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The Storage and Handling of J-Slugs

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H. Ketzlach

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THE STORAGE AND HANDLING OF J-SLUGS

Introduction

The nuclear safety specifications⁽¹⁾ for handling J-slugs have previously been reviewed. These specifications provided information for the storage of loaded 100-hole shipping containers and loaded 66-hole wood cart pallets in certain arrays. Storage of J-slugs in J-Material Crates conforming to Drawing No. H-3-6217 had not been reviewed for the previous specifications. It has become desirable to provide specifications for J-slug storage in these crates as well as make additions to the present specifications on the storage of these enriched slugs in shipping containers and pallets.

Discussion

The results of this study pertaining to arrays of J-slugs in shipping containers and pallets will be incorporated as an addition to the present specifications for handling J-slugs, and will not appear here. It was felt desirable to write this separate report covering the conditions for the safe handling of these enriched slugs in arrays of J-Material Crates ("birdcages") for the following reasons: (1) Handling of J-slugs in birdcages had not been covered by the previous specifications, and (2) the only other report⁽²⁾ on the storage of J-slugs in these carriers is for conditions that do not exist in the present birdcages.

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The safe limits established in the above-mentioned report (200,000 slugs in an array of crates, each containing 54 slugs) were based on air-moderated systems only. Each birdcage, however, has a wooden insert that holds the slugs. This insert provides a good deal of moderation and consequently a lower storage limit than previously calculated is necessary.

Experimental information on the critical masses of J-slugs moderated and reflected by water has been reported.⁽³⁾ The experimental results show that the number of J-slugs which will go critical is very dependent on the geometrical relationship of the slugs to one another and on the presence of water and other reflectors. The theorem that the critical mass of an assembly depends inversely on the square of the density has been used to estimate the critical masses of J-slugs as a function of equivalent water moderation. A plot of the critical number of J-slugs in arrays of birdcages as a function of H/U ratio is given in Figure 1. From this curve it is seen that the minimum critical number of slugs in such a system occurs at an optimum H/U ratio of about 200.

Assuming a dry wood insert in the crate, the equivalent H/U ratio is estimated to be 100. The minimum critical mass of an array with this H/U ratio is estimated to be 52,000 slugs. From Figure 1 it is seen that the critical number of slugs is very sensitive to H/U ratio in this neighborhood. Since the moisture content of the wood can vary over a wide range and a relatively small amount of water will increase the H/U ratio appreciably, the optimum H/U ratio should be used in considering the nuclear safety of these arrays. The minimum critical mass under these conditions is approximately 18,000 slugs (330 loaded birdcages). Provided that the framework is strong enough, it appears that storing a maximum 300 birdcages, loaded with J-slugs, in three layers or less is satisfactory for nuclear safety.

References

- (1) Cooper, V. R., et al., Nuclear Safety Specifications for Fuel Element Manufacturing Processes, HW-37952, 10-28-55
- (2) Brown, J. H., Handling Procedures for J-Material in 100-Areas-Bases for Specifications, HW-31690, 5-3-54
- (3) Callihan, Dixon, et al., Critical Mass Studies, Part VI, Y-801, 8-8-51

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Figure 1

Minimum Critical Number of J-Slugs
for Storage in J-Material Crates

60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000

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