REFERENCE 55

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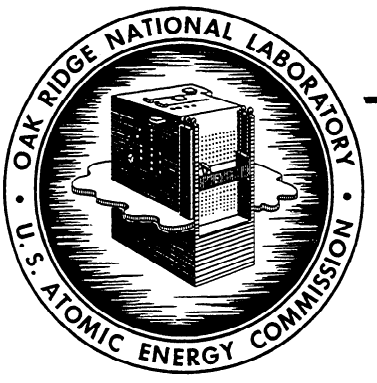

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3.4 CRITICAL PARAMETERS OF BARE AND REFLECTED 93.4 wt % U^{235}-ENRICHED URANIUM METAL SLABS

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The critical thicknesses of slabs of 93.4 wt % U^{235}-enriched uranium metal have been measured in a series of neutron multiplication experiments. The uranium metal had a density of 18.7 g/cc and was in the form of machined parallelepipeds. The effect of Plexiglas as a neutron reflector was determined, and a limited number of measurements with beryllium and graphite reflectors were made.

The experimental arrangement is shown in Fig. 3.4.1. The separable "split table" apparatus of the ORNL Critical Experiments Facility was modified by mounting on one half of the

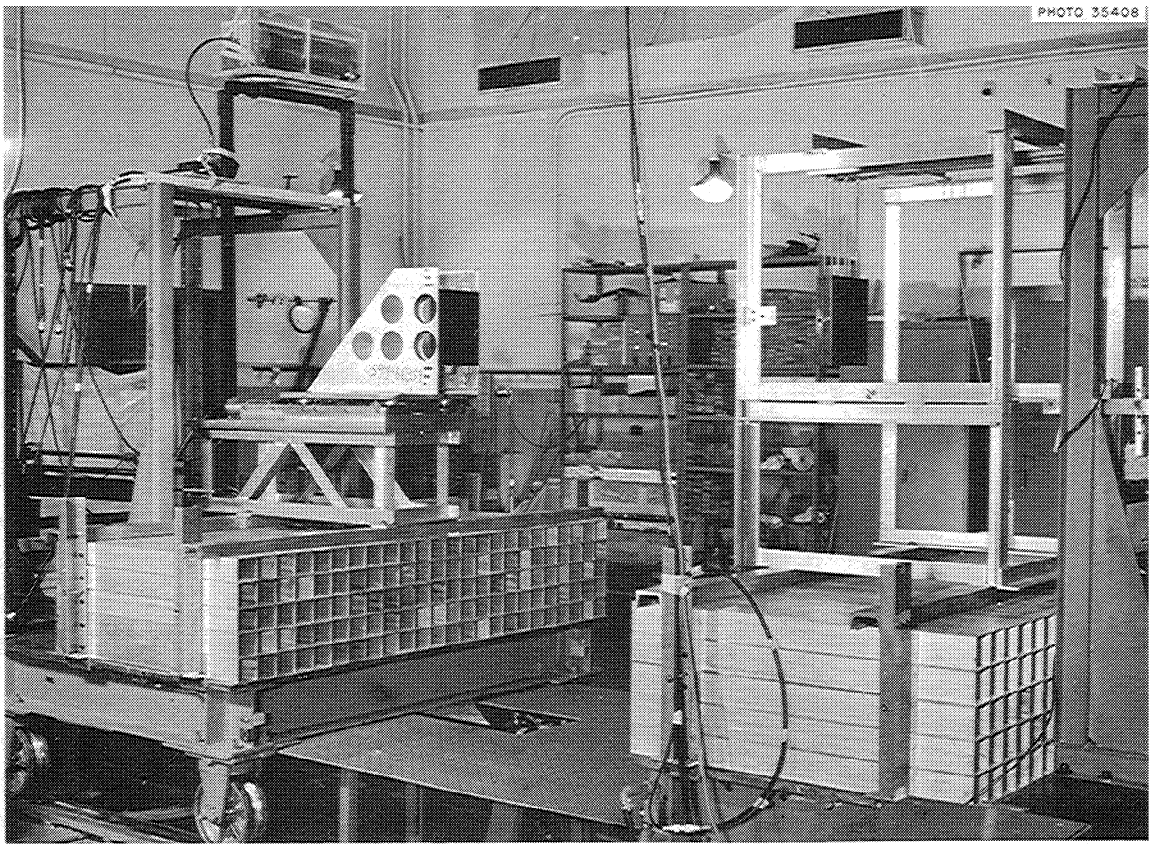

Fig. 3.4.1. Experimental Arrangement.

table a smaller, independently movable, aluminum table. A frame was attached to the other half of the table, and the experimental material divided between small table and frame. As the assembly was completed by bringing the small table against the frame, a strong spring was compressed against the small table. When the magnets which held the components together were de-energized by a scram signal, the spring repelled the small table at an initial rate of 1 in. in ~60 msec. The rapid initial separation enhanced the safety factor inherent in the use of the divided table.

The strength of the Po-Be neutron source was $\sim 10^7$ neutrons/sec. Three BF_3 gas-filled counters placed around the assemblies were used to measure the neutron multiplication. The critical mass of U^{235} as a function of the thickness $/\sqrt{\text{area}}$ ratio is shown in Fig. 3.4.2, while Table 3.4.1 gives critical thicknesses and critical masses for reflected and unreflected slabs of

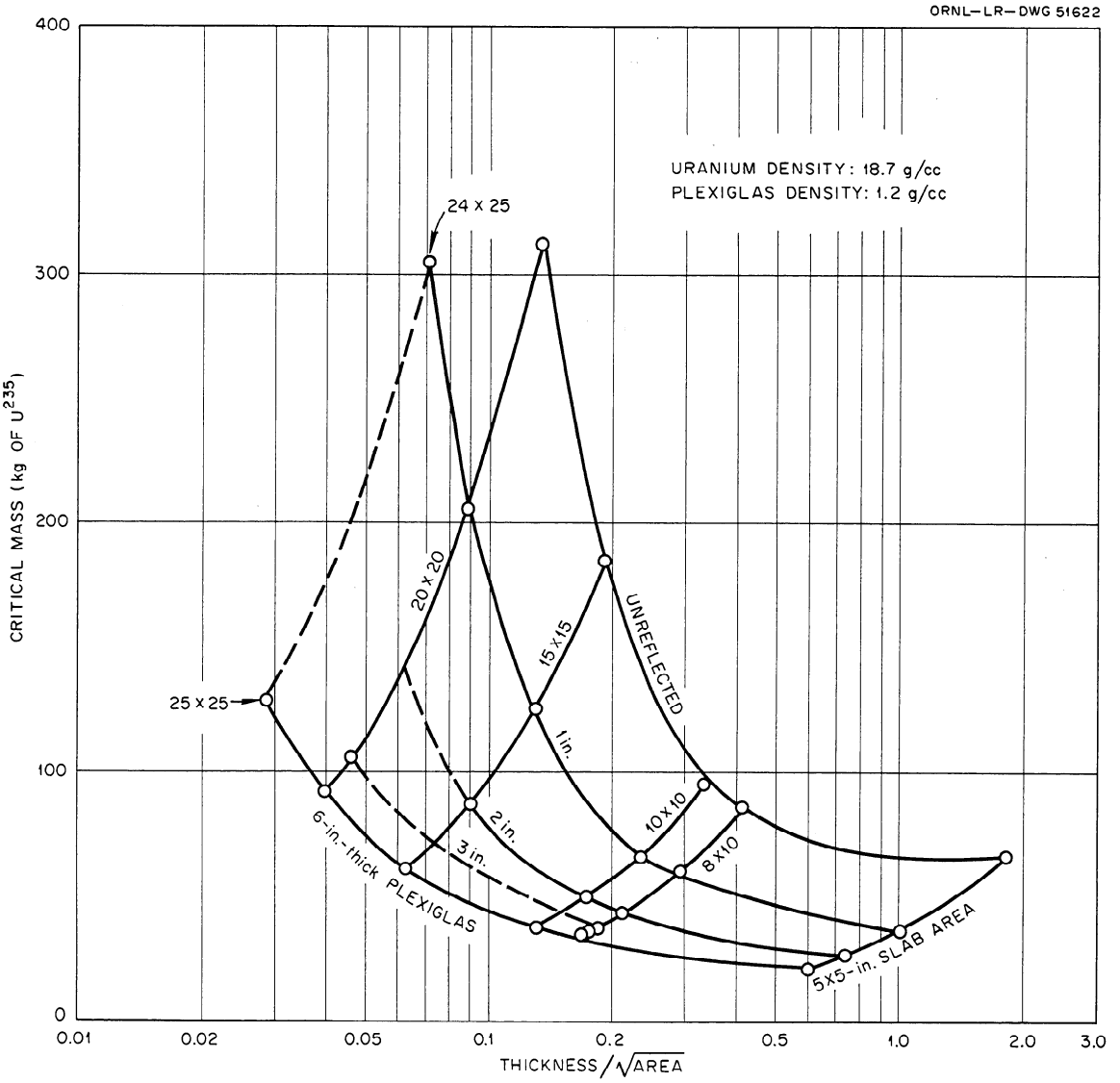

Fig. 3.4.2. Critical Mass of U^{235} as a Function of Parallelepipedal Geometry for Bare and Plexiglas-Reflected Slabs.

Table 3.4.1. Critical Thickness and Critical Mass of Slabs of 93.4 wt % U^{235}-Enriched Uranium Metal Reflected with Plexiglas

Slab Dimensions (in.)	Plexiglas-Reflector Thickness (in.)	Critical Thickness (in.)	Critical Mass (kg of U^{235})	Per Cent of Critical Mass Assembled
5 × 5	0	9.13	65.6	97
	1	4.96	35.5	96
	2	3.70	26.5	98
	6	3.05	21.8	98
8 × 10	0	3.74	85.7	97
	1	2.64	60.5	95
	2	1.89	43.3	93
	3	1.63	37.4	92
	4	1.55	35.5	97
	6	1.53	35.0	98
10 × 10	0	3.32	95.1	98
	1	2.32	65.6	97
	2	1.72	49.3	93
	6	1.30	37.3	96
15 × 15	0	2.87	184.9	96
	1	1.92	123.7	97
	2	1.35	87.0	94
	6	0.95	61.3	92
20 × ~~10~~	0	2.72	311.9	92
20 × 20	1	1.79	205.5	98
	3	0.92	105.3	95
	6	0.80	91.7	94
24 × 25	1	1.77	304.5	85
25 × 25	6	0.71	127.1	94
∞	0	2.4*		
	6	0.6*		

*Extrapolated from the above data.

various areal dimensions. Since, for reasons of safety, an exactly critical slab was never assembled, the percentage of critical mass assembled is also given. These data extrapolate to 0.6 in. as the thickness of a critical slab infinite in extent and reflected by 6 in. of Plexiglas. The thickness of a similar but unreflected slab is 2.4 in.

A slab with areal dimensions of 8 × 10 in. was reflected with AGOT graphite (density 1.72 g/cc), and the results are shown in Table 3.4.2. In another test, critical thickness and critical mass of a 5 × 5 in. slab, reflected with 12 in. of beryllium, were found to be 1.4 in. and 10.1 kg of U^{235}. The density of the beryllium was 1.86 g/cc.

Table 3.4.2. Critical Thickness and Critical Mass of 8 × 10 in. Slabs of 93.4 wt % U^{235}-Enriched Uranium Metal Reflected with Graphite

Graphite-Reflector Thickness (in.)	Critical Thickness (in.)	Critical Mass (kg of U^{235})	Per Cent of Critical Mass Assembled
1.43	2.52	57.7	94
2.87	2.11	48.4	95
5.75	1.65	37.8	91
12.0	1.32	30.3	95