COPY

CONSUMERS POWER COMPANY
General Offices - Jackson, Michigan

December 23, 1966

Re: Docket 50-155
File Copy (suppl.)

Dr. P. A. Morris, Director
Division of Reactor Licensing
United States Atomic Energy
Commission
Washington, D. C. 20545

Dear Dr. Morris:

Att: Mr. Roger S. Boyd

Transmitted herewith are three (3) executed and nineteen (19) conformed copies of a request for a change to the Technical Specifications of License DPR-6, Docket No. 50-155, issued to Consumers Power Company on May 1, 1964, for the Big Rock Point Nuclear Plant.

This proposed change (No. 12) will allow the use of the latest General Electric Company critical heat flux correlation as presented in "Design Basis for Critical Heat Flux Condition in Boiling Water Reactors," by J. M. Healzer, et al, September 1966 (APED 5286 and APED 5286, Part 2).

Copies of the referenced document (APED 5286) are not attached since it is our understanding that the Commission has recently received 70 copies in connection with the TVA Construction Permit Application. If you desire further copies, we shall be pleased to supply them.

Yours very truly,

Robert L. Haueter (Signed)

RLH/dmb
Attach.

Robert L. Haueter
Assistant Electric Production Superintendent -
Nuclear

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CONSUMERS POWER COMPANY

REQUEST FOR AUTHORIZATION OF
CHANGE IN TECHNICAL SPECIFICATIONS
LICENSE NO. DPR-6

Docket No. 50-155
File Copy (Supp)

For the reasons hereinafter set forth, it is requested that the Technical Specifications Appended to Operating License No. DPR-6, issued to Consumers Power Company on May 1, 1964 for the Big Rock Point Nuclear Plant, be changed as follows:

In Section 5.2, Principal Core Operating Limitations, replace the foo' note to 5.2.1(b), Minimum Core Burnout Ratio at Overpower, with the following:

"*Based on correlation given in 'Design Basis for Critical Heat Flux Condition in Boiling Water Reactors,' by J. M. Healzer, J. E. Hench, E. Janssen, and S. Levy, September 1966 (APED 5286 and APED 5286, Part 2)."

In Section 8.3, Reactor Operating Limits, replace the footnote to 8.3(a) with the following:

"*Based on correlation given in 'Design Basis for Critical Heat Flux Condition in Boiling Water Reactors,' by J. M. Healzer, J. E. Hench, E. Janssen, and S. Levy, September 1966 (APED 5286 and APED 5286, Part 2)."

Introduction

The previous critical heat flux (CHF) correlation upon which our present burnout ratio (or minimum critical heat flux ratio) is based is given in "Burnout Limit Curves for Boiling Water Reactors," by E. Janssen and S. Levy, April 14, 1962 (APED 3892). This correlation was based on a limit line drawn below data points from essentially all single-rod, annular coolant flow tests.

The CHF correlation based on multi-rod test data from four-rod and nine-rod test sections is given in "Design Basis for Critical Heat Flux Condition in Boiling Water Reactors" by J. M. Healzer, J. E. Hench, E. Janssen, and S. Levy, September 1966 (APED 5286). Since this more recent correlation represents the best available data applicable

to the geometry and flow conditions present in a boiling water reactor, it is proposed to apply this correlation to determine the burnout ratio as specified in the Technical Specifications. The new CHF correlation gives an overall gain of about 10% in CHF ratio and, therefore, provides more operating flexibility in core arrangement and cycle length.

Description of Changes

The detailed discussion of the proposed CHF correlation is given in APED 5286 and APED 5286, Part 2. These documents provide the technical bases for this requested change.

Application of this new correlation at Big Rock Point yields an increase of approximately 10% in the calculated CHF ratio. The exact increase is dependent on the particular flow rate, heat flux, and steam quality in each channel. The values of G, mass flow rate, are approximately:

	Mass Flow Rate
Center Channels (60)	0.70×10^6 Lb/Hr-Ft^2
Outer, Orificed Channels (24)	0.47×10^6 Lb/Hr-Ft^2

At the beginning of an operating cycle, the flux distribution is generally peaked toward the top of the core and typical values are as follows for the limiting fuel channel at overpower (radial peaking factor of 1.40, axial factor of 1.45 and local peaking factor of 1.23):

	Old Correlation	New Correlation
Mass Flow Rate, G, Lb/Hr-Ft^2 x 10^6	0.70	0.70
Minimum Critical Heat Flux Ratio (MCHFR) at Overpower	1.94	2.17
Quality at MCHFR Point, %	17.40	14.40
Heat Flux at MCHFR Point, Btu/Hr-Ft^2	280,000	332,000

Toward the end of an operating cycle, the control rods are more fully withdrawn and the flux peak is moved toward the bottom of the core. The limiting critical heat flux, therefore, occurs in the low quality portion of the limit line. Typical values at Big Rock Point are as follows:

	Center of Core	Periphery
Mass Flow Rate, G, Lb/Hr-Ft^2 x 10^6	0.70	0.47
CHF Limit, Btu/Hr-Ft^2		
Old Correlation	717,000	662,000
New Correlation	881,000	881,000
Ratio (New/Old)	1.23	1.33

The above numbers all include the effect of 1350 psia operation. There is a slight increase in the limit line as a result of the change in the pressure term with the new correlation. A change in pressure from 1,000 psia to 1,350 psia decreases the limit line by a constant value of 154,000 Btu/hr-ft^2 for the old correlation and by 119,000 Btu/hr-ft^2 (which corresponds to a multiplication factor of 0.881) for the new correlation.

Hazards Considerations

The proposed change to allow use of the new CHF correlation in APED 5286 represents an updating of thermal hydraulic parameters to the most recent and representative numbers. The previous CHF correlation was based on approximately 1000 data points, essentially all of which were from tests of single, internally heated rods with annular coolant flow. Since the corner rod is design limiting, the geometry was selected to be representative of this rod. The few multi-rod points available fell significantly and consistently above the single rod design line. Thus, the design correlation was essentially a limit line drawn below the data points.

The new CHF correlation is based on approximately 780 multi-rod data points taken on four-rod and nine-rod test sections. Since the corner rod geometry, rod spacing, pressure and flow correspond to actual boiling water reactor conditions, the correlation is valid for General Electric boiling water reactors. This new correlation is also essentially a limit line drawn below the data points.

An analytical model has been developed which has proven sound in predicting effects of changes in geometry and parameters. Comparison of the calculated critical heat flux ratio (CHFR) for the nine-rod data with the calculated CHFR for an actual reactor shows good agreement. The minimum critical heat flux ratio (MCHFR) for the nine-rod

data is less by 2-10% than the actual reactor channel depending on power distribution and orificing. This model substantiates the validity and conservatism of the new correlation.

Further conservatism is introduced by the fuel rod spacers. A best-fit correlation of test data shows the effect of properly designed spacers to be beneficial to the extent of approximately 10-15% because of the turbulence they introduce. This amounts to an increase of approximately 100,000 Btu/hr-ft^2 in the CHF. No credit is taken for this effect which means that application of the new correlation yields CHF values near the spacers as much as 100,000 Btu/hr-ft^2 below the actual reactor conditions.

The operating conditions at Big Rock Point are within the range of parameters used in the collection of data for the new CHF correlation. Thus, this correlation is considered applicable to the actual Big Rock Point operating conditions. The present license limitations on heat flux at both the steady state and overpower conditions are not affected by use of the new correlation. In our opinion, the proposed change does not involve an unreviewed or significant change in the hazards considerations described or implicit in the Final Hazards Summary Report.

CONSUMERS POWER COMPANY

By J. H. Campbell
Vice President

Date: December 23, 1966

Sworn and subscribed to before me this 23rd day of December 1966.

Grace R. Warner
Notary Public, Jackson, County, Michigan
My commission expires February 16, 1968

★ U. S. Government Printing Office: 1965—789-445

FROM: Consumers Power Company
Jackson, Michigan 49201
(M. L. Mansetar)

TO: Dr. Morris

CLASSIFICATION: U

POST OFFICE REG. NO.:

DESCRIPTION: (MUST BE UNCLASSIFIED)
Ltr. trans. the following for our review and approval:

ENCLOSURES: (3 signed & 19 conformed cys.)
"Requestion For Authorization Of Change In Tech. Spec. of Lic. DPR-6," dated and notarized 12-23-66, to allow use of the latest Gs critical heat flux correlation..

REMARKS: Distribution: 1-formal file cy.
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DATE OF DOCUMENT: 12-23-66
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ACTION NECESSARY ☐ CONCURRENCE ☐ DATE ANSWERED:
NO ACTION NECESSARY ☐ COMMENT ☐ BY:

FILE CODE: DOCKET: 50-155

REFERRED TO	DATE	RECEIVED BY	DATE
Boyd: w/all extras	12-27	-- FOR ACTION	
Dr. Morris: w/info cy.	12-27		

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ACKNOWLEDGED

U. S. ATOMIC ENERGY COMMISSION MAIL CONTROL FORM Form AEC-320S (8-69)