REFERENCE 181

J. T. THOMAS, "CRITICALITY OF ^{233}U AQUEOUS NITRATE SOLUTION IN REFLECTED AND UNREFLECTED ARRAYS," TRANS. AM. NUCL. SOC. 10: 538-539 (1967).

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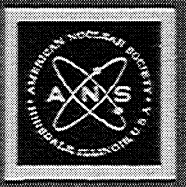

TRANSACTIONS

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5. Criticality of ^{233}U Aqueous Nitrate Solution in Reflected and Unreflected Arrays, *J. T. Thomas (ORNL)*

Uranium-233 nitrate solution at a concentration of 333 g U/liter (325 g ^{233}U/liter) was utilized in a brief study to determine the critical parameters of arrays of subcritical components each containing 4.30 liters of solution. The data are directly applicable to nuclear safety specification and serve as bases to evaluate models and methods of computing such systems. Similar experiments with ^{235}U have been reported.[1] The containers were cylindrical, fabricated of 0.25-mm-thick stainless steel, and had outside diameters and heights of 18.28 and 17.67 cm, respectively. The capacity of a container was 4.63 liters. The solution had a specific gravity of 1.468, an H:^{233}U atomic ratio of 73, and the uranium isotopic content reported in Table I.

All assembled arrays were three-dimensional, having an equal number of units along the three directions of the array. Each cylinder was supported in an array, with its axis vertical, by a 1.6-mm-thick aluminum plate positioned in space on four stainless-steel rods of 5-mm diam. The reflector material surrounding an array of cylinders was polyethylene (ρ = 0.93 g/cm^3), used in a 15.2-cm thickness only and located from the peripheral cylinders of the array of distance equal to one-half the surface separation between cylinders. The center-to-center spacing of the units in 8- and 27-unit arrays for both the reflected and the unreflected conditions are presented in Table II.

TABLE I

Isotopic Analysis of Uranium

Isotope	wt%	Isotope	wt%
^{233}U	97.54	^{236}U	0.001
^{234}U	1.047	^{238}U	1.386
^{235}U	0.026	^{232}U	(6.47 ppm)

TABLE II

Criticality Parameters for Unreflected and Reflected Arrays of 1.432-kg Units of Uranyl Nitrate Solution Containing 97.6% ^{233}U.

Number of Units in Array	Polyethylene Reflector Thickness (cm)	Center-to-Center Separation of Units		Average Uranium Density (g/cm^3)	KENO Code k_{eff}
		Horizontal (cm)	Vertical (cm)		
8	0	20.44	19.13	0.179	0.991 ± 0.005
27	0	25.72	24.57	0.088	1.007 ± 0.005
8	15.2	31.95	30.36	0.046	--
27	15.2	41.03	38.57	0.022	--

Monte Carlo calculations of the unreflected arrays using the KENO[2] code with the Hansen-Roach[3] 16-group cross-section set for ^{233}U have been accomplished and agree well with experiment. These values of k_{eff} are also given in Table II.

1. H. C. PAXTON et al., "Critical Dimensions of Systems Containing U^{235}, Pu^{239}, and U^{233}," TID-7028, Div. Tech. Info. Exten., USAEC (1964).

2. G. E. WHITESIDES, Oak Ridge Computing Technology Center, Private Communication (1967).

3. G. E. HANSEN and W. H. ROACH, "Six and Sixteen Group Cross Sections for Fast and Intermediate Critical Assemblies," LAMS-2543, Los Alamos Scientific Laboratory (1961).