LETTERS TO THE EDITOR

THE OTHER VIEW

Dear Sir:

I strongly disagree with major parts of your February editorial. You stated that "the AEC is presently pursuing the development of a particular fast breeder reactor to the nearly complete exclusion of all reactor development work that is not directly connected with this main goal." If you will trouble yourself to examine recent and projected AEC budgets, you will find that this is not true. To the best of my knowledge, the AEC has never exhibited such single-mindedness; on the contrary, the Commission has often been criticized for funding too many different kinds of programs.

Further along, you insist that "more general reactor and materials technology should be developed *now* to provide the basis for other advanced concepts that will inevitably be required in the future." You then go on to cite examples from other fields. If this "inevitability" is so clear to you, it will help those of us who are less discerning if you will list examples from our own field.

Most importantly, you seem to have missed the whole point of the FFTF. Its raison d'être is to permit the timely and economic development of the necessary materials technology; necessary in the sense that the concerned citizenry of the world consider the LMFBR the predominant first choice for meeting future, predictable energy demands.

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March 20, 1967

MANIFOLD GASEOUS ROCKET REACTOR

Dear Sir:

A recent article by Plunkett[1] summarized the characteristics of a gas-to-gas heat-transfer reactor, sometimes called the reflector-moderated or the Bell-cavity reactor. He presented the general effects of materials and geometry on a reactor consisting of an axial fuel gas surrounded by a heat-absorbing gaseous layer of propellant, which was surrounded in turn by reactor components necessary for low critical mass and gas containment. One of his conclusions was that for several very good reasons the critical mass would be high. This letter shows some of the effects of a different basic geometry.

Bussard[2] detailed the basic limitations of the gaseous reactor, as one solution to the more general nuclear space-propulsion problem, and observed that any useful geometry must be large in order to optimize the system. Starting with this observation, and recognizing the large effect of restriction of gaseous fuel radius (see Fig. 1) to permit the use of a thick, gaseous heat sink (the rocket propellant), an attempt was made to reduce the fuel-radius effect by assuming the use of a number of parallel gaseous fuel-gaseous coolant channels. Figure 2 shows the computed results of a reduction of fuel radius in one channel, in terms of relative k_{eff} (integral neutron multiplication constant) and so critical mass with constant total fuel. It is clear from the graph that the large effect on criticality occurs for relatively small radii; there is less sensitivity to this important parameter.

The atomic density of ^{235}U fuel required to make large systems critical (see Fig. 3) is not very different

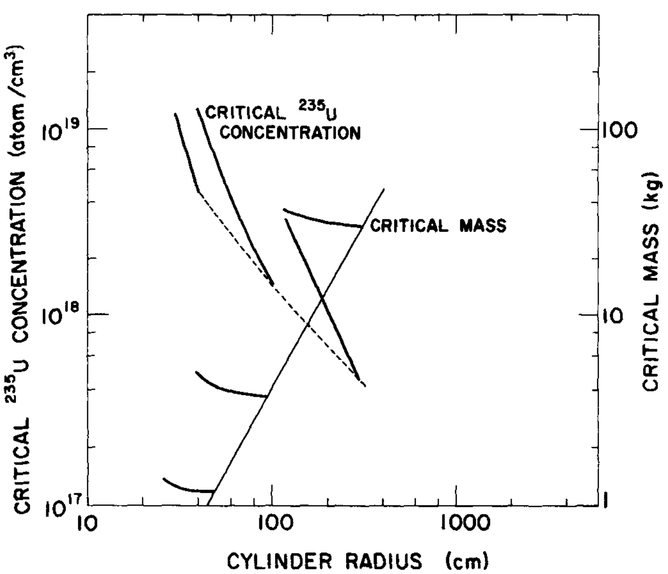

Fig. 1. Critical concentration and mass of ^{235}U gas as a function of gas radius for reactor core radii of 40, 100, and 300 cm in a 100-cm-thick D_2O reflector. Mass calculations assume core length equals diameter.

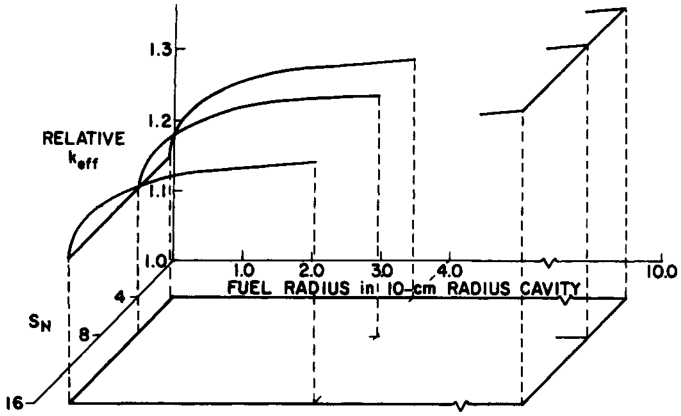

Fig. 2. k_{eff} vs fuel radius in a cylindrical cavity of 10-cm radius in a large homogeneous reactor.

for core or reflector-moderated reactors, and the material used, whether D_2O, Be, or C, is not very important.

Additional 2-dimensional calculations were made to determine whether, in fact, a large homogeneous reactor may be changed into one with multiple cavities of the gas reactor type, with almost the same total weight and fuel critical mass. The result was that, as implied by Figs. 2 and 3, small changes in k_{eff} resulted. It was found to be possible, within reasonable limits, to use homogeneous reactor neutronics for multiple-cavity reactors, including the effects of fuel radius changes.

In summary, the dark picture painted by Plunkett is a realistic one; but a path might still be found to the very high performance hoped for with the use of gaseous reactors if large "homogeneous" systems are studied.

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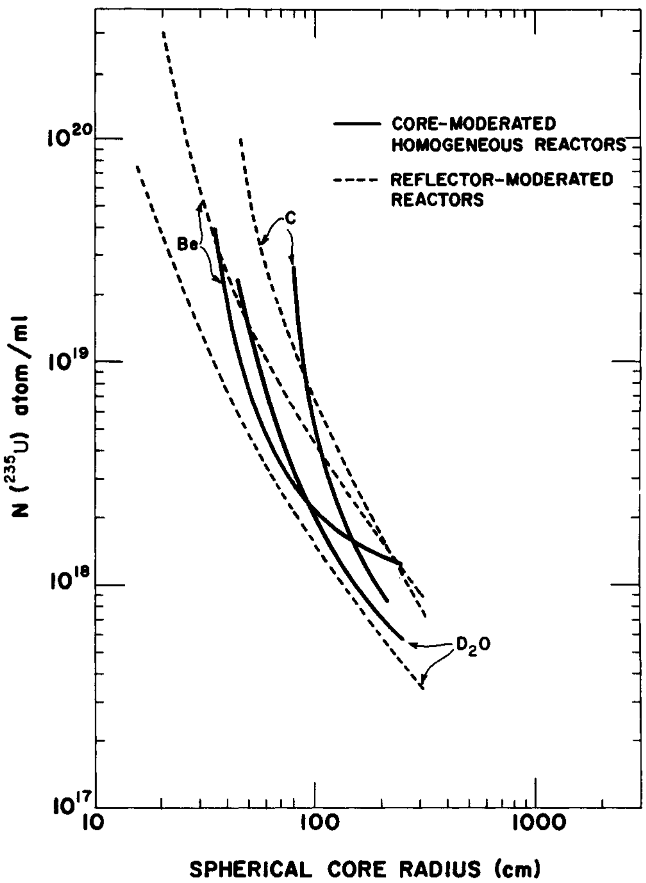

Fig. 3. Critical ^{235}U fuel concentration in reflector-moderated and bare homogeneous reactors.

REFERENCES

[1] T. F. PLUNKETT, "Nuclear Analysis of Gaseous-Core Nuclear Rockets," *Nucl. Appl.*, 3, 178 (1967).

[2] Personal Communication by R. W. BUSSARD, Los Alamos Scientific Laboratory (1960).