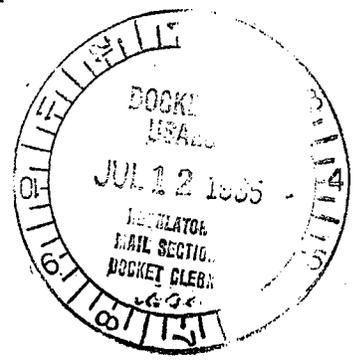


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File Copy
NUCLEAR
DIVISION
Baltimore
Maryland
21203

MARTIN COMPANY

Refer to: ACC-414
Mail No. 845
July 9, 1965



U. S. Atomic Energy Commission
Division of Material Licensing
Washington, D. C. 20545

Attention: Mr. Kenneth E. Lauterback

Subject: Additional Information

- Reference:
- (a) Martin letter from C. W. Keller - ACC-402 dated June 3, 1965
 - (b) Meeting with AEC in Bethesda, Maryland on June 30, 1965

Dear Mr. Lauterback:

In Reference (a) we requested AEC licensing approval for shipment of excess special nuclear material to a reprocessor which has now been defined as Nuclear Fuel Services, Erwin, Tennessee. During our meeting on June 30, 1965 additional information was requested in order that your review could be completed. We have attached an additional nuclear safety evaluation in compliance with that request.

We are planning to make shipment prior to the Martin vacation shutdown beginning July 24, 1965 and will appreciate receiving your approval no later than July 16, 1965. Thank you for your effort in this matter.

Very truly yours,

MARTIN MARIETTA CORPORATION
MARTIN COMPANY, Nuclear Division

C. W. Keller
C. W. Keller
Nuclear Accountability
& Licensing Representative

NOTICE
AND
U.S. ATOMIC ENERGY COMMISSION

CWK:lk

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ACKNOWLEDGED

THE AEROSPACE
DIVISION OF
MARTIN
MARIETTA

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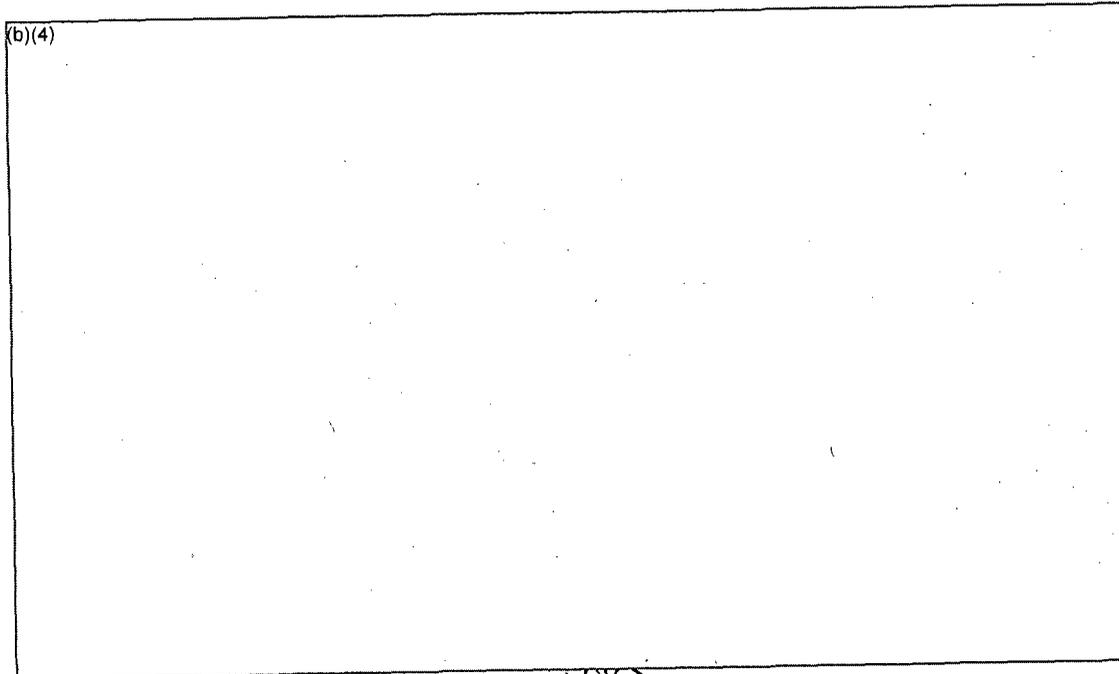
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Criticality Considerations for Fuel Shipment

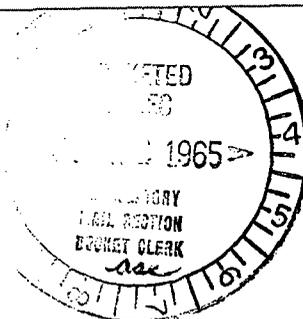
Discussion

The nuclear safety analysis for the MS containers is based on the K_{eff} calculation for a single container as presented in our most recent license renewal application. The value of 0.40 given in pages IV-CI through IV-C6 applies to 5 Kg of U235. Since the shipment containers have less than 5 Kg, solid angle calculations made with $K_{eff} = 0.40$ are valid. The following calculation demonstrates the safety of 57 containers in any array.

A most reactive array of 57 containers can be visualized as a close packed array of 19 units stacked three containers high. The accompanying figure illustrates this arrangement.



Ex4



(2)

For a 42" active container length (conservative assumption) the following table summarizes the solid angle calculation for the three high stack. Container 1 is naturally taken as the most central unit.

$$L = 3 \times 42" = 126"$$

Container	d	h (distance from 1)	$\sqrt{h^2 + (L/2)^2}$	$\sin \theta$	Ω
A	4"	17.5	65.4	.963	.440
B	4"	31.0	70.6	.992	.224

$$\begin{aligned} \text{Total Solid Angle} &= 6 \Omega_A + 6 \Omega_B \\ &= 6 (.440) + 6 (.224) = 3.98 \end{aligned}$$

Since the allowable $\Omega = 9 - 10 K_{\text{eff}} = 9 - 10(4) = 5$

is larger than the calculated value for the array, 57 containers are safe. It is interesting to note also, that even on infinite stacking of 19 containers yields a solid angle of only 4.25. Thus the safety of 57 MS containers is assured for any configuration.

The solution containers (MSL) and filter containers (MF) satisfy the condition that $M/U > 5200$ for the container completely flooded with water and the uranium homogeneously distributed. This concentration together with the limitation of the single container U235 amount to less than 800 grams assures safety for an unlimited array. The validity of this criterion arises from the creation of unfavorable geometrical arrangement through settling of suspended U235 particles.

The safety of the solution and filter containers mixed with the MS containers in a single shipment is based on their inherent safety in any amount alone, together with the limitation of less than 57 containers (46 actually) in the entire shipment. Since the allowance of an infinite array of the solution and filter containers alone, implies a lower reactivity for these units than for the MS containers, the combining of MS, solution (MSL) and filter (MF) containers is certainly safe for a total array of less than that allowed for MS containers alone (57).

Conclusion:

In view of the findings presented above, the proposed shipment of special nuclear material presents no nuclear safety problem.