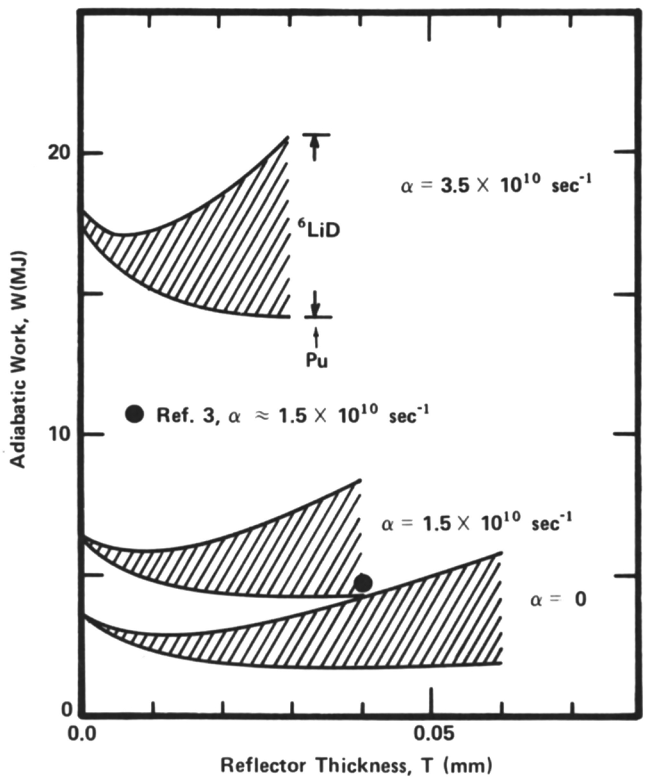

Fig. 2. Adiabatic work necessary to achieve various supercriticalities in ^{6}LiD-reflected ^{239}Pu spheres at 10^{18} dyn/cm^2.

(100 P Pa). The points given by Seifritz and Ligou fall very close to our curves (within 10%). Note that the work necessary to compress the ^{239}Pu to achieve $\alpha = 1.5 \times 10^{10}$ sec^{-1} (at a pressure of 10^{18} dyn/cm^2) is ~35% less with a 0.004-mm ^{6}LiD reflector than without, but, if the work necessary to compress the reflector is included, the total is almost 30% *greater*. For the optimum reflector, ~0.01 mm, the net savings is 10%—hardly enough to be significant. A greater difference, but only a factor of 3, results from the smaller α permissible with their enormously larger N_0.

Finally, we wish to comment on methods of calculating Rossi-α. The familiar kinetics relation,

$$\alpha = \rho/\Lambda \ ,$$

where $\rho = 1 - 1/k$ is the reactivity and Λ is the mean neutron generation time, must be used with great care for systems of this type. The full definitions of these quantities involve the flux-shape factor for the rapidly growing neutron population.[4] The conventional definitions result from the assumption that this is the same as the critical flux shape; their validity depends on the "time absorption," α/v, being negligible compared to other terms in the transport equation. As discussed in Sec. 1.5f of Ref. 4, large α favors high energy and hardens the spectrum. Thus, neutrons repeatedly scattered and slowed in a reflector such as DT simply lose importance (they cannot retard the growth), and Λ decreases toward the generation time for an unreflected pellet as α approaches the limiting value of 6.4×10^{10} sec^{-1} for infinite ^{239}Pu. Our numerical eigenvalue calculation is the only fully consistent method known to us for dealing with such highly supercritical systems. Our calculations for ^{6}LiD agree very well with those in Refs. 1 and 3 and are not very different from results for other reflecting materials given in Ref. 2. We believe, therefore, that the qualitative difference between ordinary and "absorbing" reflectors suggested by Ligou and Seifritz is not real, but rather represents the failure of the conventional kinetics equation for very high α in multiple-scattering materials.

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[4]G. I. BELL and S. GLASSTONE, *Nuclear Reactor Theory*, Sec. 9.2b, Van Nostrand Reinhold Company, New York (1970).

Comments on "Analysis of the Microfission Reactor Concept"

I would like to comment on the criticism voiced by Winterberg[1] on the conclusions reached by Cole and Renken[2] concerning reflected pellets as fuel for "microfission" reactors. Our results,[3] using time-dependent S_n transport calculations, showed that fissionable pellets of ^{239}Pu and ^{235}U surrounded by deuterium shells "never attain high neutron multiplication rates due to the long transit times of the moderated neutrons."[3] More recent calculations have led to similar results for the transplutonium fissionable isotopes.

I have recently taken up Winterberg's suggestion[1] of assuming that the neutron thermal velocity in the reflector is characteristic of a hot plasma (~10 keV), and have run time-dependent transport problems with a neutron velocity of 1.4×10^8 cm/sec in the deuterium shell for all energy groups below ~10 keV in the 16-group Hansen-Roach cross-section set. This is admittedly an extreme case but one that should give an upper limit to the effect. The pertinent deuterium neutron cross sections in these lower energy

TABLE I

Time-Dependent Transport Results for Fissionable Microspheres of Maximum Theoretical Density

Pellet Composition	k_{eff}	Neutron Multiplication at 10^{-9} sec	Assumed Lowest Neutron Velocity in Reflector (cm/sec)
^{239}Pu	1.48	4.6×10^{28}	---
^{239}Pu + D	1.54	9.0	2.18×10^5
	1.54	5.0×10^5	1.4×10^8
	1.54	6.5×10^2	4.8×10^7
^{245}Cm	1.30	1.0×10^{44}	---
^{245}Cm + D	1.56	12.0	2.18×10^5
	1.56	3.0×10^6	1.4×10^8

[1]F. WINTERBERG, *Nucl. Sci. Eng.*, **59**, 68 (1976).
[2]RANDALL K. COLE, Jr. and JAMES H. RENKEN, *Nucl. Sci. Eng.*, **58**, 345 (1975).
[3]A.D. KRUMBEIN, *Trans. Am. Nucl. Soc.*, **18**, 19 (1974).

groups are fairly constant, so that there is little need to alter them in these calculations.

The results, as given in Table I, clearly show that although there is an increase in neutron multiplication within the disassembly time of 10^{-9} sec, over the case of a "cold reflector," this multiplication is still many orders of magnitude lower than that for an unreflected pellet with a similar value of k_{eff}. For the more realistic case of a "1-keV reflector," the neutron multiplication is down by another factor of 1000.

These results help to confirm the conclusion reached by Cole and Renken[2] that the "reflected neutrons simply arrive too late to have much effect on the diverging chain."

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