Rensselaer

Department of Nuclear Engineering & Engineering Physics

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Mr. Theodore S. Michaels
Decommissioning and Environmental Project Directorate
Non-Power Reactor
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Transmittal of Information Regarding the Calculation and Measurement of Technical Specification Parameters for Erbium Burnable Absorbers at the Rensselaer Polytechnic Institute Reactor Critical Facility.

Dear Mr. Michaels:

Attached is an Addendum, pages 11 and 12, to the presentation of technical information included in my letter to you of March 25, 1991.

Very truly yours,

D. R. Harris

Dr. D.R. Harris, Director
Reactor Critical Facility (RCF)

DRH:jjd
attachment pages 11 & 12
cc: J.M. Betancourt (C-E)
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ADDENDUM: Properties of cores with all SPERT fuel. 4/12/91.

The proposed measurments use the resident SPERT (F1) fuel as a driver for the CE fuel located at the center of the core. The lattice pitch for the driver was chosen such that a good spectral match is obtained with the CE fuel. In particular the k-infinities and temperature coefficients are similar in the two regions. The choice of pitch in both regions is such that the temperature coefficients are substantially more negative than in the technical specifications of the license, Ref.1.

The technical specifications parameters do not include the lattice pitch nor do the limiting conditions for operation, Ref.1. Hence the choice of any particular lattice pitch that produces parameters within the limits of the technical specifications will satisfy the safety analyses of the license. It was shown above that the proposed measurments do this with substantial margin and hence that no change in the license is required.

In the general description of the RCF, Ref.1, a particular lattice pitch (1.48cm) is however mentioned. This is slightly lower than the pitch of the driver (1.71cm) for the proposed measurments. Although not included in the proposed measurments, a core with all SPERT fuel of 1.71 cm pitch could conceivably require a license modification. It is shown in this addendum that this is not so.

Additional Calculations for an all-SPERT core of 1.71cm pitch.

The core proposed in the main text was modified by removing all CE fuel and replacing it by SPERT fuel to form a uniform core with 376 SPERT pins. This core was then calculated at 50,68 and 100 deg F with and without rods.

The all-SPERT core with a pitch of 1.48cm (Ref.1) mentioned in section 2.4 was also calculated to indicate the expected core performance for a range of pitches. In the range 1.48-1.71cm, the SPERT lattice is undermoderated. The larger pitch is expected to have the least negative ITC and the smallest rod worth.

Rod Worth at 68 deg F.

		Core with 1.48cm pitch	Core with 1.71 cm pitch
Worth	(N)	1880 pcm = 2.46$	1622 pcm = 2.12$
	(N-1)	1410 pcm = 1.84$	1216 pcm = 1.59$
Subcritical reactivity with one rod stuck out		1.24$	0.99$
Shutdown margin, 4 rods		1.86$	1.52$

As expected the worth is somewhat lower for the higher pitch. Both are however comfortably within the technical specifications as shown in Table 1, section

2.6. The proposed cores have rod worths slightly higher than the all-SPERT core at the 1.71 cm pitch.

It may be noted that the proposed measurments do not include any unsecured experiments and do not therefore require the assumption of an excess reactivity of 0.60$ as assumed in computing subcritical reactivity and shutdown margin.

Temperature Coefficients

Since the higher pitch will have the least favorable ITC, this quantity was not recalculated at the 1.48 cm pitch. The following results were obtained for the 1.71 cm core:

Temperature deg F	ppm	k-effective
50	200	1.00600
68	200	1.00529
100	200	1.00379

Clearly, the temperature coefficient is negative in this entire interval as well as above 100 deg F. Furthermore, comparing with the corresponding results for the proposed cores, section 2.5, it is also clear that, as expected the temperature coefficients are quite similar.

Voidcoefficients have not been calculated for the all-SPERT cores but it is expected that the local value in Table 1, since it was calculated in the driver, will be quite similar to the value for the all-SPERT core with a 1.71 cm pitch.

Conclusion

It has been shown that, at a slightly higher pitch than that currently described in Ref.1, the rod worth and temperature coefficient will comfortably remain within current technical specifications. It should be noted that all temperature coefficient results in this report are unbiased. ABB/CENP methods, as documented in Ref.4, do normally predict slightly too positive coefficients In a critical experiment where the leakage is a large component of the neutron balance, the situation might however be different. To ensure that temperature coefficients remain within technical specifications they will be measured. Existing measurments on the 1.48cm core indicate a negative ITC of about -10 pcm/deg F.