Consumers
Power
Company

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

January 22, 1969

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

Re: Docket 50-155
DPR-6 ZEK

Dear Dr. Morris: Attention: Mr. D. J. Skovholt

Transmitted herewith are three (3) executed and thirty-seven (37) 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.

The proposed change (No 16) will enable Consumers Power Company to insert into the reactor at Big Rock Point a fuel design, designated Reload "E-G," which incorporates gadolinium oxide burnable poison in four fuel rods in each bundle to provide reactivity control supplemental to the reactor's control rods. This modification of the Reload "E" design will permit the attainment of longer intervals between refueling and higher fuel burnups, within the limitations of the Big Rock Point Plant control rod system.

The attached discussion of the Request for Change to the Technical Specifications of License DPR-6 is divided into two parts. Exhibit I contains a general discussion of the proposed change, its effect on the hazards considerations and conclusions. Exhibit II contains the details of the gadolinia loading which, for the reasons stated below, the General Electric Company wishes to keep confidential.

In Exhibit I, Section II, of the Request for Change to the Technical Specifications No 16, it is stated that gadolinium oxide burnable poison is carried in four fuel rods to provide supplemental reactivity control. The details regarding the loading of the gadolinia in this fuel are considered to be confidential proprietary information of General Electric Company. This information was generated by General Electric at its expense, is of substantial competitive value to General Electric so long as kept from publication, and involves an invention or inventions believed patentable and on which one or more patent applications will be filed. Publication of this information would destroy the competitive value of the information and destroy foreign patent rights on the invention. Accordingly, it is hereby requested that the USAEC withhold Exhibit II from public disclosure in accordance with 10 CFR 2.790 (b).

It is believed that withholding the attached Exhibit II from public inspection is not contrary to the public interest. The provisions of 10 CFR 2.790 (b) state that the withholding of information from public inspection does not "affect the right of persons properly and directly concerned to inspect the document." Thus, Section 2.790 (b). by its terms, recognizes a distinction between the right of the public at large and that part of the public which is "properly and directly concerned." In view of the fact that Section 2.790 (b) fully protects the interest of persons properly and directly concerned, it is submitted that the public interest test established by the third sentence of Section 2.790 (b) can relate only to the interest of members of the general public who have not made a showing and they are properly and directly concerned. We believe that the interests of the general public are fully protected since Exhibit I of the request, which will become part of the public record, includes sufficient information to enable any person to determine whether he falls within the category of "persons properly and directly concerned."

It is our intent to insert Reload "E-G" fuel into the Big Rock Point reactor during our next refueling outage which is currently scheduled for April 1969. We would, therefore, be most appreciative of an expeditious handling of this Request for a Technical Specification Change so that we might receive approval before April 1, 1969.

Very truly yours,

Gerald J. Walke

GJW/map

Gerald J. Walke
Supervisory Engineer

CONSUMERS POWER COMPANY

Docket No 50-155

Request for Change to the Technical Specifications

License No DPR-6

For the reasons hereinafter set forth, it is requested that the Technical Specifications of License DPR-6 issued to Consumers Power Company on May 1, 1964, for the Big Rock Point Nuclear Plant be changed as follows:

I. Section 5

A. In Section 5.1.5, change "(c)" to read as follows:

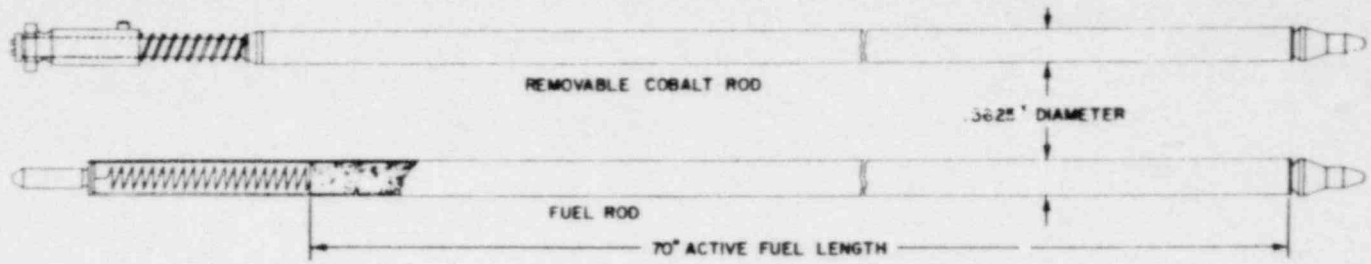
(c) Fuel Bundles

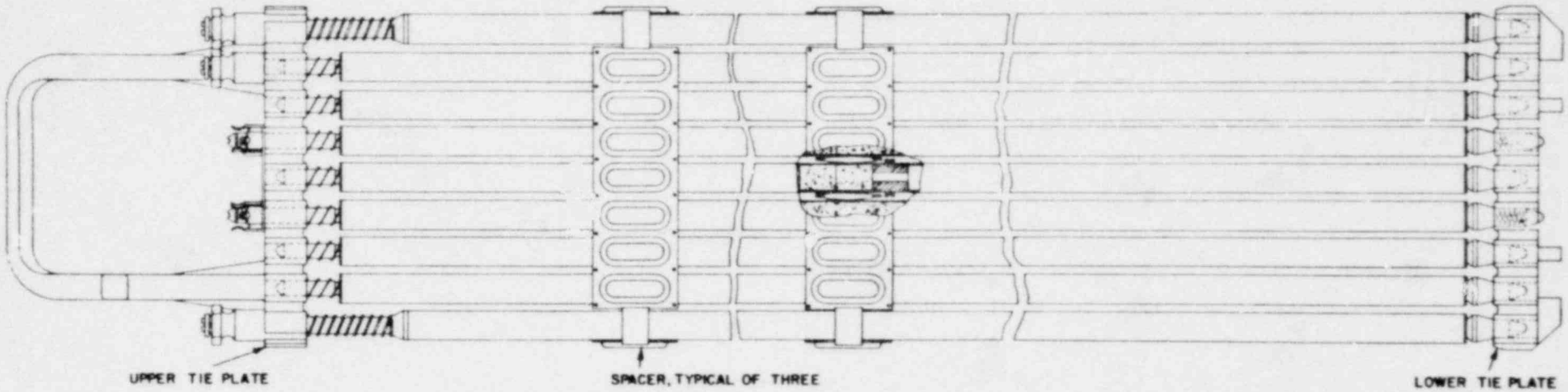
"The general dimensions and configuration of the seven types of fuel bundles shall be shown in Figures 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, and 8.1 of these specifications. Principal design features shall be essentially as follows:"

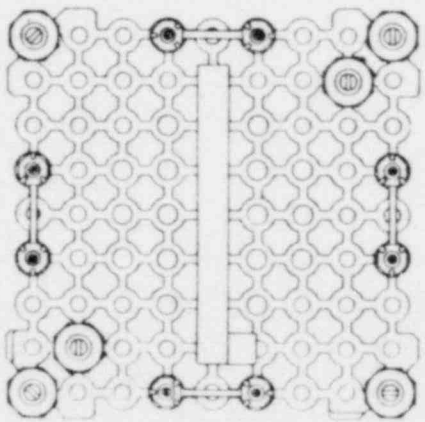
B. In Section 5.1.5, replace Figure 5.7 with the attached revised Figure 5.7.

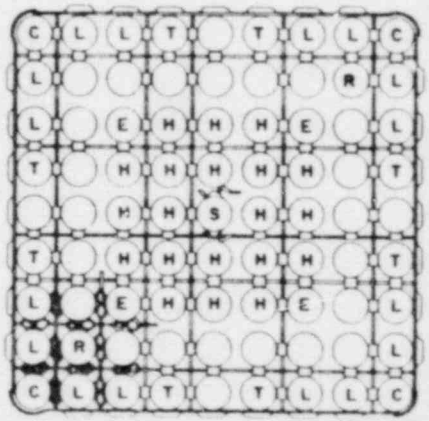
C. In Section 5.1.5, replace the present table of fuel bundle parameters with the attached revised table.

D. In Section 5.2.1 (b), in column titled "Reload 'E' Fuel," change to "Reload 'E' and 'E-G' Fuel."









S - SPACER CAPTURE ROD (HIGH ENRICHMENT)
H - HIGH ENRICHMENT RODS
- MIDDLE ENRICHMENT RODS
T - TIE RODS (MIDDLE ENRICHMENT)
L - LOW ENRICHMENT POWER CORRECTION RODS
C - REMOVABLE COBALT RODS

E-FUEL

R - REMOVABLE FUEL RODS (MIDDLE ENRICHMENT)
E - MIDDLE ENRICHMENT RODS

E-G FUEL

R - REMOVABLE FUEL RODS LOW ENRICHMENT
E - HIGH ENRICHMENT RODS

FIGURE 5.7 BIG ROCK POINT E AND E-G FUEL

5.1.5 (Contd)

	FUEL BUNDLES					Research and Development	
General	Original (A)	Reload B & C	Reload E	Reload E-G	"D" Fuel	Centermelt Intermediate	Centermelt Advanced
Geometry, Fuel Rod Array	12 x 12	11 x 11	9 x 9	9 x 9	11 x 11	8 x 8	7 x 7
Rod Pitch, Inches	0.533	0.577	0.707	0.707	0.580	0.807	0.921
Standard Fuel Rods Per Bundle	132	109	74	70	109	36	29
Special Fuel Rods Per Bundle	12[1]	12[2]	7[3]	11[5]	12	28[4]	20[4]
Spacers Per Bundle	3	5	3	3	7	5	5
Fuel Rod Cladding							
Material	304SS	Zr-2	Zr-2	Zr-2	304SS, Zr-2 Inconel 600 and/or Incoloy 800	Zr-2	Zr-2
Standard Rod Tube Wall, In.	0.019	0.034	0.040	0.040	0.010 to 0.030 Inclusive	0.035	0.040
Special Rod Tube Wall, In.	0.031	0.031	0.040	0.040	0.010 to 0.030 Inclusive	0.035	0.040
Fuel Rods							
Standard Rod Diameter, In.	0.388	0.449	0.5625	0.5625	0.425	0.570	0.700
Special Rod Diameter, In.	0.350	0.344	0.5625	0.5625	0.320	0.570	0.700
UO_2 Stacked Density, Percent Theoretical	94 ± 1	94 ± 1 Pellet 85 Powdered	90-95 Pellet	94 Pellet[6]	90-95, Inclusive	94 Pellet 85 Powder	94 Pellet 85 Powder
Active Fuel Length, Inches							
Standard Rod	70	70	69.75	70	68 to 70, Inclusive	66-67.3	65-66.3
Special Rod	59 (Corner)		64.6 Central	64.9 Central			
Fill Gas	Helium	Helium	Helium	Helium	Helium	Helium	Helium

[1] Four Special Fuel Rods at Bundle Corners Are Segmented.
[2] Reload B,C,E and E-G Fuel Bundles May Contain (in the corner regions of the bundle) Four Zr-2 Tubes Having Encapsulated Cobalt Targets Sealed Within.
[3] Reload E and E-G Fuel Bundles Have A Special Central Fuel Rod to Which the Bundle Spacers are Fixed. In addition, two of the interior bundle fuel rods are removable.
[4] Special Rods Have Depleted Uranium.
[5] In Addition to Special Rods for Reload E, Reload E-G Has Four Gadolinia Containing Rods.
[6] With 3% Dishing on Selected Rods.

EXHIBIT I

II. Discussion - Reload "E-G" Fuel

A. Fuel Description

The Reload "E-G" fuel is essentially identical physically to the Reload "E" fuel. The only differences being, an increase in the enrichment to enable the fuel to achieve approximately 20,000 Mwd/T compared to approximately 15,000 Mwd/T for the "E" reload; and the addition of gadolinium oxide burnable poison to four fuel rods to provide the required supplemental reactivity control.

This modification to the Reload "E" fuel has not increased the hazards associated with this plant and, in fact, it has increased margin-to-core-damage conditions through reduction in control blade strength, reduction in core excess reactivity and comparable void coefficients.

Over 200 General Electric designed and manufactured assemblies containing gadolinia are in operation in the Dresden I Nuclear Power Station. In addition, two assemblies containing gadolinia have been irradiated in the Big Rock Point reactor. The performance of these assemblies, both mechanically and nuclearly, has been as expected and has provided confirmation of design bases of gadolinia-containing fuel.

B. Fuel Thermal Data

All fuel pellets are standard density, ~95%, with selected rods containing 3% dishes; therefore, the standard thermal conductivity data are used for all fuel rods:

$$\int_{0^\circ C}^{2805^\circ C} KdT = 93 \text{ W/cm}$$

For the small concentrations of gadolinia involved, UO_2 properties are applied in the thermal and mechanical design of the gadolinia-containing rods. The gadolinia rods operate at specific powers less than 80% of the hottest rod in a bundle.

C. Fuel Physics Data

The principal nuclear characteristics of Reload "E-G" fuel have been calculated and are compared to Reload "E" fuel on Table 3. The reactivity values for the "E-G" fuel at all conditions are lower than for "E" fuel, resulting in ample core shutdown margin. The temperature coefficient of the "E-G" fuel is less positive than for the "E" fuel. The control rod strength with "E-G" fuel is reduced from the "E" fuel. The core will be

most reactive at the start of the cycle when there is calculated to be ample shutdown margin. The gadolinia initially controls 9% k_∞ of a bundle. A reference core containing 20 "E-G" fuel bundles has been analyzed. Approximately 3% Δk_{eff} core is initially controlled by the gadolinia. The gadolinia is designed to burn to near zero neutron absorption prior to the end of the first operating cycle that the fuel is in the reactor. Calculations show a slight decrease in core reactivity through the depletion of the gadolinia and a normal decrease thereafter. At no time does the core reactivity increase during burnup of the gadolinia.

D. Thermal-Hydraulic Data

The thermal-hydraulic characteristics of the Reload "E-G" fuel are essentially identical to the Reload "E" fuel. The only differences are slightly lower (a few percent) total peaking factors.

Because of the difficulty of predicting core configurations in the presence of the R&D fuel in Big Rock Point, specific core analyses [illegible] during the refueling outages, after fuel inspection and [illegible] start-up. These analyses assure that all license limits are met [illegible] selected core configuration.

[illegible]

Based upon the above analyses and comparisons with "E" fuel, the following conclusions may be drawn:

1. The mechanical design of the "E-G" fuel is essentially identical to the "E" fuel which is a well proven concept and has proven very satisfactory based on experience with the "E" fuel to date in the Big Rock Point reactor.

2. The thermal-hydraulic performance of the "E-G" fuel will be essentially identical to that of the "E" fuel. The local and axial power distribution will be about the same or slightly lower peaking for the "E-G" fuel. Thermal-hydraulic calculations show that there is ample critical heat flux margin throughout a representative cycle (refer to the Reload "E" submittal).

3. At the proposed license limit of a maximum fuel rod heat flux of 500,000 Btu/hr-ft^2 (at 122% overpower), no fuel melting is expected. This is the same maximum heat flux as for the "E" fuel.

4. The "E-G" fuel design contributes to greater margin-to-core-damage conditions through reduction in control blade strength, reduction in core excess reactivity and comparable void coefficients.

5. The consequences of a loss-of-coolant accident or a rod drop accident are no more severe with "E-G" fuel than with "E" fuel. Safe performance of "E" reload fuel was demonstrated in the "E" license submittal.

Based upon the above considerations, we have concluded that the use of Reload "E-G" fuel in the Big Rock Point reactor does not present a significant change in the hazards considerations described or implicit in the Final Hazards Summary Report.

CONSUMERS POWER COMPANY

By: R C Youngdahl
Vice President

Date January 22, 1969

Sworn and subscribed to before me this 22nd day of January 1969.

[illegible] Warner
Notary Public, Jackson County, Michigan
My commission expires January 15, 1972

EXHIBIT I - TABLE 1

RELOAD "E-G" FUEL DATA

	Fuel Rods	Cobalt Rods
Fuel Pellet Diameter	0.471	-
Rod Pitch, Inches	0.707	0.707
Cladding Thickness, Inches	0.040	0.040
Clad Outside Diameter, Inches	0.5625	0.5625
Active Fuel Length, Inches	70.0; Central Rod, 64.9	-
Fuel Material	UO_2	-
Fuel Density, % of Theoretical	95	-
Cladding Material	Zr-2	Zr-2
Number of Rods per Bundle	77	4
Enrichment (See Figure 5.8)	Low - 2.5%	-
	Middle - 3.4%	-
	High - 4.5%	-
Fill Gas	Helium	-

Fuel Bundle

Fuel Rod Array	9 x 9
Weight UO_2 per Bundle, Pounds	346
Moderator-to-Fuel Volume Ratio	2.39
Number of Spacers	3

EXHIBIT I - TABLE 2

THERMAL PERFORMANCE CHARACTERISTICS OF
RELOAD "E-G" FUEL

Fuel Pellet Diameter, Inches	0.471
Cladding Thickness, Inches	0.040
Cladding Outside Diameter, Inches	0.5625
Incipient Melting Temperature of UO_2, ^{o}F	5080
Fuel Density, % Theoretical	95
Fuel Center Line Temperature at 500,000 Btu/Hr-Ft^2, ^{o}F	5040
Fuel Center Line Temperature at 410,000 Btu/Hr-Ft^2, ^{o}F	4250
Heat Flux for Incipient Melting, Btu/Hr-Ft^2	>500,000
Area Fraction Molten at Peak Heat Flux	0

EXHIBIT I - TABLE 3

COMPARISON OF PRINCIPAL CALCULATED NUCLEAR CHARACTERISTICS
OF "E-G" FUEL WITH
COBALT AND GADOLINIA

		"E-G"	"E"
Reactivity (k_∞)			
68° F		1.208	1.268
572° F, 0 Voids		1.203	1.280
572° F, 25% Voids		1.183	1.262
Temperature Coefficient $\Delta k_{eff}/k_{eff}$ per °F at 77° F			
Start of Cycle		$+ .27 \times 10^{-4}$	$+ .38 \times 10^{-4}$
Void Coefficient $\Delta k/k$ per Unit Void Within Channel			
Cold (68° F)		- .08	- .07
Hot (572° F)		- .12	- .11
Doppler Coefficient $\Delta k_{eff}/k_{eff}$ per °F			
Fuel Temp	Moderator		
68° F	68° F, 0 Voids	$- 1.3 \times 10^{-5}$	$- 1.3 \times 10^{-5}$
1323° F	572° F, 0 Voids	$- 1.0 \times 10^{-5}$	$- 1.0 \times 10^{-5}$
1323° F	572° F, 25% Voids	$- 1.2 \times 10^{-5}$	$- 1.2 \times 10^{-5}$

FROM:
Consumers Power Company
Jackson, Michigan
(Gerald J. Walke)

TO:
Dr. Peter A. Morris

DATE OF DOCUMENT: Jan 22, 1969
DATE RECEIVED: Jan 27, 1969
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FILE CODE: 50-155 (Input Form Prepared)

DESCRIPTION (ABSTRACT):
Ltr trans proposed Change #16 to the tech specs enabling the licensee to insert into the reactor a fuel design, designated as Reload "E-C" ..... (40 cys each)

ENCLOSURES:
REQUEST FOR CHANGE TO THE TECH SPECS

EXHIBIT I - THERMAL PERFORMANCE CHARACTERISTICS OF RELOAD "E-C" FUEL

EXHIBIT II - DESCRIPTION OF GADOLINIA LOADING FOR RELOAD "E-C" FUEL (GE PROPRIETARY) — w/held per our 2-26-69 See Business Conf. File

REMARKS:
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EXHIBIT II ONLY

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