LETTERS TO THE EDITOR

MINIMUM ^{235}U CRITICAL MASS IN D_2O

Dear Sir:

The suggestion was made by Muehlhause[1] that a heavy-water-moderated, reflected reactor might have a critical mass almost as low as that found for a light-water-moderated, beryllium-reflected system. A low critical mass coupled with a lower fuel concentration could permit the development of a better high-flux liquid-fuel reactor than is possible with H_2O and Be.

As a result of these suggestions, a simple comparison between D_2O and H_2O moderators was made to supplement a previous criticality study.[2] The parametric results are shown in Fig. 1. While the minimum critical mass in D_2O is shown to be a factor of 2 larger than in H_2O reflected by Be, the minimum ^{235}U concentration has been decreased by an order of magnitude. There might be then, as Muehlhause suggested, a real advantage in using D_2O in a carefully optimized high-flux reactor.

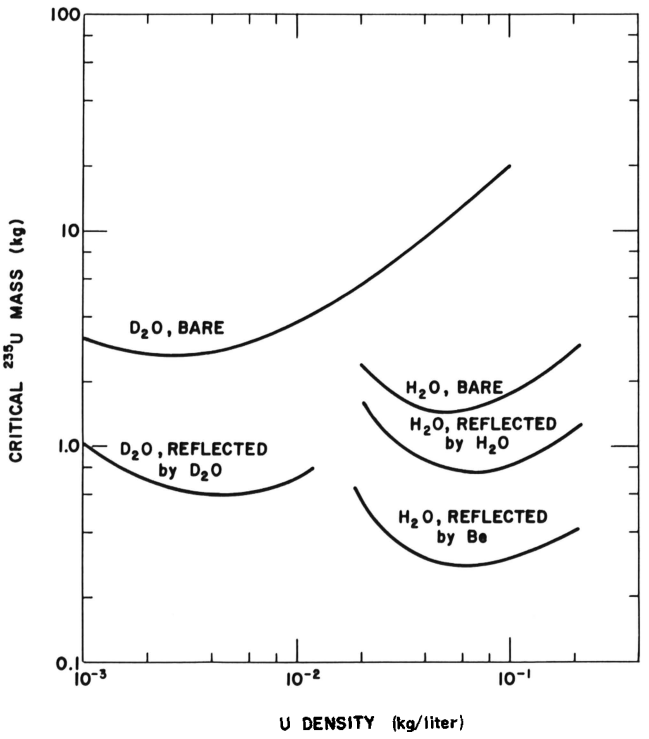

Fig. 1. Critical mass of H_2O and D_2O moderated spheres.

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ACKNOWLEDGMENTS

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REFERENCES

1. Personal Communication by CARL O. MUEHLHAUSE, National Bureau of Standards, Jan. 5, 1968.

2. CARROLL B. MILLS, "Reactor Minimum Critical Dimensions," LA-3221-MS, Los Alamos Scientific Laboratory (April 1965).

SECRET COMMUNICATION USING RECOILED FISSION FRAGMENTS

Dear Sir:

We have studied the possibility of using recoiled fission fragments for secret communication and temporary storage of secret information. This application is based on the following principle. Radioactive fission products recoil from a spontaneously fissioning source onto a catcher foil. By interchanging a collimator, which has a hole, with another, which has a slot, between the source and the catcher foil, a dot-dash pattern is formed on the latter. This pattern, which may be secretly coded, can be revealed by radioautography. Since the amount of the recoiled materials is very small, presently known methods of image detection, other than nuclear techniques, will not reveal this pattern or even detect the presence of the message. The recoil fission fragments carry a considerable amount of energy and, hence, are firmly embedded on the surfaces of the catcher foil. Depending upon the amount collected,

the radioactivities of the recoiled fission fragments will decay to an undetectable level at some time after the collection.

A ^{252}Cf source that emitted 7×10^7 fissions/min was deposited on a round hollow 5 mm in diameter and 1.5 mm deep. The distance between the bottom of the hollow and the aluminum catcher foil was ~4 mm. One collimator had a hole 0.79 mm in diameter; the other had a slot 0.4 mm wide and 6.3 mm long. Collection time for each dot or dash ranged from 1 to 10 min. Radioautography of the catcher foil was made with Polaroid films of speed ASA 3000/type 47. Exposure time varied from 0.5 to 24 h. For the 1- and 10-min collections, exposure and development made, respectively, 1 and 14 days after the end of collection of the recoils, gave clearly visible dot-dash patterns. The negatives showed much better contrast than the positives. A visible pattern was obtained for the 1-min collection with a delay of 55 h and exposure of 2.5 days.

With a better efficiency of recoil collection, a higher source strength, and perhaps a faster film, even shorter time for recoil collection and exposure and longer delay between collection and exposure could produce satisfactory results. Another pattern of information storage is the binary system of numbers that requires only dots. Coded symbols, designs, and two-dimensional plots may also be possible. With several ^{252}Cf sources, simultaneous collection of fission fragments can speed up the information storing process. A steady-state operation, sending short messages one at a time, is quite feasible.

As a great many solid articles may be used for the catcher foil, instant detection of the presence of recoiled fission fragments by nuclear radiation counters is difficult. One application of the present technique is secret marking of ransoms or maps.

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OUR RESPONSIBILITY

Dear Sir:

Thanks for expressing what many of us feel, but seldom get around to publicizing, about the moral issues of science.[1] You said it well.

I was disappointed, though, that you backed off at the end and said a scientist should "regard himself primarily as a responsible moral human being and secondarily as a professional person, rather than *vice versa*." This implies a distinction between the two, if not a dichotomy, and mitigates your previous argument. This distinction implies two differing sets of rules or, at least, a different ordering of values. The consequence?—one must choose, consciously or unconsciously, which ordering of values he is to apply under a given set of circumstances. Each of us may be schizophrenic to some degree, but this is asking a lot.

Each of us has a set of values-for-living. This set of values will be determined by what each believes in and will differ in the detail that makes each an individual. Each of us is measured by the content and constancy of our values-for-living. This is not the place to speculate on how these values were formed or should be formed. That values exist and that each of us has them is sufficient for the moment.

We make our own difficulty by using the term scientist as though that characterizes a particular group (the right-thinkers, of course). Then we discourse on how "the scientist" should or should not behave. Certainly, no scientist should prostitute his values-for-living by undertaking research whose objectives he questions on any grounds. By the same token, he should not tell me I shouldn't undertake research in which he does not believe.

This cannot be a question of whether "the scientist" should or should not engage in certain types of research, because this implies the wisdom to see and evaluate all of the ramifications. If a scientist does not want to work on the development of a better weapon because he feels he would be contributing to killing and maiming his fellow man, he should decline. But, should he deny this job to another who believes sincerely that the lives of his family or his way of life may one day depend upon his ability to devise protection? And who claims the omniscience to know which is "right"?

We are individuals and as diverse in our values as any other arbitrary grouping of individuals. I daresay there is less difference in outlook between the "average" scientist and the "average" religionist (or member of any other field) than there is between the extremes in either group. Scientists try to be objective in their work, though not always successfully, but in the subjective world in which they live they have no special qualifications except, perhaps, that of inquiry. But, inquiry does not beget objectivity.

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REFERENCE

1. LOUIS G. STANG, Jr., "Our Responsibility," *Nucl. Appl.*, 5, 50 (1968).