DOCKET NO. 70-53

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NUCLEAR
DIVISION
Baltimore,
Maryland
21203

MARTIN COMPANY

Refer to: ACC-347
Mail No. 845
November 23, 1964

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

Attention: Mr. Kenneth Lauterbach

Subject: Interim Storage of Fuel Rods Containing Slightly Enriched Uranium Oxide Pellets - Martin Marietta SNM License No. 53

Gentlemen:

In previous submissions in connection with Amendment No. 21 to Special Nuclear Material License No. 53 we have described the fabrication and storage of fuel tubes and finished fuel elements for a nuclear core of tubular design employing slightly enriched uranium oxide pellets. We have now completed processing of all tubes containing the higher (4.65%) enrichment of UO_2 pellets but because of a delay in the supply of base plates we will not be able to assemble the rods into finished fuel elements at this time. We, therefore, plan to store the completed tubes in the nuclear storage area to permit completion of the lower enriched (4.07%) tubes in the fabrication shop. Our planned storage array is detailed in the enclosed nuclear safety evaluation.

We will appreciate receiving approval of this storage arrangement by December 4, 1964. Thank you for your usual efficient processing of our request.

Very truly yours,

C. W. Keller
Nuclear Accountability
& Licensing Representative

CWK:jn

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ACKNOWLEDGED

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NUCLEAR SAFETY EVALUATION

The nuclear safety analysis has been completed for the storage of the 4.63 percent enriched MH-1A fuel tubes. These tubes are to be stored in Area E of D Building. The fuel tubes are ready to be assembled into fuel elements. However, a problem has arisen with the alignment of the grid plates and the core barrel. This problem must be resolved before assembling the fuel elements.

In order for manufacturing to start fabrication of the 4.07 percent enriched MH-1A fuel, it was decided to store the finished high enriched fuel tubes in Bay 2 of Area E. The fuel tubes are to be stored in the DMS storage containers. Fifty-two tubes are to be loaded into each storage container. A typical storage container is shown in Figure 1. Four containers are to be strapped onto a 40-inch by 48-inch pallet. The containers on each pallet are separated by a 4-inch spacer. The four containers are strapped to the pallet with steel straps which are 5/8 inch wide and 20 mils thick. The storage array showing the containers, spacers and pallets are shown in Figure 2.

The nuclear safety of the array shown in Figure 2 was determined by calculating the effective neutron multiplication factor (k_{eff}) for the most centrally located container and the total solid angle subtended by the remaining containers in the array. The k_{eff} calculations and the solid angle (Ω) calculations are shown below.

Effective Neutron Multiplication Calculation

Volume of container = 6.5x6.5x37.0x16.387 = 25,617.38 cm^3

Volume of 52 fuel tubes = 52x3.14159x(.2535)^2 x 37x16.387 = 6,365.27 cm^3

Volume of water = 25,617.38 − 6,365.27 = 19,252.11 cm^3

Volume of Stainless Steel = 52 [3.14159x(.2535)^2 x 37x16.387 − 3.14159x(.2305)^2 x 37x16.387] = 1102.64 cm^3

Volume of UO_2 pellets for 52 fuel tubes = 52 [3.14159x(.2275)^2 x 36.24x16.387] = 5,020.92 cm^3

Volume of void = 5,262.63 − 5,020.92 = 241.71 cm^3

Volume of U-235 for 52 fuel tubes = $\frac{2190.336}{18.7}$ = 117.13 cm^3

Volume of U-238 for 52 fuel tubes = $\frac{43,496.320}{18.7}$ = 2,326.01 cm^3

Volume of Oxygen + Impurities = 2570.59 cm^3

Effective Neutron Multiplication Calculation [illegible] cont'd.

U-235 per tube	[illegible] 10.9?? [illegible]
Active fuel tube length	46.00 inches
[illegible] length	[illegible] 57.00 inches
Length of top end fitting	= 1.25 inches
Length of bottom end fitting	= 1.?0 inches

Material	Volume Fraction	[illegible] cm^{-1}	[illegible] cm^{-1}
Water	.7515	.0221	.01661
[illegible] steel	.0?21	.?530	.0119?
U-235	.0?4	32.??	.1???
U-238	.0212	.12??	.01267
Oxygen + [illegible]	.1004	~ 0	~ 0
Void	.00?4	~ 0	~ 0

$$f = \frac{\Sigma_a^{fuel}}{\Sigma_a^{fuel} + \Sigma_a^{SS} + \Sigma_a^{H_2O}} = .848$$

η = 1.9?? (Rept. HW - 6??73)

$$p(E) \simeq \exp\left[-\frac{fr}{1-fr}\right]$$

$$\frac{1}{fr} = 1 + \frac{V_1}{V_0}\,\frac{\Sigma a_1}{\Sigma a_0}\,Er\;(?-1)$$

$$Er \simeq 1 + \frac{(Ko\;ro)^2}{?} - \frac{(Ko\;ro)^?}{1?}$$

$Er \simeq 1.00?$

where ro = .57975 cm

Ko = 0.31 cm^{-1}

$$Er \simeq 1 + \frac{(K_o r_o)^2}{2}\left[\frac{r_1^2}{r_1^2 - r_o^2}\ln\frac{r_1}{r_o} - \frac{1}{?}\;[illegible]\;)^2 - [illegible]\right]$$

[illegible] Amplification Calculations (cont'd)

[illegible]

$I_{[illegible]}$ [illegible] 2.6[illegible]

I = 2.[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] = 2 [illegible]

$$\frac{[illegible]}{1 + [illegible]) ([illegible] + I_{q}^{2} [illegible] + 1 - I_{2}^{2} [illegible])}$$ [illegible]

[illegible] Calculations

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	7.1	9.[illegible]	1[illegible].75	.006[illegible]
[illegible]	[illegible].2		1[illegible]7.50	.0119[illegible]
[illegible]	7.[illegible]		1[illegible].50	.015[illegible]
[illegible]	7.[illegible]		1[illegible].75	.0[illegible]
[illegible]	7.[illegible]		[illegible].75	.0[illegible]
[illegible]	7.5		78.[illegible]	.0[illegible]
[illegible]	[illegible].6		[illegible]	.0[illegible]
[illegible]	7.7		[illegible]0.00	[illegible]
[illegible]	[illegible].5		22.[illegible]	[illegible]
[illegible]	7.6		29.75	[illegible]
[illegible]	7.7		[illegible]0.00	1.0[illegible]
[illegible]	7.6		60.10	.08[illegible]
[illegible]	7.5		7[illegible].50	.04[illegible]8
[illegible]	7.[illegible]		1[illegible].25	.0[illegible]
[illegible]	7.2		137.75	.0[illegible]
[illegible]	7.[illegible]		1[illegible].50	.01[illegible]
[illegible]	[illegible].2		157.[illegible]	.0113[illegible]

Pages 8 through 10 redacted for the following reasons:

(b)(4)