To: Distribution
From: Paul N. Haubenreich
Subject: Consideration of Adding Plutonium to MSRE Fuel

The molten-salt breeder is a thorium-based system that must penetrate a plutonium-oriented economy. The production of plutonium from light-water reactors is expected to exceed the startup needs of fast breeders for the next couple of decades, creating a surplus that is costly to store and inefficient to recycle in the water reactors. So the urge would seem to be to get on with fast breeders and away from thorium systems. But the situation may, in fact, aid in the acceptance of molten-salt breeders if, as it now appears, they can efficiently use plutonium as the fissile material for startup.

Studies by Kasten\(^1\) and Thoma\(^2\) indicate a favorable outlook for the use of plutonium in molten-salt breeders. The question has naturally been raised: "Should we put plutonium in the MSRE?" This is an important question for our project and your help is needed in arriving at an answer.

Presumably the experiment would involve adding to the present fuel a significant amount of plutonium and enough thorium to cancel its reactivity effect. The additional effort that would have to be expended would include safety analyses, preparation of enriching salts, extension of MSRE operation for some months, and more complicated processing of the salt when the reactor is finally shut down.

Among the questions that must be examined and evaluated before a decision can be made are the following.

1. What benefits might there be in increased or improved reactor physics information?

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\(^1\)P. R. Kasten, Use of Plutonium in Single-Fluid MSBR's, MSR-68-64, April 13, 1968.

2. What can be learned by observing the chemistry of the salt and its compatibility with graphite and Hastelloy in the MSRE?

3. What about the processing of the salt for recovery of the fissile materials? How? Is there value in the separation of plutonium by liquid-metal extraction not only as a demonstration of an operation involved in plutonium startup of a breeder but also to some degree as a support for the proposed protactinium separation?

4. What new problems would we learn to deal with in salt handling and operation of the MSRE with the different salt?

5. What about safety?

6. What concentration of plutonium is desirable?

7. How would the plutonium and thorium be prepared and added to the MSRE?

8. What modifications would be required in the MSRE (including the processing plant)?

9. How much would all this cost?

10. How long would it take?

11. Could we expect the MSRE to continue operating through this further experiment with a reasonably low probability of breakdown?

Obviously a good deal of work must go into answering several of these questions, and some of you will be asked later to participate in this effort. At the very outset, however, we need to do two things: look at the incentives for doing the experiment, and bring the whole picture of how it would be done into slightly better focus so we can plan our work. Therefore, will you please jot down your thoughts on the possible benefits of the experiment, along with any other comments you may have, and send them to me.

Paul N. Haubenreich

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