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5 February 1959

AIR MAIL

Mr. Lynill Johnson
Licensing Branch
Div. of Licensing & Regulation
U. S. Atomic Energy Commission
Washington 25, D.C.

SUBJECT: Special Nuclear Material License No. SNM-33 - Shipping Containers

Dear Mr. Johnson:

On 31 October 1958 we submitted an application for two shipping containers for uranium dioxide. This application was supplemented by additional information on 14 November and 30 December. We request that you consider the application for the two shipping containers on the basis of the following information rather than the previous information supplied.

5 gallon drum in a "55 shorty"

1. For shipments of "limited safe" batches between the assay of 3% (approximately 88 lbs. of uranium) up to 10% (approximately 13 lbs. of uranium).

2. Maximum quantity to be shipped in any one load to be full truck or carload, single layer.

3. Maximum truckload, 70 drums - Maximum boxcar load, 90 drums.

In a single layer stack, solid angle subtended by the central drum is calculated as follows, using method B-1, Page 14 of TID-7016. Package size 11-1/4" diameter, outer drum 24" overall diameter, making edge to edge spacing 12-3/4", center to edge spacing 18-3/8"

$$\Omega = \frac{2D}{H} \sin\theta$$

$$\theta = \arctan \frac{\sqrt{(6.25)^2 + (5.625)^2}}{18.375} = \arctan 0.45769$$

$$\theta = 24°35'$$

$$\sin\theta = 0.416$$

$$\Omega = \frac{2 \times 11.25}{18.375} \times 0.416 = 0.5094 \text{ steradians}$$

$$\Sigma\Omega = 6\Omega = 3.0564 \text{ steradians}$$

$$3.0564 = 24.32\% \text{ of } 4\pi \text{ steradians}$$

E-136

NOTE: This is the maximum possible solid angle assuming the material is uniformly distributed throughout the drum. This would be true only in the case of the low assay, maximum weight load. At the high assay, the drum will be approximately 20% filled, making the solid angle subtended by the material substantially less than this number.

The second package requested is a standard 15 gallon I.C.C. 37-A type drum in a 16 gauge 88 gallon special drum. We propose to use this drum as follows:

15 gallon drum in special 88 gallon outer container

1. This shipping container will be used for material up to 3% U^{235} assay. The quantity to be shipped in any single drum will be 350 lbs. maximum or the "limited safe" batch for the particular assay, whichever is smaller. The 15 gallon inner drum is a special 20 gauge wall as specified by the Bureau of Explosives for 350 lb. maximum loading in our present Bureau Permit 343.

2. The maximum quantity to be shipped will be full carload or truckload quantities, in a single layer.

3. A truckload would be a maximum of 42 drums. A freight carload would consist of a maximum of 50 drums.

Inside drum dimensions: 16" I.D. - 18.5" high
Center to center drum spacing - 30-3/4"
Edge to edge drum spacing - 14-3/4"
Center to edge spacing - (22-3/4")

Solid angle subtended by a central drum in a coplaner array is given below:

$$\Omega = \frac{2D}{H} \sin \theta$$

$$\theta = \arctan \frac{\sqrt{8^2 + 9.25^2}}{22.75} = \arctan 0.53758$$

$$\theta = 28°42'$$

$$\sin \theta = 0.48022$$

$$\Omega = \frac{2 \times 16}{22.75} \times 0.48022 = 0.6756 \text{ steradians}$$

$$\therefore \Omega = 6\Omega = 4.0536 \text{ steradians}$$

$$4.0536 = 32.26\% \text{ of } 4\pi \text{ steradians}$$

NOTE: This is the maximum possible solid angle assuming the material is uniformly distributed throughout the drum. This would be true only in the case of the low assay, maximum weight load. At the high assay, the drum will be approximately 20% filled, making the solid angle subtended by the material substantially less than this number.

In requesting approval for these containers we list below a comparison of the proposed shipping package with the standard 20" AEC birdcage:

	AEC 20" Birdcage**	5 gallon package	15 gallon package
Water tightness	One gasket	Double drum - both gasketed	Double drum - both gasketed
Assay limit	None	3% to 10%	Up to 3%
U^{235} content	11.5 kg	0.600 kg at 10% assay 1.200 kg at 3% assay*	1.200 kg at 3% assay
Carload limits	1000 kg U^{235}	84 kg U^{235} maximum per truckload	50.5 kg U^{235} maximum per truckload
		108 kg U^{235} maximum per railcar	60.0 kg U^{235} maximum per railcar
Edge to edge spacing	10.5"	12.75"	14.75"
Center to center spacing	20.0"	24"	30.75"
Solid angle subtended single layer	20.0% of 4π ***	24.32% of 4π	32.26% of 4π
Material to be Shipped	Solid uranium metal or compounds (dry)	Solid uranium compounds (dry)	Solid uranium compounds (dry)

* - Refers to Table XVII of K-1019 Part 4, Deleted.

** - Information on this birdcage obtained from contractor personnel, Oak Ridge Area. Dimensions were obtained from Union Carbide Drawing Nos. DM-20706 and DM-20707.

*** - This solid angle is for a single layer of these birdcages. Examination of the drawings mentioned above show stacking lugs which would indicate that this package is used in a multi-stack service. A single cage above the central cage in the above calculations adds an additional 1.85% of 4π to the subtended angle shown, making a total subtended of 21.85%

Based on the fact that the above comparison shows that the proposed shipping containers offer a considerably greater margin of safety than the AEC 20" birdcage from the standpoint of quantity to be shipped, edge to edge spacing, center to center spacing, protection from accidental damage, and water inleakage, we request approval for shipment of single layer loads by any common carrier method. If you have any further questions, do not hesitate to get in touch with us in order to avoid any further delays in the approval of the proposed packages.

Very truly yours,

MALLINCKRODT NUCLEAR CORPORATION

W. M. Leaders

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Technical Director

WML:dj