Z) \times 1.03 \times 1.05 \leq (2.28)/P \times K(Z)$ for $P \geq .5$

$F_Q^N(Z) \times 1.03 \times 1.05 \leq (4.56) \times K(Z)$ for $P \leq .5$

where:

P is the fraction of full power at which the core is operating

K(Z) is the function given in Figure TS 3.10-2

Z is the core height location for the FQ of interest

B. $F^N_{\Delta H}$ Limits

(i) For Exxon Nuclear Company fuel and Westinghouse Electric Corporation fuel with burnup less than 24,000 MWD/MTU

$F^N_{\Delta H} \times 1.04 \leq 1.55\ (1 + 0.2(1 - P))$

(ii) For Westinghouse Electric Corporation fuel with burnup exceeding 24,000 MWD/MTU.

$F^N_{\Delta H} \times 1.04 \leq 1.52\ (1 + 0.2(1 - P))$

where:

P is the fraction of full power at which the core is operating

2. If, for any measured hot channel factor, the relationships specified in 3.10.b.1 are not true, reactor power shall be reduced by a fractional amount of the design power to a value for which the relationships are true, and the high neutron flux trip setpoint shall be reduced by the same fractional amount. If subsequent incore mapping cannot, within a 24 hour period, demonstrate that the hot channel factors are met, the overpower ΔT and overtemperature ΔT trip setpoints shall be similarly reduced.

3. Following initial loading and at regular effective full power monthly intervals thereafter, power distribution maps using the movable detection system shall be made to confirm that the hot channel factor limits of specification 3.10.b.1 are satisfied.

4. The measured F^{EQ}_Q (Z) hot channel factors under equilibrium conditions shall satisfy the following relationship for the central axial 80% of the core:

A. Westinghouse Electric Corporation Fuel

$F^{EQ}_Q(Z) \times 1.03 \times 1.05 \times V(Z) \leq (2.14)/P \times K(Z)$

B. Exxon Nuclear Company Fuel

$F^{EQ}_Q(Z) \times 1.03 \times 1.05 \times V(Z) \leq (2.28)/P \times K(Z)$

where:

P is the fraction of full power at which the core is operating

V(Z) is defined in Figure TS 3.10-6.

$F_Q^{EQ}(Z)$ is a measured FQ distribution obtained during the target flux determination

5. Power distribution maps using the movable detector system shall be made to confirm the relationship of specification 3.10.b.4 according to the following schedules with allowances for a 25% grace period:

   A. During the target flux difference determination or once per effective full power monthly interval whichever occurs first.

   B. Upon achieving equilibrium conditions after reaching a thermal power level more than 10% higher than the power level at which the last power distribution measurement was performed in accordance with 3.10.b.5.A above.

   C. If a power distribution map indicates an increase in peak pin power, $F_{\Delta H}^{N}$, of 2% or more, due to exposure, when compared to the last power distribution map either of the following actions shall be taken:

      i. $F_Q^{EQ}(Z)$ shall be increased by an additional 2% for comparison to the relationship specified in 3.10.b.4 OR

      ii. $F_Q^{EQ}(Z)$ shall be measured by power distribution maps using the incore movable detector system at least once every 7 effective full power days until a power distribution map indicates that the peak pin power, $F_{\Delta H}^{N}$, is not increasing with exposure when compared to the last power distribution map.

6. If, for a measured F_Q^{EQ}, the relationships of 3.10.b.4 are not satisfied and the relationships of 3.10.b.1 are satisfied, within 12 hours take one of the following actions:

An upper bound envelope for F_Q^N defined by specification 3.10.b.1 has been determined from extensive analyses considering all operating maveuvers consistent with the technical specifications on power distribution control as given in Section 3.10. The results of the loss of coolant accident analyses based on this upper bound envelope indicate that peak clad temperatures remain below the 2200°F limit.

The $F_Q^N(Z)$ limits of specification 3.10.b.1.A include consideration of enhanced fission gas release at high burnup, off-gassing (release of absorbed gases), and other effects in fuel supplied by Exxon Nuclear Company. The result of these analyses show that no additional burnup dependent penalty need be applied for Exxon fuel (7).

When a F_Q^N measurement is taken, both experimental error and manufacturing tolerance must be allowed for. Five percent is the appropriate allowance for a full core map taken with the movable incore detector flux mapping system and three percent is the appropriate allowance for manufacturing tolerance.

In specification 3.10.b.1 and 3.10.b.4 F_Q^N is arbitrarily limited for $P \leq 0.5$ (except for low power physics tests).

$F_{\Delta H}^N$, Nuclear Enthalpy Rise Hot Channel Factor

$F_{\Delta H}^N$, Nuclear Enthalpy Rise Hot Channel Factor, is defined as the ratio of the integral of linear power along the rod on which minimum DNBR occurs to the average rod power.

It should be noted that $F^N_{\Delta H}$ is based on an integral and is used as such in the DNB calculations. Local heat fluxes are obtained by using hot channel and adjacent channel explicit power shapes which take into account variations in horizontal (x-y) power shapes throughout the core. Thus the horizontal power shape at the point of maximum heat flux is not necessarily directly related to $F^N_{\Delta H}$.

In the specified limit of $F^N_{\Delta H}$ there is an 8% allowance for design protection uncertainties which means that normal operation of the core is expected to result in $F^N_{\Delta H} \leq 1.55/1.08$. When a measurement of $F^N_{\Delta H}$ is taken, experimental error must be allowed for and 4% is the appropriate allowance, as specified in 3.10.b.1. The logic behind the larger design uncertainty in this case is that (a) normal perturbations in the radial power shape (e.g. rod misalignment) affect $F^N_{\Delta H}$, in most cases without necessarily affecting F^N_Q, (b) the operator has a direct influence on F^N_Q through movement of rods, and can limit it to the desired value, he has no direct control over $F^N_{\Delta H}$ and (c) an error in the predictions for radial power shape, which may be detected during startup physics tests can be compensated for in F^N_Q by tighter axial control, but compensation for $F^N_{\Delta H}$ is less readily available.

The use of $F^N_{\Delta H}$ in specification 3.10.b.5 is to monitor "upburn" which is defined as an increase in $F^N_{\Delta H}$ with exposure. Since this is not to be confused with observed changes in peak power resulting from such phenomena as xenon redistribution, control rod movement, power level changes, or changes in the number of instrumented thimbles recorded, an allowance of 2% is used to account for such changes.

Rod Bow Effects

No penalty for rod bow effects need be included in specification 3.10.b.1 for Exxon Nuclear Company fuel rod burnups to 49,000 MWD/MTU (8). Westinghouse Electric Company fuel requires a burnup dependent penalty be incorporated through a decrease in the $F^N_{\Delta H}$ limit of 2% for 0-15,000 MWD/MTU fuel burnup, 4% for 15000-24000 MWD/MTU fuel burnup, and 6% for greater than 24000 MWD/MTU fuel burnup. These penalties are counter-balanced by credits for increased Reactor Coolant flow and lower Core inlet temperature. The Reactor Coolant System flow has been determined to exceed design flow by greater than 8%. Since the flow channel protective trips are set on a percentage of full flow, significant margin to DNB is provided. One half of the additional flow is taken as a DNB credit to offset 2% of the $F^N_{\Delta H}$ penalty. The existence of 4% additional reactor coolant flow will be verified after each refueling at power prior to exceeding 95% power. If the reactor coolant flow measured per loop averages less than 92560 gpm, the $F^N_{\Delta H}$ limit shall be reduced at the rate of 1% for every 1.8% of reactor coolant design flow (89000 gpm design flow rate) for fuel with greater than 15000 MWD/MTU burnup. Uncertainties in reactor coolant flow have already been accounted for in the flow channel protective trips for design flow. The assumed T_{inlet} for DNB analysis was 540°F while the normal T_{inlet} at 100% power is approximately 532°F. The reduction of maximum allowed T_{inlet} at 100% power to 536°F as addressed in specification 3.10.k provides an additional 2% credit to offset the rod bow penalty. The combination of the penalties and offsets results in a required 2% reduction of allowed $F^N_{\Delta H}$ for high burnup fuel, (assembly burnups > 24000 MWD/MTU). The permitted relaxation in $F^N_{\Delta H}$ allows radial power shape changes with rod insertion to the insertion limits.

(5) Letter from E. R. Mathews, (WPSC), to D. G. Eisenhut, (NRC), dated January 8, 1980, submitting information on Clad Swelling and Fuel Blockage Models.

(6) Letter from E. R. Mathews, (WPSC), to A. Schwencer, (NRC), dated December 14, 1979, submitting the ECCS Re-analysis properly accounting for the zirconium/water reaction.

(7) M. S. Stricker, "Kewaunee High Burnup Safety Analysis: Limiting Break LOCA and Radiological Consequences", XN-NF-84-31 Rev. 1, Exxon Nuclear Company, October 1984.

(8) N. E. Hoppe, "Mechanical Design Report Supplement for Kewaunee High Burnup (49GWD/MTU) Fuel Assemblies", XN-NF-84-28(P), Exxon Nuclear Company, July 1984.

(9) XN-NF-77-57 Exxon Nuclear Power Distribution Control for Pressurized Water Reactor, Phase II, January, 1978.

Westinghouse Fuel K(z) Coordinates	Exxon Nuclear Fuel K(z) Coordinates
P1 (6,1.0) P2 (10.99, 0.932) P3 (12, 0.467)	P1 (6, 1.0) P2 (10.84, 0.938) P3 (12, 0.438)
Normalized to 2.14	Normalized to 2.28

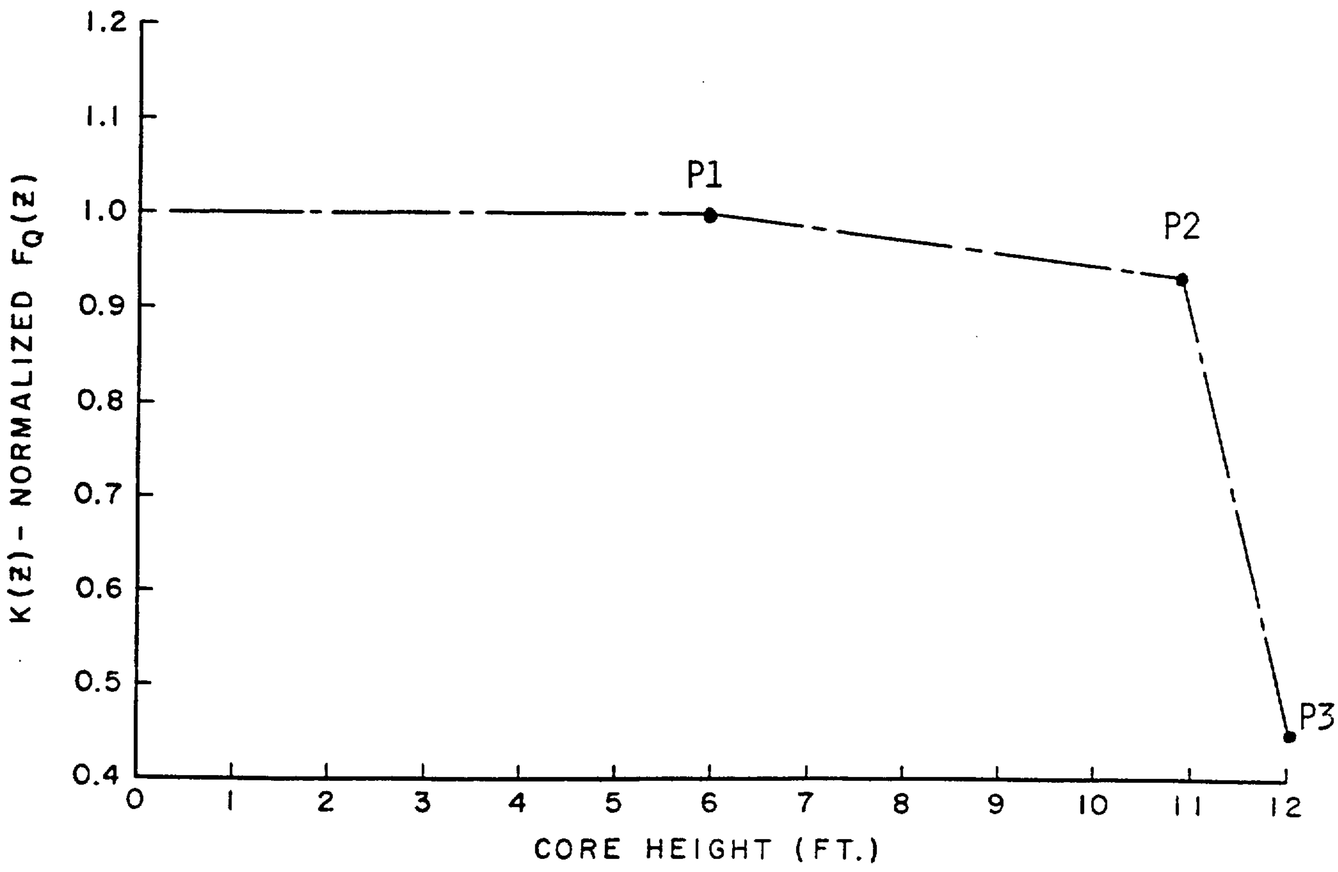
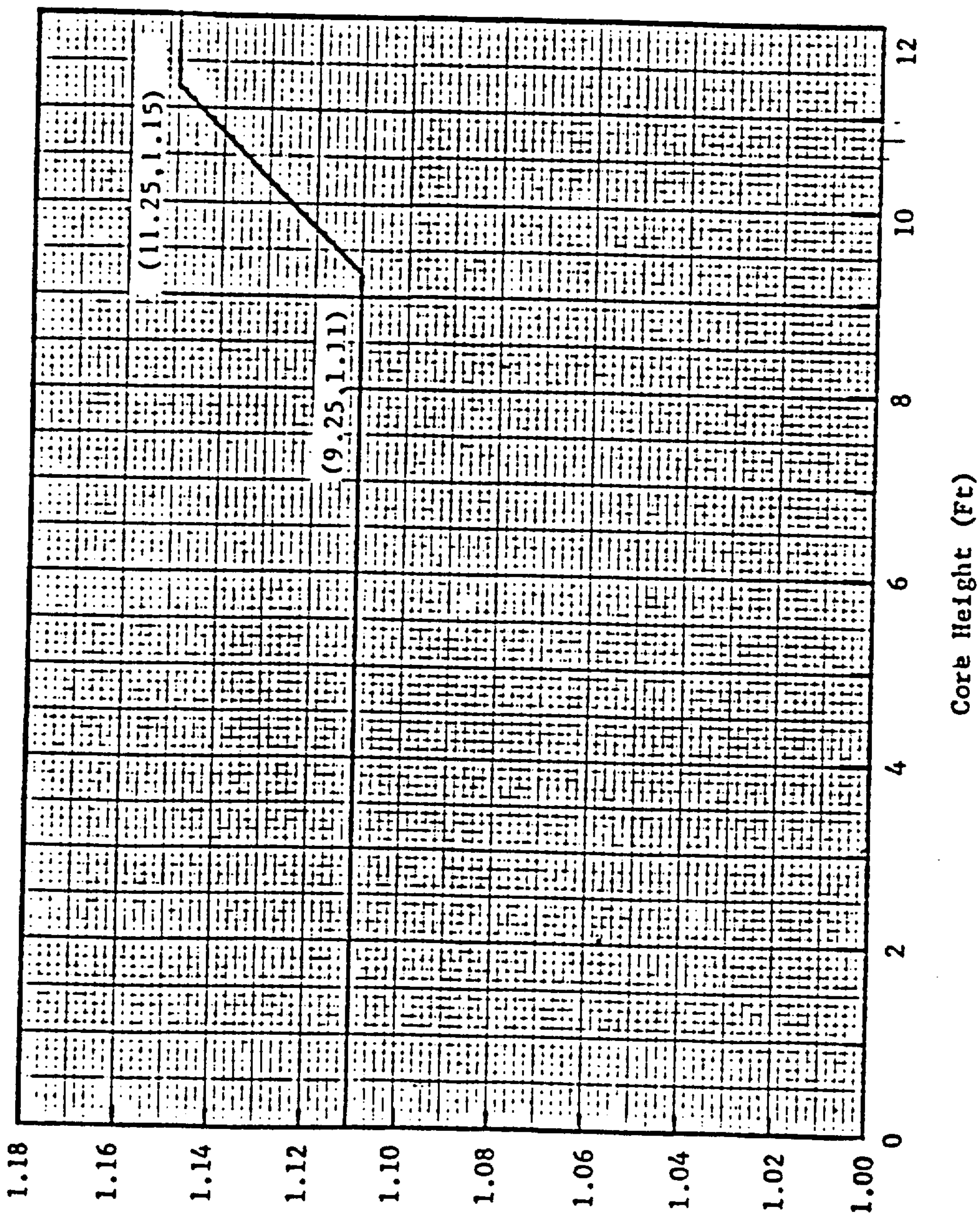


FIGURE TS 3.10-2 HOT CHANNEL FACTOR NORMALIZED OPERATING ENVELOPE



V(Z) as a Function of Core Height

Figure 3.10-6

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 62 TO FACILITY OPERATING LICENSE NO. DPR-43

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER AND LIGHT COMPANY

MADISON GAS AND ELECTRIC COMPANY

KEWAUNEE NUCLEAR POWER PLANT

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated November 30, 1984, the Wisconsin Public Service Corporation (WSPC or the licensee) requested an amendment to Facility Operating License No. DPR-43 for the Kewaunee Nuclear Power Plant (KNPP). This amendment revises Technical Specifications (TS) related to several nuclear peaking factor changes and extends Exxon fuel burnup to 49,000 MWD/MTU. The effects of 5 percent steam generator tube plugging were considered. The impact of the higher burnup was considered in regard to the fuel mechanical design and the loss-of-coolant accident (LOCA) analyses.

2.0 FUEL MECHANICAL DESIGN EVALUATION

The Kewaunee XN-1 through XN-5 reload fuel assemblies were originally designed and approved for a peak rod burnup of 43,000 MWd/MTU. The new reload fuel assemblies XN-6 through XN-9 are of improved design for high burnup irradiation. The licensee proposed a high burnup limit of 49,000 MWd/MTU (peak rod) for all fuel assemblies in the report XN-NF-84-28, Revision 1 (Ref. 13). The existing reload fuel designs (XN-1 to XN-5) and the modified design (XN-6 to XN-9) have been analyzed by the licensee to support the increase in peak rod burnup to 49,000 MWd/MTU. This report is similar in content to the ENC generic high burnup report XN-NF-82-06, Revision 1 (Ref. 14), which is currently under review. The review of XN-NF-82-06 Revision 1 has progressed to the point where only one issue remains open. This is the adequacy (conservatism) of the fuel rod power history used to determine the fuel rod internal pressure.

The licensee has presented four bounding cases of power history. These four power histories were used not only for the fuel rod internal pressure calculation but also to demonstrate that the other fuel mechanical design criteria are met. These four bounding cases of power history are based on various fuel shuffling schemes used at Kewaunee. We have reviewed these four different bounding cases and determined that they are sufficiently conservative. We thus conclude that these four cases of power history are acceptable for Kewaunee.

With these four power histories, the licensee calculated the end-of-life rod pressure. The results show that even in the worst case the rod pressure is less than the system pressure by a sufficient margin. We therefore conclude that the rod pressure will not exceed the system pressure at burnups less than or equal to 49,000 MWd/MTU for Kewaunee fuel designs XN-1 through XN-9. Based on the use of acceptable power histories proposed by the licensee to demonstrate compliance with the rod pressure criterion and favorable findings from our review of the generic report XN-NF-82-06, Rev. 1, we conclude that the Kewaunee fuel designs XN-1 to XN-9 (XN-NF-84-28, Rev. 1) are acceptable for irradiation at burnups up to 49,000 MWd/MTU peak rod.

2.1 TECHNICAL SPECIFICATIONS

The requested Technical Specification changes are all for Specification 3.10, "Control Rod and Power Distribution Limits" and the associated Bases. The Technical Specification changes are:

(1) in Section b.1.A.i: a change in the Westinghouse fuel F_Q limit value, for power greater than 50 percent, from 2.22 to 2.14, and a correpsonding change with less than 50 percent power value to 4.28.

(2) in Section b.1.A.ii: a change in the Exxon fuel F_Q limit value, for power greater than 50 percent, from a burnup dependent value with a peak of 2.21 to a non-burnup dependent value of 2.28, and a corresponding change in the less than 50 percent power value of 4.56.

(3) in Section b.1.A: the removal of the burnup dependent definition for Exxon fuel.

(4) in Section b.1.B: the removal of the burnup dependence of $F_{\Delta H}$ for Exxon fuel, thus keeping the value of 1.55 for that fuel above 24,000 MWD/MTU.

(5) in Section b.4: a change in the F_Q factors for equilibrium conditions corresponding to the change in (1) and (2) above, i.e., to 2.14 for Westinghouse fuel and 2.28 for Exxon fuel.

(6) in Section b.4: a change in the figure number for the definition of V(z).

(7) in Figure 3.10-2, as referenced in Section b.1.A: new values are provided for the K(z) curve corresponding to the new values of F_Q for Westinghouse and Exxon fuel.

(8) in Figure 3.10-6 as referenced in Section b.4: a new figure number for what had been Figure 3.10-7 since the old Figure 3.10-6 giving the burnup dependence of Exxon fuel has been removed.

These changes fall in two categories, (I) new F_Q limits for both Westinghouse and Exxon fuel as a result of new LOCA analyses including 5 percent steam generator tube plugging, and (II) the removal of burnup dependence for F_Q and $F_{\Delta H}$ limits for Exxon fuel. Changes (1), (5) and (7) are in Category I for Westinghouse fuel, changes (5) and (7) and part of (2) are in Category I for Exxon fuel and changes (3), (4) and part of (2) and (8) are in Category II. Changes in (6) and part of (8) are administrative details for a new figure number.

The Category I F_Q changes are straightforward changes based on the F_Q values used in the new LOCA analyses. The LOCA analyses are found to be acceptable in another section of this evaluation, the new F_Q values and specifications are therefore acceptable. Operation should be restricted to no more than the 5 percent steam generator tube plugging used in the analyses, and to a limit of 49,000 MWD/MTU for the Exxon fuel which was an additional basis for that analysis. The new K(z) curves are based on the new F_Q values with a separate curve for Westinghouse and Exxon fuel. The curves were calculated with the standard Westinghouse formulation. This is acceptable for the Westinghouse fuel. The acceptability of this formulation for the Exxon fuel is provided in the Exxon Fuel LOCA Analysis section of this evaluation.

The Category II changes eliminate the burnup dependence of F_Q and $F_{\Delta H}$ limits for Exxon fuel based on the characteristics of the Exxon fuel to a burnup of 49,000 MWD/MTU as discussed and approved in Section 2 of this evaluation, and on the use of this burnup limit and related characteristics in the LOCA analyses for the Exxon fuel. As the LOCA analyses and associated radiological consequences are acceptable the Category II changes are likewise acceptable.

In addition to the Technical Specification changes there are a few minor changes to the Bases and an addition to the list of references. The Bases changes on pages 3.10-10 and 3.10-12 indicate that burnup dependent F_Q and $F_{\Delta H}$ limits are not required for Exxon fuel to burnup of 49,000 MWD/MTU based on the analyses of the reports of References 4 and 13. These are in keeping with the approved changes and are acceptable. The changes on page 3.10-11 are administrative changes adding the words "design" and "design protection" as a modifier of the 8% "uncertainty" allowance. This provides an improved description of the uncertainty and is an acceptable change. The reference additions are for the new reports (References 4 and 13).

2.2. CONCLUSIONS ON FUEL MECHANICAL DESIGN

We have reviewed the report on the mechanical design of high burnup Exxon fuel (Reference 13) and the Technical Specification changes resulting from the analyses presented in that report and from the LOCA analyses. We have concluded that the Exxon supplied Kewaunee fuel mechanical design (XN-NF-84-28, Rev. 1) including XN-1 through XN-9 fuel assemblies are acceptable for high burnup to 49,000 MWD/MTU peak rod burnup, and that for the Kewaunee Technical Specifications the requested changes relating to F_Q peaking factor limits and to removal of F_Q and $F_{\Delta H}$ burnup dependence for Exxon fuel are acceptable. Operation with Exxon fuel in Kewaunee, without specific burnup dependence of peaking factors, to a burnup of 49,000 MDW/MTU is therefore acceptable.

3.0 ACCIDENT EVALUATION

The accident analyses are reported in Chapter 3 of report number XN-NF-84-31, Rev. 1. The licensee's submittal was reviewed and found to have no significant differences from the previously accepted analysis presented for Cycle 10, with the exception of considering the effect of higher burnup on rod internal pressure changes and release of volatile fission products into the pellet-clad gap.

In order to assess the effect of higher burnup, the doses from a postulated fuel handling accident inside containment were independently evaluated by the NRC. The evaluation of the fuel handling accident was performed in accordance with the methodology of Regulatory Guide 1.25, even though the conditions at the end of Cycle 11 will be beyond the bases stated in the Guide. The methodology continues to be conservative if the effect of higher burnup on the rod internal pressure and on the fraction of volatile radioactive fission products in the pellet-clad gap of the highest power module is appropriately considered. The vendor, Exxon Nuclear Company, Inc., states that the highest power module is a module at about 17,050 MWd/MTU. The staff assumed a maximum allowable linear heat generation rate of 14.76 KW/ft. The assumptions used by the staff and the results of the calculation are given in Table 1. The results show that the fuel handling delay time of 100 hours from shutdown and site related parameters are adequate to mitigate the consequences of this accident within staff Standard Review Plan acceptance criteria.

3.1 CONCLUSIONS ON ACCIDENT EVALUATION

The licensee and the staff have considered the factors dependent upon power level (to 1721 MW_t) and burnup (peak assembly discharge exposure of 49,000 MWd/MTU) that impact the radiological consequences of accidents. Assuming that the licensee's evaluation of the level of fuel failures (or absence of fuel failures) is confirmed, there are no identified issues that would preclude the extended burnup.

Table 1

ASSUMPTIONS FOR AND POTENTIAL CONSEQUENCES OF THE POSTULATED FUEL HANDLING ACCIDENTS AT THE EXCLUSION AREA BOUNDARY FOR KEWAUNEE NUCLEAR POWER PLANT

Assumptions:

Guidance in Regulatory Guide 1.25	
Power Level	1721 Mwt
Fuel Exposure Time	3 years
Power Peaking Factor	1.7
Equivalent Number of Assemblies Damaged	1
Number of Assemblies in Core	121
Charcoal Filters Available	None
Decay Time Before Moving Fuel	100 hours
0-2 Hours X/Q Value, Exclusion Area Boundary (ground level release)	2.9×10^{-4} sec/m³

	Doses, Rem	
	Thyroid	Whole Body
Exclusion Area Boundary (EAB)		
Consequences from Accidents Inside Containment	66	0.2

4.0 WESTINGHOUSE FUEL LOCA ANALYSIS EVALUATION

Previous LOCA analysis for the Westinghouse fuel in the Kewaunee Nuclear Plant was based upon an assumed steam generator tube plugging of one percent. That analysis substantiated an Fq limit of 2.22 for the Westinghouse fuel.

The licensee has performed additional LOCA analysis for the Westinghouse fuel for an assumed steam generator tube plugging limit of 5%. That analysis is documented in reference 3. In the referenced letter, Westinghouse reported that increasing the steam generator tube plugging from one to five percent on a similar two-loop plant resulted in a peak cladding temperature (PCT) increase of 80°F. Based upon the relationship that a rise of 10°F in PCT is worth about -0.01 in Fq, the licensee proposed a reduced Fq of 2.14 for the Westinghouse fuel.

We have also been informed by the licensee that only one Westinghouse fuel assembly will be loaded at the center of the Kewaunee core. The licensee further stated that this is a low power location and the Fq is not expected to exceed 1.6.

Based on the limited amount of Westinghouse fuel which will be in the Kewaunee core and the substantial Fq margin, we find the licensee's assessment acceptable.

4.1 EXXON FUEL LOCA ANALYSIS EVALUATION

As part of the amendment request of reference 1, the licensee provided a new Exxon LOCA analysis, reference 4. This analysis was performed utilizing the EXEM/PWR ECCS evaluation model. The analysis is applicable to a five percent average steam generator tube plugging and a maximum peak rod average exposure of 49,000 MWD/MTU for the Exxon fuel. A total nuclear peaking factor, Fq, of 2.28 and a nuclear enthalpy rise factor, $F_{\Delta H}$, of 1.55 was utilized in the analysis.

The EXEM/PWR ECCS evaluation model was reviewed during our examination of the D. C. Cook 2 Cycle 5 reload application. At that time, we found that the use of heat transfer augmentation factors for local rod peaking and mixing vanes was unacceptable. In reference 5, we requested that the licensee assure that these unapproved augmentation factors had not been used in the reference 4 analysis, or to provide a revised LOCA analysis which did not use these factors. The revised analysis was provided in reference 6. Subsequent discussions refer to the revised analysis.

The revised LOCA analysis was performed for the worst case, a double-ended cold leg guillotine break with a discharge coefficient of 0.4, for two burnup ranges, 0-15,000 MWD/MTU and 15,000 - 49,000 MWD/MTU. Peak cladding temperatures of 2119°F and 2132°F were obtained, respectively, for the two burnup ranges including the UPI penalty. Local metal-water reactions were 7.75% and 8.13%, respectively. In both cases, whole-core metal water reaction was less than one percent.

We have reviewed these calculations and determined that they were performed with a model wholly in conformance with Appendix K. This conclusion is based upon information received from the licensee in reference 10. In addition, we have concluded that these analyses satisfy the requirements of 10 CFR 50.46. Thus, these analyses support plant operation with up to five percent steam generator tube plugging in any steam generator and a maximum peak rod exposure of 49,000 MWD/MTU for the Exxon fuel. In addition, the Technical Specification values for Fq and $F_{\Delta H}$ values of 2.28 and 1.55, respectively, were verified. However, as described further below, an Fq limit of 2.23 is being imposed by the licensee in order to provide reasonable assurance that the Kewaunee plant satisfies the performance criteria of 10 CFR 50.46 for use of the Westinghouse derived K(z) curve for the Exxon fuel.

4.1.1 EXXON LOCA ISSUES

On March 15, 1985, Exxon informed the NRC of a coding error, in the TOODEE2 computer code, which affected the LOCA-ECCS analyses for several PWRs. In reference 2, Exxon provided a description of the coding error. The error was in an expression for a multiplier on the reflood heat transfer coefficients. The incorrect coding caused the heat transfer coefficient multiplier to be 1.045, when it was intended to be 1.0.

Besides the coding error, the staff has also become aware of other errors in the Exxon LOCA analyses. These include:

- Use of heat transfer augmentation factors for local rod peaking and mixing vanes in some recently submitted LOCA analyses, including the reference 4 Kewaunee analyses. The use of these factors were previously found unacceptable during our review of the EXEM/PWR model.

- Discovery of an input error in the St. Lucie Unit 1 LOCA analysis. This error is described in reference 7.

- Assuming the validity and applicability of the Westinghouse-derived K(z) curve to the Exxon fuel.

In order to determine the extent to which our concerns with respect to the Exxon LOCA model and analyses methods were generically applicable, we contacted, on March 20, 1985, all PWR licensees currently using Exxon fuel. At that time, we requested that each of the licensees evaluate these concerns with respect to their plants and determine if they were applicable.

In reference 8, the licensee provided its evaluation of each of these concerns on the proposed Amendment No. 64 to their Technical Specifications. With regard to the use of the unacceptable heat transfer augmentation factors, the licensee had previously provided, in reference 6, a revised LOCA analysis which did not utilize these factors. The licensee also confirmed, via an audit of the Exxon Nuclear Company on March 23, 1985, that the TOODEE2 code version utilized for that analysis did not contain the coding error described in reference 2. In addition, the licensee's audit concluded that the revised LOCA analysis does not contain the St. Lucie 1 input error. Based on our review of the licensee's response, we consider these issues have been satisfactorily resolved with respect to the licensee's amendment request No. 64.

The remaining issue concerns the validity of assuming use of the Westinghouse-derived K(z) curve for the Exxon fuel. Currently, Exxon LOCA analyses are performed to substantiate the maximum allowable peaking factor, Fq, based upon a chopped cosine axial power shape. To assure conformance to 10 CFR 50.46 for a range of power shapes, the K(z) curve is utilized, in conjunction with Fq, to limit allowable peaking factors as a function of core elevation. This K(z) curve was developed by Westinghouse for its fuel utilizing an ECCS evaluation model wholly in conformance with Appendix K. Exxon has assumed that the Westinghouse-derived K(z) curve applies to the Exxon fuel.

In reference 8, the licensee evaluated the acceptability of using the Westinghouse-derived K(z) curve for the Exxon fuel. The licensee stated that the K(z) curve was designed to address the poorer reflood cooling in the upper portions of the reactor core. The licensee believes that the reflood behavior is primarily a system effect and that the K(z) curve should not be fuel dependent. The licensee did not identify any analyses, performed with an approved ECCS evaluation model for the Exxon fuel, which verifies that use of the Westinghouse-derived K(z) curve assures conformance to 10 CFR 50.46.

Section I.A. of Appendix K to 10 CFR 50 requires "A range of power distribution shapes and peaking factors representing power distributions that may occur over the core lifetime shall be studied...". Since the licensee has not provided an analysis for the Exxon fuel that demonstrates the adequacy of the Westinghouse-derived K(z) curve for the Exxon fuel, we are unable to conclude that the Kewaunee plant LOCA analyses fully conforms to the requirements of Appendix K.

We have, however, been provided with Exxon analyses, reference 9, which demonstrates that the Exxon fuel would behave in a manner similar to the Westinghouse fuel given a postulated large break LOCA. These analyses, which were performed for both 14x14 and 15x15 fuel rod arrays, examined the core hydraulic and temperature transients for both Exxon and Westinghouse fuel assuming the same core boundary (plena) conditions during the LOCA. These results demonstrated that the hydraulic behavior for the two fuels is similar. Additionally, it was demonstrated that the peak cladding temperatures for the Exxon fuel were within a ± 50°F band of the predicted values for the Westinghouse fuel. Thus, we conclude that the functional dependence shown by the Westinghouse-derived K(z) curve should be equally applicable for both fuel types.

In order to provide reasonable assurance that application of the Westinghouse-derived K(z) curve to the Exxon fuel results in compliance with the performance criteria of 10 CFR 50.46, the licensee has committed, in reference 11, to an Fq penalty to assure that peak cladding temperatures for the Exxon fuel will be less than or equal to those obtained for Westinghouse fuel. Based upon the relationship that each 10°F increase in peak cladding temperature results in an Fq penalty of -0.01, an Fq penalty of -0.05 has been proposed. This results in an adjusted Fq limit of 2.23. Based upon this commitment from the licensee, we are reasonably assured that the plant conforms to the performance criteria of 10 CFR 50.46.

In order to reestablish conformance to the requirements of 10 CFR 50.46 and Appendix K, for the Kewaunee plant, we require that the licensee submit, within 6 months, an ECCS analysis using an approved ECCS evaluation model, which either (1) verifies the use of the current K(z) curve for the Exxon fuel or (2) determines a new K(z) curve to be applied to the Exxon fuel.

4.2 CONCLUSIONS ON LOCA ANALYSIS

Based upon the foregoing, we have concluded that:

- An Fq of 2.14 is acceptable for the Westinghouse fuel.

- The Kewaunee plant can be safely operated with up to 5% plugging in either steam generator.

- The maximum peak rod average exposure for the Exxon fuel of 49,000 MWD/MTU is acceptable.

- The LOCA analyses which were provided in reference 6 are wholly in conformance with 10 CFR 50.46 and Appendix K. These analyses support an Fq of 2.28 and an $F_{\Delta}H$ of 1.55. However, to assure that the K(z) curve provides reasonable assurance that the plant complies with the performance criteria of 10 CFR 50.46, the licensee committed to operate the plant with an Fq of 2.23. We find this commitment acceptable.

- The acceptability of applying the Westinghouse-derived K(z) curve to the Exxon fuel has not been verified using an ECCS model wholly in conformance with Appendix K. We require that the licensee provide confirmatory calculations, within 6 months, utilizing an ECCS evaluation model which conforms to the requirements of Appendix K, which either (1) verifies the use of the current K(z) curve for the Exxon fuel, or (2) determines a new K(z) curve to be applied to the Exxon fuel.

Based on the above, we have concluded that the Kewaunee plant can be operated without undue risk to the public health and safety.

5.0 REFERENCES

1. Letter to H. Denton, NRC, from C. W. Giesler, Wisconsin Public Service Corporation, "Proposed Amendment No. 64 to the Kewaunee Power Plant Technical Specifications," November 30, 1984.

2. Letter, G. F. Owsley (Exxon) to H. Denton NRC, "Error in the 48,000 MWD/MTU LOCA-ECCS Analysis for D.C. Cook Unit 1", GFO: 85:008, March 21, 1985.

3. Letter, D.C. Lind (Westinghouse) to D. Ropson (WPSC), "Revised Fq Calculations," WPS-84-618, November 26, 1984.

4. Topical Report XN-NF-84-31, Revision 1, "Kewaunee High Burnup Safety Analysis: Limiting Break LOCA and Radiological Consequences," October, 1984.

5. Letter, S. A. Varga (NRC) to D. C. Hintz (WPSC) Requesting Additional Information, dated February 5, 1985.

6. Letter, D. C. Hintz (WPSC) to S. A. Varga (NRC), "Response to NRC Request for Additional Information for Proposed Amendment No. 64," February 26, 1985.

7. Letter, J. W. Williams, Jr., (FP&L) to J. R. Miller (NRC), "St. Lucie Unit 1, Docket No. 50-335, ECCS Analysis," L-85-124, March 22, 1985.

8. Letter, D. C. Hintz (WPSC) to S. A. Varga (NRC), "Errors Reported in Exxon Nuclear ECCS Analysis," March 27, 1985.

9. Letter, J. C. Chandler (ENC) to C. O. Thomas (NRC), "Transmittal of ENC Technical Reports for Information", JCC: 067:85, April 4, 1985.

10. Letter, D. C. Hintz (WPSC) to S. A. Varga (NRC), "Exemption Request From 10 CFR 50.46," April 3, 1985.

11. Letter, D. C. Hintz (WPSC) to S. A. Varga (NRC), "Request for Exemption from 10CFR50.46", April 4, 1985.

12. Letter, C. W. Giesler (WPSC) to S. A. Varga "Request for Information Pursuant to 10 CFR 50.46(f)" May 3, 1985.

13. XN-NF-84-28(P), Revision 1, "Mechanical Design Report Supplement for Kewuanee High Burnup (49 GWD/MTU) Fuel Assemblies", July 1984.

14. XN-NF-82-06, Revision 1, "Qualification of Exxon Nuclear Fuel for Extended Burnup," June 1982.

6.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR Sec 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

7.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

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