Consumers Power Company

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

December 18, 1970

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

Re: Docket 50-155
DPR-6 ZEK
Proposed Tech Spec
Change 23

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

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.

This proposed change (No 23) will enable Consumers Power Company to insert into the reactor at Big Rock Point an instrumented fuel rod which will allow cladding temperature in a representative fuel bundle to be monitored. This information will be useful in the analysis of crud laydown rates and heat transfer phenomena associated therewith.

It is our intention to insert the instrumented rod into the Big Rock Point Reactor during our next refueling outage which is currently scheduled for February 1971. We would, therefore, be most appreciative of an expeditious handling of this Request for a Technical Specifications Change so that we might receive approval before January 15, 1971.

Yours very truly,

Gerald J. Waller

GJW/map

Nuclear Fuel Management Administrator

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CONSUMERS POWER COMPANY

Docket No 50-155

Request for Change to the Technical Specifications

Change No 23

License No DPR-6

For the reasons hereinafter set forth, the following changes to the Technical Specifications of License DPR-6 issued to Consumers Power Company on May 1, 1964, for the Big Rock Point Nuclear Plant are requested:

I. Changes: Section 8

A. In Section 8.1, change the first paragraph to read as follows: "The general dimensions and configuration of the developmental fuel designs shall be as shown in Figures 8.1 through 8.5. Principal design features shall be essentially as on Table 8.1."

B. In Section 8.1, add Figure 8.5, Big Rock Point F Fuel with Instrumented Fuel Rod.

C. Add a new Section 8.1.3:

"8.1.3 Instrumented Fuel Bundle

One reload-F fuel bundle may be modified to include an instrumented fuel rod. The instrumented fuel rod shall incorporate reload-F design and fabrication features except that provision shall be made to locate thermocouples in the fuel rod and to extend thermocouple leads from the rod to a penetration seal in the reactor pressure vessel head.

Nuclear and thermal hydraulic characteristics of the instrumented fuel bundle shall be the same as for the reload-F bundles."

D. In Section 8.2, add the attached column and footnotes to Table 8.1.

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Section 8.2, Table 8.2 (Column and footnotes to be added):

	"Reload (F) With Instrumented Fuel Rod
General	
Geometry	9 x 9
Rod Pitch, Inch	0.707
Standard Fuel Rods per Bundle	69
Special Fuel Rods per Bundle	12(8)
Spacers per Bundle	
Fuel Rod Cladding	
Material	Zr-2
Standard Rod Tube Wall, Inch	0.040
Special Rod Tube Wall, Inch	0.040 and 0.060(9)
Fuel Rods	
Standard Rod Diameter, Inch	0.5625
Special Rod Diameter, Inch	0.5625
Fuel Stacked Density, Percent Theoretical	94 Pellet(8)
Active Fuel Length, Inches - Standard Rod	70
- Special Rod	64.9 Central 68.4 Instrumented
Fill Gas	Helium

(8) Same as E-G fuel except that the bundle contains an instrumented fuel rod.

(9) Instrumented fuel rod is clad with tubing having 0.060-inch wall. Tubing contains axial grooves on inner surface. The depth of the grooves is 0.020 inch."

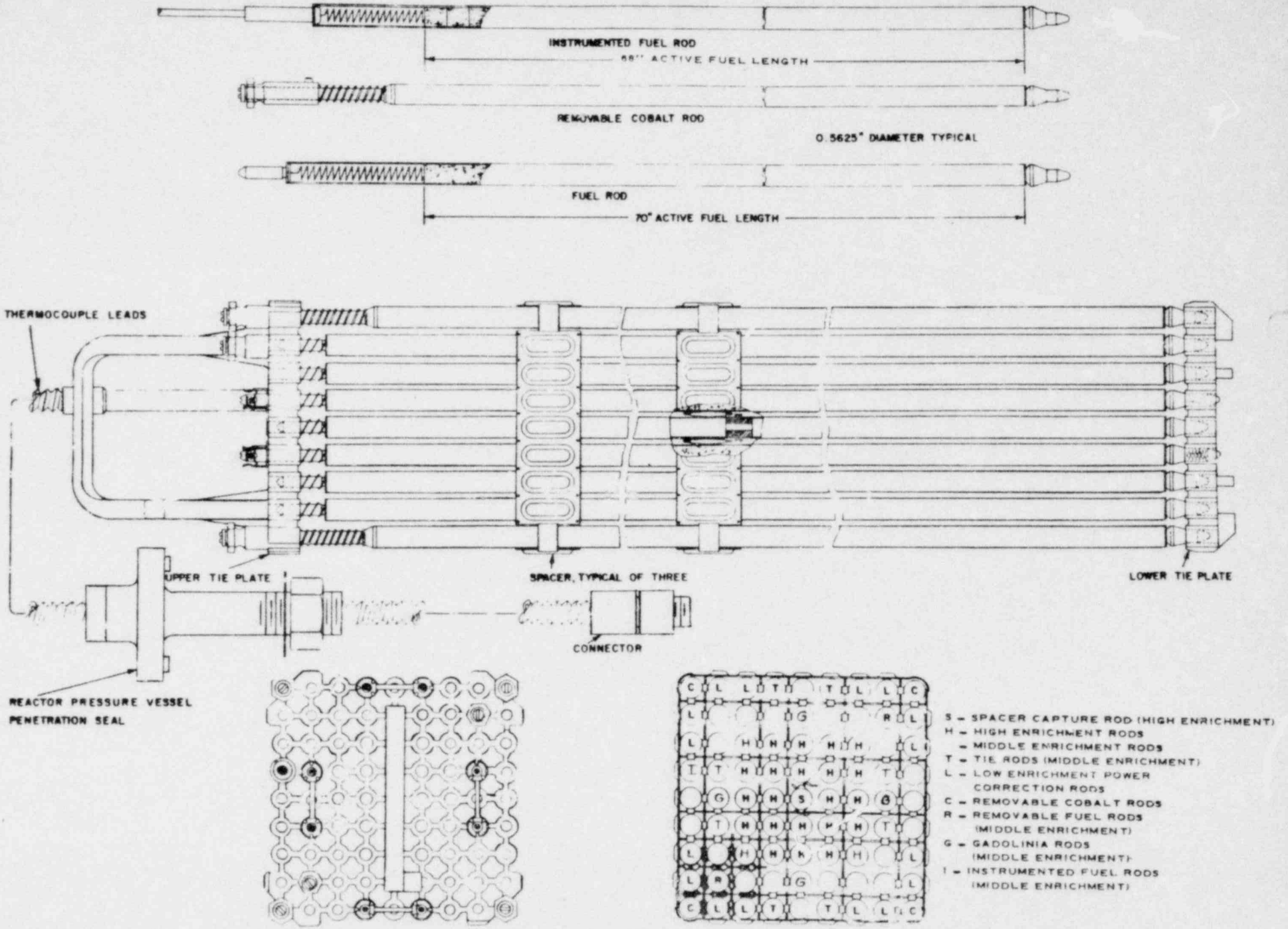

Figure 8.5

BIG ROCK POINT F FUEL

WITH INSTRUMENTED FUEL ROD

II. Discussion - Instrumented F Fuel Rod

A. Program Description

One reload-F fuel bundle will be modified to include an instrumented fuel rod.

A summary of program elements is shown below:

1. Modify a reload-F fuel bundle

   a. Remove the upper tie-plate and one fuel rod.

   b. Install an instrumented fuel rod and a new upper tie-plate which has been modified to permit extension of the thermocouple lead out of the fuel rod.

2. Irradiate the instrumented fuel bundle for one to three reactor cycles.

3. Remove the instrumented fuel rod and conduct a post-irradiation examination.

4. Depending on the bundle reactivity after irradiation of the instrumented rod, the bundle will either be stored as spent fuel or returned to the core as a power producing element. If the bundle is returned to the core, a conventional type-F fuel rod and upper tie-plate will be installed.

B. Fuel and Instrumentation Description

The design, nuclear, and thermal-hydraulic characteristics of the instrumented F bundle will be essentially the same as standard Reload-F bundles. However, slight changes will be required to permit placement of thermocouples in the instrumented fuel rod and extension of thermocouple leads from the fuel rod to a penetration seal in the reactor head. Details are shown in Figures 1, 5.13 and the fuel characteristic table. Differences between the instrumented fuel bundle and Reload-F bundles are summarized below:

1. A standard type-F upper tie-plate will be modified. The modification will consist of the addition of a sleeve which permits extension of thermocouple leads through the tie-plate. The modification will not interfere with the function of the tie-plate as a structural element and will not affect nuclear or thermal-hydraulic characteristics of the bundle.

2. The upper end-plug of the fuel rod will be changed to permit extension of thermocouples out of the fuel rod. A tandem-extruded Zr-2 to stainless steel transition will be welded to the end-plug. Thermocouples will extend through the end-plug and transition and be sealed in a stainless steel over-sheath. The over-sheath will be welded to the Zr-2 to stainless transition. The over-sheath and thermocouples are part of the lead-out assembly which will extend from the instrumented fuel rod to the reactor head.

   Both the lead-out assembly and tandem-extended transition incorporate design features from previous in-core development activity and current General Electric reactor control instrumentation.

   Tandem-extruded joints between Zircaloy and austenitic stainless steel have been tested and found suitable for use in fuel elements for thermal spectrum reactors.[1)] The lead-out assembly is similar to the instrumented fuel assembly used in the Big Rock Point Reactor during the Research and Development phase and incorporates design features of the current General Electric in-core sensors.

3. Thickness of the fuel cladding will be increased to 0.060 in. Axial grooves will be cut on the inner surface of the cladding. Stress analyses of the cladding for the instrumented fuel rod indicate that cladding integrity will not be compromised by the use of thick wall tubing and the presence of axial grooves.

4. The diameter of the UO_2 pellets in the instrumented fuel rod is less than the diameter of Reload-F fuel. Fuel enrichment will be increased so that the power factors for the instrumented rod are nearly equal to standard F fuel.

5. Thermocouple leads will extend from the instrumented fuel rod to a penetration seal in the reactor head. The leads will run from the central region of the core upwards through an existing opening in the steam baffle. The routing will be to the same as was used during irradiation of the instrumented fuel assembly listed in Section 3.0 of the Technical Specifications.

C. Nuclear Design

Analyses of the instrumented F bundle indicate that the nuclear properties of the instrumented rod and the instrumented bundle will be the same as Reload-F fuel.

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[1] Busboom, H. J. and M. E. Snyder, "Fabrication and Testing of Dissimilar Metal Joints for Thermal Spectram Superheat Reactors," GEAP-4756, December 1964.

D. Thermal Design

The thermal properties of the instrumented F bundle are essentially identical to the Reload-F fuel. As in the F-fuel, a 122% overpower condition will produce fuel centerline temperatures which exceed the melting point of UO_2. The worst condition exists at the end of Cycle 1 when operation at 122% overpower, 500,000 BTU/hr-ft^2, would produce a fuel centerline temperature of 5276°F [2]. However, fuel porosity and the presence of 3% dishes in each fuel pellet provide sufficient space to absorb volumetric increases due to transformation of state by the UO_2 fuel.

E. Thermal-Hydraulic Design

Thermal-hydraulic characteristics of the instrumented F bundle are the same as Reload F fuel. The instrumented rod has the same local and axial power factors as the F-rod which it replaces. Consequently, no changes in the critical heat flux margin will be encountered.

F. Accident Analysis

1. Reactivity Excursion Analysis: The response of the instrumented-F bundle to all postulated reactivity accidents is the same as the response of Reload-F fuel. The instrumented fuel rod was designed to be loaded into a Type-F fuel bundle without perturbing nuclear and thermal-hydraulic characteristics. The consequences of a reactivity excursion are no more severe for the instrumented-F bundle than for the Reload-F fuel.

2. Primary System Integrity: Analysis of primary system integrity is needed because thermocouple leads extend from the instrumented fuel rod through the reactor pressure vessel. Requirements which must be satisfied are that fission gasses be contained in the instrumented fuel rod and that coolant be contained in the pressure vessel.

   Fission gas and primary coolant containment requirements will be satisfied in a straightforward manner. As described previously, thermocouple leads will extend out of the fuel rod into an over-sheath. The over-sheath will be sealed against gas or fluid leakage by braze joints at both ends and at an intermediate position. The sheath will be attached to the instrumented fuel rod by a fusion weld and to the pressure vessel penetration by a braze joint.

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2) The maximum centerline temperature for the instrumented rod is 5276°F and is greater than the corresponding temperature in the F-fuel (VIZ 5203°F) because of differences in cladding thickness and in fuel diameter.

F. Accident Analysis (Cont.)

Fission products will be contained in the fuel rod by the braze seal at the lower end of the over-sheath. The seal will prevent fission gasses from traveling past the upper fuel rod end-plug. Redundant containment is provided by two additional braze seals located midway between the rod and the reactor penetration and at the upper end of the over-sheath.

Coolant will be contained in the primary system by the over-sheath and pressure vessel penetration seal. The over-sheath is protected from physical damage by a second sheath which consists of a flexible metallic bellows. The braze joint at the upper end of the over-sheath provides a redundant seal to contain reactor coolant if the over-sheath should be damaged.

The reactor penetration and instrument lead-out assembly is based on proven designs. The over-sheath assembly incorporates features used on the current General Electric in-core instrumentation. The configuration of the pressure vessel penetration seal and the method of extending leads out of the reactor from the instrumented rod was taken from the Instrumented Fuel Assembly used in the Big Rock Point Reactor during the Research and Development phase. Primary system integrity will not be compromised by the instrumented fuel rod.

3. Loss of Coolant Accident: The mechanical, nuclear and thermal-hydraulic characteristics of the instrumented-F fuel bundle will be equal to Reload-F fuel. Consequently, the response of the instrumented-F bundle to emergency procedures during a loss of coolant accident will be the same as the response of Reload-F fuel. The safety of F fuel during a loss of coolant accident was shown previously in data submitted for license change numbers 14 and 16.

G. Conclusions

Based on the preceding analysis and comparison with "F" fuel the following can be concluded:

1. The mechanical design of the instrumented fuel rod is the same as "F" rods except for changes required to install thermocouples. The changes will not adversely affect the performance of the instrumented fuel rod or the fuel bundle in which the rod is loaded.

2. The nuclear and thermal-hydraulic characteristics of the instrumented fuel rod are equal to the characteristics of "F" fuel. Nuclear and thermal-hydraulic properties of the "F" fuel will not be changed by the addition of the instrumented fuel rod.

G. Conclusions (Cont.)

3. The consequences of a reactivity excursion or loss of coolant accident are no more severe with the instrumented fuel rod in the core than with standard "F" fuel.

4. The integrity of the primary reactor system will not be compromised. Redundant coolant and fission gas seals protect the primary system in the event of equipment damage.

Based on the preceding considerations, we conclude that the addition of an instrumented fuel rod in the Big Rock Point Reactor does not present a significant change in the hazards consideration described or implied in the Final Hazards Summary Report.

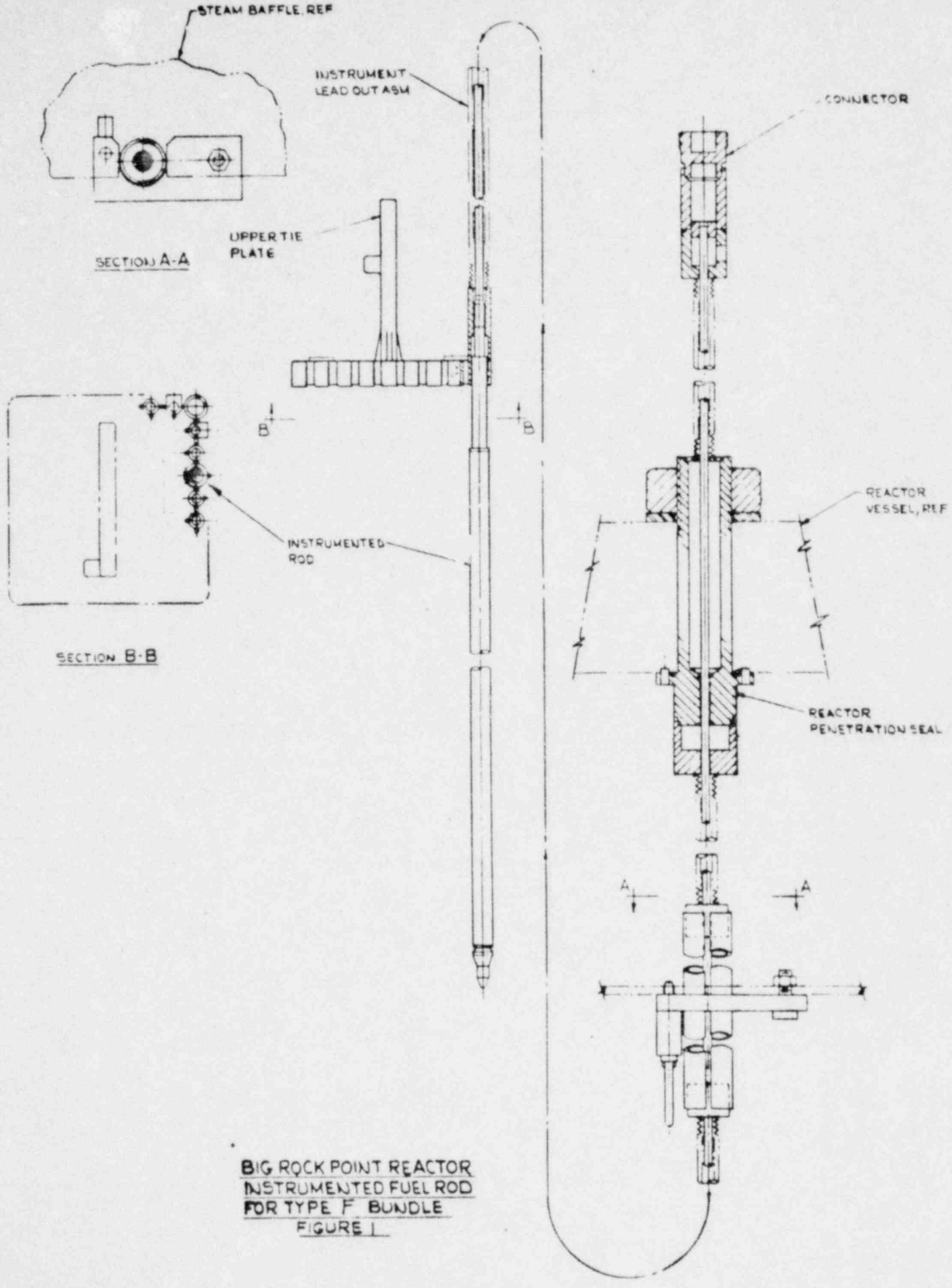
CONSUMERS POWER COMPANY

By H R Wahl
Senior Vice President

Date: December 17, 1970

Sworn and subscribed to before me this 17th day of December 1970.

Grace R Warner
Notary Public, Jackson County, Michigan
My Commission Expires January 15, 1972



BIG ROCK POINT REACTOR
INSTRUMENTED FUEL ROD
FOR TYPE F BUNDLE
FIGURE 1

FROM:
Consumers Power Co.
Jackson, Mich.
Gerald J. Walker

DATE OF DOCUMENT: 12-18-70
DATE RECEIVED: 1-4-71
NO.:
LTR. X MEMO: REPORT: OTHER:
notarized 12-17-70

TO:
Morris

ORIG.: CC: OTHER:
3 signed & 37 confid cys

ACTION NECESSARY ☐ NO ACTION NECESSARY ☐
CONCURRENCE ☐ COMMENT ☐
DATE ANSWERED:
BY:

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REG. NO.:

FILE CODE: 50-155 INput form

DESCRIPTION: (Must Be Unclassified)

Ltr trans the following req. change in Tech Specs to auth insertion of an instrumented fuel rod which will allow cladding temp. in a rep. fuel bundle to be monitored.

ENCLOSURES:
PROPOSED CHANGE # 23, notarized 12-17-70 to Tech. Specs...
40 cys

(Postmarked 12-30-70)

REFERRED TO	DATE	RECEIVED BY	DATE
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ACKNOWLEDGED

REMARKS:

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