Thus, the indium wires experienced epicadmium activation of

$$\text{epicadmium activation} = \frac{1}{CR - 1} = 0.14^{\underline{6}} \ .$$

We chose to assume that this relatively small fraction of epicadmium activation attenuated approximately as the thermal-neutron activation. Because of the complexity of the mockup mixtures (see Table I in the Note), which were selected to mock up the 2200 m/s absorption cross section of UO_2 at various enrichments, detailed account of the behavior of epithermal absorption was not attempted. One can only set an extreme upper bound to the possible error introduced by epithermal neutrons by assuming no attenuation in the absorbing material. For example, for the 0.953-cm-diam rod mocking up the 5% enrichment, the upper bound correction is to reduce the reported value of 0.86 to

$$\frac{0.86 - 0.15}{1.00 - 0.15} = 0.83^{\underline{5}} \quad ,$$

or, hence, a 3% decrease from the reported measured value. This extreme correction would only reduce the 100% enrichment value (the worst case) from 0.43 to 0.33, still a large factor away from the <0.001 value suggested by Sullivan.[2]

While we will admit possible underestimates of the true thermal-neutron flux depression by our mockup experiments, we believe that our results are representative of the actual situation.

James E. Gibson
J. N. Anno

University of Cincinnati
Department of Chemical and Nuclear Engineering
Cincinnati, Ohio 45221

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FURTHER COMMENTS ON "THERMAL-NEUTRON FLUX DEPRESSION IN CYLINDRICAL UO_2 FUEL RODS"

Reference 1 discusses two possible correction factors, both of which would tend to reduce the measured flux ratios reported in Ref. 2, in the direction indicated by the calculations presented in Ref. 3. The correction due to the perturbation caused by the central indium wire must be small since it occupies <1% of the rod volume even for the smallest rods measured (0.25 in. in diameter).

The correction due to epithermal-neutron activation was estimated in Ref. 1, using 7.7 as the measured cadmium ratio at the site of the experiment and assuming this value is appropriate for both low- and high-enrichment rods. A second assumption was that the epicadmium activation attenuates approximately as the thermal-neutron activation, which is equivalent to assuming that the cadmium ratios at the surface and at the center of the rods are the same.

Both of the above assumptions appear questionable for the range of measurements reported in Ref. 2. For rods with low absorption, the cadmium ratio at both the surface and the centerline is probably close to the measured value in the unperturbed flux. For highly absorbing rods, one would expect the cadmium ratio *even at the rod surface* to be considerably reduced due to two effects:

1. Spatial shielding of the indium wire surface facing the rod, which, as an upper limit for a flat wire surrounding a thermally black rod, would reduce the thermal activation by a factor of 2.

2. The depression of thermal flux in the moderator, which, for highly absorbing rods, is probably the most important effect.

As shown by the calculations made in Ref. 1, the correction to the measured centerline-to-edge thermal flux ratio is larger for highly absorbing rods and could become very large as the cadmium ratio approaches one.

To a first approximation, the assumption that the epicadmium activation attenuates approximately as the thermal-neutron activation is probably adequate for low enrichment rods when epicadmium neutrons account for a small fraction of the activations. For highly enriched rods, a much larger fraction of the activations will be from epithermal neutrons, and a measurement of the surface and centerline cadmium ratios in the presence of the experiment would appear to be necessary.

Raymond P. Sullivan

NUS Corporation
Energy Systems Division
4 Research Place
Rockville, Maryland 20850

February 1, 1980

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