DOCKET NO. 70-58

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NUCLEAR
DIVISION
Baltimore 3,
Maryland

MARTIN COMPANY

Refer to:
ACC-190

Mail No. 807
May 17, 1963

U. S. Atomic Energy Commission
Source and Special Nuclear Materials Branch
Washington 25, D. C.

RECEIVED
MAY 20 1963
U. S. ATOMIC ENERGY COMMISSION
Division of
Licensing & Regulation

Attention: Mr. Donald A. Nussbaumer, Chief
Source and Special Nuclear
Materials Branch

Subject: Additional Information for
Amendment No. 18 to SNM-53

Enclosure: (1) Nuclear Safety Evaluation

Gentlemen:

As you will recall, we recently submitted our application for Amendment No. 18 to SNM-53 to obtain approval for use of storage racks and boxes both during manufacturing operations and for an in-process storage area. In discussions with Mr. John Lane of your office, it was determined that your criticality review included evaluation of only one rack with two storage boxes in the entire manufacturing area. Actually, we plan to use approximately 50 racks. Individual racks with capacity for 2 boxes will be located at the various machine locations throughout the fabrication area.

Our criticality engineer has just completed additional calculations to show that safety is assured even if 4 completely filled racks are placed as close as physically possible. To complete your analysis, we are furnishing this additional data as Enclosure (1).

Since placement of the racks in close proximity would not permit easy access to the fabricated pieces, any utilization of the racks in this manner is not a logical utilization in a manufacturing process. Space considerations prohibit any such occurrence at the machine locations.

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ACKNOWLEDGED

THE AEROSPACE
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Further, each box is considered a work area which, under our basic criticality philosophy, will be separated from any other box or work area by a distance of two feet. Administrative control will assure that this spacing is maintained.

Since utilization of the boxes and racks is becoming a critical item in our fabrication of Pathfinder fuel, approval is requested as soon as possible.

Very truly yours,

C. W. Keller

C. W. Keller
SS Representative

CWK/men

Encls.

Docket No. 70-58

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NUCLEAR SAFETY EVALUATION

The method used to evaluate safety of an array of storage racks and boxes shown in Fig. 1 is that recommended in TID-7016, "Nuclear Safety Guide", 1961. The multiplication factor of the most reactive container in an array is plotted against the total fractional solid angle (Ωf) of the container in the array. The two are related by Fig. 26 of TID-7016 in which a combination of k and Ω f producing a point below the curve indicates a safe array while a point located above the line indicates an unsafe combination.

The multiplication factors and interaction calculations are summarized below in tabular form. These data are plotted on Fig. 2.

The calculations for k eff and interaction calculations for the array shown in Fig. 1 are also presented.

The data shown in Fig. 2 indicates that at least four and probably five racks can be merged under the optimum conditions for criticality without producing a criticality hazard.

SUMMARY OF k eff AND Ω f CALCULATIONS

Id. No.	U-235	k eff	Ωf	
				Short Container
1	679	.642*	.271	Total Ωf for containers (2), (3), (4), (5) and (6)
2	679	.642*	.182	Total Ωf for containers (2), (5), and (6)
3	679	.642*	.053	Total Ωf for container (5).
				Large Container
4	1218	.527*	.350	Total Ωf for containers (2), (3), (4), (5), and (6)
5	1218	.527*	.213	Total Ωf for containers (2), (5), and (6).
6	1218	.527*	.050	Total Ωf for container (5).

*Only largest value of k eff used since lower values represent a safer condition.

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- -
(b)(4)

Calculation of K eff

The container configuration, shown below, consists of two standard in-process boxes contiguous on their long side. The container dimensions then become 5-7/16" x 11-1/2" x (15-7/8" or 31-3/8"). The two lengths represent short and long containers. The system is considered to be homogeneous.

(b)(4)

E/4

The method of analysis used is identical to that presented in Amendment #18. The total U-235 weight is 2000 grams. Each fuel element consists of 16.5 w/o UO_2 and 83.5 w/o SS.

The H/U ratios and corresponding multiplication factors are as follows:

H/U	K eff	Short Container
379	.642	when full
340	.358	when 1/2 full
226	.180	when 1/3 full
		Long Container
1218	.527	when full
609	.299	when 1/2 full
406	.182	when 1/3 full

Solid Angle Calculation

The array considered is shown in Fig. 1 and is the product of six racks. Container (1) is taken as the most central and the solid angle subtended by containers (2), (3), (4), (5) and (6) determined. The equations used are as follows

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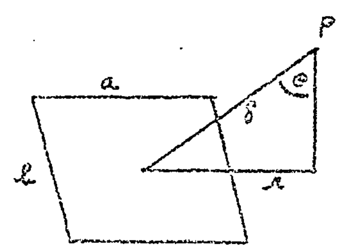

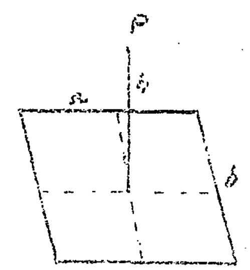

$\Omega = (a\ell/\rho^2)\cos\theta$

$$\Omega = 4\sin^{-1}\frac{(a/2)(\ell/2)}{\sqrt{(a/2)^2+h^2}\;\sqrt{(\ell/2)^2+h^2}}$$

The fractional solid angles subtended at container (1) by the other containers are shown in the following table for both long and short containers.

Container No.	Fractional Solid Angle (Ω_f)	
		Short Container
2	.068	
3	.058	
4	.041	
5	.073	
6	.047	
		Long Container
2	.073	
3	.073	
4	.072	
5	.058	
6	.072	

K&E 10 X 10 TO THE 1/2 INCH 359-11

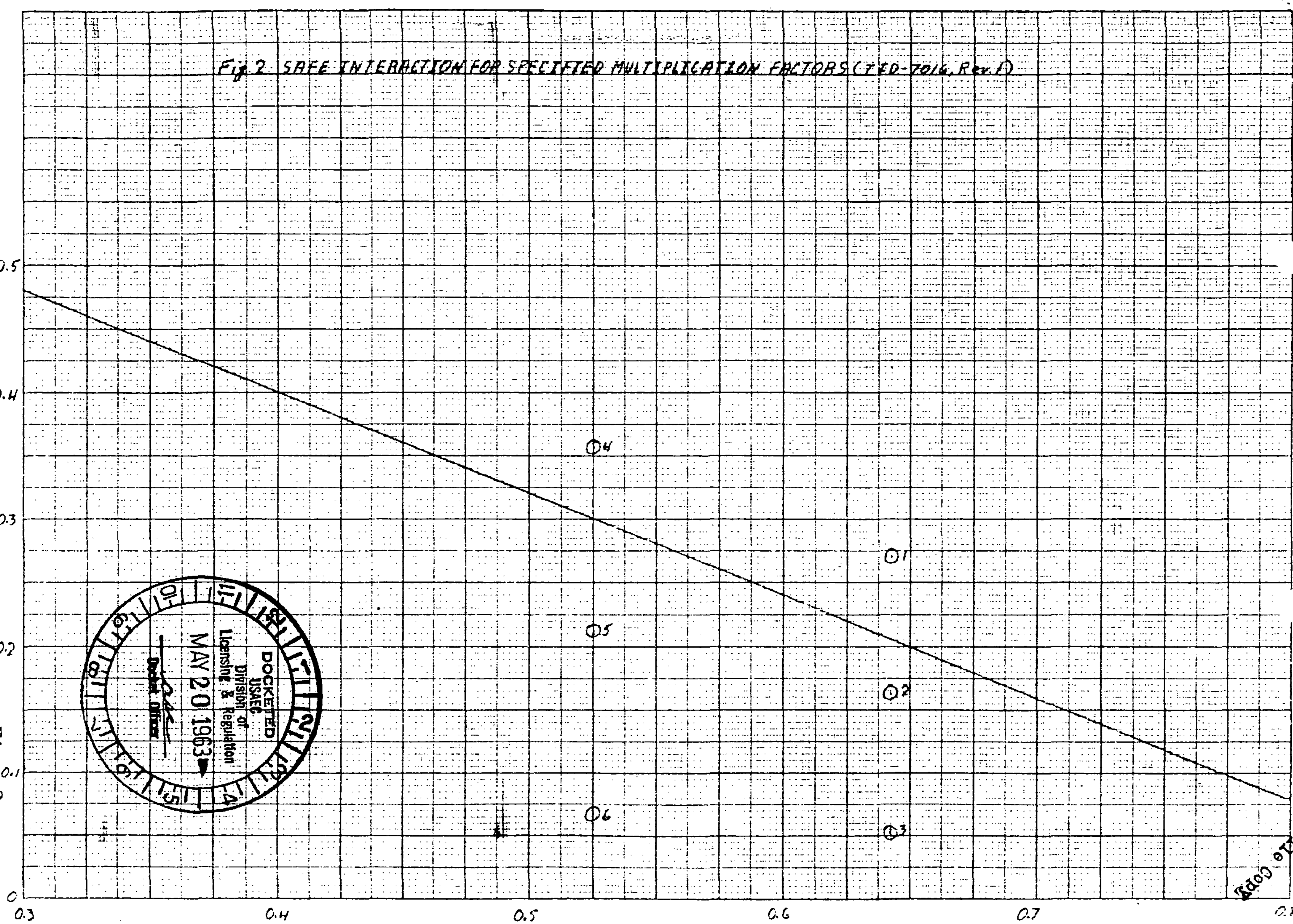

Fig. 2

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