LA-7170-MS, Suppl.

Informal Report

c.3

Experimental Criticality Specifications

Update Through 1979

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LA-7170-MS, Suppl.
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Compiled by

Hugh C. Paxton

EXPERIMENTAL CRITICALITY SPECIFICATIONS

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ABSTRACT

A table of contents for LA-7170-MS is provided, and publications of criticality specifications that appeared in 1978 and 1979 are listed.

INTRODUCTION

An incentive for this supplement was the omission of a table of contents from the original document. Without this table, the organization is not clear and part of the document's value is lost. Further, there is the opportunity to include in this supplement items published in 1978 and 1979.

Since LA-7170-MS was issued, a more complete criticality bibliography was published by Brian L. Koponen, Thomas P. Wilcox, and Viktor E. Hampel of the Lawrence Livermore Laboratory. It is UCRL-52769, Vols. 1, 2, and 3, entitled, "Nuclear Criticality Experiments from 1943 to 1978, an Annotated Bibliography." Volume 1 consists of a main listing, Volume 2 of lookup tables, and Volume 3 of a subject index. LA-7170-MS with Supplement may still be useful as a convenient abbreviation of the LLL documents when only sources of experimental criticality specifications are desired.

TABLE OF CONTENTS OF LA-7170-MS

TABLE OF CONTENTS OF LA-7170-MS (Cont.)

PUBLICATIONS IN 1978 AND 1979

I. COMPILATIONS

U. P. Jenquin and S. R. Bierman, "Benchmark Experiments to Test Plutonium and Stainless Steel Cross Sections," Pacific Northwest Laboratory report PNL-2273-- NUREG/CR-0210 (June 1978).

Benchmark critical specifications selected from the literature, 16 homogeneous Pu (solutions, 2 in ss spheres; compacts, or metal) and 28 water-moderated lattices (Al-Pu, UO_2-PuO_2, or UO_2 for comparison of ss and Al clad).

II. SIMPLE UNITS

A. U($\geq$90)

1. Solutions, Slurries

R. E. Rothe and I. Oh, "Benchmark Critical Experiments on High-Enriched Uranyl Nitrate Solution Systems," Nucl. Technol. 41, 207-225 (December 1978).

$U(93)O_2(NO_3)_2$ solution, 55 to 370 g U/liter, single 27.9- to 50.7-cm-diam cylinders, clustered 16.1- and 21.1-cm-diam cylinders in air, unreflected and in concrete or plastic enclosures of 122-cm inside dimension (see IV.A.1.).

B. U(10 to 90)

2. Metal, Nonhydrogenous Mixtures

G. E. Hansen and H. C. Paxton, "A Critical Assembly of Uranium Enriched to 10% in Uranium-235," Nucl. Sci. Eng. 72, 230-236 (November 1979).

53.3-cm-diam x 55.9-cm-long metal core, homogeneous U(10) on axis surrounded by interleaved U(nat) and U(93) plates averaging U(10); depleted U reflector, 15.2-cm-thick on radius, 20.3-cm-thick at ends.

C. U($<$10)

1. Solutions, Hydrogenous Mixtures

G. Tuck and I. Oh, "Benchmark Critical Experiments on Low-Enriched Uranium Oxide Systems with H/U = 0.77," Rocky Flats Plant report NUREG/CR-0674 (August 1979).

77-cm cube of damp $U(4.46)_3O_8$, reflected by 25.4-cm-thick concrete or methyl methacrylate or 0.8-cm-thick Al plus steel; criticality required near-critical "driver" of U(93) metal or solution; no correction for gap at parting plane, space about driver or access slot.

D. Pu

3. Nonhydrogenous Mixtures

S. K. Battacharyya, D. C. Wade, R. G. Bucher, D. M. Smith, R. D. McKnight, and L. G. LeSage, "A Critical Experimental Study of Intergral Physics Parameters in Simulated Liquid-Metal Fast Breeder Reactor Meltdown Cores," Nucl. Technol. 46, 517-524 (Mid-December 1979).

Reference core 88.4-cm-equilateral cylinder described as "LMFBR outer-core composition" (14 vol % U + Pu containing 22% Pu, Na, ss, presumably Fe_2O_3) reflected by thick UO_2 + Na + ss in ss. In 38-cm-diam zone, effects of voiding Na, then concentrating fuel at twice density in various locations within the zone.

4. Metal

G. E. Hansen and H. C. Paxton, "Thor, A Thorium-Reflected Plutonium-Metal Critical Assembly," Nucl. Sci. Eng. 71, 287-293 (September 1979).

A δ-Pu sphere in a 53.3-cm-equilateral Th cylinder, one-dimensional specifications are deduced.

E. PuO_2-UO_2 Mixtures

S. R. Bierman, B. M. Durst, and E. D. Clayton, "Critical Experiments Measuring the Reactivity Worths of Materials Commonly Encountered as Fixed Neutron Absorbers," Nucl. Sci. Eng. 65, 41-48 (January 1978).

PuO_2-U(nat)O_2-polystyrene compacts, 14.6 wt % PuO_2 in $tPuO_2$ + UO_2, H/(Pu + U) = 30.6, plexiglas reflector; effects of ss, boron ss, depleted U. boral, Cd, Pb sheets of various thicknesses on midplane; also as driver for other compacts.

III. MODERATED LATTICES

A. Hydrogenous

1. Enriched U

J. C. Manaranche, D. Mangin, L. Maubert, G. Colomb, and G. Poullot, "Critical Experiments with Lattices of 4.75-wt%-^{235}U-Enriched UO_2 Rods in Water," Nucl. Sci. Eng. 71, 154-163 (August 1979).

0.79-cm-diam U(4.75)O_2 rods, square pitches 1.26 cm to 2.52 cm, triangular pitches 1.35 cm to 2.26 cm, spanning optimum moderation.

S. R. Bierman, B. M. Durst, and E. D. Clayton, "Criticality Experiments with Subcritical Clusters of 2.35 wt% and 4.29 wt% ^{235}U Enriched UO_2 Rods in Water with Uranium or Lead Reflecting Walls," Pacific Northwest Laboratory report PNL-2827 -- NUREG/CR-0796 (April 1979).

1.26-cm-diam $U(4.29)O_2$ rods at 2.54-cm pitch, 1.12-cm-diam $U(2.35)O_2$ rods at 2.03-cm pitch, 3 in-line clusters, spacing adjusted to criticality with 7.7-cm-thick depleted U or 10.2-cm-thick Pb slabs in the water reflector at various distances from the line of clusters; benchmarks for shipping-cask design.

S. R. Bierman, B. M. Durst, and E. D. Clayton, "Critical Separation Between Subcritical Clusters of Low Enriched UO_2 Rods in Water with Fixed Poisons," Nucl. Technol. 42, 237-249 (March 1979).

1.26-cm-diam $U(4.29)O_2$ rods at 2.54-cm pitch, 1.12-cm-diam $U(2.35)O_2$ rods at 2.03-cm pitch, critical single clusters and 3 in-line clusters, unpoisoned; effects of Cd, Al, Zircaloy between clusters; benchmarks for shipping-cask design.

3. Pu

S. R. Bierman, B. M. Durst, E. D. Clayton, R. I. Scherpelz, and H. T. Kerr, "Critical Experiments with Fast Test Reactor Fuel Pins in Water," Nucl. Technol. 44, 141-151 (June 1979).

0.5-cm-diam PuO_2-$U(nat)O_2$ rods, 19.8 wt% Pu(11.5% ^{240}Pu), square lattice pitches from 0.77 to 1.90 cm.

IV. INTERACTING UNITS

A. Enriched U

1. Solutions, Mixtures

R. E. Rothe and I. Oh, "Benchmark Critical Experiments on High-Enriched Uranyl Nitrate Solution Systems," Nucl. Technol. 41, 207-225 (December 1978).

$U(93)O_2(NO_3)_2$ solution, 55 to 370 g U/liter, single 27.9- to 50.7-cm-diam cylinders, clustered 16.1- and 21.1-cm-diam cylinders in air, unreflected and in concrete or plastic enclosures of 122-cm inside dimension (see II.A.1).

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