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MONTHLY TECHNICAL REPORT
APRIL, 1963

REACTOR PHYSICS.

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MONTHLY TECHNICAL REPORT
APRIL, 1963

REACTOR PHYSICS

Paul F. Nichols

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MONTHLY TECHNICAL REPORT
APRIL, 1963

REACTOR PHYSICS

I. RESEARCH AND DEVELOPMENT ACTIVITIES

A. Project Proposals

1. A supplementary project proposal has been prepared for submission to the AEC. The proposal is entitled "Supplementary Advanced Physics Studies." The basic goal of the program is the establishment of broad nuclear physical bases for the selection of future fuel element designs for N-Reactor, or other Hanford reactors. The work proposed is both experimental and theoretical. It will include:
 - a) basic reactor physics studies in the PCTR as well as work in both the PCTR and exponential piles on fuel element designs similar to those which could be used directly in N,
 - b) support for the neutron cross-section program, and
 - c) analytical physics work directed toward the calculation of the distribution of neutrons in energy and space in a heterogeneous lattice.
2. Work has been started on the preparation of material for the physics part of the technical document which will give the bases for our 1964-1965 R&D program.

B. Isotope Production in N-Reactor

1. Preliminary calculations have been made to obtain estimates of the amount of Pu^{238} which could be produced from irradiation of Np^{237} targets in N-Reactor. The results indicate that after an exposure ϕt of 10^{21} neutrons per cm, one might achieve approximately 13 per cent conversion of the Np^{237} to Pu^{238} . This corresponds to about 500 days at N-Reactor flux levels.

The processes involved are as shown below:

In order to simplify the treatment, two approximations were made. First, the intermediate step involving Np^{238} was omitted. The half-life of Np^{238} is approximately 2 days and its destruction cross-section is only moderately different than that of Pu^{238} . Therefore the appearance of Pu^{238} was assumed to be simultaneous with the absorption of a neutron by Np^{237} . Secondly, the alpha decay of Pu^{238} was neglected due to its long half-life, thus the reaction chain assumed was:

The results are only approximate, but are useful estimates for survey studies.

2. The Np production estimates given by Nilson in HW-76026 have been extended from 2000 MWD/T to 3000 MWD/T. The production from U^{238} and U^{236} initially present in the fuel is linear up to 2000 MWD/T and has been extended on that basis to 3000 MWD/T. However, it was necessary to calculate additional points in the exposure region between 2000 MWD/T and 3000 MWD/T for the production from U^{235} precursors because of the non-linear behavior of the buildup.
3. The preparation of standard tabular values of the conversion ratio, Pu^{240} content, and U^{235} burnout as a function of exposure to be used for all economic studies and production estimates is partially complete. The use of these standard values will make economic and production studies based on these values directly comparable and remove the need for frequent normalization and re-normalization. These standard values will not be changed until significantly better values of the parameters are obtained.
4. A rough draft of a report on the nuclear aspects of the production capabilities of N-Reactor for several heavy isotopes has been prepared during the month. In light of the information generated about the production of Pu^{238} from Np^{237} , it appears that the yield of Pu^{238} from a Np^{237} target irradiated for one year at typical N-Reactor flux levels is about ten per cent.
5. Work has been started on the selection of fuel element dimensions to be used for the Hanford Laboratories study of production rates and

fuel cycles using Pu as a fuel in conjunction with a non-fissile target element. Several different geometries will be selected.

Flex 2 is being used to select the dimensions.

6. A study is underway on the selection of LiAl target tube dimensions and concentrations for use with the 1.25 per cent U^{235} outer fuel tube assemblies in the event that these are not needed for reactivity tailoring during the power ascension program. Flex 2 is being used for this study.

C. Code Development

1. Flex 2

Flex 2 is being converted from Fortran to FAP in order to secure sufficient room for the entire program as it now exists and additional room for future expansions. This conversion is approximately 80 per cent complete.

D. Technical Bases

1. Nuclear Instrumentation

This work is in its initial stages. The primary method of analysis will be through the use of the IBM 7090, one space dimension, reactor kinetics code CLUMSY I by R. E. Tiller of IPD. These results from this code will be compared with results obtained from the TRIP code and a multinode analog simulation.

Most of the work thus far has been devoted to learning the code and its input requirements. This is slow because no formal write-up exists, although one is being prepared at this time by Tiller.

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The first set of problems which will probably be investigated are reruns of some of the cases discussed in the hazards reports. They are already defined and can serve as tests to ensure that the code is being used properly. They also serve as a check on the hazards cases run on the TRIP code.

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