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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO USE OF I-2 FUEL IN THE CYCLE 22 RELOAD

CONSUMERS POWER COMPANY

BIG ROCK POINT PLANT

DOCKET NO. 50-155

1.0 INTRODUCTION

By letter dated December 5, 1986 (Ref. 1) from K. W. Berry, Consumers Power Company (CPC), to the Director of NRR, NRC, CPC proposed changes to the Big Rock Point Plant Technical Specification Section 5.1 to incorporate a new design of control blades. The new design provides for replacement of the top one quarter of the boron carbide absorber rods with hafnium absorber rods in the outer two rods on each control blade wing and the use of a new cladding material intended to eliminate intergranular corrosion cracking of absorber tubes containing boron carbide. The new design is expected to increase control rod assembly life. In addition, the licensee proposed changes to the core operating limits Tables 1 and 2 of Technical Specification Section 5.2.1 to include Reload I-2 fuel for Cycle 22 operation.

In a separate submittal dated Dec. 29, 1986 (Ref. 2) from Ralph R. Frisch, CPC, to the Director of NRR, NRC, the licensee provided documentation regarding fuel performance in recent operating cycles and fuel inspection plans for the Cycle 22 reload fuel. This information was provided in response to concerns identified by the NRC Region 3 inspectors and the staff in several conference calls regarding CPC policy for identification and removal of known leaking fuel pins from a new reload core.

During our preliminary review of Reference 1, the staff informed the licensee of a need for more detailed information regarding the hafnium hybrid control rod design and for additional information regarding the Cycle 22 reload and safety analysis which concluded that core operating limits defined in the Technical Specifications will be satisfied. The licensee responded with a submittal dated January 20, 1987 (Ref. 3) from Ralph R. Frisch, CPC, to the NRC.

This report describes the staff's review of the above submittals and provides the staff's safety evaluation of the proposed Cycle 22 reload which denies CPC's requested changes to Section 5.2.1 of the Big Rock Point Technical Specifications concerning changes to the core operating limits tables to reference use of Reload I-2 fuel.

2.0 BACKGROUND

2.1 Core Description

Big Rock Point (BRP) is the oldest commercial BWR still in operation, having started up in 1962. The plant is a BWR-1 rated at 240 MWt or about 72 MWe (gross), but has been restricted to a lower power level during much of its operating history because of restrictive core thermal limits.

Although BRP is fundamentally similar to current BWR designs, there are some significant differences in design and mode of operation:

1. The BRP reactor core is small, the active region being about six feet in height and six feet in diameter. An advantage of this is a very stable, leakage controlled power distribution as compared to modern plants whose core volume is about eight times larger. To compensate for the high leakage associated with the small core, reactivity (K-infinity) and hence fuel enrichment must be higher than for most later plants.

2. Although shorter, BRP fuel assemblies are wider than modern plants (7½" pitch versus ~ 6"). The BRP 11 x 11 assembly is roughly the same in rod diameter and pitch as the modern 8 x 8 BWR assembly. Because of the larger assembly, the ratio of control rods to interior assemblies is one to two rather than the typical one to four, i.e. a "D" lattice.

3. BRP has external recirculation loops with constant velocity pumps, therefore flow control is not employed, and maneuvering is done entirely with control rods. This is a disadvantage as far as plant flexibility, but greatly simplifies predictive physics analysis and power distribution surveillance.

4. BRP has only 32 control rods, as opposed to around 200 in the large modern plants. Since the reactivity inventory is about the same as a larger plant, individual control rod worths are generally larger for BRP. During operation, banking the control rods in groups of greater than two rods would result in unacceptable axial power shapes, so that X - Y symmetry is limited to half core rotational, rather than quadrant or octant.

5. LPRMs are present but they are not part of the reactor protective system. A high flux trip is provided by three excore detectors.

6. In-core power distribution measurements are provided by the activation of flux wires, rather than a movable TIP detector. There are only eight measurement locations arranged in four symmetrically located pairs. These are employed to verify calculated axial power shapes, but because of the small number of locations, they are not considered useful for radial power measurements.

7. The primary coolant system is pressurized to 1350 psi versus the typical 1000 psi. Maximum exit void fractions are about 55%, which is much lower than modern plants.

8. There is no on-line power distribution monitoring system comparable to later plants. The LPRMs are used to monitor changes in power distribution, but there is not an on-line thermal margin calculation.

The Cycle 22 core loading consists of 20 fresh I-2 assemblies (identical to I-1), 20 once-burned I-1 assemblies, 20 twice-burned H-4 assemblies, 18 twice-burned H-3 and H-2 assemblies, two four-times-burned H-1 assemblies and four reconstituted H-2 assemblies which were irradiated earlier for two cycles. A description of the fuel comprising the Cycle 22 reload is provided in Table 1 (from Reference 3).

TABLE 1

CYCLE 22 CORE LOADING

FUEL TYPE	NO. CYCLES IN CORE	NO.OF ASSEMBLIES	INITIAL U235 ENRICHMENT	INITIAL FUEL DENSITY	INITIAL RADIAL GAP(MIL)	BOC 22 ** EXP(GWD/T)
H-1	4	2	3.15	93.5	9.5	19.6
H-2	3	2	3.43	93.5	9.5	16.1
H-3	3	16	3.43	94.0	9.5	16.6
H-2[A]	2	4	3.43	93.5	9.5	9.6
H-4	2	20	3.43	94.0	9.5	12.0
I-1	1	20	3.43	94.0	7.5*	5.7
I-2	0	20	3.43	94.0	7.5	0

* Excludes Special Test Rods

** Based upon outage starting 10/24/86

A Reconstituted Bundles H201, H202, H204, H205

3.0 EVALUATION OF HAFNIUM HYBRID CONTROL BLADE DESIGN

The staff's evaluation of the proposed changes relating to inclusion of hafnium hybrid control rods in the core will be included in a separate licensing action.

4.0 PROPOSED CHANGES TO TECHNICAL SPECIFICATIONS

Section 5.2.1(b), Table 1

Current Reload	Proposed Reload
I1	I1/I2

Section 5.2.1(b), Table 2

Current Reload	Proposed Reload
I1	I1/I2

5.0 Evaluation of Core Operating Limits

The limiting core thermal-hydraulic conditions were evaluated as a function of Cycle 22 exposure increments using the approved methodology. Based on the Cycle 22 safety analyses, the licensee concluded that the core limiting operating conditions are based on peak heat flux early in the cycle, then on MCPR until the MAPLHGR limit becomes controlling at the Cycle 22 exposure level of 5.0 GWD/ST. Limiting values, including approved uncertainty factors, determined by the licensee (Ref. 3), are provided in Table 2. Power derating of the reactor is necessary in order to meet the operating limits determined by the safety analyses. The licensee imposes these operating limits, which are more restrictive than the Technical Specification values, by administrative procedures. Thus, steady state operation at conditions which could lead to violation of safety limits (based on the safety analyses) is prevented only by administrative procedures not by Limiting Conditions for Operation set forth in the Technical Specifications. The staff finds this to be unacceptable.

TABLE 2

LIMITING CORE POWER VERSUS CYCLE EXPOSURE

EXPOSURE (GWD/ST	POWER (THERMAL MW)	LIMITING FACTOR
0	215	Heatflux = 294,060 BTU/Hr-ft^2
.5	213	Heatflux = 292,190 BTU/Hr-ft^2
1.0	233	MCPR = 1.768
2.0	237	MCPR = 1.782
3.0	230	MCPR = 1.793
4.0	227	MCPR = 1.767
5.0	224	MAPLHGR = 89.11 %
6.0	217	MAPLHGR = 90.73 %
6.25	212	MAPLHGR = 91.89 %

Limits including uncertainty

MCPR > 1.743 (1.763 for I fuel)$_2$
Heat Flux < 294,420 BTU/Hr - ft
MAPLHGR Ratio < 92.16 %
Bundle Power < 96.23 %

6.0 CONCLUSIONS

The staff has reviewed the Technical Specification change request and the additional information submitted by CPC in response to staff requests. The staff will provide its evaluation of the proposed changes to Technical Specification Sections 5.1.1 and 5.1.2 to permit the inclusion of hafnium hybrid control rods in a separate action.

The staff finds the proposed changes to Technical Specification Section 5.2.1, Tables 1 and 2 (defining the operating limits for the new reload (I-2) fuel), to be unacceptable. Based on the reviewed submittals (References 1 and 3), the staff concludes that operation at the current Technical Specification limit could result in violation of the safety limit for the most limiting transients. The staff, therefore, denies this proposed license amendment. The core operating limit values in the Technical Specifications must be defined consistent with the safety analyses for the reload core in order to conform with 10 CFR 50.36 and 50.59 of the Commission's regulations.

7.0 REFERENCES

1. Letter from K. W. Berry, Consumers Power Company, to the Director, Nuclear Reactor Regulation, NRC, December 5, 1986.

2. Letter from R. R. Frisch, Consumers Power Company to the Director, Nuclear Reactor Regulation, NRC, December 29, 1986.

3. Letter from R. R. Frisch, Consumers Power Company, to the Nuclear Regulatory Commission Document Control Desk, January 20, 1987.

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