Consumers
Power
Company

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-0550

August 3, 1983

Dennis M Crutchfield, Chief
Operating Reactors Branch No 5
Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

DOCKET 50-155 - LICENSE DPR-6 -
BIG ROCK POINT PLANT - RESPONSE TO NRC
STAFF CONCERNS - AMENDMENT 2 TO SPENT FUEL
RACK ADDITION - "CONSOLIDATED APPLICATION"

Our analysis of the structural integrity of the spent fuel pool at elevated temperatures was enclosed in Consumers Power Company submittal dated January 10, 1983. NRC Staff review and response to our submittal yielded a Safety Evaluation Report dated May 16, 1983, requesting additional information before the Staff would approve plant start-up following our current refueling outage. Additional information was supplied by letter dated June 8 and June 10, 1983. Consumers Power Company committed, at a meeting held on July 6, 1983 with NRC Staff representatives, to provide additional analyses addressing two concerns. These two concerns were related to the handling of material properties input associated with orthotropic plate conditions; and, the use of "temperature steps" instead of "time steps" in the ANSYS computer code.

Consumers Power Company representatives again met with NRC Staff representatives on July 28, 1983 to present the results of these additional analyses. These results are provided as attachments to this letter and are identified as follows:

1. Orthotropic Plate Assumptions
2. Effect of Thermal Stress Analysis Procedure
3. Forces on the Shear Key
4. Displacements at South Wall and West Wall Shear Keys
5. The Effect of Liner Forces in the Safety Margins.

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It was concluded during the July 28, 1983 meeting that the attachments satisfy the stated concerns and the results are within the proper bounds. We request your formal approval and prompt issuance of the Safety Evaluation Report so that the Big Rock Point Plant can be started up on schedule.

Thomas C Bordine DTV

Thomas C Bordine
Staff Licensing Engineer

CC Administrator, Region III, USNRC
NRC Resident Inspector-Big Rock Point

Attachment

oc0783-0239a142

LICENSING CORRESPONDENCE - RECORD SUMMARY

DATE: DRAFT - for review & comment

DOCKET 50-155 LICENSE DPR-6
BIG ROCK POINT PLANT

RESPONSE TO STAFF QUESTIONS ON MCPR TECHNICAL SPECIFICATION CHANGE REQUEST

SUMMARY:

Provides Consumers Power Company responses to staff questions on RETRAN and COBRA analyses by describing parameters and assumptions used to calculate MCPR.

COMMITMENTS MADE:

None.

COMMITMENTS CLOSED:

6/8/83 telephone commitment.

Previous NRC/CP Co Correspondence:

CPC letters dated 8/31/77, 10/30/78
7/15,81, 11/04/82, 4/26/83

Special Distribution:

KDBrienzo
WJBeckius
JAUmbarger
JRKneeland

AIR No

UFI No

740-22*13*10
740-70*01*07*01

Individuals Providing Information:

GFPratt
JAMeincke

Individuals Assigned Responsibility for Implementing Commitments:

None.

Concurrences:

DJVandeWalle
GFPratt
JAMeincke
WGFogg

Cost/Budget Impact:

	Actual/Potential
Year(s)	
Materials/Parts	
Labor	
Capital	
Contractors	

Originator:

LLCastiglione

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DRAFT - Rev 1

Dennis M Crutchfield, Chief
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DOCKET 50-155 - LICENSE DPR-6 -
BIG ROCK POINT PLANT - RESPONSE
TO STAFF QUESTIONS ON MCPR TECHNICAL
SPECIFICATION CHANGE REQUEST

A conference call was held between Consumers Power Company and the NRC on July 3, 1983. The purpose of the call was to discuss the Minimum Critical Power Ratio (MCPR) technical specification change request submitted on April 26, 1983. As a result of that conversation, lists of RETRAN analysis parameters and COBRA analysis assumptions were developed for further clarification.

The attached response reflects our interpretation of the questions presented by the Staff during the above referenced telecon. As stated in our December 20, 1982 submittal, this request is necessary for Big Rock Point to increase thermal power level. Your prompt approval is requested.

Thomas C Bordine (Signed)

Thomas C Bordine
Staff Licensing Engineer

CC Administrator, Region III, USNRC
NRC Resident Inspector-Big Rock Point

Attachment

oc0783-0237a142

Consumers Power Company
Big Rock Point Plant
Docket 50-155

RETRAN ANALYSIS SENSITIVITY

(Draft)

4 pages

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RETRAN SENSITIVITY ANALYSIS

Question

Show that the RETRAN analysis is conservative by evaluating the sensitivity of the model (in terms of ΔMCPR/initial MCPR) to the following parameters:

- Void Coefficient
- Doppler Coefficient
- Scram Reactivity
- Prompt Neutron Heating
- Void Fraction Model (Homogeneous Assumption)
- Fuel Heat Transfer Model
- System Inertia (L/A)
- Core Pressure Drop (or Core Bypass Flow)
- Separator Inertia (L/A)
- Separator ΔP
- Steamline Pressure Loss (Loss Coefficient)

Evaluate to include Sensitivity Study or if sensitivity is known, provide a written basis why the analysis assumed a conservative value of the parameter.

Response

The results of sensitivity studies that had been performed in the latter part of 1981 were submitted in correspondence to the NRC dated April 26, 1983. These studies reported on the sensitivity of Turbine Valve Closure Time, Core Bypass Flow, Scram Rod Work, Scram Time, β/Λ, Doppler Coefficient, and Void Coefficient. The results of further sensitivity studies follow. One difference in the following analysis from the previous sensitivity study was the new analysis uses the RETRAN/COBRA model developed for the Technical Specification Change Request of December 20, 1982. Therefore, this study has an initial Critical Power Ratio (CPR) of 1.591 as opposed to 1.681 of the 1981 study.

1) Steam Line Pressure Loss - The steam line loss coefficients in junctions 140, 150, 160, 170 and 180 (see attachment 1) were increased 50% and decreased 50% from the base case. The results below show that MCPR is insensitive to changes in steam line pressure losses.

	Base Case	0.5 x Base Case Coefficients	1.5 x Base Case Coefficients
Initial CPR	1.591	1.591	1.591
MCPR	1.320	1.321	1.320
MCPR change from base case	N/A	+0.001	0.0
$\frac{MCPR - MCPR_{(Base)}}{MCPR_{(Base)}} \times 100\%$	N/A	+0.08%	0.0%

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2) Steam Separator Inertia - The steam separator inertia ($^{L}/A$ base case of 0.63 was increased by 100% to 1.26. A neglible decrease in MCPR was observed as a result of doubling the separator inertia. The results are shown below.

	Base Case	2.0 x Base Case Inertia
Initial CPR	1.591	1.591
MCPR	1.320	1.318
MCPR change from base case	N/A	-0.002
$\frac{MCPR-MCPR_{(Base)}}{MCPR_{(Base)}} \times 100\%$	N/A	-0.15%

3) Fuel Heat Transfer Model - The gap conductivity was varied to show sensitivity of MCPR to changes in the heat transfer parameters for the fuel. In the RETRAN model, the base case gap conductivities are listed in Table I ("Gap Conductivities"). These conductivities were selected so the fuel temperatures and stored energies at different power levels matched those calculated in XN-76-21, "Design Report for Big Rock Point Reactor Reload G-3 Fuel, Addendum 4." The fuel temperature in XN-76-21 was calculated by the GAPEX computer code. The results of the sensitivity runs are shown below. As can be seen, for even large changes in Gap conductivity, MCPR changes very little.

	Base Case	+25%	+300%
Initial CPR	1.591	1.591	1.591
MCPR	1.320	1.308	1.298
MCPR change from from base case	N/A	-0.012	-0.022
$\frac{MCPR-MCPR_{(Base)}}{MCPR_{(Base)}}$	N/A	-0.9%	-1.7%

TABLE I

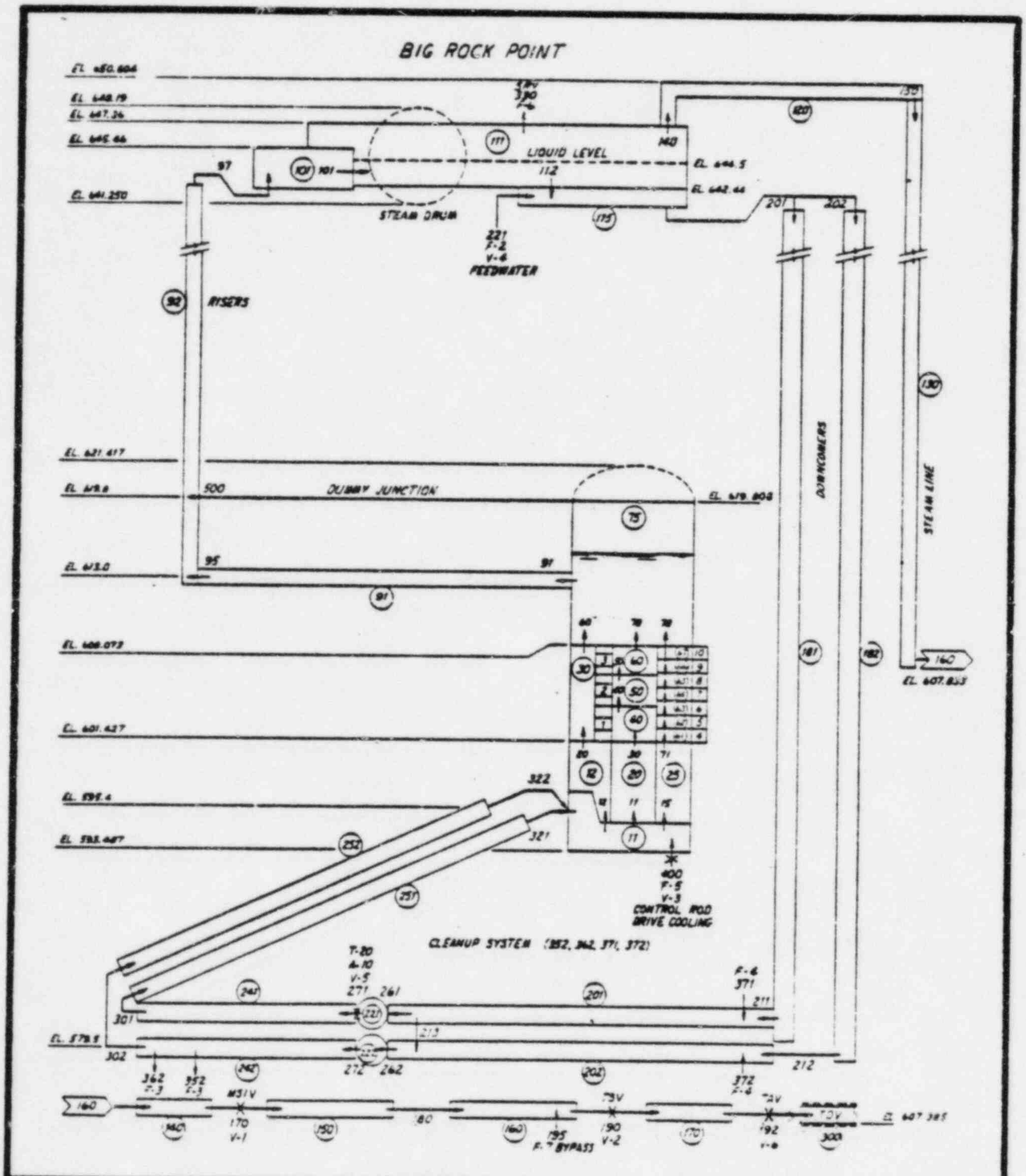
Temp (°F	Gap Conductivities Base Case (Btu/ft-hr-°F)	+25%	+300%
0.0	.044	.055	.132
333.0	.052	.065	.156
900.0	.12	.150	.36
1200.0	.1745	.218125	.5235
2500.0	.1745	.218125	.5235

4) Prompt Neutron Heating - In the RETRAN/COBRA analysis for the MCPR Technical Specification Change Request, 97% of the heat was assumed to be

generated in the fuel and 3% in the moderator, which is consistent with NX-76-21. The normal valves for heat generated in the full range from 90 to 95%. The 97% figure used in the RETRAN/COBRA is conservative because reducing the heat generated in the fuel correspondingly reduces the heat flux and increases the MCPR.

5) System Inertia and Separator ΔP - Sensitivity studies were not done on these parameters because they would have no effect on the MCPR for the turbin trip without bypass transient. The MCPR in the transient occurs very early (<3 seconds) before any variations in flow can manifest themselves. The results of varying the steam line pressure loss and core bypass sesnitivity studies verified this. The Δ CPR did not change even though the parameter was varied.

6) Void Fraction Model (Homogeneous Assumption) - In a homogeneous model the vapor velocity equals the liquid velocity as opposed to a slip model where the vapor velocity is greater than the liquid velocity. In the homogeneous model, the equality of the vapor and liquid flows over predicts the void fraction as compared to a slip model. In the turbine trip without bypass transient where the void collapse produced the rapid reactivity addition, it is conservative to use a homogeneous model because it produces the largest reactivity addition.



BRP SYSTEM NODALIZATION DIAGRAM

Consumers Power Company
Big Rock Point Plant
Docket 50-155

DESCRIPTION OF COBRA ANALYSIS MAJOR ASSUMPTIONS

(Draft)

3 pages

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DESCRIPTION OF COBRA ANALYSIS MAJOR ASSUMPTIONS

Question: Describe the method used to calculate MCPR (ie, COBRA analysis). Discuss major analysis assumptions including:

Friction Factor
Form Loss Coefficients
Two-Phase Friction Multiplier
Gap Conductance
Nodalization
Time Step Size
Link between RETRAN and COBRA
Void Fraction Model
Subcooled Void Model
Heat Transfer Model in different flow regions L/A input

Describe the specific input to friction factor and form loss coefficients to justify their conservativeness. Describe why each assumption is conservative.

Response: A one-quarter core geometry was used to perform the thermal margin analysis. The single-phase friction factors and form loss coefficients shown in Table I, "Big Rock Point Friction and Form Loss Coefficients," are based upon experimental data obtained by Exxon (Reference 1) during the hydraulic and fretting corrosion tests performed using the Reload G fuel design. The current fuel design has the same hydraulic characteristics as the Reload G fuel. Any minor differences would be insignificant compared to the high form loss coefficients of the flow distribution orifice in each fuel assembly channel.

The Modified Armond void correlation was used for this analysis based upon our analysis of the data contained in Reference 2. Several correlations were compared with the General Electric data and the modified Armond model void correlation was judged to provide the best results for the data obtained near the operating pressure of the Big Rock Point Plant core. A subcooled void fraction model was not utilized for this analysis. The Armond model was selected for the two-phase friction multiplier. A sensitivity study was performed using the homogeneous two-phase friction multiplier correlation. The ΔCPR calculated using the Armond correlation is the same as the ΔCPR for the homogeneous correlations.

The RETRAN computer code analysis provided the boundary condition of normalized heat flux, core flow rate, core inlet enthalpy and core exit pressure for the COBRA thermal margin analysis. The data is read directly from the RETRAN restart file. The location of each of the four above variables plus the location of the transient time parameter are input parameters for the COBRA computer code.

A time step size of 0.2 seconds was selected for most of the COBRA analyses. The line printer plot produced at the end of the COBRA out is reviewed to ensure that the minimum CPR was found. If the CPR curve was flat near the minimum, the time step was reduced to ensure that the MCPR was calculated.

The axial node size selected for this series of thermal margin calculations is four inches. Since the XNB CPR correlation is based upon channel average properties, a small axial node size is not required. The node size was reduced to approximately three inches for the TTW/OBP Transient and the calculated thermal margins did not change.

The COBRA code analysis did not contain a thermal model of the fuel rods, therefore, the pellet to clad gap conductance was not a required input variable. The normalized heat flux was obtained from the RETRAN analysis as described above.

REFERENCES

1) "Evaluation of hydraulic and Fretting Corrosion Behavior of Big Rock Point Reload G Fuel", XN-73-20, (June 1973). (Exxon proprietary report.)

2) "Steady State and Transient Void Fraction in Two-Phase Flow Systems. Final Report for the Program of Two-Phase Flow Investigation.", GEAP-5417, (January 1967).

TABLE II

Big Rock Point Friction and Form Loss Coefficients

Inlet	K*
Standard channel	13.50
Peripherical channel	69.40
Lower End Fitting	.800
Spacer Grid	1.020
Upper End Fitting	1.060

*Based on nominal flow area of a fuel assembly in the flow channel.