3p82

Project: S-8
Docket: 70-36

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MAR 7 1962

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UNITED NUCLEAR-MALLINCKRODT -- DOCKET 70-36

REF: DLR:CDL

We have reviewed the United Nuclear applications dated December 28, 1961, and January 5, 1962, requesting approval of shipping procedures for UO_2 pellets with enrichments up to 5% U-235.

We do not recommend approval of the proposed procedures for two reasons. First, for mass controlled units in containers of sheet metal as described by the applicant, it is not proper to multiply the safe mass at optimum moderation by a factor of 1.8, because the full safety factor of 2.3 is necessary to protect against criticality in the event of accident, moderation and the combining of the contents of two containers.

Second, we recommend against the proposed notation on the bill of lading to prevent commingling. Please refer to the fourth paragraph of our January 4 memo for a possible alternative.

We suggest Mr. Christian Beck give you his thoughts on the structural integrity of the shipping container.

Attachments:
1. Ltr dtd 12/28/61
2. Ltr dtd 1/5/62

DLR:FL:CEB
CDLuke/vj
3/7/62

b,90

File with ... in working file
Unit. Nuc (Mallinckr.)
70-36
S—

Dec 28, 1961 UO_2 fuel Rod Ship. Cont.

≤ 5% enr UO_2 3/4" dia pellets (ρ = 10.5) in metal or paper (plastic) tubes

length 18" to 60"

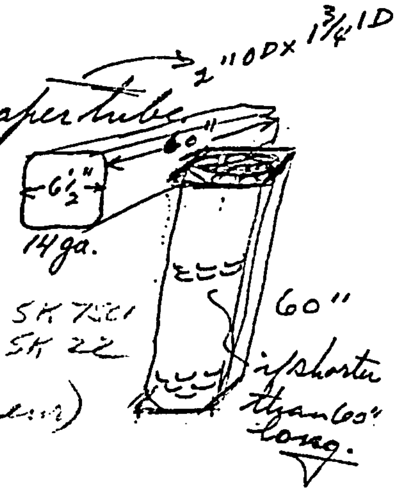
wt 200 - 2000 g UO_2

Tie seven rods together ❀ and put in paper tube

Put nine or more in container (7501)

Container filled for 2.5% enr and lower

Above 2.5% use shim and restriction plate SK 7501 SK 22



Max. loading ... 1.8 x M_s ... Fig. 3 (for ..., ... enr)

Example: Enr. 2.4%

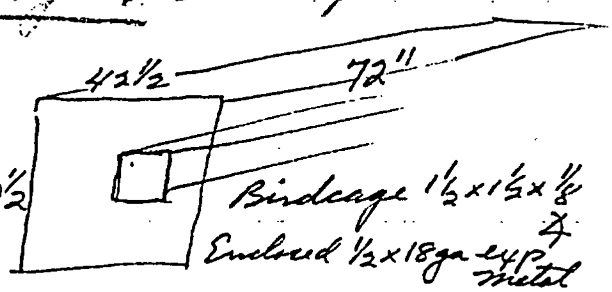
M_s (Fig. 13) = 1.2 kg

M = ... = 2.16 Kg X = 2.16 x $\frac{1}{.034}$ x $\frac{1}{.88}$ = 10... Kg UO_2

However, only 134 ... or 96 kg UO_2 can be placed in the container

Truck 7'11" high 7'8" wide

RR Car 8'6" high 8'6" wide
or 10'6" " 9'2" "



∴ most compact array is single row, double layer array (...)

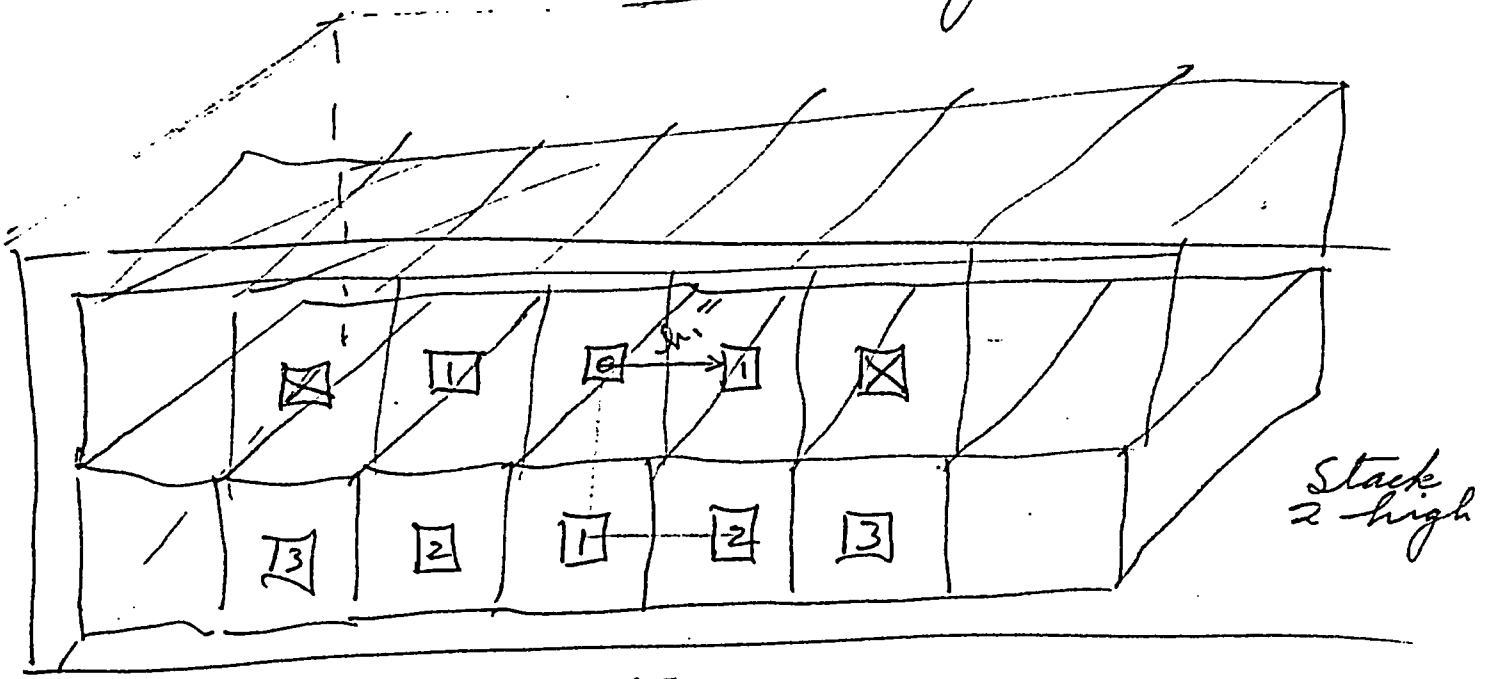
Ship LTL, LCL or ry express. Max 22 containers

$\bar{v}_f$ = .093 (1.17 ster); with twin v_f = 0.135 (1.7 ster)

Since k_{eff} = 0.65, max v_f = 0.20, so spacing is OK.

Avoid commingling by instructions on B/L.

Check on Solid Angle



From 0 to three #1 $h_1 = 42.5 - \frac{6.5}{2} = 42.5 - 3.3 = 39.2''$

K-1309

$\sigma = \frac{e \pm e}{dia} = \frac{42.5 - 6.5}{6.5} = \frac{36}{6.5} = 5.53$

$\lambda = \frac{\ell}{d} = \frac{60}{6.5} = 9.2$

$\bar{\eta} = .0155$ (see Jetriegraph. Via Hall 0.016

C_0 to $C_2 = \sqrt{42.5^2 + 42.5^2} = \sqrt{1805 + 1805} = \sqrt{3610} = 60$

$\sigma = \frac{e \pm e}{dia} = \frac{60 - 6.5}{6.5} = \frac{53.5}{6.5} = \frac{53.5}{9.2} = 5.8$

$\lambda = \frac{\ell}{d} = \frac{60}{6.5} = \frac{60}{9.2} = 6.5$

$\bar{\eta} = .009$ .011 Via Hall .0126