# CRITICAL AMOUNTS OF URANIUM COMPOUNDS

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Problem & Results:

By a critical amount of material, we mean the least amount of that material which under the prevailing geometrical conditions is capable of supporting a chain reaction. The critical amount depends on the geometric shape. In the following we shall assume that the material is present in the form of a sphere. This gives the critical amount its smallest value since it minimizes the loss of neutrons through the surface. The critical amount also depends on the reflection of neutrons from materials in the neighborhood of the reacting substance. We shall discuss the influence of various reflectors. Above all, the critical amount depends on the chemical and isotopic composition of the reacting materials. Calculations have been carried out which are applicable to fluorides and oxides and to isotopic mixtures ranging from 20% to 100% of 25 content.

The result of the calculation is that approximately rather more than 100 KG of the pure 25 isotope must be present in any isotopic mixture or chemical compound of the type discussed in order that the substance should become chain reacting. The figure given here already includes the effect of some neutron reflection from a container not more than an inch in thickness and also from the walls of the room.

The above statements must be qualified in two ways. First, physical data on which the calculations are based are exceedingly rough. Thus previous calculations which were based on measurements of Leipunsky et al. give little more than one half the critical masses just mentioned. Leipunsky's data seem to be definitely much less reliable than those on which the present calculations are based. They had been adopted in order to obtain the smallest amount of critical materials compatible with published measurements.

The second and even more important qualification of our statements is that they hold only in the absence of hydrogenous materials. In dilute solution in water and in the absence of absorbing material such as boron less than a kilogram of 25 may become chain reacting. Calculations on this point have been published by Christy and Wheeler (Report CP-400). Further calculations giving similar results have been carried out and will be mentioned below. Appropriate use of boron can prevent the danger from hydrogenous materials.

The Constants Used*

Uranium. We shall distinguish two groups of neutrons which we shall call the "fast" and the "slow." The "fast" neutrons are those having

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* See Report CP-334.