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COMPARISON OF PHYSICS PARAMETERS FOR
N AND K REACTORS

August 2, 1963

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4-18-94.

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COMPARISON OF PHYSICS PARAMETERS FOR
N AND K REACTORS

1. Power, Conversion Ratios, Westcott Flux, Neutron Temperature and "r" Value

The following physics parameters have been selected by the authors as representing the best set presently available for comparison purposes. Although these numbers may differ from some quoted earlier in hazards reports, etc., they represent the most consistent set we have for the present purpose.

The parameters are summarized in Table I.

TABLE I
PHYSICS PARAMETERS

	<u>N</u>	<u>K</u>
Reactor Power	4000	4400
Average Westcott Core Flux (Fuel)	2.67×10^{13}	2.93×10^{13}
T_n	700° K	650° K
r	0.105	0.0625
Conversion Ratio for 6% Pu	.865 (21.6 lb/ft fuel)	.885 KV fuel
Production Only in gm/MWD	.885 (24.0 lb/ft fuel)	

The bases for these numbers are as follows:

a. Power Level

This is the design level for N and the present administrative limit for K.

b. Average Westcott Core Flux in Fuel

This is an over-all average for N and an average for K in the natural uranium core region.

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c. Neutron Temperature

These numbers are for fuel regions estimated from MOFDA calculations and both have arbitrarily been reduced 50° K to be in line with IPD operating experience with temperature and exposure transients.

d. "r" Value

These are average values in the fuel. The numbers were obtained by averaging FLEX and MOFDA calculations.

e. Conversion Ratio

The value for N Reactor at 6% Pu²⁴⁰ is from FLEX calculations for 21.6 lb/ft and 24 lb/ft fuel with the standard normalizations used in HW-77806, "Physics Input Data for Economics Studies; Tube-in-Tube Fuel Elements" - P. F. Nichols (Secret), i.e., 8.6% Pu²⁴⁰ at 1300 MWD/T and a conversion ratio of 0.82 @ 1200 MWD/T for the 21.6 lb/ft fuel element. The value for K Reactor at 6% Pu²⁴⁰ is from HW-50300 B-Rev., "Plutonium Conversion Tables" - A. D. Vaughn (Secret) and assumes that 12% of the MWD is in KV enriched fuel and 88% of the MWD in KV natural fuel.

2. Reactor Rates

Ratios of reaction rates in N Reactor and K Reactor have been calculated from the flux, r, and T_n values shown in Table I for several target materials. These ratios are listed in the "Average Core Flux" row in Table I.

Because the average to peak flux ratios are different in N Reactor and K Reactor (~ 0.63 in N and ~ 0.56 in K), ratios of reaction rates are also listed in the "Peak Core Flux" row in Table II.

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The ratios shown in Table II are valid only for dilute absorbers in the flux and spectral environments of production fuel in the two reactors.

TABLE II
RATIO OF REACTION RATES (N TO K) PER TARGET ATOM

A. Productive Capture Reactions

Target Atom	1/v	Np ²³⁷	Am ²⁴¹	Am ²⁴³	Pu ²⁴⁰	Pu ²⁴²	Th ²³²	Pu ²⁴¹	U ²³⁶	Pu ²³⁹	U ²³⁵
Average Core Flux	0.91	1.10	1.07	1.24	1.41	1.43	1.28	0.94	1.73	1.00	0.94
Peak Core Flux	0.81	0.98	0.95	1.10	1.26	1.27	1.14	0.83	1.54	0.89	0.83

B. Destructive Fission or Capture Reactions

Target Atom	1/v (Capture)	Pu ²³⁹ (Fission)	U ²³⁵ (Fission)	Pu ²⁴¹ (Fission)
Average Core Flux	0.91	0.98	0.91	0.94
Peak Core Flux	0.81	0.87	0.81	0.83

Productive 1/v capture reaction targets would include Li⁶ and Bi, and destructive 1/v reaction targets would include Am²⁴² (fission), Cm²⁴³ (fission), Cm²⁴⁴ (capture), and Cm²⁴² (capture) which is destructive in the production of Cm²⁴² but not Cm²⁴⁴.

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