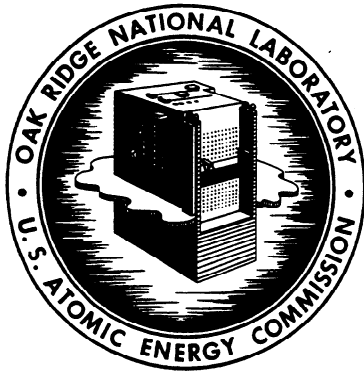


E. B. JOHNSON, "CRITICAL DIMENSIONS OF ARRAYS OF AQUEOUS URANYL FLUORIDE SOLUTION CONTAINING URANIUM ENRICHED TO 5% IN ²³⁵U," IN "NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 1, 1965," OAK RIDGE NATIONAL LABORATORY REPORT ORNL-3858 (NOVEMBER 1965), PP. 15, 16.

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OAK RIDGE NATIONAL LABORATORY

operated by

UNION CARBIDE CORPORATION

for the

U.S. ATOMIC ENERGY COMMISSION

2.6 CRITICAL DIMENSIONS OF ARRAYS OF AQUEOUS URANYL FLUORIDE SOLUTION CONTAINING URANIUM ENRICHED TO 5% IN ^{235}U

E. B. Johnson

The program concerned with the determination of critical parameters of aqueous uranyl fluoride solution containing uranium enriched to 4.98% in ^{235}U is being continued. Experiments with cylinders of solution at a concentration of 901 g of uranium per liter ($H:^{235}\text{U} = 496$) contained in aluminum and having no hydrogenous reflector have been reported.¹

In more recent experiments critical arrays have been assembled in which the $\text{U}(4.98)\text{O}_2\text{F}_2$ solution at the same concentration was contained in 10.75-in.-diam polyethylene bottles having a capacity of about 25 liters. Since these bottles are used for storage and for intraplant transfer of uranium solutions of low enrichment, the results of these experiments form bases for safe and economic handling criteria although the geometry of the units is not amenable to calculation. The bottles were molded polyethylene of varying wall thicknesses (0.25 in. at the bottom and 0.10 in. at the top) with a concave upward bottom and a screw cap. Each bottle contained about 1.1 kg of ^{235}U in 24 liters of solution.

Planar arrays of these units in square and triangular patterns were critical under the conditions indicated in Fig. 2.6.1. It should be emphasized that although the side and bottom reflectors were in contact with the bottle surfaces the top reflector, when present, was about 10 in. from the top of the solution because of the bottle caps. Nine units in a line and in contact were subcritical when completely surrounded with polyethylene. The array of 32 units, surrounded on five sides with 6-in.-thick polyethylene, shown in Fig. 2.6.2, was critical at a surface separation of 8.33 in. between rows. A similar array containing only 16 units, arranged in two rows of eight units each, was critical at a separation of 6.65 in. between rows when surrounded on five sides with 6-in.-thick polyethylene. The effect of Plexiglas centered between the rows of the array with the separation between rows equal to 6 in. was determined; Fig. 2.6.3 indicates that the optimum

thickness of Plexiglas was about 0.75 in. The relative effects of materials such as concrete, wood, Plexiglas, foamed plastic, and Foamglas as reflectors for this enrichment were determined by substitution in one side of the reflector.

Reference

¹E. B. Johnson and D. F. Cronin, *Neutron Phys. Div. Ann. Progr. Rept. Aug. 1, 1964*, ORNL-3714, vol. I, p. 31.

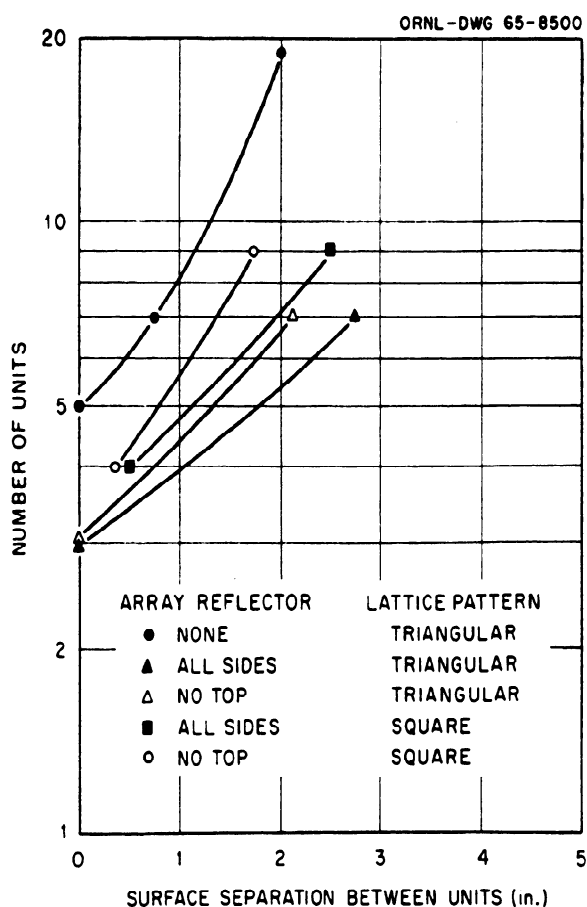


Fig. 2.6.1. The Critical Planar Arrays of Aqueous $\text{U}(4.98)\text{O}_2\text{F}_2$ Solution at a Concentration of 901 g of Uranium per Liter Contained in 10.75-in.-diam Polyethylene Bottles. The reflector was 6-in.-thick polyethylene.

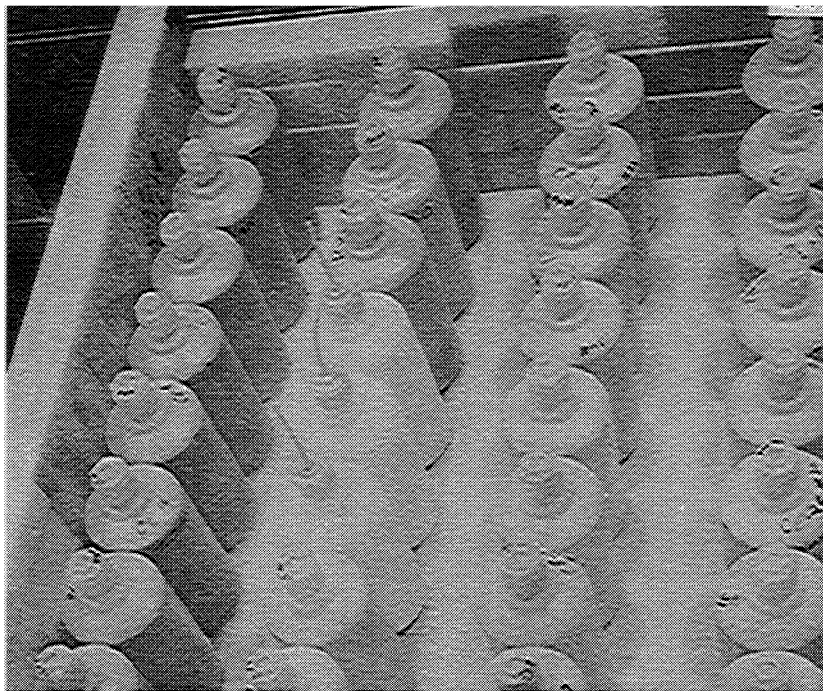


Fig. 2.6.2. An Array of Thirty-Two Units of Aqueous $U(4.98)O_2F_2$ Solution at a Concentration of 901 g of Uranium per Liter Contained in Polyethylene Bottles and Surrounded on Five Sides by 6-in.-Thick Polyethylene.

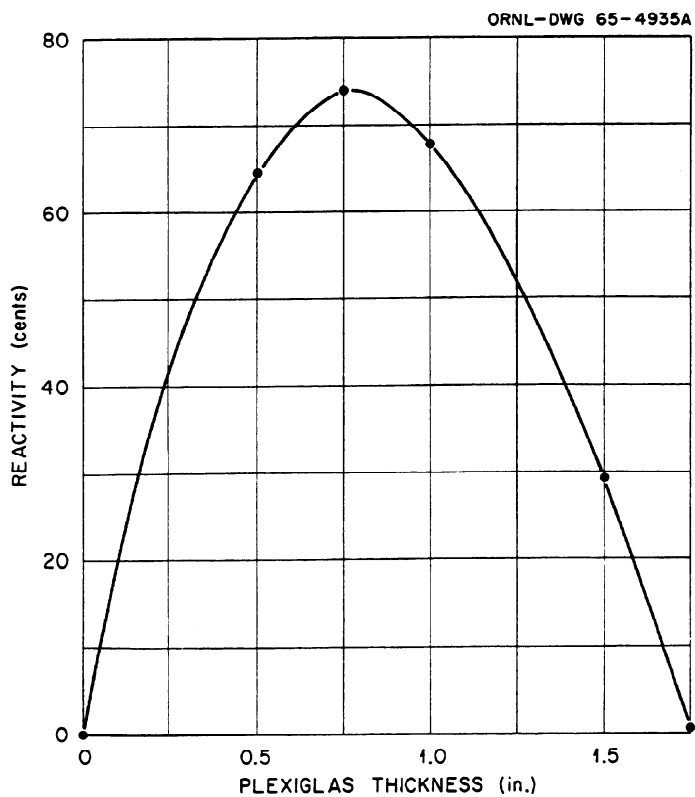


Fig. 2.6.3. Reactivity Introduced by Plexiglas Centered Between the Rows of a Reflected Array of Polyethylene Bottles of Aqueous $U(4.98)O_2F_2$ Solution at a Concentration of 901 g of Uranium per Liter.