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Project SNM-8
Docket 70-36

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MALLINCKRODT CHEMICAL WORKS

We have reviewed the Mallinckrodt application dated February 5, 1959, requesting AEC approval of two shipping containers for uranium dioxide. As you know, we have evaluated previous proposals (Oct. 31, Nov. 14 and Dec. 30, 1958) for these same containers and have found that the individual mass limits proposed for each container were acceptable. However, we have been unable, on the basis of information submitted by the applicant, to approve transportation procedures involving shipment of numerous containers in the same carrier.

The two shipping containers proposed by Mallinckrodt are: (1) a five gallon drum inside a 55 gallon shorty drum, for enrichments of 3% to 10% U-235 and (2) a fifteen gallon drum inside an 88 gallon, for enrichments of 3% or less.

In the February 5 application Mallinckrodt requests approval of the containers on the basis of a comparison with the standard 20" AEC birdcage. Parameters assumed by the applicant for the 20" birdcage were as follows: U-235 content, 11.5 kg; enrichment limit, none; edge to edge spacing, 10.5" (approx. diameter of inner container, 9.5"); material to be shipped, solid U metal or compounds. The hydrogen - U-235 ratio was not specified.

Based upon our analysis of the application, we cannot approve the shipping procedures proposed by Mallinckrodt, and suggest that your communication to the applicant include the following:

"We have reviewed your application dated February 5, 1959, for approval of two shipping containers. On the basis of the information presented therein, we cannot approve the proposed shipping procedures for numerous such containers arranged in planar array within the same carrier. The reasons for this opinion are as follows:

- a. Comparison of your containers with the standard AEC birdcage is based on parameters for the AEC birdcage which we would not consider acceptable from the hazard point of view. For example, 11.5 kg U-235 as highly enriched UO_2 is considerably more than a "limited safe" mass and hence would not meet our present criteria.

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Furthermore, we understand that the height of the 10" diameter inner container for the 20" AEC birdcage should be limited to 5" or less for enrichments above 5% U-235, in which case the total interaction solid angle would be of the order of 9% of 4π , versus the 20% of your calculation.

b. We believe that the inner drums of your containers should vary in size so that the limited safe mass for any given enrichment would occupy at least 80% of the superficial volume of the inner drums, in order to limit the amount of material which, through error, might be put into the container.

"We have re-examined your proposed containers in the light of criteria outlined in TID-7016. Under certain circumstances, where the H/U-235 ratio cannot exceed 20, we are considering waiving the 4.5 liter maximum volume limitation of TID-7016. However, this would not apply to your case, because if the oxide should become wetted, and we must assume that it might, the H/U-235 ratio would exceed 20.

"Consequently, we suggest that you adjust container dimensions to values which will give allowable maximum subtended solid angles from a central container for the limited-safe individual mass units you propose to ship. As you know, the allowable maximum solid angle depends on the value of k_{eff} for the individual shipping unit. If you are not able to determine or calculate k_{eff} with reasonable confidence, we suggest you use a value of 0.65, which would permit you to use a total solid angle of 20% of 4π steradians subtended at a central unit. We are able to make this suggestion because it has been determined that, if the contents of individual containers are restricted to "limited safe masses," k_{eff} may be assumed, for purposes of arriving at the maximum allowable subtended solid angle (see K-1019 and K-1380), as being not in excess of 0.65."

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CKBeck

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