HAZARDS ANALYSIS BY THE RESEARCH AND POWER REACTOR SAFETY BRANCH

DIVISION OF LICENSING AND REGULATION

IN THE MATTER OF

COMMONWEALTH EDISON COMPANY

PROPOSED CHANGE NO. 4 - TYPE III FUEL RELOAD

Introduction

Commonwealth Edison Company has requested, by application dated August 5, 1963, authorization to load up to 200 Type III fuel assemblies in the Dresden reactor at the forthcoming refueling period. This change, which was considered by the staff pursuant to the provisions of Section 50.59 of 10 CFR 50, has been designated Proposed Change No. 4.

Background

On January 27, 1961, Commonwealth Edison Company requested revision of its license authorizing reactor operation with "Dresden Core I" to provide for the loading of 100 Type II fuel elements and 12 experimental fuel elements into "Dresden Core II." Subsequently, this request was modified in scope to request a reconstitution of "Dresden Core I" to permit the use of only two Type II fuel elements and one each of the 12 experimental elements, with the balance of the fuel to be Type I elements ("Dresden Core I, Modified"). The modified request was approved on June 9, 1961.

On August 6, 1962, on the basis of its application dated January 5, 1962, Edison was authorized to load up to 108 of the Type II stainless steel clad fuel assemblies into the Dresden reactor at the 1962 refueling period. Additional background material regarding this refueling may be found in the Division of Licensing and Regulation hazards analysis also dated August 6, 1962.

In the fuel reload now proposed, up to 200 Type III fuel elements would be used in the Dresden Core, up to 107 Type II elements, PF elements 8 through 12, and the remainder of Type I elements for a maximum loading of 488 elements.

Discussion

The proposed Type III fuel is quite similar to the original Type I fuel. The table on the following page presents a comparison of the characteristics of these two types of elements. The basic differences between the Type III fuel and the Type I fuel is that the Type III fuel rods are non-segmented, each contains 1500 ppm of Er_2O_3 burnable poison, and five rods in each fuel

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assembly have thickened clad and reduced diameter fuel pellets to reduce local power peaking due to control blade effects.

The fuel loading proposed is a scattered configuration similar to that used in loading the Type II fuel elements. Sketches of possible loading configurations are included in the application. Calculations by the applicant indicate that, with the maximum Type III loading proposed, the resulting core reactivity is expected to be less than that of the initial Dresden core. Further, the difference in reactivity is calculated to be greater than the reduction in control rod worth from that of the initial core. Thus, conditions arising from additions of reactivity to the core are expected to be less severe than those previously analyzed and found to be acceptable.

The temperature and void coefficients of reactivity of the Type III core have been calculated to be negative at operating temperatures (546°F), as was the case with previous cores. The void coefficient is expected to be negative for all temperatures and the temperature coefficient, which is positive at room temperature, is expected to become negative at about 315°F - 378°F. This is permissible under current license requirements. Additionally, the cold shutdown margin is expected to increase with core life since the erbium oxide burnable poison is calculated to deplete at a rate slower than that of the fuel with respect to reactivity worth.

Erbium oxide, which was not used in the initial Type I fuel, has been used in several of the experimental fuel bundles (PF-1, PF-2, and PF-10), previously irradiated at Dresden. Cladding failures of the PF-1 and PF-2 fuel rods have not been attributed to the presence of the burnable poison, and there has been no evidence to indicate that the use of Er_2O_3 as a burnable poison would be detrimental to safe operation.

Commonwealth Edison anticipates using a scattered fuel loading. Calculations of two possible scattered loadings under conditions of maximum primary and secondary steam flow rates at 125% power indicate that for all cases the burnout ratio will be greater than 2.0. The specific power of the Type I fuel elements, at a maximum steady state heat flux of 320,000 Btu/(hr)(ft^2), was limited to 14 Kw/ft. The Type III fuel, with a higher heat flux of 330,000 Btu/(hr)(ft^2), but with a smaller fuel pin diameter, will also generate the same specific power of 14 Kw/ft. Based upon a review of these calculations, the staff has concluded that thermal conditions expected for these loadings are not significantly different from previous loadings and are acceptable from a safety standpoint.

Hazards Evaluation

The safety evaluation submitted by the applicant considers situations with the new core involving additions of reactivity, loss of coolant, system stability, fuel cladding failure, and the maximum credible accident. With regard

TABLE 1. COMPARISON OF THE CHARACTERISTICS OF DRESDEN TYPE I AND TYPE III FUEL ASSEMBLIES

	Type I	Type III
Cladding		
Material	Zr-2	Zr-2
O.D., inches	0.567	0.555
Wall Thickness, inches	0.030	0.035*
Configuration	6 x 6	6 x 6
Regular Rods		
Number Required	36	31
% Fuel Composition	100% UO_2	99.85% UO_2
		0.15% Er_2O_3
% UO_2 Enrichment	1.5	1.83
Pellet Diameter, inches	0.498	0.478
Special Corner Rods		
Number Required	-	5
% Fuel Composition	–	99.85% UO_2
		0.15% Er_2O_3
% UO_2 Enrichment	-	1.83
Pellet Diameter, inches	-	0.438

*Wall thickness for the corner rods is 0.055 inches to reactivity additions, control rod worths are less with Type III than with Type I fuel. This results in less severe reactivity accidents attributable to rod motion than those previously analyzed. The loss of coolant accident analysis indicates that the minimum burnout ratios reached are larger than those previously calculated for all Type I loadings. The previous fuel cladding failure analysis for Type I fuel considered the potential consequences of failure of 4000 fuel element segments. The Type II and Type III rods are not segmented, so that the same consequences would result from failure of only 1000 of these types of rods. However, we believe that the factor of four decrease in the number of welds in Type II and Type III rods should adequately compensate for the increase of consequences of failure of single rods by decreasing the probability of such failures. Experimental evidence obtained through special testing and regular operation of the Dresden reactor indicates a large margin exists from conditions of instability. Operation with Type III fuel is not expected to contribute to any stability problems.

Due to the similarity between Type I and Type III fuel assemblies, it is expected that the use of Type III fuel will have a negligible effect on the safety or performance of the Dresden reactor. We have concluded that the use of Type III fuel will have no substantial effect on the probability or consequences of the maximum credible accident previously analyzed for this facility.

Technical Specifications

To provide authorization of Proposed Change No. 4, the technical specifications of License No. DPR-2 should be amended as follows:

1. Section B.2, page 1, in its entirety, as follows:

Nuclear Core

Maximum Core Diameter (circumscribed circle)	129 in.
Maximum active fuel length - cold	112 in.
Maximum number of fuel assemblies by types:	
Type I	352
Type II	107
Type III	200
Type PF-8 through PF-12 (one each)	5
Maximum total number of fuel assemblies	488

The various fuel assemblies may be located in any position of the reactor, provided overall core symmetry is preserved and provided that fuel assemblies Type PF-8 through 12 are each separated from any other such assembly by at least four Type I, Type II, or Type II fuel assemblies.

The reactor may be operated at any power up to and including rated power with any number of the various types of fuel assemblies installed, provided the maximum number and location are within the limits specified above.

2. Section B.3, page 2, second paragraph, as follows:

   The minimum fuel pellet density averaged over a fuel segment is 94% of theoretical for all fuel assemblies except PF-8 and PF-9 which have fuel densities 90% of theoretical.

3. The tabulation in Secton D.3, page 12, is amended to read as follows:

Fuel Type I	320,000
Fuel Type II	410,000
Fuel Type III	330,000
Fuel Type PF8 and PF-9	470,000
Fuel Type PF-10 through PF-12	510,000

4. Table II (revised December 31, 1961) is replaced by Table II (revised June 15, 1963) set forth in Commonwealth Edison's application dated August 5, 1963.

Conclusion

Based upon our review of the information submitted, we have concluded that operation of the reactor in accordance with the proposed change does not involve significant hazards considerations not described or implicit in the hazards summary report and that there is reasonable assurance that the health and safety of the public will not be endangered.

Accordingly, we believe that the technical specifications of License No. DPR-2 should be revised as indicated above.

Robert H. Bryan, Chief
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Division of Licensing & Regulation

Dated: DEC 1 8 1963