

Safe Thickness for D1 Dissolver with 1500 GM Plutonium

by

T. A. Reilly

E. I. du Pont de Nemours and Company
Savannah River Site
Aiken, South Carolina 29808

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DOE Contract No. _____

This paper was prepared in connection with work done under the above contract number with the U. S. Department of Energy. By acceptance of this paper, the publisher and/or recipient acknowledges the U. S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper, along with the right to reproduce and to authorize others to reproduce all or part of the copyrighted paper.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831; prices available from (423) 576-8401.

Available to the public from the National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

ACC # 243605



DPSPU-88-272-21

INTER-OFFICE MEMORANDUM
SAVANNAH RIVER PLANT

January 20, 1988

INFORMATION ONLY

TO: J. W. McClard, 703-F

FROM: T. A. Reilly, 244-2H

T. A. Reilly

SAFE THICKNESS FOR D1 DISSOLVER WITH 1500 GM PLUTONIUM

SUMMARY

There is some concern that the FB-Line D1 dissolver may have been pressurized above the liquid head pressure by a reaction that occurred in the dissolver. The D1 Pu limit of 8.8 kg is based on a tank with an inner slab thickness of 3.34" and a wall thickness of 0.40" for a total slab thickness of 4.14". When the incident occurred there was less than 1500 gm Pu (1323 gm) in the dissolver. Some calculations were made to determine the safe slab thickness for 1500 gm Pu in the D1 dissolver. Calculations show that 1500 gm Pu can be safely contained in a 6" thick D1 dissolver provided the cabinet panels are in place.

DISCUSSION

The D1 dissolver was treated as a 6 ft by 8 ft slab 6" thick. The wall was ignored and the Pu solution thickness was taken as 6". The back surface of the dissolver was taken as 5" away from the maintenance panel unless otherwise noted and the front surface of the dissolver was taken as 25" from the operating panel. Full water reflection was assumed at the panel faces.

Calculations were made using the computer codes HRXN and KENO as described in DPSOP 131 Section IV E. Code bias was based on the bias determined in H. K. Clark's Memo DPST-79-524. K-effective critical is taken as 0.99 with K-effective safe taken as 0.94. Three times the KENO K-effective standard deviation was added to the K-effective to determine K-effective max. This K-effective max must be 0.94 or less to be safe. Materials used in the calculations are shown in the attached Table. The 1500 gm of Pu was conservatively assumed to be in the shape of a right circular cylinder 6" thick. The K-effective was determined for cylinders of various radii to determine a maximum and to verify that this maximum does not exceed a safe value.

Results are presented in the attached Figure. When the 6" slab is 5" from the maintenance panel and 25" from the operating panel the K-effective is less than 0.90 and is safe. Moving the dissolver 2" from the maintenance panel is still safe with a K-effective of 0.94. When the dissolver is against a fully water reflected maintenance panel the delta K-effective is less than the required margin of 0.05 but does not calculate as critical. In summary, a D1 dissolver increased in width to 6" is safe under operating conditions provided it contains no more than 1500 gm of Pu.

CC: D. R. Finch, 773-41A
H. W. Fincher, Jr, 703-F
J. F. Ortaldo, 703-A
R. E. Meadors, 703-F
J. S. Bullington, 244-2H
R. V. Stachowiak, 244-2H
L. A. Hedlund, 704-15F
Central Files, 703-A

MATERIALS USED IN KENO CALCULATIONS

---> TYPICAL

MIXTURE NO. 1 DENSITY = 1.0874E+00 G/CC AT 20.0 DEG C
 DENSITIES OF U AND PU COMPOUNDS ARE: 1.9200E+01

PU SOLUTION

NUCLIDE	ID	ATOM DENSITY	CONC(G/L)	WT %
PU238	50	1.1790E-05	4.6993E+00	4.3216E-01
PU239	49	2.2494E-04	8.9290E+01	8.3110E+00
H	1	6.0418E-02	1.1117E+02	1.0223E+01
O	10	3.3209E-02	8.8229E+02	8.1134E+01

WT % PU238, PU239, PU240, PU241, PU242 IN PU: 0.0 95.0000 5.0000 0.0 0.0

RATIO OF HYDROGEN ATOMS TO FISSIONABLE ATOMS = 2.806E+02
 RATIO OF HYDROGEN ATOMS TO FISSILE ATOMS = 2.953E+02

TOTAL CONCENTRATION OF FISSIONABLE NUCLIDES = 9.399E+01 G/L
 TOTAL CONCENTRATION OF FISSILE NUCLIDES = 8.929E+01 G/L

MACROSCOPIC POTENTIAL SCATTERING CROSS SECTION = 1.48362E+00 CM**2

FISSION SPECTRUM 0.0 % U235, 100.0 % PU239

0 KEFF = 1.0000, AFTER 4 ITERATIONS, B**2 = 2.43292E-02 CM-2, H**2 = 2.89047E+01 CM2, K = 1.7032

--->

MIXTURE NO. 2 DENSITY = 9.9823E-01 G/CC AT 20.0 DEG C

WATER

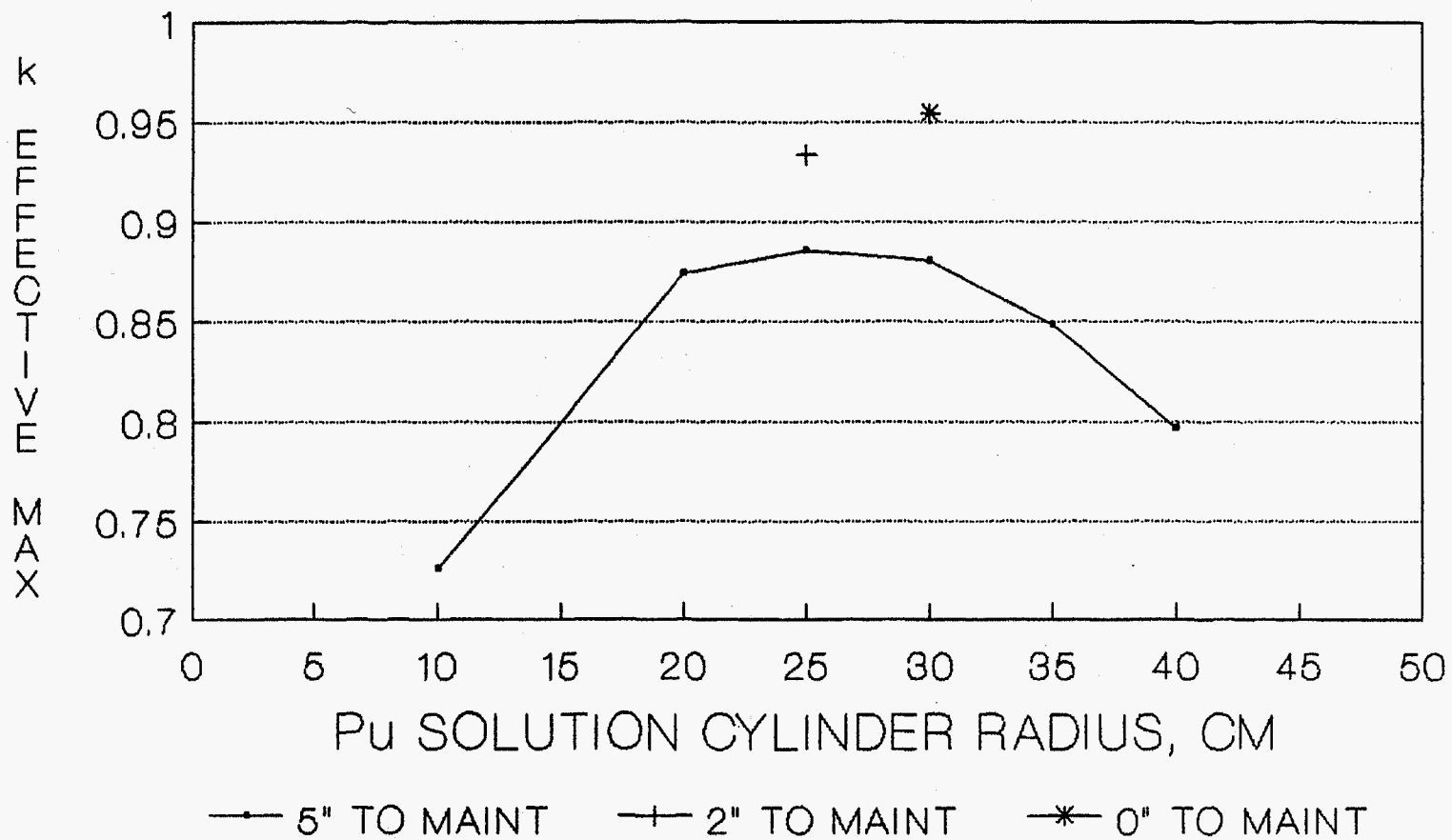
NUCLIDE	ID	ATOM DENSITY	CONC(G/L)	WT %
H	1	6.0738E-02	1.1170E+02	1.1190E+01
O	10	3.3369E-02	8.8535E+02	8.8810E+01

MACROSCOPIC POTENTIAL SCATTERING CROSS SECTION = 1.48825E+00 CM**2

FISSION SPECTRUM 100.0 % U235, 0.0 % PU239

0 KEFF = 0.0, AFTER 0 ITERATIONS, B**2 = 0.0 CM-2, H**2 = 3.48398E+01 CM2, K = 0.0

D 1 DISSOLVER WITH 1500 GM PLUTONIUM SIX INCH THICK SLAB; 5% PU-240



NO DISSOLVER WALL
DIST TO MAINT PANEL NOTED; 25" TO OPER
PANEL; FULL WATER REFL AT PANEL FACE