-1-

ARGONNE NATIONAL LABORATORY
P. O. Box 299
Lemont, Illinois

JOINT STATUS REPORT ON FAST REACTOR PHYSICS

by

D. Okrent, Argonne National Laboratory
L. S. Shepherd, AERE, Harwell, England

Photostat Charge \$ <u>1.05</u> (OTS only)
Microcard Charge \$ _____
for Access Permittees
Available from Technical Information Service Extension P. O. Box 1001, Oak Ridge, Tennessee

October, 1955

Operated by The University of Chicago
under
Contract W-31-109-eng-38

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

2

JOINT STATUS REPORT ON FAST REACTOR PHYSICS

by

D. Okrent, Argonne National Laboratory
L. S. Shepherd, AERE, Harwell, England

1. The authors have jointly examined the status of fast reactor physics in the United Kingdom and the U.S.A. and find a gratifying degree of agreement. During our recent meetings at Harwell (August 26 and 29, 1955), the authors, in conjunction with Dr. Holmes of AERE, discussed the published results in some detail. While the ANL people have not analyzed the Zephyr assembly specifically, fortunately a calculation is reported in Table IV of Geneva Conference Paper No. 609⁽¹⁾ for a hypothetical reactor which is rather similar to the first loading of Zephyr. This allows a direct comparison of British measurements and American expectations of the breeding ratio of such an assembly. If we assign the same value of $\alpha = \sigma_c / \sigma_f$ for Pu^{239} to each assembly, say $\alpha = 0.06$, based on EBR-I measurements, the ANL calculation predicts a breeding ratio of 2.0 while the Zephyr measurement results in a value of 2.1 ± 0.2 .

2. This substantial agreement appears not only in the final performance figure, but also in the detailed analyses. For example, the fraction of the total fissions which will occur in the U^{238} agrees between experiment and calculation, within the assigned error. Similarly, where a comparison of spectrum measurements is possible, there is a wide area of general agreement, although minor discrepancies point out the need of further measurement and analysis.

3. It is noted that the relatively high breeding ratio predicted for Zephyr is quite consistent with the value of 1.6, estimated by Dr. Zinn for a large, fast power reactor in Geneva Paper No. 814.⁽²⁾ As mentioned in this paper, the following factors all combine to lower the performance of such a reactor in practice:

- A. The more dilute reactor will have a softer spectrum and, hence, a considerably higher value of α . Based on EBR-I measurements, a value of $\alpha = 0.2$ would be reasonable.
- B. It is not expected that an appreciable increase in the fraction of fissions from U^{238} will result. This is demonstrated by the calculations reported in Table IV, Paper No. 609.⁽¹⁾ Indeed, the increased dilution of the assembly with structure and coolant, as well as the reduced density of the blanket, may prevent any increase.

- 6
- C. It is to be expected that the neutron capture in structure and coolant will be more significant.
 - D. There will be some fission product buildup with resultant neutron losses.
 - E. There will be some losses of fissionable material in chemical processing.
 - F. Engineering and control requirements will prevent the construction of a perfectly efficient blanket so that some neutron leakage will still exist.

4. It is to be hoped that a rapid exchange and a continuing broad discussion of fast reactor physics information between the U.S.A. and the U.K. can be achieved at an early date. Considerable information has been presented in Geneva Conference Papers No. 609 and 404,⁽³⁾ but much remains in reports which are nominally classified. Furthermore, expanding programs at Harwell and ANL on fairly similar reactors can gain much by continued close contact.

References

1. D. Okrent, R. Avery and H. H. Hummel, "A Survey of the Theoretical and Experimental Aspects of Fast Reactor Physics," Paper No. 609, International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland (1955).
2. W. H. Zinn, "Review of Fast Power Reactors," Paper No. 814, International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland (1955).
3. J. E. R. Holmes, D. D. McVicar, H. Rose, R. D. Smith and L. R. Shepherd, "Experimental Studies on Fast Neutron Reactors at A.E.R.E.," Paper No. 404, International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland (1955).