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UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P. O. BOX X, OAK RIDGE, TENNESSEE 37830

May 2, 1979

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Mr. Homer Lowenberg
Assistant Director for
Operating and Technology
Office of Nuclear Material Safety
and Safeguards
Nuclear Regulatory Commission
Washingron, D. C. 20555

Dear Mr. Lowenberg:

In the April 20, 1979 letter to you, I listed various reasons for differences between the experimental and ORIGEN-S computed isotopic compositions of the H. B. Robinson Reactor discharged fuel. An expansion of Table 3 is presented here. The table displays through footnootes the predominant reason (as evaluated) for the deviation in results of each isotope, for which there is an appreciable difference.

A combination of reasons and errors contributes to each set of differences. Thus, the evaluation for determining the most likely reason is somewhat speculative and subject to error. For example, relatively high values of ^{244}Cm and ^{243}Am would result from an overestimate of total fissions (or, burnup), or $\sigma(n,\gamma)$ for ^{242}Pu being too large, or both. A decreased value of burnup would further decrease the low computed value of the ratio of $^{242}Pu/^{241}Pu$. Also, $\sigma(n,\gamma)$ for ^{242}Pu has been questioned, in the past, as being too large. While both of the above reasons may be significant, there appears to be more evidence that the cross section error is predominant.

The computed results for ^{243}Cm and ^{247}Cm were considerably incorrect. This should be attributed to the necessity of using incomplete $\sigma(n,\gamma)$ values for the two isotopes and their precursors. However, these two isotopes are

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usually less important than other heavy isotopes, such as ^{242}Cm or ^{244}Cm, in shipping cask evaluations, processing plant studies, and most other analyses.

Sincerely,

O. W. Hermann

O. W. Hermann
Computer Sciences Division

OWH:bbf

Enclosure

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Table 3. Comparison of Mass Analyses and ORIGEN-S Results (Revised, May 2, 1979)

H. B. Robinson Reactor Fuel, Discharged May 6, 1974. From Dissolver Run 2 (Assumed from "Full Burnup" Region) 31,364 MWD/MTU, Cooled 669 Days (3/16/76).

Isotope	Atom % Found	Atom % ORIGEN-S	Data From ENDF/B-IV
^{234}U	0.014	0.014	yes
^{235}U	0.653	0.585[a]	yes
^{236}U	0.347	0.347	yes
^{237}U	ND	4.2×10^{-9}	no
^{238}U	98.99	99.05	yes
^{238}Pu	1.56	1.62	yes
^{239}Pu	55.79	56.51[b]	yes
^{240}Pu	24.91	22.91[b]	yes
^{241}Pu	12.29	13.36[b]	yes
^{242}Pu	5.45	5.60	yes
^{241}Am	62.4	55.8[c]	yes
^{242}Am	0.312	0.41[d]	no
^{243}Am	37.29	43.8[c]	yes
^{242}Cm	3.28	2.42[c]	no
^{243}Cm	1.21	0.31[d]	no
^{244}Cm	90.66	92.51[c]	yes
^{245}Cm	4.43	4.15	no
^{246}Cm	0.453	0.56	no
^{247}Cm	0.004	0.009[d]	no
^{248}Cm	0.001	0.0008	no

[a] Uncertainty in expermental values of burnup (±5%) and assumed 200 MeV/fission approximation in ORIGEN-S model could lead to differences on this order.

[b] Isotopic distribution in plutonium could be in error due to data for low-energy resonances.

[c] $^{242}Pu\ (n,\gamma) \rightarrow {}^{243}Am\ (n,\gamma) \rightarrow {}^{244}Cm$ transmutations could be too high due to $\sigma(n,\gamma)$ of ^{242}Pu being too large. This contributes to low percentages for ^{241}Am and ^{242}Cm.

[d] Analytical results are very likely in error due to older, incomplete cross section data.