LA--309

Copy 35

LA - 309

[redacted]

June 14, 1945

This document contains 7 pages

SUMMARY OF KNOWN CRITICAL MASSES OF 25 AND 49

Compiled by

B. T. Feld

[redacted]

SUMMARY OF KNOWN CRITICAL MASSES OF 25 AND 49

The following tables summarize our present knowledge of the critical masses of active materials in various configurations. By critical mass is meant the amount of active material (25 or 49) required to produce a chain reaction which will just maintain itself on all the neutrons (including the delayed) emitted in fission. The figures quoted have been experimentally determined whenever possible; where theoretical figures are the only ones available, an attempt is made to include a configuration which has also been investigated experimentally and for which the theoretical value has been calculated in the same way. Unless otherwise stated, the core of active material is spherical in shape.

In cases where it has not been possible to assemble enough material to reach criticality, the maximum amount of material assembled is given and, if measured, the multiplication of the assembled configuration is included. The multiplication, M, of an assembly may be connected with the multiplication constant, k (k = 1 is critical), by the formula

$$M = 1/(1-k).$$

The tables run from the case of complete hydration (water boiler) through the hydrides to metal assemblies containing no hydrogen in the core of active material. In the case of metal dispersed in a hydrogenous medium, the mass of metal effective in producing a water boiler has been found to be approximately that contained in a surface layer of thickness equal to a quarter of the mean free path of thermal neutrons in the metal ($\lambda/4$ equals approximately .01 cm in 25 metal of density 18.8 and .005 cm in 49 metal of density 19.4).

[redacted]

[redacted]

The figures quoted represent the work of many individuals and groups; references to reports in which the experiments have been discussed in detail are given wherever such reports are available.

[redacted]

APPROVED FOR PUBLIC RELEASE

[redacted]

25 CRITICAL ASSEMBLIES

CORE COMPOSITION	TAMPER	CRITICAL MASS OF 25	COMMENTS
UO_2SO_4, 14.7% 25, in 15 liters H_2O solution	BeO, 1 ft thick, density 2.7 gms/cm^2, effectively infinite	565 gms	Low-Power Water Boiler (Lo Po)(LA-134)
"	C, density 1.6 effectively infinite	760 gms	Lo Po extrapolation (LA-134)
"	H_2O, effectively infinite	1200 $\pm$ 50 gms	Lo Po extrapolation (LA-244)
$UO_2(NO_2)_2$ 14.7% 25, in 13.6 liters same conditions as Lo Po except for the nitrogen	BeO, density 2.7, effectively infinite	643 gms	The measured value of the critical mass of the High Power Water Boiler (Hi Po) is 806 gms. This is for a 25 concentration of 14.0% and includes the effect of a cooling coil, a central empty tube, and a thicker wall than was used in the Lo Po (the net effect of these additions corresponds to about 130 gms of 25). By courtesy of L.D.P. King and Group F-2
Pure 25 in H_2O solution 11.4 liters	H_2O, infinite tamper	600 gms	Calculated, Christy (LAMS-18)
Pure 25 in H_2O solution 33.5 liters	None	1500 gms	"
UH_{30} 70% 25	BeO, density 2.7, thick tamper	1.4 kg	All the hydride experiments were performed by Group G-1 under the supervision of Holloway. The active material was in the form of ½" cubes of UH_{10} of density 3. The rest of the hydrogen was introduced as polyphene. The self absorption effects for this high hydrogen concentration were rather large. For a homogeneous mixture, the critical mass is probably much closer to 1 kg.

APPROVED FOR PUBLIC RELEASE

UNCLASSIFIED

 [redacted]

25 CRITICAL ASSEMBLIES (Cont.)

[redacted]

CORE COMPOSITION	TAMPER	CRITICAL MASS OF 25	COMMENTS
UH_{45} 70% 25	BeO, density 2.7, thick tamper	1.5 kg	
UH_{20} 70% 25	"	2.3 kg	
UH_{15} 70% 25	"	2.9 kg	
UH_{10} 70% 25	BeO, density 2.7, 12" tamper thickness	2.65 kg	Calculated value 2.26 kg Feynman (LAMS-201)
"	BeO, density 2.7, 6" tamper	3.34 kg	Calculated value 2.79 kg (LAMS-201)
"	BeO, density 2.7, thick tamper; Cd between core and tamper	5.5 kg	
"	WC, density 15.5	6.9 kg	Calculated value 4.2 kg (LAMS-201)
"	Tu, density 18.8	7.0 kg	Calculated value 4.5 kg (LAMS-201)
"	Fe, density 7.8	8.4 kg	
"	Pb, density 11.0	9.3 kg	Calculated value 6.0 kg (LAMS-201)
UH_3C[illegible] 70% 25, density 9	Perfect	7.6 kg	There are no experiments on UH_3; all values are calculated by Feynman and his group (LAMS-149)
"	BeO, density 2.7, infinite	8.5 kg	"
"	WC, infinite	8.2 kg	"
"	Tu, infinite	9.4 kg	"

[redacted]

[redacted]

APPROVED FOR PUBLIC RELEASE