Consumers Power Company

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

February 13, 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
Additional Information
for Proposed Tech Spec
Change No. 19

Dear Dr. Morris:

Attention: Mr. D. J. Skovolt

Transmitted herewith are 40 copies of a second set of additional information requested by your staff relative to the accident analyses of the "EEI-UO_2-PuO_2" fuel contained in our recently submitted Technical Specifications - Proposed Change No. 19 (12-22-69).

Proposed change (No. 19) will enable Consumers Power Company to insert into the reactor at Big Rock Point a fuel design designated as "EEI-UO_2-PuO_2" which will permit the irradiation of plutonium-uranium mixed oxide fuel. The purpose of this irradiation is to provide needed data on the operating characteristics of mixed oxide fuel with a statistically significant number of fuel rods.

It is our intention to insert no more than three "EEI-UO_2-PuO_2" fuel bundles into the Big Rock Point Reactor during our next refueling outage which is currently scheduled to begin February 16, 1970. We would, therefore, be most appreciative of an expeditious handling of this Request for a Technical Specifications Change so that we might receive approval as soon as possible.

Yours very truly,

G. J. Walke

GJW/dmb

Gerald J. Walke
Nuclear Fuel Management Administrator

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ADDITIONAL INFORMATION
Change No. 19
Consumers Power Company
Request for Change to the Technical Specifications
License No. DPR-6

Received date: 2-13-70

EFFECT OF BETA CHANGES ON REACTIVITY ACCIDENT

Accidents involving transients have typically been evaluated with an effective delayed neutron fraction which is not spatially dependent. The introduction of plutonium to the core has the effect of reducing the delayed neutron fraction and creating a potential for local regions with lower than average delayed neutron fraction. We have evaluated these effects through the use of an "effective delayed neutron fraction".

The average delayed neutron fraction is given by

$$\bar{\beta} = \frac{\sum_i P_i \beta_i \nu_i}{\sum_i P_i \nu_i}$$

where P_i is fission power in region i

ν_i is neutron/fission in region i

and β_i is delayed fraction in region i.

β_i implies an effective average over all the isotopes contributing (particularly U-235, Pu-239, and U-238).

An "effective" delayed neutron fraction is obtained by weighting the spatially dependent importance of neutrons contributing to the multiplication process (adjoint flux). We have approximated this weighting distribution by the power distribution and obtain:

$$\overline{\beta_{eff}} = \frac{\sum_i P_i^2 \beta_i \nu_i}{\sum_i P_i^2 \nu_i}$$

The following results are obtained for the power distributions associated with the Big Rock Point rod drop accident, for the case (Case A) of a single

plutonium bundle at the power peak next to the dropped rod and the other two bundles at average locations and for the case (Case B) with all three Pu bundles at the rod drop location.

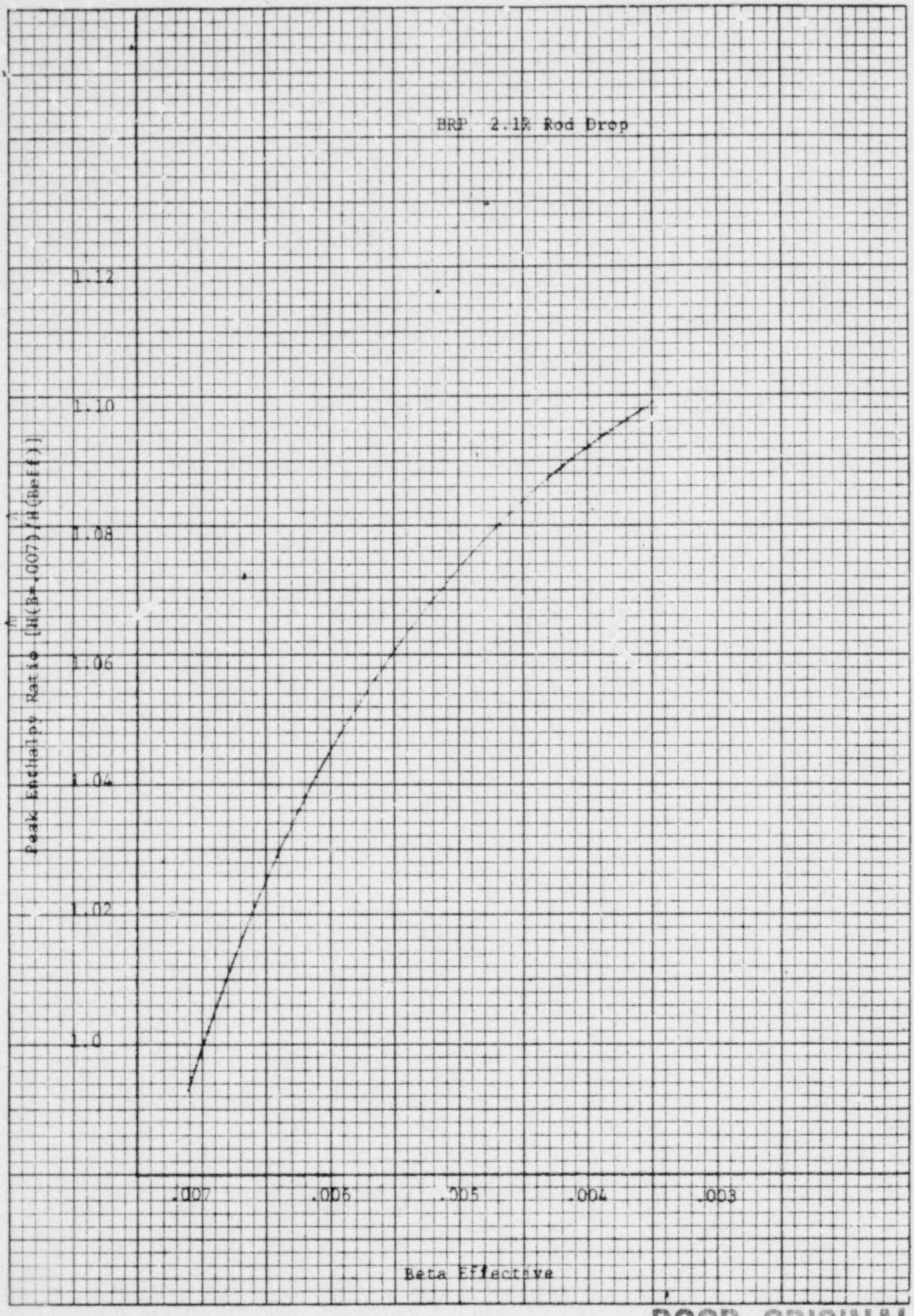
	Case A	Case B
Average $\beta, \bar{\beta}$	.589 %	.578 %
Effective β, $\overline{\beta_{eff}}$	.579 %	.550 %

These values are to be compared to values of .605% for the exposed uranium fuel and .385% for the fresh plutonium fuel assemblies. The value for fresh uranium assemblies is .724%.

The reduced $\overline{\beta_{eff}}$ has the effect of reducing the period for a given Δk inserted into the reactor. The relative enthalpy rise in a rod drop accident as a function of $\bar{\beta}_{eff}$ is shown in the attached figure. From this it can be seen that the effect of changing β_{eff} from uranium at .605% to three clustered Pu assemblies at .55% is about 1.3%. If one made the artificial assumption that β were that of the plutonium assemblies (.385%) the enthalpy increase would be about 5%. These results were calculated for same conditions used to calculate the accident in previous analyses.

The relatively small dependence on β can be understood by noting that in super-prompt critical excursion the excursion is turned around when the energy in the fuel is sufficient to compensate for $k_{excess}-\beta$. This is relatively slowly varying with β when k_{excess} is large. In addition, in ramp type accidents, the shorter period associated with smaller β turns the accident around with less reactivity inserted and therefore less energy inserted. This is a relatively small effect but is in the direction to diminish the effect of reductions in β.

February 13, 1970



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FROM:
Consumers Power Co.
Jackson, Mich.
Gearald J. Walke

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Morris

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40 cys each)

ENCLOSURES:
Addtl info to Change # 19, re: Effect of Beta Changes on Reactivity accidents (Consisting of 3 pages.

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