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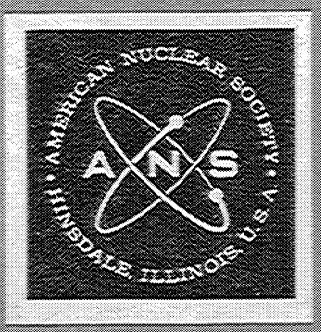

TRANSACTIONS

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NUCLEAR CRITICALITY SAFETY

1. Criticality of U(3.85) Rods and Cylindrical Annuli in Water, *E. B. Johnson (UCC-ND)*

In recent years the Oak Ridge Critical Experiments Facility has reported data for large uranium-metal cylindrical annuli of 1.95% enrichment in ^{235}U with water moderator and reflector.[1,2] These studies have been extended to metal enriched to 3.85% in ^{235}U, both as solid rods and as cylindrical annuli.

The outside diameters of the annuli were 7.2, 6.2, and 5.2 in., with inside diameters of 2.6 in. Solid rods slightly less than 2.6 in. in diameter could be inserted into these annuli to produce effectively solid rods of each of the three outside diameters. All rods and annuli were 30 in. long.

These rods and annuli were latticed in water in both square and triangular patterns, each at several spacings to determine the effect of moderation on criticality. The units in each lattice were arranged in the manner most favorable for criticality so that the minimum number required was determined. The units in subcritical arrays were similarly arranged. Curves for each of the two patterns were obtained for each of the three diameter annuli and for each of the four diameter rods. In each case, the number of rods and the mass required for criticality was greater for solid rods than for annuli of the same outside diameter. Figure 1 shows a typical curve for the 7.2-in.-o.d. rods and annuli. Criticality was achieved by the addition of water, in the absence of control rods, and the reactivity associated with a single rod; hence, the increments of reactivity by which a lattice could be adjusted were large. As a result, only a few lattices were critical when completely reflected by water and it was necessary to interpolate, on the basis of the height of water at criticality, between two lattices, one supercritical and the other subcritical when completely water-reflected, that differed by one rod in order to arrive at an estimate of a critical lattice at that spacing.

It was reported[1] that the number of rods required for criticality in a square pattern of the U(1.95) cylindrical annuli, 7.2-in. o.d. and 2.6-in. i.d., was a factor of 2 greater (at optimum moderation) than that for these annuli arranged in triangular patterns. In the present case, the same effect was observed but the magnitude was reduced to a factor of about 1.3 for the larger diameter annuli. However, for the same outside diameter (7.2 in.), the minimum critical number of solid rods was a factor of 1.7 greater when arranged in a square pattern than when in a triangular pattern.

1. E. B. JOHNSON, *Trans. Am. Nucl. Soc.*, 9, 185 (1966).
2. E. B. JOHNSON, "Critical Parameters of U(1.95) Metal Cylindrical Annuli," *Neutron Physics Div. Annual Prog. Rept. for Period Ending May 31, 1966*, ORNL-3973, Vol. I, p. 15, Oak Ridge National Laboratory (1966).

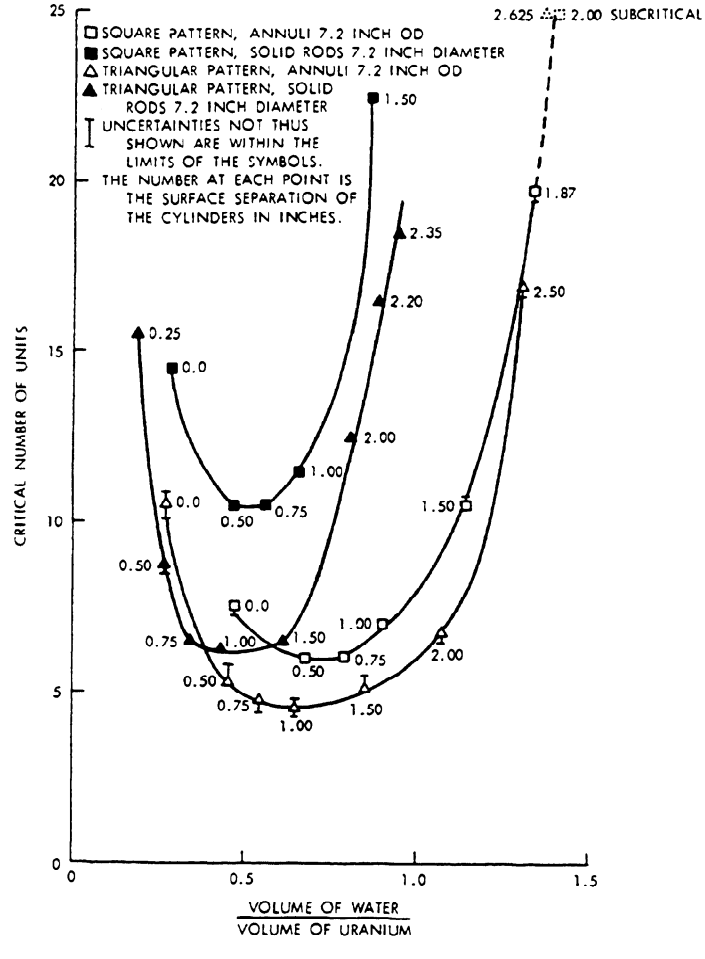

Fig. 1. Critical lattices of U(3.85) annular cylinders and solid rods moderated and reflected by water. The outside diameter of the rods and annuli was 7.2 in.; the inside diameter of the annuli was 2.6 in.