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REACTIVITY COEFFICIENTS OF HEAVY ISOTOPES IN LASL'S FAST CRITICAL ASSEMBLIES

by

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We are attempting a systematic investigation of heavy isotope behavior in the Pajarito fast-neutron critical assemblies. Included will be central reactivity coefficient measurements and fission rate measurements in natural uranium reflected plutonium and 93%-enriched uranium metal assemblies and in Big Ten, a depleted uranium reflected 10%-enriched uranium metal assembly.

A few reactivity coefficients have recently been measured for ^{235}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{242}Pu, and ^{241}Am. The experimental technique has been described by Stubbins, Barton, and Loandier,[1] and preliminary results are listed in the Table.

Similar data for some of these isotopes in unreflected plutonium (Jezebel) and 93%-enriched uranium (Godiva) have previously been reported.[1-3]

Central reactivity coefficients are closely related to neutron net-production cross sections of the samples which in turn are related to criticality. By establishing the bias in the computed coefficients, one may obtain improved

estimations of critical dimensions. Six group cross section sets, developed for the above isotopes, have been used in this fashion to give the following bare sphere critical mass estimates.

$m_c(^{238}Pu) \approx 12$ kg, $m_c(^{242}Pu) \approx 90$ kg, and $m_c(^{241}Am) \approx 58$ kg.

It is hoped that these data will be useful to the standards work group which is currently developing a criticality safety standard for operations with the actinide elements.

TABLE

Central Reactivity Coefficient Ratios in Flattop-Pu, Flattop-U(93), and Big Ten

Isotope	Flattop-Pu	Flattop-U(93.2)	Big Ten
^{235}U	0.524±0.007	0.528±0.010	0.585±0.006 → .65
^{237}Np	-	0.42 ±0.02	0.065±0.006 → .06
^{238}Pu	0.899±0.014	0.889±0.014	0.661±0.018 → .6
^{239}Pu	≡1.00	≡1.00	≡1.00
^{242}Pu	0.494±0.010	0.479±0.010	-
^{241}Am	0.605±0.011	0.530±0.010	-

References

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2. D. M. Barton, "Central Reactivity Contributions of ^{244}Cm, ^{239}Pu and ^{235}U in a Bare Critical Assembly of Plutonium Metal," Nucl. Sci. Eng. 33, 51-55, (1968).

3. L. B. Engle, G. E. Hansen, and H. C. Paxton, "Reactivity Contributions of Various Materials in Topsy, Godiva, and Jezebel," Nucl. Sci. Eng. 8, 543-560, (1960).