LA-8869-MS

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This work was supported by the Electric Power Research Institute and the US Department of Energy, Spent Fuel Project Office, under the technical direction of the Savannah River Laboratory.

UNITED STATES
DEPARTMENT OF ENERGY
CONTRACT W-7405-ENG. 36

LA-8869-MS

UC-34c
Issued: June 1981

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NEUTRON PRODUCTION FROM (α,n) REACTIONS AND SPONTANEOUS FISSION IN ThO_2, UO_2, AND $(U,Pu)O_2$ FUELS

by

R. T. Perry and W. B. Wilson

ABSTRACT

Available alpha-particle stopping cross-section and $^{17,18}O(\alpha,n)$ cross-section data were adjusted, fitted, and used in calculating the thick-target neutron production function for alpha particles below 10 MeV in oxide fuels. The spent UO_2 function produced was folded with actinide decay spectra to determine (α,n) neutron production by each of 89 actinides. Spontaneous-fission (SF) neutron production for 40 actinides was calculated as the product of $\bar{\nu}$(SF) and SF branching-fraction values accumulated or estimated from available data. These contributions and total neutron production in spent UO_2 fuel are tabulated and, when combined with any calculated inventory, describe the spent UO_2 neutron source. All data are tabulated and methodology is described to permit easy extension to specialized problems.

I. INTRODUCTION

Neutron sources are present in reactor fuel from the spontaneous-fission (SF) decay of actinide nuclides and from the interaction of their decay alpha particles with low- and medium-Z nuclides in (α,n) reactions. The (α,n) source in oxide fuels is dominated by reactions with ^{17}O and ^{18}O, which are present in ^{NAT}O in 0.038 and 0.204 atom percent abundancies, respectively.

The probability of neutron production by an alpha particle emitted at energy E_α in the fuel is given by the thick-target neutron production function $P(E_\alpha)$, which we have evaluated for four fuel compositions--clean ThO_2 thermal reactor fuel, clean and spent UO_2 thermal reactor fuel, and clean $(U,Pu)O_2$ fast reactor fuel. The (α,n) neutron production function has been evaluated at the Hanford Engineering Development Laboratory (HEDL) by Ombrellaro and Johnson for alpha particles in FFTF fuel;[1] however, $P(E_\alpha)$ has not been calculated for the fuels of interest here, and the change in $P(E_\alpha)$ with exposure has not been evaluated. We have employed the methodology and data used in the HEDL work[1] with minor exceptions in data and energy range of calculation.

The equations describing (α,n) and SF neutron production and the data quantities used in the calculations are given in Sec. II. The available data sources and adjustments made to the data are described in Sec. III. Details of the (α,n) calculations are briefly discussed in Sec. IV. Resulting (α,n), SF, and total neutron production values are given in Sec. V for each of a variety of actinide nuclides produced in reactor fuels.

Selected results of these calculations have been reported previously.[2-5]

II. THEORY

The slowing and stopping of alpha particles in a material are described by the material's alpha-particle stopping power,

$$SP(E) = -\frac{dE}{dx} \quad , \tag{1}$$

which gives the energy-dependent energy loss of alpha particles of energy E per unit path length x.[6] The energy loss of an alpha particle of initial energy E_α in traveling a distance X can be determined from the stopping power as

$$\Delta E = E_\alpha - E'_\alpha = \int_0^X \left(-\frac{dE}{dx}\right) dx \quad . \tag{2}$$

Similarly, the distance traveled in slowing from E_α to E'_α is

$$X = \int_{E_\alpha}^{E'_\alpha} \frac{1}{\left(\frac{dE}{dx}\right)} dE = \int_{E'_\alpha}^{E_\alpha} \frac{1}{\left(-\frac{dE}{dx}\right)} dE \quad . \tag{3}$$

Neutrons may be produced within the material by (α,n) reactions with nuclide i, which has atom density N_i and microscopic (α,n) cross section $\sigma_i(E)$. The probability of (α,n) interaction with nuclide i by an alpha particle of energy E traveling from x to x + dx is

$$N_i\sigma_i(E)dx = \frac{N_i\sigma_i(E)dE}{\left(\frac{dE}{dx}\right)} \quad . \tag{4}$$

The probability of (α,n) interaction with nuclide i by an alpha particle in lieu of slowing from E_α to E'_α is then

$$p_i(E_\alpha,E'_\alpha) = \int_{E_\alpha}^{E'_\alpha} \frac{N_i\sigma_i(E)dE}{\left(\frac{dE}{dx}\right)} = \int_{E'_\alpha}^{E_\alpha} \frac{N_i\sigma_i(E)dE}{\left(-\frac{dE}{dx}\right)} \quad . \tag{5}$$

The probability of (α,n) interaction with nuclide i by an alpha particle prior to stopping in the material is given by the thick-target neutron production function

$$P_i(E_\alpha) = \int_0^{E_\alpha} \frac{N_i\sigma_i(E)dE}{\left(-\frac{dE}{dx}\right)} \quad . \tag{6}$$

In addition to that of the above definition of Eq. (1), a variety of quantities are referred to as "stopping powers" or often alternately "stopping cross sections." These include (typically without explicit regard to sign) the quantities $\frac{dE}{d\chi} = \frac{dE}{d(\rho x)} = \frac{dE}{\rho dx}$,[7] $\frac{dE}{Z^2dx}$,[8] $\rho\frac{dE}{dx}$, and $\frac{dE}{Ndx}$.[9] Here χ is material thickness (mg/cm^2), Z is atomic number, ρ is material density (g/cm^3), and N is the total atom density of the material (atoms/cm^3). The last quantity is also called the stopping cross section,

$$\varepsilon(E) = -\frac{1}{N}\frac{dE}{dx} \quad , \tag{7}$$

a notation adopted here. Equations above defining p_i and P_i may now be written in terms of ε as

$$p_i(E_\alpha,E'_\alpha) = \frac{N_i}{N}\int_{E'_\alpha}^{E_\alpha} \frac{\sigma_i(E)}{\varepsilon(E)}\,dE \tag{8}$$

and

$$P_i(E_\alpha) = \frac{N_i}{N}\int_0^{E_\alpha} \frac{\sigma_i(E)}{\varepsilon(E)}\,dE \quad . \tag{9}$$

Note that p_i and P_i are related by

$$p_i(E_\alpha,E'_\alpha) = P_i(E_\alpha) - P_i(E'_\alpha) \quad . \tag{10}$$

The stopping cross section $\varepsilon(E)$ of a material composed of J elemental constituents may be calculated using the Bragg-Kleeman[10] relationship, which may be written as

$$\varepsilon(E) \simeq \frac{1}{N}\sum_{j=1}^{J} N_j\varepsilon_j(E) \quad , \tag{11}$$

where

$$N = \sum_{j=1}^{J} N_j \quad . \tag{12}$$

The accuracy of the approximation of Eq. (11) will be discussed in Sec. III.

A fraction of the decays of nuclide k within the material may be by alpha-particle emission. This fraction F_k^α of alpha decays may occur with the emission of one of L possible alpha-particle energies. The intensity $f_{k\ell}^\alpha$ is the fraction of all decays of nuclide k resulting in an alpha particle of energy $E_{k\ell}$, and

$$F_k^\alpha = \sum_{\ell=1}^{L} f_{k\ell}^\alpha \quad . \tag{13}$$

The fraction of nuclide k decays resulting in (α,n) neutron production in a thick-target material containing I nuclides with (α,n) cross sections is thus

$$R_k(\alpha,n) = \sum_{\ell=1}^{L} f_{k\ell}^{\alpha} \sum_{i=1}^{I} P_i(E_{k\ell}) \quad . \tag{14}$$

The SF of an actinide nuclide k is accompanied by the emission of an average $\overline{\nu}_k$(SF) neutrons. The SF activity A_k^{SF} of nuclide k, having atom density N_k, is

$$A_k^{SF} = \lambda_k^{SF} N_k \quad . \tag{15}$$

Here, λ_k^{SF} is the SF decay constant defined by

$$\lambda_k^{SF} = \ell n2/T_{1/2}^k(SF) \quad , \tag{16}$$

where $T_{1/2}^k$ (SF) is the SF half-life of nuclide k. SF is typically only one of M modes of decay; the total activity due to nuclide k is

$$A_k = \lambda_k N_k = \sum_{m=1}^{M} A_k^m \quad , \tag{17}$$

where λ_k is the total decay constant of nuclide k,

$$\lambda_k = \sum_{m=1}^{M} \lambda_k^m = \ell n2/T_{1/2}^k \quad , \tag{18}$$

and $T_{1/2}^k$ is the total half-life of nuclide k. The fraction of nuclide k decays by SF is given by the SF branching fraction

$$F_k^{SF} = A_k^{SF}/A_k = \lambda_k^{SF}/\lambda_k = T_{1/2}^k/T_{1/2}^k(SF) \quad . \tag{19}$$

The average number of SF neutrons emitted per decay (by any mode) of nuclide k is then

$$R_k(SF) = F_k^{SF} \bar{\nu}_k(SF) \quad . \tag{20}$$

The total number of neutrons, on the average, emitted due to (α,n) reactions and SF is

$$R_k = R_k(\alpha,n) + R_k(SF) \quad . \tag{21}$$

The total neutron source S from (α,n) reactions and SF within a material containing K pertinent radionuclides is then

$$S = \sum_{k=1}^{K} \lambda_k N_k R_k \quad . \tag{22}$$

The evaluation of the quantities $R_k(\alpha,n)$, $R_k(SF)$, and R_k for a number of actinide nuclides is described in the following sections.

III. DATA

The data quantities required to compute the neutron production fractions $R_k(\alpha,n)$ and $R_k(SF)$ for each of the four fuels of interest include the following.

- For each major elemental constituent j of the material: N_j, the atom density; and $\varepsilon_j(E)$, the alpha-particle stopping cross section.

- For each nuclide i within the material having an (α,n) cross section: N_i, the atom density; and $\sigma_i(E)$, the microscopic (α,n) cross section.

- For each nuclide k decaying by alpha decay: $f_{k\ell}^{\alpha}$, the intensity for emission of each L alpha particles; and $E_{k\ell}$, the energy of each of L alpha particles.

- For each nuclide k decaying by SF: F_k^{SF}, the SF branching fraction; and $\bar{\nu}_k(SF)$, the average number of neutrons emitted per SF.

A. Stopping Cross Section $\varepsilon(E)$

Densities of each constituent of each fuel type are given in Table I. The fuel compositon of UO_2 LWR fuel is given for clean and spent conditions for the evaluation of the effect of exposure-dependent fuel composition on stopping cross section ε; here, ${}_{41}Nb$ and ${}_{59}Pr$ represent the low- and high-mass fission products, respectively. Concentrations of ${}_{93}Np$, ${}_{95}Am$, and ${}_{96}Cm$ are given for the spent UO_2 fuel, although the minor contributions to ε from these nuclides are included as plutonium. Elements contributing to the material stopping cross sections are thus O, Nb, Pr, Th, U, and Pu.

A bibliography of experimental and theoretical stopping-power references by Anderson[11] notes that some 900 papers have been published on the subject of ion energy loss in matter. Anderson, noting the observation by Bichsel[12] that stopping powers measured by different groups often did not agree within stated uncertainties, was unable to resolve discrepancies after careful analysis and cautioned that stopping-power data sources should be selected carefully. We have chosen as the major stopping cross-section data source the comprehensive volume edited by Ziegler,[13] which gives tabulated alpha stopping cross-section values and functional fits for elements in the range $1 \leq Z \leq 92$.

No values of the alpha-stopping cross section for plutonium were identified, although values for plutonium compounds were found.[7] Northcliffe and Schilling[8] have tabulated values of the stopping power $dE/d\chi$ for $Z \leq 92$. They have shown graphically, for each Z including Z = 94, the energy-dependent ratio $(dE/d\chi)_Z:(dE/d\chi)_{A\ell}$. In order to form a stopping cross section for plutonium consistent with the data of Ziegler,[13] we have used the stopping power ratio of Ref. 8 in the expression

$$\varepsilon_{Pu} = \varepsilon_u \frac{A_{Pu}}{A_U} \left[(dE/d\chi)_{Pu}:(dE/d\chi)_{A\ell} \frac{(dE/d\chi)_{A\ell}}{(dE/d\chi)_U} \right] , \tag{23}$$

where all quantities enclosed in brackets [] were taken from Ref. 8. Values used and produced in this calculation are given in Table II.

Fourth-degree polynomial functions of the form

$$\ell n\varepsilon = C_0 + C_1 \ell nE + C_2 \ell n^2 E + C_3 \ell n^3 E + C_4 \ell n^4 E \tag{24}$$

TABLE I

PROPERTIES OF OXIDE FUELS

	Thermal Reactor Fuels			Fast Reactor Fuel
	UO_2 Clean	UO_2 Spent	ThO_2 Clean	$(U,Pu)O_2$ Clean
Fuel Density (g/cm^3)	9.95	9.95	9.17	9.62
Exposure GWd/t	0	34	0	0
Atom Densities (atoms/b-cm)				
$^{NAT}_{8}O$	0.04372	0.04372	0.04184	0.04215
^{16}O	0.04361	0.04361	0.04174	0.04205
^{17}O	1.6614-5	1.6614-5	1.5899-5	1.6017-5
^{18}O	8.9189-5	8.9189-5	8.5354-5	8.5986-5
$_{41}Nb$	0	7.893-4	0	0
$_{59}Pr$	0	7.893-4	0	0
$_{90}Th$	0	0	0.02025	0
$_{92}U$	0.02186	0.02085	6.724-4	0.01887
$_{93}Np$	0	1.043-5	0	0
$_{94}Pu$	0	2.037-4	0	0.002634
$_{95}Am$	0	5.692-6	0	0
$_{96}Cm$	0	1.131-6	0	0

TABLE II

DATA OF NORTHCLIFFE AND SCHILLING[a] AND ZIEGLER[b] USED IN CALCULATING THE ALPHA PARTICLE STOPPING CROSS SECTION OF PLUTONIUM

	Stopping Power Ratios and Values from Northcliffe and Schilling				$\varepsilon(E)$ Stopping Cross Section	
E_α MeV	$\frac{(dE/d\chi)_{Pu}}{(dE/d\chi)_{A\ell}}$	(MeV/mg/cm²) $(dE/d\chi)_{A\ell}$	(MeV/mg/cm²) $(dE/d\chi)_U$	$\frac{(dE/d\chi)_{Pu}}{(dE/d\chi)_U}$	eV/(10¹⁵ atoms/cm²) U(Ziegler)	eV/(10¹⁵ atoms/cm²) Pu(Calculated)
0.100	0.150	0.752	0.135	0.837	75.80	63.74
0.320	0.188	1.219	0.243	0.942	139.93	132.48
0.500	0.214	1.317	0.286	0.986	165.64	164.08
0.805	0.235	1.299	0.312	0.978	178.59	175.40
1.281	0.256	1.170	0.307	0.977	166.77	163.72
2.402	0.291	0.904	0.269	0.978	129.15	126.86
4.003	0.322	0.682	0.223	0.982	100.57	99.23
6.404	0.350	0.512	0.183	0.978	78.65	77.29
10.007	0.382	0.379	0.148	0.980	60.67	59.71
16.010	0.418	0.270	0.114	0.991	47.09	46.90
24.016	0.448	0.200	0.090	1.000	37.01	37.18
48.031	0.490	0.118	0.059	0.983	23.64	23.35

[a]Northcliffe and Schilling, Nucl. Data Tables A7, 233 (1970)

[b]J. F. Ziegler, Helium Stopping Powers and Ranges in All Elemental Matter, Vol. 4 of The Stopping and Ranges of Ions In Matter Series (Pergamon Press, New York, 1977).

were fit to each set of tabulated stopping cross-section values, representing the values within 1% at any energy over the range 0.5 MeV $\leq E_\alpha \leq$ 10 MeV. These functional stopping cross sections are shown in Fig. 1. Coefficients of the polynomial functions are given in Table III. Stopping cross sections of the oxide fuels were formed from these component stopping cross-section functions using the Bragg-Kleeman relationship of Eq. (11) and component densities given in Table I.

Stopping cross-section values of UO_2, ThO_2, and $(U_{.8}Pu_{.2})O_2$ were computed over the range 2 MeV $\leq E_\alpha \leq$ 8 MeV and compared in Table IV with values of ε converted from experimentally measured values of $dE/d\chi$ reported by Nitzki and Matzke.[7] The measured and calculated values of ε agree within 9% over this range, with calculated values generally lower than measured values.

B. (α,n) Cross Sections

The cross sections for the $^{17,18}O(\alpha,n)$ reactions have been reported over four limited ranges of E_α, although no single measurement extends over the entire range of our interest. Bair and Willard[14] plotted their measured $^{18}O(\alpha,n)^{21}Ne$ cross-section values over the range 2.37 MeV $\leq E_\alpha \leq$ 5.15 MeV. Bair and Hass[15] extended the range of these data down to 1.14 MeV and plotted the $^{17}O(\alpha,n)^{20}Ne$ cross section over the range 1.31 MeV $\leq E_\alpha \leq$ 5.31 MeV. Bair and del Campo[16] later plotted the $^{NAT}O(\alpha,n)$ cross section over the range 3.1 MeV $\leq E_\alpha \leq$ 8 MeV and, based on their measured $^{NAT}O(\alpha,n)$ neutron production by alpha particles in the range 4.62 MeV $\leq E_\alpha \leq$ 4.8 MeV, recommended that the $^{17,18}O(\alpha,n)$ cross sections reported in Refs. 14 and 15 be increased by 35%.

Differential cross sections $d\sigma(E)/d\Omega$ for $^{17,18}O(\alpha,n)$ reactions were measured at higher energies by Hansen et al.,[17] who fit their measured angular distributions with Legendre polynomial expansions that they integrated to yield total $\sigma(\alpha,n)$ values. These values were plotted for the range 4.3 MeV $\leq E_\alpha \leq$ 12.3 MeV, and smooth curves were plotted approximating each set of data.

Except for cross-section values given by Hansen et al.[17] at 9.8, 11.6, and 12.3 MeV, no data were available in other than graphic form--despite the best efforts of Bair,[18] del Campo,[19] and Hansen[20] to resurrect their numerical data. Data taken from the $^{17,18}O(\alpha,n)$ cross-section curves of Refs. 14 and 15 for the earlier HEDL work[1] were supplied to us.[21] These data were thinned to 744 values of the $^{17}O(\alpha,n)$ cross section and 687 values of the $^{18}O(\alpha,n)$ cross section. Fourth-degree polynomial fits were made to data taken from the

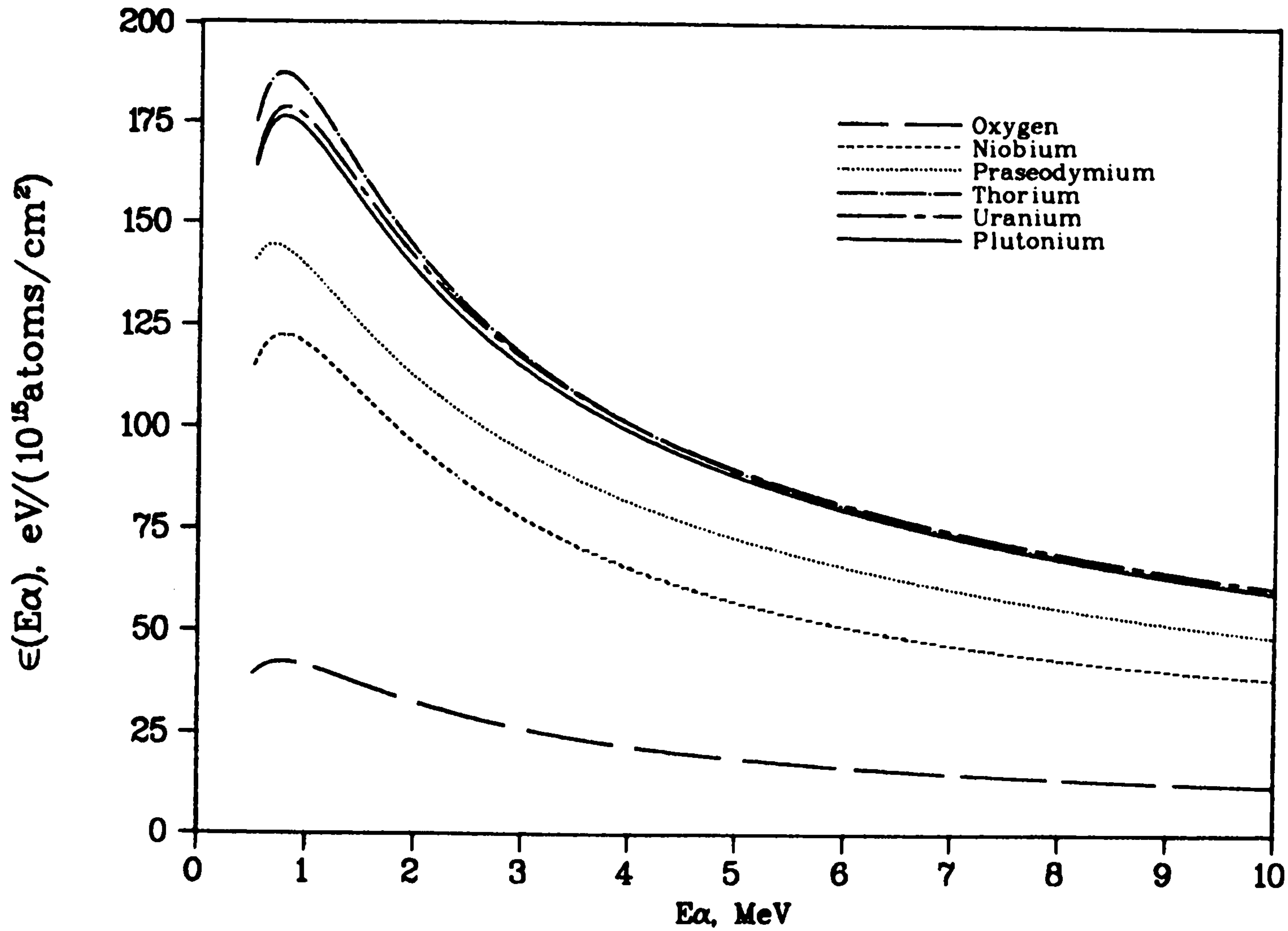

Fig. 1.
Stopping cross sections $\varepsilon(E_\alpha)$ of O, Nb, Pr, Th, U, and Pu.

TABLE III

COEFFICIENTS OF POLYNOMIAL FITS TO STOPPING CROSS SECTIONS[a]

Element	C_0	C_1	C_2	C_3	C_4
O	3.7213	-0.168700	-0.300138	0.0700466	-0.00377296
Ni	4.7872	-0.156294	-0.278932	0.0533399	0.00186590
Pr	4.9321	-0.192312	-0.199561	0.0592391	-0.00940776
Th	5.2027	-0.195369	-0.278809	0.105037	-0.0163945
U	5.1648	-0.161478	-0.279242	0.099232	-0.0146254
Pu	5.1486	-0.171158	-0.272723	0.100975	-0.0160365

[a] $\ell n \varepsilon = C_0 + C_1 \ell n E + C_2 \ell n^2 E + C_3 \ell n^3 E + C_4 \ell n^4 E$,
E is alpha-particle energy in MeV, $0.5 \leq E \text{ (MeV)} \leq 10.0$, and
ε is stopping cross section in $eV/(10^{15} \text{ atoms/cm}^2)$.

TABLE IV

COMPARISON OF CALCULATED AND MEASURED ALPHA STOPPING CROSS SECTIONS FOR OXIDE FUELS

	$\varepsilon(E)$ for ThO_2			$\varepsilon(E)$ for UO_2			$\varepsilon(E)$ for $(U_{.8}Pu_{.2})O_2$		
E MeV	From a	From Table III and Eq. (11)	% Dif	From a	From Table III and Eq. (11)	% Dif	From a	From Table III and Eq. (11)	% Dif
2	68.96	69.40	0.6	71.10	68.73	-3.3	72.17	68.55	-5.0
3	59.38	56.27	-5.2	59.91	55.93	-6.6	60.48	55.84	-7.7
4	52.13	48.67	-6.6	51.76	48.13	-7.0	52.05	48.01	-7.8
5	46.46	42.43	-8.7	45.56	42.53	-6.6	45.69	42.43	-7.1
6	41.91	38.20	-8.9	40.69	38.37	-5.7	40.71	38.27	-6.0
7	38.16	34.87	-8.6	36.76	35.10	-4.5	36.71	35.00	-4.7
8	35.03	32.23	-8.0	33.52	32.50	-3.0	33.42	32.41	-3.0

[a] Nitzki and Matzke, Phys. Rev. B8, 1894 (1973).

$^{NAT}O(\alpha,n)$ cross-section plot of Ref. 16 and to data taken from the $^{17,18}O(\alpha,n)$ cross-section plots of Ref. 17. These five cross-section descriptions are shown in Fig. 2.

The $^{17,18}O(\alpha,n)$ cross sections used in the present calculations were composed of the lower energy data of Refs. 14 and 15 increased by 35% as recommended in Ref. 16 and joined with the adjusted higher energy data of Ref. 17. This adjustment, amounting to a 9.2% reduction, was determined by normalizing the integral of the $^{NAT}O(\alpha,n)$ cross section formed from the functional fits to $^{17,18}O(\alpha,n)$ cross sections of Ref. 17 to the integral of the $^{NAT}O(\alpha,n)$ cross section of Ref. 16 over the range 5.15 MeV $\leq E_\alpha \leq$ 8 MeV. The resulting adjusted cross sections are shown in Fig. 3. The adjusted $^{17}O(\alpha,n)$ cross section is given in Table V, and the adjusted $^{18}O(\alpha,n)$ cross section is given in Table VI; cross sections are defined there by interpolation points at low energies ($\lesssim$ 5 MeV) and by polynomial functions at higher energies.

C. Alpha-Decay Data

A total of 144 actinide nuclides produced in reactor fuel have been identified,[22] using data of ENDF/B-V and Refs. 23-25. Of these, 89 decay at least partly by alpha decay. Each nuclide has some L different alpha-particle energies with $1 \leq L \leq 26$ for the data collection used. Alpha-particle energies in the data collection fall in the range 3.71 MeV $\lesssim E_\alpha \lesssim$ 8.78 MeV. TABLE VII lists the alpha-particle energies and intensities for each nuclide.

D. Spontaneous-Fission Data

Of the 144 actinide nuclides identified, 40 decay at least partly by spontaneous fission. Values of $\overline{\nu}_p(SF)$, the major prompt contribution to $\overline{\nu}(SF)$, are given by Manero and Konshin[26] for many of these. These values were used in Fig. 4 to estimate values of $\overline{\nu}_p(SF)$ for nuclides without data.

Branching fractions F^{SF}, if not given in a data reference, were constructed from total and SF half-life values $T_{1/2}(SF)$ using Eq. (19). Values of $T_{1/2}(SF)$ given as limiting values were used and quoted without qualification. The values of $\overline{\nu}(SF)$, F^{SF}, and R(SF) for each of the 40 nuclides are given in Table VIII.

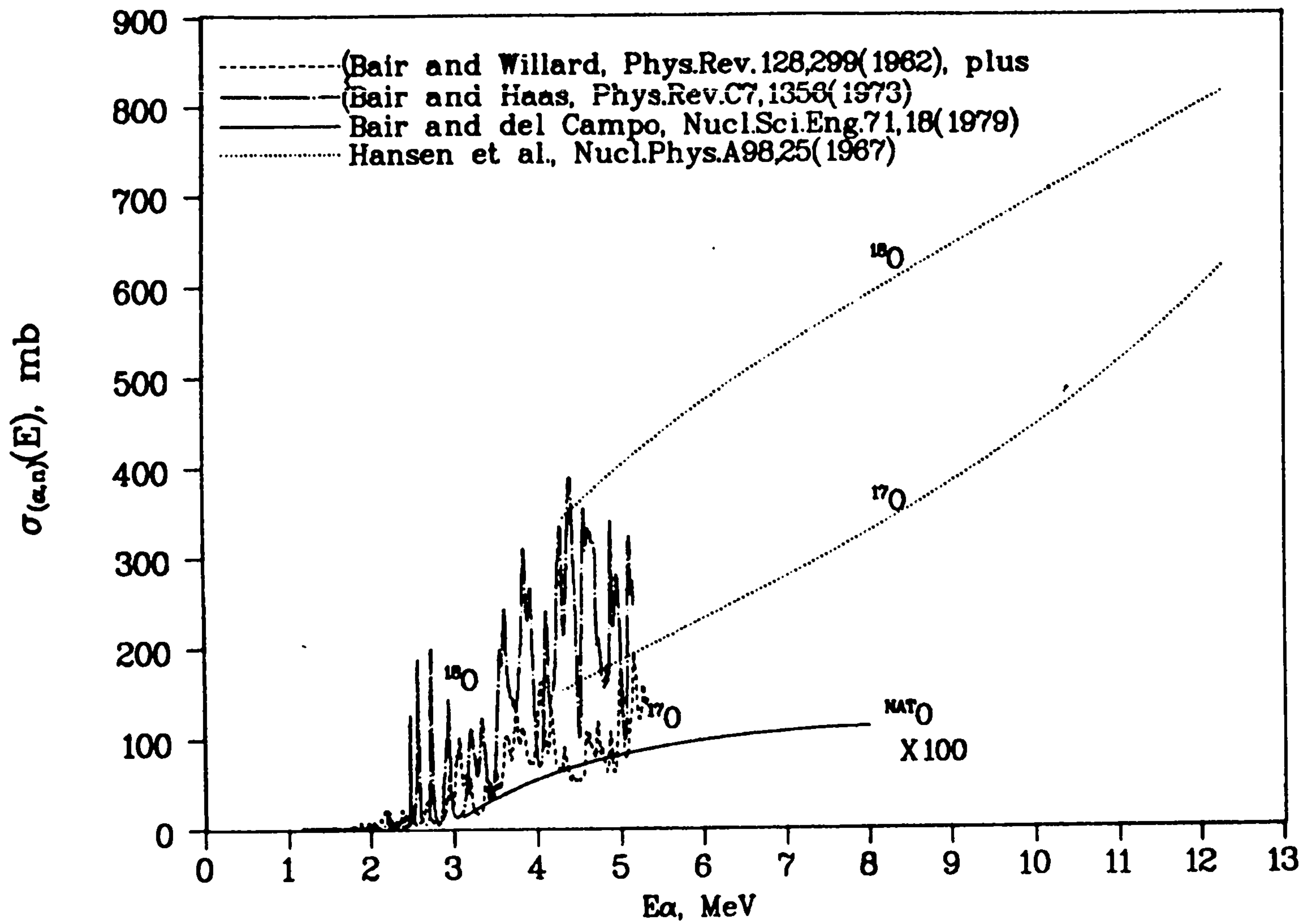

Fig. 2.
^{17}O, ^{18}O, and ^{NAT}O (α,n) cross-section data.

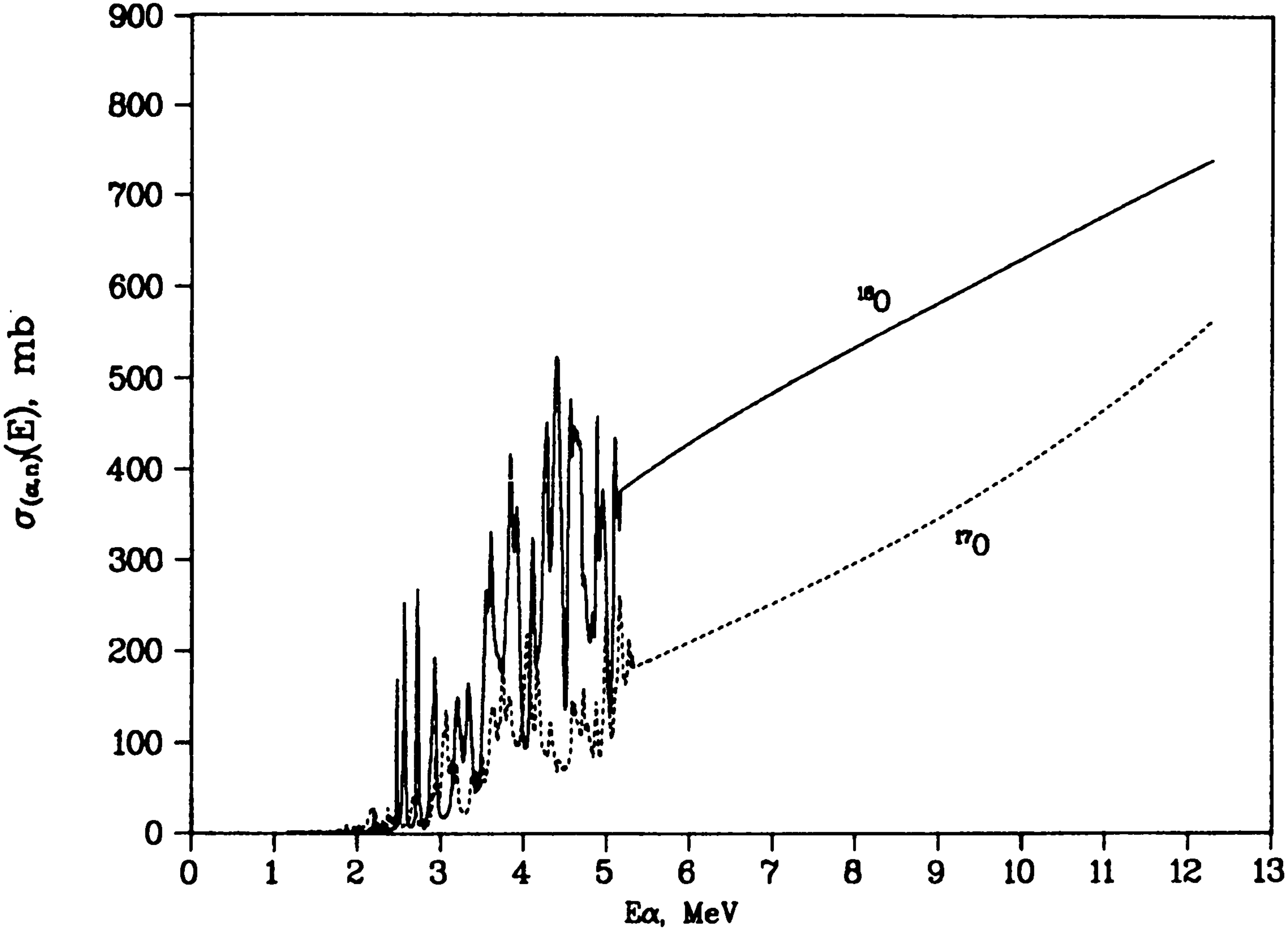

Fig. 3.
^{17}O and ^{18}O adjusted (α,n) cross sections.

TABLE V

ADJUSTED ^{17}O (α,n) CROSS SECTION

E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)
1.3117	.03	1.5885	.04	1.8131	.94	2.1579	25.10	2.4845	13.61	2.8901	23.54	3.3322	27.73	3.7914	127.44	4.2865	85.87	4.8113	93.77
1.3139	.03	1.5927	.12	1.8177	.78	2.1628	26.32	2.4901	18.44	2.8960	38.77	3.3383	28.88	3.7978	131.57	4.2933	90.84	4.8189	91.62
1.3158	0.00	1.5968	.13	1.8221	.61	2.1677	26.23	2.4951	20.25	2.9016	45.71	3.3444	32.44	3.8041	140.13	4.3002	96.50	4.8260	85.17
1.3178	.12	1.6007	.16	1.8265	.73	2.1726	25.92	2.5005	18.22	2.9072	44.74	3.3503	38.07	3.8105	144.96	4.3070	108.69	4.8331	84.66
1.3195	.12	1.6051	.22	1.8311	.62	2.1775	28.09	2.5056	14.93	2.9128	41.46	3.3564	51.15	3.8171	150.16	4.3139	120.84	4.8401	89.15
1.3214	.03	1.6094	.26	1.8356	.58	2.1824	26.33	2.5110	11.81	2.9241	47.80	3.3625	61.87	3.8234	150.04	4.3207	121.73	4.8475	96.59
1.3234	.04	1.6135	.13	1.8400	2.07	2.1872	27.24	2.5161	9.09	2.9298	68.26	3.3686	64.62	3.8298	143.59	4.3276	113.21	4.8545	118.76
1.3250	.07	1.6177	.26	1.8447	1.36	2.1921	26.45	2.5212	7.99	2.9354	83.75	3.3744	63.36	3.8361	145.39	4.3345	105.07	4.8621	135.39
1.3272	0.00	1.6218	.49	1.8490	1.34	2.1970	25.34	2.5266	7.01	2.9464	71.05	3.3805	60.95	3.8427	141.48	4.3413	102.42	4.8692	144.37
1.3289	.03	1.6232	.26	1.8533	1.46	2.2019	23.35	2.5317	6.98	2.9522	55.97	3.3867	58.85	3.8491	135.55	4.3481	101.61	4.8763	139.54
1.3306	0.00	1.6246	.31	1.8580	1.30	2.2068	22.38	2.5371	6.52	2.9582	46.58	3.3925	56.66	3.8554	124.56	4.3550	94.84	4.8836	125.50
1.3328	.03	1.6260	.39	1.8625	1.48	2.2117	21.25	2.5422	7.57	2.9638	39.77	3.3986	61.05	3.8622	118.17	4.3618	92.42	4.8913	110.55
1.3345	.01	1.6301	.26	1.8671	1.32	2.2169	23.87	2.5474	8.64	2.9694	35.38	3.4047	67.86	3.8683	109.98	4.3686	86.66	4.8981	99.06
1.3366	.07	1.6304	.53	1.8715	1.42	2.2217	19.08	2.5531	8.99	2.9753	33.84	3.4108	70.08	3.8749	109.59	4.3755	84.38	4.9054	88.82
1.3385	.03	1.6343	.38	1.8761	.99	2.2265	16.21	2.5582	8.72	2.9809	35.05	3.4169	69.48	3.8813	103.83	4.3823	78.26	4.9127	83.89
1.3424	.03	1.6345	.43	1.8805	1.32	2.2314	14.46	2.5636	8.91	2.9846	35.65	3.4230	65.08	3.8879	102.55	4.3891	74.88	4.9203	84.62
1.3441	0.00	1.6385	.43	1.8852	1.16	2.2363	12.96	2.5689	8.06	2.9883	38.91	3.4291	64.44	3.8942	102.10	4.3962	68.86	4.9276	85.16
1.3461	.03	1.6388	.58	1.8899	1.44	2.2414	11.87	2.5741	8.72	2.9921	41.09	3.4352	62.23	3.9008	100.10	4.4033	68.67	4.9350	93.01
1.3498	.01	1.6426	.35	1.8943	.93	2.2463	9.79	2.5792	8.30	2.9981	48.18	3.4413	59.79	3.9072	96.74	4.4104	76.87	4.9418	104.46
1.3537	.04	1.6431	.32	1.8987	1.17	2.2512	8.40	2.5846	8.84	3.0037	54.88	3.4474	54.86	3.9138	96.88	4.4170	80.39	4.9491	120.67
1.3576	.04	1.6467	.38	1.9036	.92	2.2564	5.94	2.5897	10.07	3.0093	65.73	3.4535	55.12	3.9201	100.08	4.4231	80.81	4.9567	134.85
1.3616	.01	1.6475	.34	1.9079	1.03	2.2613	5.08	2.5951	10.79	3.0152	77.73	3.4596	52.54	3.9267	97.51	4.4307	79.43	4.9638	151.05
1.3655	0.00	1.6509	.34	1.9125	1.42	2.2662	3.73	2.6004	12.30	3.0208	95.28	3.4658	51.58	3.9335	99.37	4.4380	77.36	4.9711	176.05
1.3691	.01	1.6516	.45	1.9172	1.15	2.2707	2.86	2.6058	12.91	3.0264	107.08	3.4721	50.73	3.9399	99.35	4.4443	76.44	4.9784	202.89
1.3730	.04	1.6550	.35	1.9217	.94	2.2713	3.56	2.6112	14.49	3.0322	110.11	3.4780	50.23	3.9462	96.92	4.4516	73.79	4.9857	222.25
1.3770	.07	1.6558	.42	1.9265	1.28	2.2761	3.23	2.6167	15.15	3.0381	109.03	3.4841	52.61	3.9528	100.95	4.4585	71.23	4.9931	235.94
1.3808	.07	1.6592	.45	1.9309	1.01	2.2807	2.54	2.6218	17.01	3.0441	105.07	3.4904	60.47	3.9594	104.52	4.4653	73.02	5.0004	239.31
1.3845	.05	1.6602	.32	1.9356	1.58	2.2810	3.69	2.6272	18.01	3.0494	107.51	3.4963	75.34	3.9660	113.68	4.4725	71.05	5.0082	228.16
1.3884	.05	1.6633	.43	1.9402	2.07	2.2861	4.64	2.6325	18.44	3.0553	116.48	3.5026	85.10	3.9726	118.00	4.4793	70.31	5.0154	209.80
1.3923	.04	1.6644	.53	1.9448	2.74	2.2908	8.82	2.6379	19.90	3.0609	127.87	3.5087	79.33	3.9792	125.35	4.4864	74.10	5.0225	183.94
1.3962	.03	1.6678	.38	1.9496	4.31	2.2912	9.77	2.6433	22.55	3.0670	136.27	3.5148	70.31	3.9855	129.42	4.4933	73.22	5.0298	153.32
1.4001	.05	1.6688	.42	1.9542	5.59	2.2957	12.60	2.6486	27.70	3.0729	129.71	3.5209	64.14	3.9921	137.71	4.5003	74.06	5.0374	131.42
1.4041	.04	1.6720	.43	1.9585	7.13	2.2962	13.00	2.6540	32.39	3.0785	116.45	3.5273	59.20	3.9987	149.39	4.5069	71.29	5.0447	117.50
1.4080	0.00	1.6732	.51	1.9634	8.59	2.3006	13.43	2.6594	35.53	3.0842	103.87	3.5334	57.54	4.0053	161.20	4.5140	77.10	5.0522	106.84
1.4120	.01	1.6761	.38	1.9678	7.28	2.3011	13.35	2.6647	37.83	3.0901	87.45	3.5397	58.90	4.0119	178.00	4.5211	76.77	5.0593	104.95
1.4198	.01	1.6774	.41	1.9727	7.03	2.3055	12.50	2.6701	40.45	3.0959	74.40	3.5458	60.16	4.0185	188.04	4.5279	77.37	5.0669	106.73
1.4237	.03	1.6805	.45	1.9774	6.87	2.3062	12.01	2.6756	39.57	3.1018	68.81	3.5519	63.75	4.0251	202.23	4.5348	78.79	5.0740	110.38
1.4276	.05	1.6818	.42	1.9818	6.21	2.3093	10.73	2.6810	36.45	3.1074	65.07	3.5580	69.19	4.0318	211.88	4.5421	78.62	5.0813	119.35
1.4314	.07	1.6847	.36	1.9867	5.32	2.3124	11.11	2.6863	32.29	3.1135	70.04	3.5644	73.74	4.0384	217.76	4.5492	79.91	5.0886	132.33
1.4354	.35	1.6859	.45	1.9913	5.02	2.3155	8.48	2.6917	28.62	3.1191	70.69	3.5707	76.45	4.0452	210.78	4.5558	84.36	5.0962	145.02
1.4393	.47	1.6888	.73	1.9960	4.62	2.3162	9.00	2.6971	25.56	3.1251	77.18	3.5768	85.72	4.0515	202.66	4.5628	89.30	5.1038	154.62
1.4432	.82	1.6903	.47	2.0006	4.32	2.3206	7.55	2.7027	23.38	3.1309	77.19	3.5832	96.11	4.0581	179.28	4.5697	103.94	5.1111	161.04
1.4474	.90	1.6933	.42	2.0053	4.36	2.3214	8.18	2.7081	21.22	3.1368	80.70	3.5893	107.62	4.0650	166.52	4.5767	131.49	5.1184	166.01
1.4513	.80	1.6944	.49	2.0100	4.68	2.3258	7.18	2.7134	19.14	3.1427	79.14	3.5959	119.69	4.0716	161.81	4.5841	144.41	5.1257	167.21
1.4549	.74	1.6974	.92	2.0148	6.55	2.3264	7.44	2.7188	16.24	3.1485	77.18	3.6017	127.80	4.0782	159.50	4.5907	137.20	5.1336	179.83
1.4592	.63	1.6988	.53	2.0194	7.87	2.3309	6.70	2.7244	14.80	3.1544	70.96	3.6081	134.97	4.0847	151.15	4.5977	129.73	5.1407	208.03
1.4631	.54	1.7015	.53	2.0241	9.21	2.3359	6.56	2.7298	12.78	3.1602	66.60	3.6144	136.82	4.0913	142.55	4.6051	132.31	5.1483	246.55
1.4670	.43	1.7032	.54	2.0287	8.29	2.3410	5.82	2.7352	10.92	3.1664	60.01	3.6205	135.01	4.0979	131.19	4.6119	142.13	5.1556	260.43
1.4709	.30	1.7059	.49	2.0336	7.56	2.3461	5.33	2.7409	9.87	3.1721	54.85	3.6269	137.09	4.1045	122.88	4.6193	138.21	5.1629	252.30
1.4751	.22	1.7076	.65	2.0382	6.56	2.3510	5.71	2.7462	8.61	3.1782	54.74	3.6330	136.92	4.1114	119.58	4.6262	131.38	5.1703	236.90
1.4790	.22	1.7103	.58	2.0428	5.58	2.3564	7.76	2.7516	8.45	3.1838	65.45	3.6393	139.31	4.1180	112.45	4.6332	125.47	5.1778	224.05
1.4829	.12	1.7118	.62	2.0477	5.24	2.3613	17.73	2.7572	8.07	3.1896	76.59	3.6454	135.31	4.1248	111.51	4.6403	123.11	5.1854	214.12
1.4870	.38	1.7145	.63	2.0525	5.71	2.3664	25.93	2.7626	7.51	3.1955	74.64	3.6518	131.00	4.1314	116.06	4.6474	122.20	5.1927	194.70
1.4909	.09	1.7162	.53	2.0574	5.64	2.3715	28.01	2.7680	7.01	3.2013	63.77	3.6581	119.88	4.1380	128.17	4.6545	118.35	5.2005	180.04
1.4948	.07	1.7207	.69	2.0620	5.72	2.3765	26.00	2.7736	5.95	3.2072	51.54	3.6645	114.99	4.1451	152.50	4.6618	114.60	5.2076	169.64
1.5029	.07	1.7251	.74	2.0668	6.13	2.3816	19.06	2.7792	5.53	3.2133	41.54	3.6708	110.74	4.1516	169.80	4.6686	114.43	5.2149	166.06
1.5069	.09	1.7292	.74	2.0714	6.28	2.3865	14.51	2.7846	5.72	3.2192	35.30	3.6772	103.19	4.1580	176.36	4.6760	111.54	5.2225	163.35
1.5108	.09	1.7336	.90	2.0739	6.17	2.3919	11.11	2.7899	5.70	3.2253	32.17	3.6833	102.49	4.1648	180.47	4.6833	109.48	5.2301	165.66
1.5149	.08	1.7380	.82	2.0763	6.06	2.3970	10.26	2.7957	6.88	3.2309	29.86	3.6875	112.01	4.1714	168.67	4.6901	105.91	5.2376	172.72
1.5189	.08	1.7424	1.20	2.0809	6.76	2.4021	16.43	2.8010	6.24	3.2367	27.67	3.6917	121.05	4.1784	160.76	4.6972	116.59	5.2450	173.37
1.5230	.09	1.7467	1.32	2.0858	7.24	2.4070	19.94	2.8067	5.47	3.2426	26.32	3.6960	120.99	4.1852	145.58	4.7045	132.52	5.2528	189.53
1.5272	.08	1.7512	1.40	2.0905	7.57	2.4122	19.57	2.8123	5.43	3.2487	24.96	3.7023	119.87	4.1918	136.30	4.7114	150.46	5.2600	208.71
1.5311	.30	1.7556	1.74	2.0954	8.06	2.4175	17.44	2.8176	6.71	3.2546	24.30	3.7087	121.41	4.1986	122.00	4.7185	159.02	5.2680	214.07
1.5353	.12	1.7600	2.04	2.1001	8.22	2.4226	14.94	2.8235	8.50	3.2604	24.42	3.7150	128.91	4.2055	110.67	4.7255	155.11	5.2751	206.04
1.5391	.04	1.7644	2.04	2.1050	9.94	2.4278	10.49	2.8288	9.60	3.2665	22.63	3.7214	149.81	4.2120	104.89	4.7331	136.97	5.2824	195.14
1.5433	.07	1.7688	1.85	2.1096	10.08	2.4330	7.10	2.8345	10.41	3.2724	22.67	3.7277	162.36	4.2189	97.24	4.7399	120.33	5.2902	188.80
1.5513	.07	1.7732	1.97	2.1145	11.77	2.4381	5.17	2.8400	10.71	3.2785	23.02	3.7341	170.86	4.2255	94.54	4.7470	112.29	5.2978	182.94
1.5556	.09	1.7777	2.98	2.1193	11.11	2.4435	5.63	2.8456	9.60	3.2844	21.79	3.7404	183.57	4.2323	92.29	4.7541	117.13	5.3051	183.41
1.5597	.15	1.7821	2.79	2.1241	14.08	2.4484	5.01	2.8512	9.10	3.2902	21.92	3.7468	185.79	4.2389	93.20	4.7614	119.41	5.3127	194.08
1.5639	.05	1.7864	2.71	2.1290	15.21	2.4535	4.82	2.8568	12.45	3.2963	21.80	3.7531	174.06	4.2457	91.41	4.7686	122.09		
1.5678	.05	1.7908	2.50	2.1338	15.71	2.4586	6.43	2.8622	18.41	3.3024	22.79	3.7595	153.98	4.2526	90.67	4.7757	116.05		
1.5719	.15	1.7952	2.31	2.1387	18.72	2.4640	6.97	2.8678	21.63	3.3083	23.22	3.7660	139.25	4.2597	87.61	4.7828	110.31		
1.5761	.09	1.7998	1.66	2.1435	20.56	2.4691	6.76	2.8734	20.05	3.3144	24.07	3.7721	128.51	4.2660	88.37	4.7901	104.72		
1.5802	.09	1.8042	1.26	2.1484	22.98	2.4743	8.84	2.8791	20.14	3.3202	25.72	3.7787	128.44	4.2728	87.74	4.7972	101.05		
1.5845	.16	1.8087	1.16	2.1531	24.87	2.4796	10.87	2.8847	19.05	3.3263	26.01	3.7851	125.04	4.2799	88.80	4.8045	96.05		

CX(mb) = 0 (assumed), E(MeV) < 1.31,
$= -126.76 + 89.624E - 9.0873E^2 + 0.647207E^3 - 0.0105365E^4$, $5.3127 \le E(MeV) \le 12.3$.

TABLE VI

ADJUSTED ^{18}O (α,n) CROSS SECTION

E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)	E(MEV)	CX(MB)
1.1448	0.00	1.5432	.68	1.8707	4.18	2.1957	27.20	2.5100	15.32	2.9240	168.47	3.3100	119.76	3.7240	177.86	4.1944	210.40	4.6848	413.82
1.1482	.07	1.5474	.55	1.8751	1.48	2.2004	22.61	2.5140	17.46	2.9261	187.69	3.3180	135.78	3.7401	177.88	4.1984	215.74	4.6888	390.33
1.1516	.05	1.5515	.45	1.8797	.66	2.2048	10.89	2.5180	22.80	2.9281	193.04	3.3234	156.07	3.7441	184.29	4.2064	230.70	4.6928	352.94
1.1553	.07	1.5554	.38	1.8841	.43	2.2097	3.83	2.5261	29.21	2.9306	190.90	3.3287	164.62	3.7522	192.83	4.2104	246.73	4.7009	305.98
1.1590	.05	1.5596	.31	1.8885	.34	2.2143	2.38	2.5301	37.77	2.9331	168.48	3.3341	163.57	3.7602	203.53	4.2225	280.91	4.7089	271.81
1.1625	.05	1.5637	.23	1.8936	.31	2.2189	1.94	2.5341	46.32	2.9356	163.13	3.3381	157.15	3.7682	209.94	4.2292	316.16	4.7170	275.02
1.1661	.01	1.5679	.22	1.8973	.23	2.2236	1.70	2.5381	61.26	2.9381	142.84	3.3461	148.62	3.7736	223.83	4.2359	366.35	4.7250	282.50
1.1696	0.00	1.5719	.19	1.9019	.23	2.2287	1.62	2.5421	69.82	2.9406	117.22	3.3502	140.09	3.7790	239.85	4.2426	396.25	4.7290	276.24
1.1947	0.00	1.5760	.19	1.9064	.22	2.2334	1.62	2.5462	79.43	2.9431	114.02	3.3542	128.34	3.7843	251.60	4.2547	404.81	4.7371	271.84
1.1982	.13	1.5802	.16	1.9108	.18	2.2383	1.65	2.5542	124.29	2.9457	90.53	3.3622	119.81	3.7964	264.44	4.2587	412.29	4.7411	266.50
1.2019	0.00	1.5843	.16	1.9152	.19	2.2430	1.70	2.5582	215.06	2.9482	74.52	3.3662	114.48	3.8004	279.38	4.2627	425.10	4.7531	251.57
1.2055	.01	1.5885	.13	1.9196	.19	2.2478	1.80	2.5636	252.45	2.9522	54.23	3.3703	103.80	3.8044	299.69	4.2748	450.75	4.7572	239.83
1.2092	0.00	1.5926	.11	1.9242	.18	2.2525	1.86	2.5689	191.58	2.9602	46.76	3.3756	97.40	3.8125	322.11	4.2801	446.49	4.7612	233.45
1.2640	0.00	1.5965	.16	1.9286	.19	2.2574	2.55	2.5743	100.82	2.9642	36.10	3.3810	90.99	3.8205	349.88	4.2855	424.06	4.7692	223.82
1.2678	.01	1.6009	.11	1.9330	.18	2.2620	2.78	2.5823	57.04	2.9683	30.75	3.3863	81.39	3.8245	376.58	4.2908	377.08	4.7773	220.63
1.2826	.01	1.6051	.09	1.9377	.19	2.2669	2.71	2.5864	35.69	2.9723	26.49	3.3904	69.65	3.8326	399.02	4.2949	337.58	4.7813	213.15
1.2863	0.00	1.6093	.09	1.9423	.23	2.2715	2.19	2.5904	25.02	2.9763	24.35	3.3971	57.91	3.8366	415.04	4.3029	303.41	4.7893	211.03
1.3013	0.00	1.6135	.11	1.9467	.57	2.2764	1.97	2.5944	20.75	2.9843	22.23	3.4038	51.52	3.8406	416.11	4.3109	293.81	4.7974	209.97
1.3052	.01	1.6176	.09	1.9512	1.39	2.2810	2.02	2.5984	15.42	2.9924	20.10	3.4105	45.12	3.8486	400.10	4.3150	287.41	4.8014	212.11
1.3089	.01	1.6215	.08	1.9556	1.42	2.2859	1.98	2.6024	13.28	2.9964	19.05	3.4185	47.25	3.8527	373.41	4.3230	301.31	4.8094	217.46
1.3125	.03	1.6340	.08	1.9602	1.26	2.2906	2.13	2.6078	11.15	3.0044	17.98	3.4225	49.40	3.8567	353.13	4.3310	316.26	4.8175	227.07
1.3164	.16	1.6381	.07	1.9646	.57	2.2955	2.25	2.6132	9.02	3.0165	18.00	3.4265	67.55	3.8687	332.86	4.3391	349.37	4.8255	242.04
1.3201	.43	1.6423	.08	1.9693	.30	2.3002	2.34	2.6185	7.97	3.0286	16.94	3.4346	64.35	3.8728	314.70	4.3431	364.32	4.8335	218.55
1.3238	.18	1.6464	.07	1.9739	.30	2.3051	2.47	2.6266	6.90	3.0326	16.94	3.4386	49.41	3.8808	310.45	4.3511	394.23	4.8389	215.35
1.3277	.15	1.6548	.07	1.9783	.27	2.3097	2.73	2.6386	6.91	3.0446	16.96	3.4453	47.29	3.8848	308.31	4.3592	433.75	4.8443	215.35
1.3316	.07	1.6590	.08	1.9829	.26	2.3148	3.05	2.6467	6.93	3.0487	18.04	3.4520	49.42	3.8929	320.06	4.3672	452.98	4.8496	217.50
1.3353	.01	1.6631	.08	1.9876	.30	2.3195	4.20	2.6547	6.93	3.0567	19.10	3.4587	54.77	3.8969	336.08	4.3753	485.03	4.8577	249.55
1.3390	0.00	1.6675	.07	1.9921	.34	2.3244	6.70	2.6627	8.01	3.0688	20.18	3.4667	60.12	3.9009	340.36	4.3793	497.84	4.8697	355.28
1.3466	0.00	1.6841	.07	1.9967	.35	2.3290	9.46	2.6681	10.15	3.0728	21.26	3.4708	66.53	3.9130	357.45	4.3873	521.34	4.8737	438.57
1.3505	.01	1.6885	.09	2.0013	.34	2.3344	10.98	2.6735	11.22	3.0848	22.34	3.4748	75.07	3.9170	357.47	4.3994	522.42	4.8818	457.80
1.3544	0.00	1.6930	.05	2.0055	.41	2.3388	9.71	2.6788	14.43	3.0929	23.42	3.4868	86.85	3.9210	331.84	4.4034	517.09	4.8858	385.20
1.3583	0.00	1.6972	.07	2.0104	.43	2.3436	7.49	2.6869	15.51	3.0969	25.56	3.4909	99.66	3.9331	308.35	4.4074	504.28	4.8938	337.15
1.3619	.01	1.7013	.07	2.0148	.51	2.3485	6.10	2.6949	25.12	3.1009	27.70	3.4989	114.62	3.9371	273.12	4.4114	487.20	4.8979	302.98
1.3659	0.00	1.7057	.08	2.0284	.51	2.3533	4.83	2.6989	36.88	3.1049	29.84	3.5029	129.57	3.9491	235.76	4.4195	459.45	4.9059	299.78
1.3696	.01	1.7096	.09	2.0331	.49	2.3581	4.23	2.7029	64.65	3.1090	30.91	3.5086	152.01	3.9532	208.01	4.4275	429.56	4.9180	305.14
1.3811	.01	1.7140	.07	2.0377	.58	2.3630	4.06	2.7070	141.53	3.1130	30.91	3.5142	166.95	3.9612	175.97	4.4315	398.59	4.9260	325.43
1.3850	0.00	1.7228	.07	2.0424	.62	2.3679	3.89	2.7190	245.13	3.1170	36.25	3.5198	179.78	3.9652	161.03	4.4396	376.18	4.9300	343.59
1.4007	0.00	1.7270	.09	2.0470	.65	2.3728	3.58	2.7271	267.57	3.1210	41.59	3.5254	196.86	3.9733	141.82	4.4436	362.30	4.9421	363.89
1.4046	.01	1.7311	.08	2.0515	.63	2.3777	3.25	2.7311	188.55	3.1291	46.95	3.5311	210.76	3.9813	129.01	4.4516	330.26	4.9501	377.78
1.4083	0.00	1.7353	.08	2.0561	.68	2.3826	3.09	2.7351	126.62	3.1331	49.09	3.5331	220.37	3.9853	112.99	4.4597	305.72	4.9582	369.25
1.4122	0.00	1.7398	.13	2.0608	.69	2.3877	3.10	2.7391	78.57	3.1411	58.71	3.5351	237.45	3.9893	105.53	4.4637	272.62	4.9622	361.79
1.4161	.01	1.7442	.07	2.0654	.73	2.3926	3.04	2.7431	56.15	3.1492	68.32	3.5471	266.30	3.9974	101.26	4.4717	240.60	4.9702	351.11
1.4239	.01	1.7483	.08	2.0700	.74	2.3934	4.52	2.7458	43.33	3.1572	76.88	3.5512	256.70	4.0054	95.93	4.4758	200.02	4.9783	323.35
1.4281	.16	1.7527	.09	2.0747	.80	2.4014	3.46	2.7485	35.86	3.1612	84.36	3.5592	248.16	4.0094	93.80	4.4838	169.06	4.9863	306.27
1.4320	.01	1.7571	.08	2.0791	.96	2.4095	3.47	2.7512	30.52	3.1652	96.11	3.5632	242.82	4.0175	93.81	4.4918	145.57	4.9903	294.53
1.4360	.03	1.7612	.09	2.0840	.84	2.4135	3.47	2.7579	27.34	3.1693	110.00	3.5672	246.04	4.0255	94.89	4.4959	135.97	4.9984	242.22
1.4399	.15	1.7654	.08	2.0884	.94	2.4215	4.55	2.7646	21.99	3.1773	118.54	3.5753	255.65	4.0336	95.96	4.5079	141.32	5.0064	187.77
1.4435	.26	1.7700	.09	2.0930	1.04	2.4376	6.70	2.7713	14.53	3.1813	128.16	3.5833	270.62	4.0456	101.32	4.5160	168.02	5.0104	166.41
1.4477	.24	1.7787	.09	2.0976	1.07	2.4416	6.71	2.7753	10.26	3.1894	142.05	3.5914	285.57	4.0496	113.06	4.5200	238.50	5.0185	155.75
1.4516	.24	1.7828	.11	2.1023	1.15	2.4497	7.78	2.7833	10.27	3.1974	147.39	3.5994	312.28	4.0577	121.62	4.5280	317.53	5.0305	144.00
1.4555	.19	1.7870	.11	2.1069	1.36	2.4517	12.06	2.7914	10.29	3.2014	149.54	3.6034	330.44	4.0657	142.98	4.5361	382.68	5.0386	132.27
1.4594	.08	1.7914	.09	2.1117	1.47	2.4537	14.19	2.7994	11.35	3.2054	147.41	3.6074	319.76	4.0738	172.89	4.5441	419.00	5.0506	137.62
1.4633	.05	1.7958	.08	2.1160	1.62	2.4557	16.34	2.8075	12.43	3.2095	142.07	3.6155	302.68	4.0818	219.89	4.5521	452.11	5.0587	152.59
1.4790	.05	1.8004	.09	2.1207	1.97	2.4577	18.47	2.8155	13.51	3.2148	130.34	3.6195	270.65	4.0858	246.59	4.5602	476.68	5.0667	177.15
1.4832	.08	1.8046	.11	2.1256	2.17	2.4617	27.95	2.8195	15.65	3.2202	121.78	3.6275	246.11	4.0939	282.91	4.5682	435.04	5.0747	217.74
1.4871	.08	1.8087	.15	2.1300	2.52	2.4648	38.77	2.8316	16.73	3.2255	120.73	3.6316	233.29	4.0979	312.81	4.5763	413.69	5.0828	288.22
1.4910	.11	1.8131	.15	2.1348	3.01	2.4678	94.30	2.8356	19.94	3.2336	106.85	3.6396	222.61	4.1059	323.49	4.5883	426.52	5.0868	381.13
1.4952	.16	1.8177	.22	2.1392	3.51	2.4708	108.18	2.8436	23.15	3.2376	109.00	3.6436	213.02	4.1140	309.62	4.5950	432.93	5.0989	434.54
1.4991	.19	1.8220	.18	2.1441	4.06	2.4738	169.05	2.8597	37.04	3.2456	100.47	3.6517	210.88	4.1220	274.39	4.6017	446.81	5.1069	424.94
1.5031	.26	1.8266	.19	2.1488	4.47	2.4754	148.77	2.8637	65.88	3.2497	94.07	3.6597	205.55	4.1260	237.02	4.6084	443.62	5.1123	391.84
1.5072	.34	1.8308	.24	2.1534	4.67	2.4770	94.31	2.8798	81.92	3.2537	88.72	3.6637	197.02	4.1300	210.33	4.6124	436.16	5.1176	366.21
1.5111	.51	1.8352	.24	2.1580	5.09	2.4786	47.32	2.8838	95.81	3.2577	85.52	3.6718	197.02	4.1381	192.19	4.6205	439.37	5.1230	347.00
1.5150	.68	1.8396	.35	2.1624	4.87	2.4802	25.97	2.8879	104.36	3.2617	83.39	3.6798	194.90	4.1421	181.51	4.6285	441.52	5.1310	353.42
1.5192	.85	1.8440	.49	2.1673	4.58	2.4818	15.30	2.8999	126.79	3.2698	80.20	3.6878	193.83	4.1501	185.79	4.6366	441.52	5.1391	367.31
1.5231	1.15	1.8484	.80	2.1721	4.40	2.4839	15.30	2.9120	140.68	3.2738	79.14	3.6959	192.78	4.1582	194.35	4.6446	430.85	5.1471	363.04
1.5272	1.24	1.8528	2.63	2.1769	4.25	2.4859	11.03	2.9160	148.16	3.2778	82.35	3.6999	187.45	4.1622	192.21	4.6486	426.59	5.1511	332.09
1.5312	1.20	1.8574	7.21	2.1816	4.48	2.4899	9.96	2.9180	149.24	3.2858	85.56	3.7039	181.03	4.1702	192.21	4.6526	427.65		
1.5353	.99	1.8618	8.56	2.1862	6.51	2.4939	11.03	2.9200	153.51	3.2939	91.98	3.7160	183.19	4.1743	198.63	4.6687	428.75		
1.5393	.85	1.8663	7.69	2.1909	24.25	2.5019	13.18	2.9220	156.72	3.2979	103.72	3.7200	181.06	4.1823	200.77	4.6727	429.81		

CX(mb) = 0 (assumed), Threshold = $0.85 \leq E(MeV) < 1.14$,
$= -320.68 + 241.227E - 29.6216E^2 + 2.011956E^3 - 0.0511101E^4$, $5.1511 \leq E(MeV) \leq 12.3$.

TABLE VII

ALPHA DECAY SPECTRA OF ACTINIDE NUCLIDES

82-PB-210
1 ALPHA , REF B

E,MEV.	DK FRACTION
3.7198	1.70000E-08

83-BI-210
2 ALPHAS, REF B

E,MEV.	DK FRACTION
4.6479	7.80000E-07
4.6861	5.20000E-07

84-PO-210
2 ALPHAS, REF B

E,MEV.	DK FRACTION
4.5168	1.07000E-05
5.3046	9.99989E-01

83-BI-211
2 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2790	1.59562E-01
6.6233	8.37698E-01

84-PO-211
3 ALPHAS, REF B

E,MEV.	DK FRACTION
6.5694	5.40000E-03
6.8914	5.50000E-03
7.4502	9.89100E-01

83-BI-212
8 ALPHAS, REF B

E,MEV.	DK FRACTION
5.3024	3.95857E-07
5.3456	3.59870E-06
5.4849	5.39805E-05
5.6069	3.95857E-03
5.6258	5.39805E-04
5.7684	6.00983E-03
6.0511	2.51549E-01
6.0902	9.78847E-02

84-PO-212
1 ALPHA , REF B

E,MEV.	DK FRACTION
8.7846	1.00000E+00

83-BI-213
2 ALPHAS, REF B

E,MEV.	DK FRACTION
5.5508	1.62963E-03
5.8687	2.03704E-02

84-PO-213
2 ALPHAS, REF B

E,MEV.	DK FRACTION
7.6123	3.00000E-05
8.3757	9.99970E-01

83-BI-214
6 ALPHAS, REF B

E,MEV.	DK FRACTION
4.9420	5.25210E-07
5.0234	4.41176E-07
5.1824	1.26050E-06
5.2638	1.21849E-05
5.4508	1.13235E-04
5.5121	8.23529E-05

84-PO-214
2 ALPHAS, REF B

E,MEV.	DK FRACTION
6.9025	1.00000E-04
7.6873	9.99900E-01

84-PO-215
3 ALPHAS, REF B

E,MEV.	DK FRACTION
6.9497	2.20000E-04
6.9559	3.40000E-04
7.3865	9.99440E-01

85-AT-215
2 ALPHAS, REF B

E,MEV.	DK FRACTION
7.6285	5.00000E-04
8.0258	9.99500E-01

84-PO-216
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.9850	2.10000E-05
6.7785	9.99979E-01

85-AT-217
4 ALPHAS, REF B

E,MEV.	DK FRACTION
6.4846	4.00100E-04
6.6113	1.00025E-04
6.8134	2.50063E-04
7.0677	9.99250E-01

86-RN-217
1 ALPHA , REF B

E,MEV.	DK FRACTION
7.7426	1.00000E+00

84-PO-218
2 ALPHAS, REF B

E,MEV.	DK FRACTION
5.1810	1.10000E-05
6.0027	9.99989E-01

85-AT-218
3 ALPHAS, REF B

E,MEV.	DK FRACTION
6.6625	6.40000E-02
6.7045	9.00000E-01
6.7567	3.60000E-02

86-RN-218
2 ALPHAS, REF B

E,MEV.	DK FRACTION
6.5349	1.30091E-03
7.1331	9.98699E-01

85-AT-219
1 ALPHA , REF B

E,MEV.	DK FRACTION
6.2733	9.70000E-01

86-RN-219
4 ALPHAS, REF B

E,MEV.	DK FRACTION
6.4250	7.49101E-02
6.5310	1.19856E-03
6.5532	1.14862E-01
6.8194	8.09029E-01

86-RN-220
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.7490	7.00000E-04
6.2883	9.99300E-01

87-FR-221 .
4 ALPHAS, REF B

E,MEV.	DK FRACTION
6.0752	1.36426E-03
6.1275	1.37335E-01
6.2434	1.11236E-02
6.3411	8.49477E-01

86-RN-222
2 ALPHAS, REF B

E,MEV.	DK FRACTION
4.9870	7.80172E-04
5.4898	9.99220E-01

87-FR-222
1 ALPHA , REF B

E,MEV.	DK FRACTION
5.7092	1.00000E-03

88-RA-222
2 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2373	3.10000E-02
6.5557	9.69000E-01

87-FR-223
1 ALPHA , REF B

E,MEV.	DK FRACTION
5.3330	4.00000E-05

88-RA-223
12 ALPHAS, REF B

E,MEV.	DK FRACTION
5.2839	1.00000E-03
5.2885	1.30000E-03
5.3399	1.00000E-03
5.3660	1.10000E-03
5.4347	2.30000E-02
5.5025	1.00000E-02
5.5396	9.10000E-02
5.6073	2.40000E-01
5.7161	5.28900E-01
5.7474	9.10000E-02
5.8577	3.20000E-03
5.8718	8.50000E-03

88-RA-224
5 ALPHAS, REF A

E,MEV.	DK FRACTION
5.0340	3.09345E-05
5.0470	7.19873E-05
5.1610	7.29872E-05
5.4490	4.89914E-02
5.6856	9.50833E-01

89-AC-225
13 ALPHAS, REF B

E,MEV.	DK FRACTION
5.2871	2.30161E-03
5.4432	1.50105E-03
5.5539	1.00070E-03
5.5809	1.20084E-02
5.6093	1.20084E-02
5.6377	4.35305E-02
5.6824	1.25088E-02
5.7235	3.40238E-02
5.7320	1.01071E-01
5.7921	9.00630E-02
5.7939	1.80126E-01
5.8043	3.00210E-03
5.8299	5.06855E-01

88-RA-226
2 ALPHAS, REF B

E,MEV.	DK FRACTION
4.6017	5.55000E-02
4.7846	9.44500E-01

89-AC-226
1 ALPHA , REF B

E,MEV.	DK FRACTION
5.4400	6.00000E-05

90-TH-226
5 ALPHAS, REF B

E,MEV.	DK FRACTION
6.0258	2.00682E-03
6.0414	1.90648E-03
6.0997	1.27433E-02
6.2284	2.30785E-01
6.3375	7.52559E-01

89-AC-227
8 ALPHAS, REF B

E,MEV.	DK FRACTION
4.7151	4.30252E-05
4.7701	1.94308E-04
4.7967	1.12421E-04
4.8556	5.13527E-04
4.8733	8.46626E-04
4.9008	1.52670E-05
4.9416	5.55164E-03
4.9538	6.52318E-03

90-TH-227
19 ALPHAS, REF B

E,MEV.	DK FRACTION
5.5862	1.81892E-03
5.6021	1.71787E-03
5.6136	2.22312E-03
5.6686	2.12207E-02
5.6940	1.51576E-02
5.7017	3.63783E-02
5.7097	8.28618E-02
5.7142	4.95150E-02
5.7572	2.02102E-01
5.7630	2.32417E-03
5.7952	3.13258E-03
5.8076	1.31366E-02
5.8667	2.42522E-02
5.9103	1.71787E-03
5.9166	7.88197E-03
5.9599	3.03153E-02
5.9779	2.32417E-01
6.0089	2.93048E-02
6.0383	2.42522E-01

90-TH-228
5 ALPHAS, REF A

E,MEV.	DK FRACTION
5.1380	5.00050E-04
5.1770	1.80018E-03
5.2110	3.60036E-03
5.3405	2.67027E-01
5.4233	7.27073E-01

90-TH-229
14 ALPHAS, REF B

E,MEV.	DK FRACTION
4.7626	6.36107E-03
4.7987	1.28231E-02
4.8148	8.48142E-02
4.8390	4.84653E-02
4.8460	5.67447E-01
4.8622	1.81745E-03
4.9017	1.09047E-01
4.9309	1.11066E-03
4.9686	6.46204E-02
4.9795	3.23102E-02
5.0363	2.42326E-03
5.0492	5.25040E-02
5.0534	1.61551E-02
5.0783	1.00969E-04

90-TH-230
7 ALPHAS, REF A

E,MEV.	DK FRACTION
4.2440	5.00746E-08
4.2780	8.01194E-08
4.3720	1.00149E-05
4.4380	3.00448E-04
4.4800	1.20179E-03
4.6210	2.34349E-01
4.6875	7.64136E-01

91-PA-230
18 ALPHAS, REF B

E,MEV.	DK FRACTION
4.7653	6.40446E-08
4.7987	9.60672E-09
4.9343	1.28090E-07
4.9726	2.24157E-07
5.0600	1.28090E-07
5.0836	2.24157E-07
5.1190	1.92134E-07
5.1534	1.28090E-07
5.1859	1.60112E-07
5.2173	1.60112E-07
5.2683	1.12078E-06
5.2762	9.60672E-07
5.2880	9.60672E-07
5.3008	5.44381E-06
5.3126	4.16291E-06
5.3263	5.76403E-06
5.3401	4.80336E-06
5.3450	7.36516E-06

92- U-230
4 ALPHAS, REF B

E,MEV.	DK FRACTION
5.6622	2.30023E-03
5.6661	3.60036E-03
5.8176	3.19032E-01
5.8886	6.75068E-01

91-PA-231
19 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5090	3.02822E-05
4.5660	8.07526E-05
4.6000	1.51411E-04
4.6330	1.00941E-03
4.6440	1.00941E-03
4.6820	1.51411E-02
4.7130	1.00941E-02
4.7360	8.47902E-02
4.7960	4.03763E-04
4.8540	1.41317E-02
4.9020	2.01882E-05
4.9340	3.02822E-02
4.9517	2.30145E-01
4.9760	4.03763E-03
4.9860	1.41317E-02
5.0141	2.56390E-01
5.0297	2.01882E-01
5.0320	2.52352E-02
5.0590	1.11035E-01

TABLE VII (cont.)

92- U-231
1 ALPHA , REF B

E,MEV.	DK FRACTION
5.4539	5.50000E-05

90-TH-232
3 ALPHAS, REF A

E,MEV.	DK FRACTION
3.8300	1.99601E-03
3.9530	2.29541E-01
4.0120	7.68463E-01

92- U-232
7 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5090	2.39800E-07
4.9291	2.09825E-06
4.9460	1.69859E-06
4.9973	2.89759E-05
5.1373	2.79767E-03
5.2635	3.11740E-01
5.3203	6.85429E-01

92- U-233
25 ALPHAS, REF A

E,MEV.	DK FRACTION
4.3070	9.01370E-06
4.4060	8.01218E-06
4.4570	2.80426E-05
4.4650	3.00457E-05
4.4830	1.40213E-05
4.5030	1.00152E-05
4.5070	1.20183E-04
4.5130	1.80274E-04
4.5380	4.00609E-05
4.5650	2.80426E-05
4.5720	2.30350E-05
4.5900	7.01066E-05
4.6110	6.00913E-05
4.6150	4.00609E-05
4.6340	1.00152E-04
4.6410	3.00457E-05
4.6560	4.00609E-05
4.6640	4.20639E-04
4.6810	1.00152E-04
4.7010	6.00913E-04
4.7290	1.61245E-02
4.7540	1.63248E-03
4.7825	1.32201E-01
4.7960	2.80426E-03
4.8242	8.45285E-01

92- U-234
5 ALPHAS, REF A

E,MEV.	DK FRACTION
4.1200	3.29013E-07
4.2740	4.48654E-07
4.6030	2.99102E-03
4.7228	2.74177E-01
4.7730	7.22831E-01

92- U-235
12 ALPHAS, REF A

E,MEV.	DK FRACTION
4.1540	9.00000E-03
4.2170	5.70000E-02
4.2270	9.00000E-03
4.2710	4.00000E-03
4.3240	4.70000E-02
4.3640	1.70000E-01
4.3980	5.60000E-01
4.4160	2.10000E-02
4.4390	7.00000E-03
4.5020	1.70000E-02
4.5560	4.50000E-02
4.5980	5.40000E-02

93-NP-235
11 ALPHAS, REF B

E,MEV.	DK FRACTION
4.8042	1.60160E-08
4.8599	1.12112E-07
4.9227	1.84184E-06
4.9365	9.60961E-08
4.9933	9.60961E-07
5.0025	8.00801E-08
5.0033	3.84384E-06
5.0203	8.48849E-06
5.0455	2.88288E-07
5.0940	3.20320E-08
5.1030	2.40240E-07

94-PU-235
1 ALPHA , REF B

E,MEV.	DK FRACTION
5.8556	1.30000E-04

92- U-236
3 ALPHAS, REF A

E,MEV.	DK FRACTION
4.3310	2.59326E-03
4.4450	2.59326E-01
4.4940	7.38081E-01

94-PU-236
6 ALPHAS, REF A

E,MEV.	DK FRACTION
5.0880	6.00103E-06
5.2140	2.70046E-06
5.4520	2.00034E-05
5.6150	1.80031E-03
5.7210	3.09053E-01
5.7680	6.89118E-01

93-NP-237
14 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5140	3.98843E-04
4.5810	3.98843E-03
4.5980	3.39017E-03
4.6391	6.16213E-02
4.6640	3.31040E-02
4.6940	4.78612E-03
4.7120	1.12673E-02
4.7659	7.97687E-02
4.7701	2.49277E-01
4.7882	4.68641E-01
4.8030	2.99133E-02
4.8170	2.49277E-02
4.8660	2.99133E-03
4.8730	2.59248E-02

94-PU-237
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.3600	2.60700E-05
5.6500	6.93000E-06

92- U-238
3 ALPHAS, REF A

E,MEV.	DK FRACTION
4.0390	2.29472E-03
4.1490	2.29472E-01
4.1960	7.68233E-01

94-PU-238
11 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5670	1.10071E-09
4.5880	1.60104E-08
4.6620	3.00195E-08
4.6640	3.00195E-09
4.7030	9.00584E-07
4.7260	1.00065E-07
5.0110	7.00455E-08
5.2080	5.00325E-05
5.3590	1.30084E-03
5.4565	2.87186E-01
5.4992	7.11462E-01

94-PU-239
21 ALPHAS, REF A

E,MEV.	DK FRACTION
4.3990	2.50024E-07
4.5100	8.00078E-07
4.6300	7.00068E-06
4.6890	5.00048E-06
4.7360	4.50044E-05
4.7490	6.00058E-06
4.7690	8.00078E-06
4.7950	7.00068E-06
4.8280	2.40023E-05
4.8680	8.00078E-06
4.9110	2.00019E-06
4.9350	3.00029E-05
4.9620	3.00029E-05
4.9870	7.00068E-05
5.0080	8.00078E-05
5.0280	5.00048E-05
5.0540	2.10020E-04
5.0750	3.20031E-04
5.1046	1.15011E-01
5.1429	1.51015E-01
5.1554	7.33071E-01

94-PU-240
5 ALPHAS, REF A

E,MEV.	DK FRACTION
4.4800	2.10015E-07
4.8510	2.00014E-05
5.0140	9.10064E-04
5.1234	2.65018E-01
5.1683	7.34051E-01

95-AM-240
3 ALPHAS, REF A

E,MEV.	DK FRACTION
5.2860	2.33630E-08
5.3370	2.27932E-07
5.3780	1.64871E-06

96-CM-240
4 ALPHAS, REF B

E,MEV.	DK FRACTION
5.9909	1.39908E-04
6.1482	5.19657E-04
6.2469	2.88809E-01
6.2908	7.10531E-01

94-PU-241
11 ALPHAS, REF A

E,MEV.	DK FRACTION
4.6920	7.35662E-09
4.7320	7.35662E-09
4.7420	1.71654E-08
4.7830	4.90441E-08
4.7970	2.94265E-07
4.8535	2.96717E-06
4.8965	2.04024E-05
4.9720	3.18787E-07
4.9990	1.00540E-07
5.0420	2.50125E-07
5.0540	8.58272E-08

95-AM-241
21 ALPHAS, REF A

E,MEV.	DK FRACTION
4.8000	9.00775E-07
4.8340	7.00603E-06
5.0040	1.00086E-06
5.0680	1.40121E-06
5.0890	4.00345E-06
5.0960	4.00345E-06
5.1140	4.00345E-06
5.1560	7.00603E-06
5.1780	3.00258E-06
5.1820	9.00775E-06
5.1940	6.00517E-06
5.2230	1.30112E-05
5.2440	2.40207E-05
5.2790	5.00431E-06
5.3220	1.50129E-04
5.3690	1.33115E-02
5.4170	1.00086E-04
5.4430	1.28110E-01
5.4857	8.52734E-01
5.5130	2.00172E-03
5.5443	3.50302E-03

96-CM-241
11 ALPHAS, REF A

E,MEV.	DK FRACTION
5.6870	2.20044E-05
5.7190	8.00160E-06
5.7850	7.00140E-06
5.8630	1.40028E-05
5.8843	1.18024E-03
5.9140	1.20024E-05
5.9260	1.81036E-03
5.9386	6.89138E-03
5.9780	2.80056E-05
6.0360	1.20024E-05
6.0820	1.50030E-05

94-PU-242
4 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5985	1.30001E-05
4.7546	9.80007E-04
4.8563	2.24002E-01
4.9006	7.75005E-01

95-AM-242M
7 ALPHAS, REF A

E,MEV.	DK FRACTION
5.0650	1.20056E-05
5.0860	1.53672E-05
5.1400	2.90537E-04
5.2050	4.27401E-03
5.3130	3.84181E-05
5.3650	7.20339E-05
5.4080	5.76271E-05

96-CM-242
8 ALPHAS, REF A

E,MEV.	DK FRACTION
5.1460	4.99796E-08
5.1890	2.49898E-07
5.5140	2.49898E-06
5.6090	1.99918E-07
5.8170	4.59812E-05
5.9720	3.59853E-04
6.0696	2.59894E-01
6.1129	7.39697E-01

95-AM-243
13 ALPHAS, REF A

E,MEV.	DK FRACTION
4.6950	1.60296E-05
4.9190	8.51572E-07
4.9300	1.80333E-06
4.9460	3.40629E-06
5.0080	1.60296E-05
5.0320	2.20407E-05
5.0860	4.00740E-05
5.1130	5.40999E-05
5.1810	1.10203E-02
5.2335	1.10203E-01
5.2754	8.75616E-01
5.3210	1.20222E-03
5.3492	1.80333E-03

96-CM-243
28 ALPHAS, REF A

E,MEV.	DK FRACTION
5.2260	3.86467E-06
5.2660	1.46041E-05
5.3150	9.90940E-06
5.3220	2.97282E-05
5.3310	2.97282E-05
5.5220	1.98188E-05
5.5310	5.94564E-05
5.5360	1.98188E-05
5.5670	6.93658E-05
5.5740	6.93658E-05
5.5810	8.91846E-05
5.5860	1.98188E-04
5.5920	9.90940E-05
5.6060	9.90940E-05
5.6110	3.96376E-04
5.6210	5.94564E-04
5.6380	1.38732E-03
5.6450	2.97282E-04
5.6810	1.98188E-03
5.6850	1.58550E-02
5.7415	1.13956E-01
5.7847	7.25368E-01
5.8750	6.93658E-03
5.9060	9.90940E-04
5.9920	5.64836E-02
6.0090	1.09003E-02
6.0560	4.65742E-02
6.0670	1.48641E-02

TABLE VII (cont.)

94-PU-244
2 ALPHAS, REF A

E,MEV.	DK FRACTION
4.5460	1.93757E-01
4.5890	8.04993E-01

96-CM-244
8 ALPHAS, REF A

E,MEV.	DK FRACTION
4.9200	8.99767E-07
4.9600	1.99948E-06
5.2150	1.19969E-06
5.3130	3.99896E-07
5.5130	3.49909E-05
5.6640	2.19943E-04
5.7628	2.35939E-01
5.8050	7.63802E-01

96-CM-245
6 ALPHAS, REF A

E,MEV.	DK FRACTION
5.2346	3.20256E-03
5.3038	4.97398E-02
5.3620	9.32546E-01
5.4363	4.00320E-04
5.4887	8.30665E-03
5.5292	5.80464E-03

96-CM-246
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.3430	2.09945E-01
5.3860	7.89793E-01

96-CM-247
7 ALPHAS, REF A

E,MEV.	DK FRACTION
4.8140	4.70000E-02
4.8680	7.10000E-01
4.9410	1.60000E-02
4.9830	2.00000E-02
5.1450	1.20000E-02
5.2100	5.70000E-02
5.2650	1.38000E-01

96-CM-248
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.0340	1.66049E-01
5.0780	7.51351E-01

98-CF-248
2 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2241	1.80000E-01
6.2663	8.20000E-01

97-BK-249
7 ALPHAS, REF A

E,MEV.	DK FRACTION
5.0450	1.45291E-08
5.1150	3.92285E-07
5.2530	1.45291E-08
5.3510	3.77756E-07
5.3899	2.67335E-06
5.4168	1.00541E-05
5.4373	9.73447E-07

98-CF-249
16 ALPHAS, REF A

E,MEV.	DK FRACTION
5.3510	1.99410E-05
5.4310	9.97049E-05
5.5020	4.38701E-04
5.5590	1.09675E-03
5.6230	1.99410E-04
5.6940	2.99115E-03
5.7597	4.78583E-02
5.7840	2.49262E-03
5.8120	8.23562E-01
5.8495	1.39587E-02
5.9034	3.19056E-02
5.9462	3.38997E-02
6.0000	5.98229E-04
6.0720	3.98819E-03
6.1395	1.29616E-02
6.1940	2.39292E-02

98-CF-250
4 ALPHAS, REF A

E,MEV.	DK FRACTION
5.7367	9.99130E-05
5.8900	2.99739E-03
5.9891	1.61659E-01
6.0308	8.34274E-01

98-CF-251
14 ALPHAS, REF A

E,MEV.	DK FRACTION
5.5010	3.04569E-03
5.5660	1.52284E-02
5.6030	2.03046E-03
5.6320	4.56853E-02
5.6480	3.55330E-02
5.6770	3.53299E-01
5.7380	1.01523E-02
5.7620	3.85787E-02
5.7930	2.03046E-02
5.8140	4.26396E-02
5.8520	2.78173E-01
5.9430	6.09137E-03
6.0140	1.21827E-01
6.0740	2.74112E-02

98-CF-252
5 ALPHAS, REF A

E,MEV.	DK FRACTION
5.6160	5.80623E-07
5.8263	1.93541E-05
5.9766	2.32249E-03
6.0757	1.51930E-01
6.1183	8.14807E-01

98-CF-253
2 ALPHAS, REF A

E,MEV.	DK FRACTION
5.9210	1.64300E-04
5.9790	2.93570E-03

99-ES-253
28 ALPHAS, REF A

E,MEV.	DK FRACTION
5.7300	8.00043E-07
5.9100	2.70015E-07
5.9350	4.00022E-07
5.9440	1.50008E-06
6.0190	1.80010E-06
6.0370	2.90016E-06
6.0460	4.00022E-06
6.0840	2.50013E-06
6.1000	3.40018E-05
6.1220	7.80042E-06
6.1660	1.50008E-04
6.2110	3.90021E-04
6.2170	1.50008E-05
6.2300	1.20006E-06
6.2500	4.50024E-04
6.2660	8.00043E-06
6.3250	4.00022E-06
6.3540	8.20044E-05
6.4080	1.30007E-04
6.4320	6.10033E-04
6.4800	8.50046E-04
6.4980	2.60014E-03
6.5400	8.50046E-03
6.5520	7.10038E-03
6.5920	6.60036E-02
6.5940	7.00038E-03
6.6240	8.00043E-03
6.6327	8.98048E-01

98-CF-254
2 ALPHAS, REF B

E,MEV.	DK FRACTION
5.7943	5.27000E-04
5.8366	2.57300E-03

99-ES-254
8 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2669	2.21953E-03
6.2758	1.61421E-03
6.3467	7.46570E-03
6.3595	2.92575E-02
6.3841	1.31154E-03
6.4155	1.71509E-02
6.4283	9.38257E-01
6.4780	2.72397E-03

99-ES-254M
7 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2472	7.37056E-05
6.2797	2.78071E-04
6.3045	2.51269E-03
6.3405	6.03046E-05
6.4361	4.69036E-05
6.4791	1.94315E-04
6.5130	1.34010E-04

100-FM-254
3 ALPHAS, REF B

E,MEV.	DK FRACTION
7.0492	9.00369E-03
7.1468	1.40057E-01
7.1889	8.50349E-01

99-ES-255
3 ALPHAS, REF B

E,MEV.	DK FRACTION
6.2137	2.00000E-03
6.2609	7.84000E-03
6.2996	7.01600E-02

100-FM-255
6 ALPHAS, REF B

E,MEV.	DK FRACTION
6.8069	1.10375E-03
6.8915	6.22115E-03
6.9634	5.01706E-02
6.9829	1.30444E-03
7.0225	9.37186E-01
7.0800	4.01365E-03

100-FM-256
1 ALPHA , REF B

E,MEV.	DK FRACTION
6.9152	1.00000E+00

100-FM-257
5 ALPHAS, REF B

E,MEV.	DK FRACTION
6.3467	3.01811E-03
6.4410	2.01207E-02
6.5199	9.35614E-01
6.6965	3.52113E-02
6.7572	6.03622E-03

REFERENCE A= ENDFB/B-V
REFERENCE B= TABLE OF ISOTOPES, SEVENTH EDITION

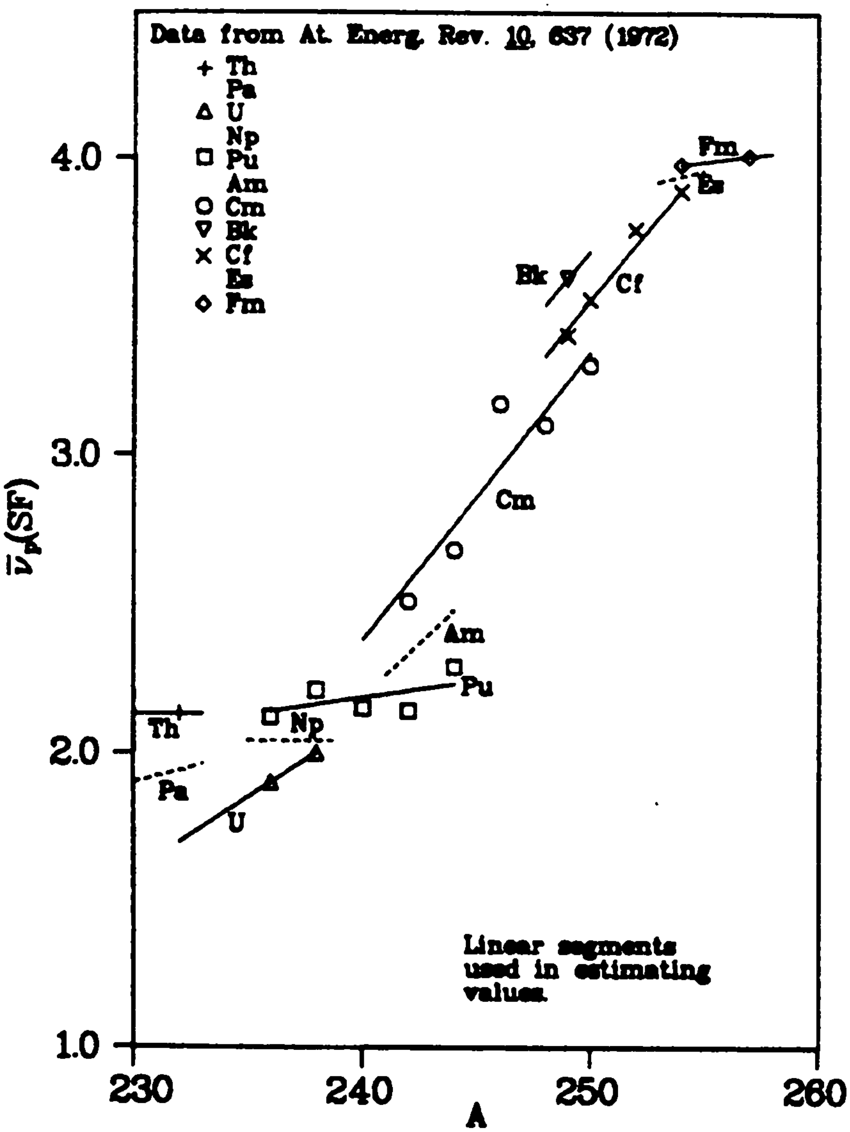

Fig. 4.
Values of $\overline{\nu}_p$(SF).

TABLE VIII

SPONTANEOUS-FISSION NEUTRON PRODUCTION BY ACTINDE DECAY

NUCLIDE	NU-BAR VALUES PROMPT	DELAYED	TOTAL	SPONTANEOUS FISSION BRANCHING	NEUTRONS PER NUCLIDE DECAY
90-TH-230	2.13	.01	2.14	5.330-13 A	1.14 -12
91-PA-231	1.92	.01	1.93	2.980-12 A	5.75 -12
90-TH-232	2.130+.200 B	.01	2.14	1.410-11 A	3.02 -11
92- U-232	1.70	.01	1.71	9.000-13 C	1.54 -12
92- U-233	1.75	.01	1.76	1.300-12 C	2.29 -12
92- U-234	1.80	.01	1.81	1.200-11 C	2.17 -11
92- U-235	1.85	.01	1.86	2.011-09 A	3.74 -09
92- U-236	1.900+.050 B	.01	1.91	1.200-09 C	2.29 -09
94-PU-236	2.120+.130 B	.01	2.13	8.100-10 C	1.73 -09
93-NP-237	2.04	.01	2.05	2.140-12 A	4.39 -12
92- U-238	2.000+.030 B	.01	2.01	5.450-07 C	1.095-06
94-PU-238	2.210+.130 B	.01	2.22	1.840-09 C	4.08 -09
94-PU-239	2.15	.01	2.16	4.400-12 C	9.37 -12
94-PU-240	2.151+.006 B	.01	2.16	5.000-08 C	1.08 -07
96-CM-240	2.38	.01	2.39	3.860-08 A	9.23 -08
95-AM-241	2.26	.01	2.27	4.100-12 C	9.31 -12
94-PU-242	2.141+.190 B	.01	2.15	5.500-06 C	1.18 -05
95-AM-242M	2.33	.01	2.34	1.600-10 C	3.74 -10
96-CM-242	2.510+.060 B	.01	2.52	6.800-08 C	1.71 -07
95-AM-243	2.41	.01	2.42	2.200-10 C	5.32 -10
94-PU-244	2.290+.190 B	.01	2.30	1.250-03 C	2.88 -03
96-CM-244	2.681+.011 B	.01	2.69	1.347-06 C	3.62 -06
96-CM-246	3.170+.220 B	.01	3.18	2.614-04 C	8.31 -04
96-CM-248	3.100+.090 B	.01	3.11	8.260-02 C	2.569-01
98-CF-248	3.33	.01	3.34	2.850-05 A	9.52 -05
97-BK-249	3.590+.160 B	.01	3.60	4.600-10 C	1.66 -09
98-CF-249	3.400+.400 B	.01	3.41	5.020-09 A	1.71 -08
96-CM-250	3.300+.080 B	.01	3.31	7.000-01 D	2.32 +00
98-CF-250	3.520+.090 B	.01	3.53	3.092-02 C	2.72 -03
98-CF-252	3.756+.012 B	.009 B	3.765+.010 B	3.092-02 C	1.164-01
99-ES-253	3.92	.01	3.93	8.700-08 C	3.42 -07
98-CF-254	3.890+.050 B	.01	3.890+.050 E	9.969-01 A	3.88 +00
99-ES-254	3.94	.01	3.95	3.020-08 A	1.19 -07
99-ES-254M	3.94	.01	3.95	4.500-08 A	1.78 -07
100-FM-254	3.980+.140 B	.01	3.96 +.14 F	5.900-04 A	2.34 -03
99-ES-255	3.96	.01	3.97	4.000-05 A	1.59 -04
100-FM-255	3.99	.01	3.73 +.18 F	2.290-07 A	8.54 -07
100-FM-256	4.00	.01	4.01	9.190-01 A	3.69 +00
100-FM-257	4.010+.130 B	.01	3.85 +.05 G	2.100-03 A	8.09 -03
100-FM-258	4.02	.01	4.03	1.000+00 A	4.03 +00

DATA REFERENCES USED
A=TABLE OF ISOTOPES, SEVENTH EDITION
B=MANERO AND KONSHIN, ATOMIC ENERGY REV. 10,637-756(1972)
C=ENDF/B-V
D=A.TOBIAS,U.K.,PRIVATE COMMUNICATION
E=C.J.ORTH,NUCL.SCI.ENG.43,54(1971)
F=Y.A.LAZAREV,ATOMIC ENERGY REV.15,75(1977)
G=D.C.HOFFMAN ET AL.,PHYS.REV.C21,637(1980)
ADDITIONAL REFERENCES SURVEYED
J.W.BOLDEMAN,IN NEUTRON STD. REF.DATA, I.A.E.A. VIENNA (1974)
J.P.BALAGNA ET AL.,PHYS.REV.LETT.26,145(1971)

PROMPT NU-BAR VALUES GIVEN WITHOUT REFERENCE HAVE BEEN ESTIMATED FROM THE VALUES OF REFERENCE B. DELAYED NU-BAR VALUES GIVEN WITHOUT REFERENCE HAVE BEEN ARBITRARILY ASSUMED.

IV. CALCULATION OF THE THICK-TARGET NEUTRON-PRODUCTION FUNCTION $P_i(E_\alpha)$

The neutron-production function $P_i(E_\alpha)$ defined by Eqs. (6) and (9) gives the contribution from reactions with nuclude i to the probability of neutron production by a decay alpha particle of energy E_α emitted within the material. The POFEAL code calculates values of P_i OF E-ALPHA using the algorithm

$$P(J) = 1.E+6* \frac{N_i}{N} \sum_{j=2}^{J} \frac{[\sigma_i(j-1)+\sigma_i(j)]/2}{[\varepsilon(j-1)+\varepsilon(j)]/2} [E(j)-E(j-1)] \quad , \tag{25}$$

where

N_i is the atom density of nuclide i (atoms/cm^3),

N is the total atom density (atoms/cm^3),

E_j is the jth regular energy point at or above the cross-section threshold (MeV),

$\sigma_i(j)$ is the value of the (α,n) cross section of nuclide i at E_j (mb),

$\varepsilon(j)$ is the value of the stopping cross section (eV/10^{15} atoms/cm^2),

and the leading quantity of 1×10^6 is required because of the units of σ, ε, and E.

The ^{17}O and ^{18}O contributions to the (α,n) neutron-production rate are given in Tables IX-XII for each of the four fuel compositions given in Table I. Values for the four compositions at any energy differ by less than 4%. The ^{17}O and ^{18}O contributions to (α,n) neutron production in spent UO_2 fuel are shown in Fig. 5.

V. RESULTS

The half-lives, average decay energies, and spent UO_2 fuel neutron-production values $R_k(\alpha,n)$, $R_k(SF)$, and R_k for each of the actinide nuclides k are given in Table XIII. Values of $R_k(SF)$ are repeated from Table VIII. Values of $R_k(\alpha,n)$ were obtained using the alpha spectra data of Table VII and $P(E_\alpha)$ values given in Table XI for $^{17,18}O(\alpha,n)$ in spent UO_2 fuel.

TABLE IX

$^{17,18}O(\alpha,n)$ NEUTRON PRODUCTION IN CLEAN ThO_2 FUEL BY ALPHA PARTICLES BELOW 10 MeV

	**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL
0.000	0.	0.	0.
1.139	0.	0.	0.
1.141	0.	0.	0.
1.161	0.0- 0	1.5-14	1.52-14
1.186	0.0- 0	1.8-14	1.77-14
1.211	0.0- 0	2.6-14	2.61-14
1.236	0.0- 0	2.6-14	2.61-14
1.261	0.0- 0	2.6-14	2.61-14
1.286	0.0- 0	3.0-14	3.03-14
1.309	0.0- 0	3.2-14	3.19-14
1.311	1.0-16	3.3-14	3.29-14
1.319	1.5-15	5.7-14	5.84-14
1.324	2.4-15	8.0-14	8.26-14
1.349	4.2-15	9.8-14	1.02-13
1.374	6.2-15	1.0-13	1.07-13
1.399	1.0-14	1.0-13	1.13-13
1.424	1.2-14	1.1-13	1.19-13
1.449	4.8-14	1.7-13	2.13-13
1.474	9.1-14	2.1-13	3.01-13
1.499	1.0-13	2.6-13	3.60-13
1.524	1.1-13	5.2-13	6.33-13
1.549	1.2-13	9.2-13	1.04-12
1.574	1.3-13	1.0-12	1.17-12
1.599	1.4-13	1.1-12	1.25-12
1.624	1.6-13	1.2-12	1.31-12
1.649	1.9-13	1.2-12	1.38-12
1.674	2.2-13	1.2-12	1.44-12
1.699	2.7-13	1.3-12	1.52-12
1.724	3.2-13	1.3-12	1.60-12
1.749	4.0-13	1.3-12	1.73-12
1.774	5.7-13	1.4-12	1.94-12
1.799	7.9-13	1.4-12	2.20-12
1.824	8.7-13	1.5-12	2.36-12
1.849	9.7-13	1.7-12	2.66-12
1.874	1.1-12	4.3-12	5.39-12
1.899	1.2-12	4.5-12	5.73-12
1.924	1.3-12	4.6-12	5.93-12
1.949	1.5-12	4.8-12	6.26-12
1.974	2.1-12	5.2-12	7.30-12
1.999	2.6-12	5.3-12	7.96-12
2.024	3.2-12	5.6-12	8.74-12
2.049	3.8-12	5.8-12	9.64-12
2.074	4.3-12	6.2-12	1.05-11
2.099	5.0-12	6.7-12	1.17-11
2.124	6.0-12	7.5-12	1.35-11
2.149	7.8-12	9.2-12	1.69-11
2.174	1.0-11	1.2-11	2.17-11
2.199	1.3-11	1.9-11	3.16-11
2.224	1.5-11	2.2-11	3.68-11
2.249	1.6-11	2.3-11	3.89-11
2.274	1.7-11	2.4-11	4.06-11
2.299	1.7-11	2.5-11	4.24-11
2.324	1.8-11	2.7-11	4.53-11
2.349	1.9-11	3.2-11	5.05-11
2.374	2.1-11	3.4-11	5.45-11
2.399	2.2-11	3.6-11	5.78-11
2.424	2.4-11	3.8-11	6.16-11
2.449	2.5-11	4.1-11	6.58-11
2.474	2.5-11	7.2-11	9.68-11
2.499	2.7-11	8.6-11	1.13-10
2.524	2.8-11	9.7-11	1.25-10
2.549	2.9-11	1.3-10	1.58-10
2.574	3.0-11	2.3-10	2.57-10
2.599	3.1-11	2.5-10	2.82-10
2.624	3.2-11	2.6-10	2.89-10
2.649	3.4-11	2.6-10	2.95-10
2.674	3.8-11	2.7-10	3.03-10
2.699	4.2-11	2.8-10	3.18-10
2.724	4.4-11	3.8-10	4.21-10
2.749	4.5-11	4.5-10	4.93-10
2.774	4.6-11	4.6-10	5.06-10
2.799	4.6-11	4.7-10	5.13-10

	**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL
2.824	4.7-11	4.7-10	5.22-10
2.849	4.8-11	4.9-10	5.35-10
2.874	5.0-11	5.2-10	5.68-10
2.899	5.3-11	5.8-10	6.31-10
2.924	5.8-11	6.6-10	7.21-10
2.949	6.6-11	7.5-10	8.12-10
2.974	7.0-11	7.7-10	8.42-10
2.999	7.5-11	7.8-10	8.59-10
3.024	8.3-11	7.9-10	8.78-10
3.049	9.5-11	8.1-10	9.01-10
3.074	1.1-10	8.2-10	9.27-10
3.099	1.2-10	8.3-10	9.52-10
3.124	1.3-10	8.5-10	9.81-10
3.149	1.4-10	8.9-10	1.024-9
3.174	1.4-10	9.4-10	1.087-9
3.199	1.5-10	1.03-9	1.180-9
3.224	1.6-10	1.11-9	1.269-9
3.249	1.6-10	1.18-9	1.340-9
3.274	1.6-10	1.23-9	1.395-9
3.299	1.7-10	1.29-9	1.454-9
3.324	1.7-10	1.37-9	1.538-9
3.349	1.7-10	1.47-9	1.641-9
3.374	1.8-10	1.54-9	1.724-9
3.399	1.9-10	1.59-9	1.780-9
3.424	1.9-10	1.63-9	1.820-9
3.449	2.0-10	1.66-9	1.864-9
3.474	2.1-10	1.70-9	1.908-9
3.499	2.2-10	1.76-9	1.976-9
3.524	2.2-10	1.87-9	2.090-9
3.549	2.3-10	2.02-9	2.253-9
3.574	2.4-10	2.19-9	2.427-9
3.599	2.5-10	2.37-9	2.626-9
3.624	2.7-10	2.57-9	2.843-9
3.649	2.9-10	2.72-9	3.011-9
3.674	3.0-10	2.86-9	3.162-9
3.699	3.2-10	2.99-9	3.306-9
3.724	3.3-10	3.11-9	3.446-9
3.749	3.6-10	3.24-9	3.590-9
3.774	3.7-10	3.38-9	3.750-9
3.799	3.9-10	3.55-9	3.938-9
3.824	4.1-10	3.77-9	4.181-9
3.849	4.3-10	4.05-9	4.476-9
3.874	4.4-10	4.29-9	4.730-9
3.899	4.6-10	4.51-9	4.964-9
3.924	4.7-10	4.75-9	5.218-9
3.949	4.8-10	4.94-9	5.426-9
3.974	5.0-10	5.07-9	5.563-9
3.999	5.1-10	5.15-9	5.661-9
4.024	5.4-10	5.21-9	5.751-9
4.049	5.6-10	5.29-9	5.850-9
4.074	5.9-10	5.38-9	5.971-9
4.099	6.1-10	5.56-9	6.170-9
4.124	6.2-10	5.78-9	6.403-9
4.149	6.4-10	5.92-9	6.563-9
4.174	6.6-10	6.06-9	6.725-9
4.199	6.8-10	6.21-9	6.894-9
4.224	7.0-10	6.39-9	7.091-9
4.249	7.1-10	6.66-9	7.368-9
4.274	7.2-10	6.97-9	7.690-9
4.299	7.3-10	7.26-9	7.992-9
4.324	7.5-10	7.48-9	8.227-9
4.349	7.6-10	7.73-9	8.496-9
4.374	7.8-10	8.06-9	8.834-9
4.399	7.9-10	8.44-9	9.225-9
4.424	8.0-10	8.80-9	9.597-9
4.449	8.1-10	9.09-9	9.895-9
4.474	8.2-10	9.30-9	1.012-8
4.499	8.3-10	9.42-9	1.025-8
4.524	8.4-10	9.56-9	1.040-8
4.549	8.5-10	9.84-9	1.069-8
4.574	8.6-10	1.02-8	1.105-8
4.599	8.8-10	1.05-8	1.139-8

	**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL
4.624	9.0-10	1.08-8	1.175-8
4.649	9.2-10	1.12-8	1.210-8
4.674	9.4-10	1.15-8	1.245-8
4.699	9.5-10	1.18-8	1.276-8
4.724	9.7-10	1.20-8	1.300-8
4.749	9.9-10	1.22-8	1.323-8
4.774	1.01-9	1.24-8	1.343-8
4.799	1.03-9	1.26-8	1.361-8
4.824	1.04-9	1.28-8	1.380-8
4.849	1.05-9	1.29-8	1.399-8
4.874	1.07-9	1.32-8	1.425-8
4.899	1.09-9	1.35-8	1.457-8
4.924	1.10-9	1.37-8	1.482-8
4.949	1.12-9	1.40-8	1.512-8
4.974	1.14-9	1.43-8	1.543-8
4.999	1.17-9	1.45-8	1.570-8
5.024	1.20-9	1.47-8	1.587-8
5.049	1.22-9	1.48-8	1.600-8
5.074	1.24-9	1.49-8	1.615-8
5.099	1.26-9	1.52-8	1.646-8
5.124	1.29-9	1.55-8	1.680-8
5.149	1.32-9	1.58-8	1.712-8
5.174	1.35-9	1.61-8	1.747-8
5.199	1.38-9	1.64-8	1.781-8
5.224	1.41-9	1.67-8	1.814-8
5.249	1.44-9	1.70-8	1.848-8
5.274	1.47-9	1.74-8	1.883-8
5.299	1.50-9	1.77-8	1.918-8
5.324	1.53-9	1.80-8	1.953-8
5.349	1.56-9	1.83-8	1.988-8
5.374	1.58-9	1.86-8	2.023-8
5.399	1.61-9	1.90-8	2.059-8
5.424	1.64-9	1.93-8	2.095-8
5.449	1.67-9	1.96-8	2.131-8
5.474	1.70-9	2.00-8	2.167-8
5.499	1.73-9	2.03-8	2.204-8
5.524	1.76-9	2.06-8	2.240-8
5.549	1.79-9	2.10-8	2.278-8
5.574	1.82-9	2.13-8	2.315-8
5.599	1.85-9	2.17-8	2.352-8
5.624	1.88-9	2.20-8	2.390-8
5.649	1.91-9	2.24-8	2.428-8
5.674	1.95-9	2.27-8	2.467-8
5.699	1.98-9	2.31-8	2.505-8
5.724	2.01-9	2.34-8	2.544-8
5.749	2.04-9	2.38-8	2.583-8
5.774	2.07-9	2.42-8	2.623-8
5.799	2.11-9	2.45-8	2.662-8
5.824	2.14-9	2.49-8	2.702-8
5.849	2.17-9	2.52-8	2.742-8
5.874	2.21-9	2.56-8	2.782-8
5.899	2.24-9	2.60-8	2.823-8
5.924	2.27-9	2.64-8	2.864-8
5.949	2.31-9	2.67-8	2.905-8
5.974	2.34-9	2.71-8	2.946-8
5.999	2.38-9	2.75-8	2.988-8
6.024	2.41-9	2.79-8	3.030-8
6.049	2.45-9	2.83-8	3.072-8
6.074	2.48-9	2.87-8	3.114-8
6.099	2.52-9	2.90-8	3.157-8
6.124	2.55-9	2.94-8	3.200-8
6.149	2.59-9	2.98-8	3.243-8
6.174	2.63-9	3.02-8	3.286-8
6.199	2.66-9	3.06-8	3.330-8
6.224	2.70-9	3.10-8	3.373-8
6.249	2.74-9	3.14-8	3.418-8
6.274	2.78-9	3.18-8	3.462-8
6.299	2.81-9	3.23-8	3.507-8
6.324	2.85-9	3.27-8	3.551-8
6.349	2.89-9	3.31-8	3.596-8
6.374	2.93-9	3.35-8	3.642-8
6.399	2.97-9	3.39-8	3.687-8

	**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL
6.424	3.01-9	3.43-8	3.733-8
6.449	3.05-9	3.47-8	3.779-8
6.474	3.09-9	3.52-8	3.825-8
6.499	3.13-9	3.56-8	3.872-8
6.524	3.17-9	3.60-8	3.919-8
6.549	3.21-9	3.65-8	3.966-8
6.574	3.25-9	3.69-8	4.014-8
6.599	3.29-9	3.73-8	4.061-8
6.624	3.33-9	3.78-8	4.109-8
6.649	3.37-9	3.82-8	4.157-8
6.674	3.42-9	3.86-8	4.206-8
6.699	3.46-9	3.91-8	4.255-8
6.724	3.50-9	3.95-8	4.303-8
6.749	3.54-9	4.00-8	4.353-8
6.774	3.59-9	4.04-8	4.402-8
6.799	3.63-9	4.09-8	4.452-8
6.824	3.67-9	4.13-8	4.502-8
6.849	3.72-9	4.18-8	4.552-8
6.874	3.76-9	4.23-8	4.602-8
6.899	3.81-9	4.27-8	4.653-8
6.924	3.85-9	4.32-8	4.704-8
6.949	3.90-9	4.37-8	4.755-8
6.974	3.94-9	4.41-8	4.807-8
6.999	3.99-9	4.46-8	4.858-8
7.024	4.03-9	4.51-8	4.910-8
7.049	4.08-9	4.55-8	4.962-8
7.074	4.13-9	4.60-8	5.015-8
7.099	4.17-9	4.65-8	5.068-8
7.124	4.22-9	4.70-8	5.121-8
7.149	4.27-9	4.75-8	5.174-8
7.174	4.31-9	4.80-8	5.228-8
7.199	4.36-9	4.84-8	5.281-8
7.224	4.41-9	4.89-8	5.335-8
7.249	4.46-9	4.94-8	5.390-8
7.274	4.51-9	4.99-8	5.444-8
7.299	4.56-9	5.04-8	5.499-8
7.324	4.61-9	5.09-8	5.554-8
7.349	4.66-9	5.14-8	5.609-8
7.374	4.71-9	5.19-8	5.665-8
7.399	4.76-9	5.25-8	5.721-8
7.424	4.81-9	5.30-8	5.777-8
7.449	4.86-9	5.35-8	5.833-8
7.474	4.91-9	5.40-8	5.890-8
7.499	4.96-9	5.45-8	5.947-8
7.524	5.02-9	5.50-8	6.004-8
7.549	5.07-9	5.55-8	6.062-8
7.574	5.12-9	5.61-8	6.119-8
7.599	5.17-9	5.66-8	6.177-8
7.624	5.23-9	5.71-8	6.235-8
7.649	5.28-9	5.77-8	6.294-8
7.674	5.34-9	5.82-8	6.353-8
7.699	5.39-9	5.87-8	6.412-8
7.724	5.44-9	5.93-8	6.471-8
7.749	5.50-9	5.98-8	6.530-8
7.774	5.55-9	6.03-8	6.590-8
7.799	5.61-9	6.09-8	6.650-8
7.824	5.67-9	6.14-8	6.711-8
7.849	5.72-9	6.20-8	6.771-8
7.874	5.78-9	6.25-8	6.832-8
7.899	5.84-9	6.31-8	6.893-8
7.924	5.89-9	6.37-8	6.955-8
7.949	5.95-9	6.42-8	7.016-8
7.974	6.01-9	6.48-8	7.078-8
7.999	6.07-9	6.53-8	7.141-8
8.024	6.13-9	6.59-8	7.203-8
8.049	6.18-9	6.65-8	7.266-8
8.074	6.24-9	6.70-8	7.329-8
8.099	6.30-9	6.76-8	7.392-8
8.124	6.36-9	6.82-8	7.456-8
8.149	6.42-9	6.88-8	7.520-8
8.174	6.48-9	6.94-8	7.584-8
8.199	6.55-9	6.99-8	7.648-8

	**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL
8.224	6.61-9	7.05-8	7.713-8
8.249	6.67-9	7.11-8	7.778-8
8.274	6.73-9	7.17-8	7.843-8
8.299	6.79-9	7.23-8	7.908-8
8.324	6.86-9	7.29-8	7.974-8
8.349	6.92-9	7.35-8	8.040-8
8.374	6.98-9	7.41-8	8.106-8
8.399	7.05-9	7.47-8	8.173-8
8.424	7.11-9	7.53-8	8.240-8
8.449	7.18-9	7.59-8	8.307-8
8.474	7.24-9	7.65-8	8.374-8
8.499	7.31-9	7.71-8	8.442-8
8.524	7.37-9	7.77-8	8.510-8
8.549	7.44-9	7.83-8	8.578-8
8.574	7.51-9	7.90-8	8.647-8
8.599	7.57-9	7.96-8	8.715-8
8.624	7.64-9	8.02-8	8.784-8
8.649	7.71-9	8.08-8	8.854-8
8.674	7.77-9	8.15-8	8.923-8
8.699	7.84-9	8.21-8	8.993-8
8.724	7.91-9	8.27-8	9.064-8
8.749	7.98-9	8.34-8	9.134-8
8.774	8.05-9	8.40-8	9.205-8
8.799	8.12-9	8.46-8	9.276-8
8.824	8.19-9	8.53-8	9.347-8
8.849	8.26-9	8.59-8	9.419-8
8.874	8.33-9	8.66-8	9.491-8
8.899	8.40-9	8.72-8	9.563-8
8.924	8.48-9	8.79-8	9.635-8
8.949	8.55-9	8.85-8	9.708-8
8.974	8.62-9	8.92-8	9.781-8
8.999	8.69-9	8.98-8	9.854-8
9.024	8.77-9	9.05-8	9.928-8
9.049	8.84-9	9.12-8	1.000-7
9.074	8.92-9	9.18-8	1.008-7
9.099	8.99-9	9.25-8	1.015-7
9.124	9.07-9	9.32-8	1.023-7
9.149	9.14-9	9.39-8	1.030-7
9.174	9.22-9	9.45-8	1.038-7
9.199	9.29-9	9.52-8	1.045-7
9.224	9.37-9	9.59-8	1.053-7
9.249	9.45-9	9.66-8	1.060-7
9.274	9.52-9	9.73-8	1.068-7
9.299	9.60-9	9.80-8	1.076-7
9.324	9.68-9	9.87-8	1.083-7
9.349	9.76-9	9.94-8	1.091-7
9.374	9.84-9	1.00-7	1.099-7
9.399	9.92-9	1.01-7	1.107-7
9.424	..00-9	1.01-7	1.115-7
9.449	1.01-8	1.02-7	1.122-7
9.474	1.02-8	1.03-7	1.130-7
9.499	1.02-8	1.04-7	1.138-7
9.524	1.03-8	1.04-7	1.146-7
9.549	1.04-8	1.05-7	1.154-7
9.574	1.05-8	1.06-7	1.162-7
9.599	1.06-8	1.06-7	1.170-7
9.624	1.07-8	1.07-7	1.178-7
9.649	1.07-8	1.08-7	1.186-7
9.674	1.08-8	1.09-7	1.194-7
9.699	1.09-8	1.09-7	1.203-7
9.724	1.10-8	1.10-7	1.211-7
9.749	1.11-8	1.11-7	1.219-7
9.774	1.12-8	1.12-7	1.227-7
9.799	1.13-8	1.12-7	1.236-7
9.824	1.13-8	1.13-7	1.244-7
9.849	1.14-8	1.14-7	1.252-7
9.874	1.15-8	1.15-7	1.261-7
9.899	1.16-8	1.15-7	1.269-7
9.924	1.17-8	1.16-7	1.277-7
9.949	1.18-8	1.17-7	1.286-7
9.974	1.19-8	1.18-7	1.294-7
9.999	1.20-8	1.18-7	1.303-7

TABLE X

$^{17,18}O(\alpha,n)$ NEUTRON PRODUCTION IN CLEAN UO_2 FUEL BY ALPHA PARTICLES BELOW 10 MeV

	**NEUTRONS-PER-ALPHA*				**NEUTRONS-PER-ALPHA*				**NEUTRONS-PER-ALPHA*				**NEUTRONS-PER-ALPHA*				**NEUTRONS-PER-ALPHA*		
E,MEV	O-17	O-18	TOTAL	E,MEV	O-17	O-18	TOTAL	E,MEV	O-17	O-18	TOTAL	E,MEV	O-17	O-18	TOTAL	E,MEV	O-17	O-18	TOTAL
0.000	0.	0.	0.	2.824	4.7-11	4.7-10	5.17-10	4.624	8.9-10	1.07-8	1.158-8	6.424	2.96-9	3.37-8	3.667-8	8.224	6.48-9	6.91-8	7.557-8
1.139	0.	0.	0.	2.849	4.8-11	4.8-10	5.30-10	4.649	9.1-10	1.10-8	1.192-8	6.449	2.99-9	3.41-8	3.712-8	8.249	6.54-9	6.97-8	7.620-8
1.141	0.	0.	0.	2.874	4.9-11	5.1-10	5.63-10	4.674	9.2-10	1.13-8	1.226-8	6.474	3.03-9	3.45-8	3.757-8	8.274	6.60-9	7.02-8	7.684-8
1.161	0.0- 0	1.5-14	1.53-14	2.899	5.2-11	5.7-10	6.25-10	4.699	9.4-10	1.16-8	1.257-8	6.499	3.07-9	3.50-8	3.803-8	8.299	6.66-9	7.06-8	7.748-8
1.186	0.0- 0	1.8-14	1.78-14	2.924	5.7-11	6.6-10	7.14-10	4.724	9.6-10	1.18-8	1.281-8	6.524	3.11-9	3.54-8	3.849-8	8.324	6.72-9	7.14-8	7.812-8
1.211	0.0- 0	2.6-14	2.63-14	2.949	6.5-11	7.4-10	8.04-10	4.749	9.8-10	1.21-8	1.303-8	6.549	3.15-9	3.58-8	3.895-8	8.349	6.78-9	7.20-8	7.876-8
1.236	0.0- 0	2.6-14	2.63-14	2.974	7.0-11	7.6-10	8.33-10	4.774	[illegible]	1.22-8	1.321-8	6.574	3.19-9	3.62-8	3.942-8	8.374	6.84-9	7.26-8	7.941-8
1.261	0.0- 0	2.6-14	2.63-14	2.999	7.4-11	7.8-10	8.50-10	4.799	1.01-9	1.24-8	1.341-8	6.599	3.23-9	3.66-8	3.988-8	8.399	6.90-9	7.32-8	8.006-8
1.266	0.0- 0	3.0-14	3.04-14	3.024	8.2-11	7.9-10	8.69-10	4.824	1.02-9	1.26-8	1.359-8	6.624	3.27-9	3.71-8	4.035-8	8.424	6.97-9	7.37-8	8.071-8
1.309	0.0- 0	3.2-14	3.21-14	3.049	9.4-11	8.0-10	8.92-10	4.849	1.04-9	1.27-8	1.377-8	6.649	3.31-9	3.75-8	4.082-8	8.449	7.03-9	7.43-8	8.137-8
1.311	1.0-16	3.3-14	3.31-14	3.074	1.1-10	8.1-10	9.17-10	4.874	1.06-9	1.30-8	1.403-8	6.674	3.35-9	3.79-8	4.130-8	8.474	7.09-9	7.49-8	8.203-8
1.319	1.5-15	5.7-14	5.87-14	3.099	1.2-10	8.2-10	9.42-10	4.899	1.07-9	1.33-8	1.434-8	6.699	3.40-9	3.84-8	4.177-8	8.499	7.16-9	7.55-8	8.269-8
1.324	2.4-15	8.1-14	8.30-14	3.124	1.3-10	8.4-10	9.71-10	4.924	1.09-9	1.35-8	1.459-8	6.724	3.44-9	3.88-8	4.225-8	8.524	7.22-9	7.61-8	8.335-8
1.349	4.2-15	9.8-14	1.02-13	3.149	1.4-10	8.8-10	1.013-9	4.949	1.10-9	1.38-8	1.489-8	6.749	3.48-9	3.93-8	4.273-8	8.549	7.29-9	7.67-8	8.401-8
1.374	6.2-15	1.0-13	1.07-13	3.174	1.4-10	9.3-10	1.076-9	4.974	1.12-9	1.41-8	1.519-8	6.774	3.52-9	3.97-8	4.322-8	8.574	7.35-9	7.73-8	8.468-8
1.399	1.0-14	1.0-13	1.13-13	3.199	1.5-10	1.02-9	1.167-9	4.999	1.16-9	1.43-8	1.546-8	6.799	3.56-9	4.01-8	4.370-8	8.599	7.42-9	7.79-8	8.535-8
1.424	1.2-14	1.1-13	1.19-13	3.224	1.6-10	1.10-9	1.256-9	5.024	1.19-9	1.44-8	1.562-8	6.824	3.61-9	4.06-8	4.419-8	8.624	7.48-9	7.85-8	8.603-8
1.449	4.8-14	1.7-13	2.13-13	3.249	1.6-10	1.17-9	1.325-9	5.049	1.21-9	1.45-8	1.575-8	6.849	3.65-9	4.10-8	4.468-8	8.649	7.55-9	7.92-8	8.670-8
1.474	9.1-14	2.1-13	3.02-13	3.274	1.6-10	1.22-9	1.380-9	5.074	1.22-9	1.47-8	1.590-8	6.874	3.69-9	4.15-8	4.517-8	8.674	7.61-9	7.98-8	8.738-8
1.499	1.0-13	2.6-13	3.61-13	3.299	1.6-10	1.27-9	1.438-9	5.099	1.24-9	1.50-8	1.620-8	6.899	3.74-9	4.19-8	4.567-8	8.699	7.68-9	8.04-8	8.807-8
1.524	1.1-13	5.2-13	6.33-13	3.324	1.7-10	1.35-9	1.521-9	5.124	1.27-9	1.53-8	1.654-8	6.924	3.78-9	4.24-8	4.617-8	8.724	7.75-9	8.10-8	8.875-8
1.549	1.2-13	9.2-13	1.04-12	3.349	1.7-10	1.45-9	1.623-9	5.149	1.30-9	1.56-8	1.685-8	6.949	3.82-9	4.28-8	4.667-8	8.749	7.82-9	8.16-8	8.944-8
1.574	1.3-13	1.0-12	1.17-12	3.374	1.8-10	1.53-9	1.704-9	5.174	1.33-9	1.59-8	1.719-8	6.974	3.87-9	4.33-8	4.717-8	8.774	7.88-9	8.22-8	9.013-8
1.599	1.4-13	1.1-12	1.25-12	3.399	1.8-10	1.58-9	1.760-9	5.199	1.36-9	1.62-8	1.752-8	6.999	3.91-9	4.38-8	4.768-8	8.799	7.95-9	8.29-8	9.082-8
1.624	1.6-13	1.2-12	1.31-12	3.424	1.9-10	1.61-9	1.799-9	5.224	1.39-9	1.65-8	1.786-8	7.024	3.96-9	4.42-8	4.819-8	8.824	8.02-9	8.35-8	9.152-8
1.649	1.9-13	1.2-12	1.38-12	3.449	2.0-10	1.64-9	1.843-9	5.249	1.41-9	1.68-8	1.819-8	7.049	4.00-9	4.47-8	4.870-8	8.849	8.09-9	8.41-8	9.221-8
1.674	2.2-13	1.2-12	1.44-12	3.474	2.1-10	1.68-9	1.887-9	5.274	1.45-9	1.71-8	1.853-8	7.074	4.05-9	4.52-8	4.921-8	8.874	8.16-9	8.46-8	9.291-8
1.699	2.7-13	1.3-12	1.52-12	3.499	2.1-10	1.74-9	1.954-9	5.299	1.47-9	1.74-8	1.887-8	7.099	4.10-9	4.56-8	4.973-8	8.899	8.23-9	8.54-8	9.362-8
1.724	3.2-13	1.3-12	1.60-12	3.524	2.2-10	1.84-9	2.066-9	5.324	1.50-9	1.77-8	1.921-8	7.124	4.14-9	4.61-8	5.025-8	8.924	8.30-9	8.60-8	9.432-8
1.749	4.0-13	1.3-12	1.73-12	3.549	2.3-10	2.00-9	2.227-9	5.349	1.53-9	1.80-8	1.956-8	7.149	4.19-9	4.66-8	5.077-8	8.949	8.37-9	8.67-8	9.503-8
1.774	5.7-13	1.4-12	1.93-12	3.574	2.4-10	2.16-9	2.398-9	5.374	1.56-9	1.83-8	1.991-8	7.174	4.23-9	4.71-8	5.129-8	8.974	8.44-9	8.73-8	9.575-8
1.799	7.8-13	1.4-12	2.20-12	3.599	2.5-10	2.34-9	2.595-9	5.399	1.59-9	1.87-8	2.025-8	7.199	4.28-9	4.75-8	5.182-8	8.999	8.51-9	8.79-8	9.646-8
1.824	8.7-13	1.5-12	2.36-12	3.624	2.7-10	2.54-9	2.808-9	5.424	1.62-9	1.90-8	2.061-8	7.224	4.33-9	4.80-8	5.234-8	9.024	8.58-9	8.86-8	9.718-8
1.849	9.7-13	1.7-12	2.65-12	3.649	2.8-10	2.69-9	2.974-9	5.449	1.64-9	1.93-8	2.096-8	7.249	4.38-9	4.85-8	5.288-8	9.049	8.65-9	8.92-8	9.790-8
1.874	1.1-12	4.3-12	5.37-12	3.674	3.0-10	2.82-9	3.122-9	5.474	1.67-9	1.96-8	2.132-8	7.274	4.42-9	4.90-8	5.341-8	9.074	8.73-9	8.99-8	9.862-8
1.899	1.2-12	4.5-12	5.72-12	3.699	3.1-10	2.95-9	3.265-9	5.499	1.70-9	2.00-8	2.168-8	7.299	4.47-9	4.95-8	5.395-8	9.099	8.80-9	9.05-8	9.935-8
1.924	1.3-12	4.6-12	5.91-12	3.724	3.3-10	3.07-9	3.402-9	5.524	1.73-9	2.03-8	2.204-8	7.324	4.52-9	5.00-8	5.448-8	9.124	8.87-9	9.12-8	1.001-7
1.949	1.5-12	4.8-12	6.25-12	3.749	3.5-10	3.19-9	3.545-9	5.549	1.76-9	2.06-8	2.240-8	7.349	4.57-9	5.05-8	5.502-8	9.149	8.95-9	9.19-8	1.008-7
1.974	2.1-12	5.2-12	7.28-12	3.774	3.7-10	3.33-9	3.702-9	5.574	1.79-9	2.10-8	2.277-8	7.374	4.62-9	5.09-8	5.557-8	9.174	9.02-9	9.25-8	1.015-7
1.999	2.6-12	5.3-12	7.93-12	3.799	3.9-10	3.50-9	3.889-9	5.599	1.82-9	2.13-8	2.314-8	7.399	4.67-9	5.14-8	5.611-8	9.199	9.10-9	9.32-8	1.023-7
2.024	3.2-12	5.6-12	8.71-12	3.824	4.0-10	3.72-9	4.127-9	5.624	1.85-9	2.17-8	2.351-8	7.424	4.72-9	5.19-8	5.666-8	9.224	9.17-9	9.38-8	1.030-7
2.049	3.8-12	5.8-12	9.61-12	3.849	4.2-10	4.00-9	4.418-9	5.649	1.88-9	2.20-8	2.388-8	7.449	4.77-9	5.24-8	5.721-8	9.249	9.25-9	9.45-8	1.038-7
2.074	4.3-12	6.2-12	1.05-11	3.874	4.4-10	4.23-9	4.668-9	5.674	1.91-9	2.23-8	2.426-8	7.474	4.82-9	5.29-8	5.777-8	9.274	9.32-9	9.52-8	1.045-7
2.099	5.0-12	6.7-12	1.17-11	3.899	4.5-10	4.45-9	4.898-9	5.699	1.94-9	2.27-8	2.464-8	7.499	4.87-9	5.35-8	5.832-8	9.299	9.40-9	9.59-8	1.053-7
2.124	6.0-12	7.4-12	1.35-11	3.924	4.6-10	4.69-9	5.148-9	5.724	1.98-9	2.30-8	2.502-8	7.524	4.92-9	5.40-8	5.888-8	9.324	9.47-9	9.65-8	1.060-7
2.149	7.7-12	9.1-12	1.68-11	3.949	4.8-10	4.88-9	5.353-9	5.749	2.01-9	2.34-8	2.540-8	7.549	4.97-9	5.45-8	5.944-8	9.349	9.55-9	9.72-8	1.068-7
2.174	1.0-11	1.1-11	2.16-11	3.974	4.9-10	5.00-9	5.488-9	5.774	2.04-9	2.37-8	2.578-8	7.574	5.02-9	5.50-8	6.001-8	9.374	9.63-9	9.79-8	1.075-7
2.199	1.3-11	1.9-11	3.19-11	3.999	5.1-10	5.08-9	5.585-9	5.799	2.07-9	2.41-8	2.617-8	7.599	5.07-9	5.55-8	6.057-8	9.399	9.71-9	9.86-8	1.083-7
2.224	1.5-11	2.2-11	3.66-11	4.024	5.3-10	5.14-9	5.674-9	5.824	2.10-9	2.45-8	2.656-8	7.624	5.13-9	5.60-8	6.114-8	9.424	9.78-9	9.93-8	1.090-7
2.249	1.6-11	2.3-11	3.87-11	4.049	5.6-10	5.21-9	5.771-9	5.849	2.14-9	2.48-8	2.696-8	7.649	5.18-9	5.65-8	6.171-8	9.449	9.86-9	9.99-8	1.098-7
2.274	1.6-11	2.4-11	4.04-11	4.074	5.8-10	5.31-9	5.890-9	5.874	2.17-9	2.52-8	2.735-8	7.674	5.23-9	5.71-8	6.229-8	9.474	9.94-9	1.01-7	1.106-7
2.299	1.7-11	2.5-11	4.22-11	4.099	6.0-10	5.49-9	6.086-9	5.899	2.20-9	2.55-8	2.775-8	7.699	5.29-9	5.76-8	6.286-8	9.499	1.00-8	1.01-7	1.113-7
2.324	1.8-11	2.7-11	4.50-11	4.124	6.1-10	5.70-9	6.315-9	5.924	2.24-9	2.59-8	2.815-8	7.724	5.34-9	5.81-8	6.344-8	9.524	1.01-8	1.02-7	1.121-7
2.349	1.9-11	3.1-11	5.02-11	4.149	6.3-10	5.84-9	6.473-9	5.949	2.27-9	2.63-8	2.855-8	7.749	5.39-9	5.86-8	6.403-8	9.549	1.02-8	1.03-7	1.129-7
2.374	2.0-11	3.4-11	5.41-11	4.174	6.6-10	5.98-9	6.633-9	5.974	2.30-9	2.67-8	2.896-8	7.774	5.45-9	5.92-8	6.461-8	9.574	1.03-8	1.03-7	1.137-7
2.399	2.2-11	3.5-11	5.75-11	4.199	6.7-10	6.12-9	6.798-9	5.999	2.34-9	2.70-8	2.937-8	7.799	5.50-9	5.97-8	6.520-8	9.599	1.03-8	1.04-7	1.145-7
2.424	2.4-11	3.7-11	6.13-11	4.224	6.9-10	6.30-9	6.993-9	6.024	2.37-9	2.74-8	2.978-8	7.824	5.56-9	6.02-8	6.579-8	9.624	1.04-8	1.05-7	1.152-7
2.449	2.4-11	4.1-11	6.54-11	4.249	7.0-10	6.56-9	7.265-9	6.049	2.41-9	2.78-8	3.019-8	7.849	5.61-9	6.08-8	6.638-8	9.649	1.05-8	1.06-7	1.160-7
2.474	2.5-11	7.1-11	9.61-11	4.274	7.1-10	6.87-9	7.582-9	6.074	2.44-9	2.82-8	3.060-8	7.874	5.67-9	6.13-8	6.697-8	9.674	1.06-8	1.06-7	1.168-7
2.499	2.7-11	8.6-11	1.12-10	4.299	7.2-10	7.16-9	7.880-9	6.099	2.48-9	2.85-8	3.102-8	7.899	5.72-9	6.18-8	6.757-8	9.699	1.07-8	1.07-7	1.176-7
2.524	2.8-11	9.6-11	1.24-10	4.324	7.4-10	7.37-9	8.111-9	6.124	2.51-9	2.89-8	3.144-8	7.924	5.78-9	6.24-8	6.817-8	9.724	1.08-8	1.08-7	1.184-7
2.549	2.9-11	1.3-10	1.56-10	4.349	7.5-10	7.62-9	8.375-9	6.149	2.55-9	2.93-8	3.186-8	7.949	5.83-9	6.29-8	6.877-8	9.749	1.08-8	1.08-7	1.192-7
2.574	3.0-11	2.3-10	2.55-10	4.374	7.7-10	7.94-9	8.707-9	6.174	2.58-9	2.97-8	3.229-8	7.974	5.89-9	6.35-8	6.938-8	9.774	1.09-8	1.09-7	1.200-7
2.599	3.0-11	2.5-10	2.79-10	4.399	7.8-10	8.32-9	9.092-9	6.199	2.62-9	3.01-8	3.271-8	7.999	5.95-9	6.40-8	6.998-8	9.799	1.10-8	1.10-7	1.208-7
2.624	3.2-11	2.5-10	2.86-10	4.424	7.9-10	8.67-9	9.458-9	6.224	2.66-9	3.05-8	3.314-8	8.024	6.00-9	6.46-8	7.059-8	9.824	1.11-8	1.11-7	1.216-7
2.649	3.4-11	2.6-10	2.92-10	4.449	8.0-10	8.95-9	9.751-9	6.249	2.69-9	3.09-8	3.358-8	8.049	6.06-9	6.51-8	7.121-8	9.849	1.12-8	1.11-7	1.224-7
2.674	3.8-11	2.6-10	3.01-10	4.474	8.1-10	9.16-9	9.969-9	6.274	2.73-9	3.13-8	3.401-8	8.074	6.12-9	6.57-8	7.182-8	9.874	1.13-8	1.12-7	1.233-7
2.699	4.1-11	2.7-10	3.16-10	4.499	8.2-10	9.28-9	1.010-8	6.299	2.77-9	3.17-8	3.445-8	8.099	6.18-9	6.63-8	7.244-8	9.899	1.13-8	1.13-7	1.241-7
2.724	4.3-11	3.7-10	4.17-10	4.524	8.3-10	9.42-9	1.024-8	6.324	2.80-9	3.21-8	3.489-8	8.124	6.24-9	6.68-8	7.306-8	9.924	1.14-8	1.13-7	1.249-7
2.749	4.4-11	4.4-10	4.88-10	4.549	8.4-10	9.70-9	1.054-8	6.349	2.84-9	3.25-8	3.533-8	8.149	6.30-9	6.74-8	7.368-8	9.949	1.15-8	1.14-7	1.257-7
2.774	4.5-11	4.6-10	5.02-10	4.574	8.5-10	1.00-8	1.089-8	6.374	2.88-9	3.29-8	3.577-8	8.174	6.36-9	6.80-8	7.431-8	9.974	1.16-8	1.15-7	1.265-7
2.799	4.6-11	4.6-10	5.08-10	4.599	8.7-10	1.04-8	1.122-8	6.399	2.92-9	3.33-8	3.622-8	8.199	6.42-9	6.85-8	7.494-8	9.999	1.17-8	1.16-7	1.274-7

TABLE XI

$^{17,18}O(\alpha,n)$ NEUTRON PRODUCTION IN SPENT UO_2 FUEL BY ALPHA PARTICLES BELOW 10 MeV

E,MEV	**NEUTRONS-PER-ALPHA*			E,MeV	**NEUTRONS-PER-ALPHA*			E,MeV	**NEUTRONS-PER-ALPHA*			E,MeV	**NEUTRONS-PER-ALPHA*			E,MeV	**NEUTRONS-PER-ALPHA*		
	O-17	O-18	TOTAL		O-17	O-18	TOTAL		O-17	O-18	TOTAL		O-17	O-18	TOTAL		O-17	O-18	TOTAL
0.000	0.	0.	0.	2.824	4.6-11	4.6-10	5.11-10	4.624	8.8-10	1.06-8	1.144-8	6.424	2.92-9	3.33-8	3.625-8	8.224	6.40-9	6.83-8	7.471-8
1.139	0.	0.	0.	2.849	4.7-11	4.8-10	5.24-10	4.649	9.0-10	1.09-8	1.178-8	6.449	2.96-9	3.37-8	3.669-8	8.249	6.46-9	6.89-8	7.534-8
1.151	0.	0.	0.	2.874	4.9-11	5.1-10	5.56-10	4.674	9.1-10	1.12-8	1.212-8	6.474	3.00-9	3.41-8	3.714-8	8.274	6.52-9	6.94-8	7.597-8
1.161	0.0- 0	1.5-14	1.52-14	2.899	5.2-11	5.7-10	6.17-10	4.699	9.3-10	1.15-8	1.242-8	6.499	3.04-9	3.46-8	3.759-8	8.299	6.58-9	7.00-8	7.660-8
1.186	0.0- 0	1.8-14	1.76-14	2.924	5.6-11	6.5-10	7.05-10	4.724	9.5-10	1.17-8	1.266-8	6.524	3.08-9	3.50-8	3.805-8	8.324	6.64-9	7.06-8	7.724-8
1.211	0.0- 0	2.6-14	2.59-14	2.949	6.4-11	7.3-10	7.95-10	4.749	9.7-10	1.19-8	1.288-8	6.549	3.12-9	3.54-8	3.850-8	8.349	6.70-9	7.12-8	7.787-8
1.236	0.0- 0	2.6-14	2.59-14	2.974	6.9-11	7.5-10	8.23-10	4.774	9.8-10	1.21-8	1.307-8	6.574	3.15-9	3.58-8	3.896-8	8.374	6.76-9	7.17-8	7.851-8
1.261	0.0- 0	2.6-14	2.59-14	2.999	7.3-11	7.7-10	8.40-10	4.799	.0-10	1.23-8	1.325-8	6.599	3.19-9	3.62-8	3.942-8	8.399	6.83-9	7.23-8	7.915-8
1.286	0.0- 0	3.0-14	3.01-14	3.024	8.1-11	7.8-10	8.59-10	4.824	1.01-9	1.24-8	1.343-8	6.624	3.23-9	3.67-8	3.989-8	8.424	6.89-9	7.29-8	7.980-8
1.309	0.0- 0	3.2-14	3.17-14	3.049	9.3-11	7.9-10	8.81-10	4.849	1.03-9	1.26-8	1.361-8	6.649	3.28-9	3.71-8	4.035-8	8.449	6.95-9	7.35-8	8.045-8
1.311	1.0-16	3.3-14	3.27-14	3.074	1.1-10	8.0-10	9.07-10	4.874	1.04-9	1.28-8	1.387-8	6.674	3.32-9	3.75-8	4.082-8	8.474	7.01-9	7.41-8	8.110-8
1.319	1.5-15	5.7-14	5.80-14	3.099	1.2-10	8.1-10	9.31-10	4.899	1.06-9	1.31-8	1.418-8	6.699	3.36-9	3.79-8	4.129-8	8.499	7.08-9	7.47-8	8.175-8
1.324	2.3-15	8.0-14	8.20-14	3.124	1.3-10	8.3-10	9.59-10	4.924	1.07-9	1.34-8	1.442-8	6.724	3.40-9	3.84-8	4.177-8	8.524	7.14-9	7.53-8	8.241-8
1.349	4.2-15	9.7-14	1.01-13	3.149	1.3-10	8.7-10	1.001-9	4.949	1.09-9	1.36-8	1.471-8	6.749	3.44-9	3.88-8	4.224-8	8.549	7.20-9	7.59-8	8.306-8
1.374	6.1-15	1.0-13	1.06-13	3.174	1.4-10	9.2-10	1.063-9	4.974	1.11-9	1.39-8	1.501-8	6.774	3.48-9	3.92-8	4.272-8	8.574	7.27-9	7.65-8	8.372-8
1.399	1.0-14	1.0-13	1.12-13	3.199	1.5-10	1.00-9	1.153-9	4.999	1.14-9	1.41-8	1.528-8	6.799	3.52-9	3.97-8	4.320-8	8.599	7.33-9	7.71-8	8.439-8
1.424	1.2-14	1.1-13	1.18-13	3.224	1.5-10	1.09-9	1.241-9	5.024	1.17-9	1.43-8	1.544-8	6.824	3.57-9	4.01-8	4.368-8	8.624	7.40-9	7.77-8	8.505-8
1.449	4.7-14	1.6-13	2.11-13	3.249	1.6-10	1.15-9	1.310-9	5.049	1.19-9	1.44-8	1.557-8	6.849	3.61-9	4.06-8	4.417-8	8.649	7.46-9	7.83-8	8.572-8
1.474	9.0-14	2.1-13	2.99-13	3.274	1.6-10	1.20-9	1.364-9	5.074	1.21-9	1.45-8	1.572-8	6.874	3.65-9	4.10-8	4.466-8	8.674	7.53-9	7.89-8	8.639-8
1.499	1.0-13	2.5-13	3.57-13	3.299	1.6-10	1.26-9	1.422-9	5.099	1.23-9	1.48-8	1.601-8	6.899	3.69-9	4.15-8	4.515-8	8.699	7.59-9	7.95-8	8.707-8
1.524	1.1-13	5.2-13	6.26-13	3.324	1.7-10	1.34-9	1.503-9	5.124	1.25-9	1.51-8	1.634-8	6.924	3.74-9	4.19-8	4.564-8	8.724	7.66-9	8.01-8	8.775-8
1.549	1.2-13	9.1-13	1.03-12	3.349	1.7-10	1.44-9	1.604-9	5.149	1.28-9	1.54-8	1.666-8	6.949	3.78-9	4.24-8	4.614-8	8.749	7.73-9	8.07-8	8.843-8
1.574	1.3-13	1.0-12	1.16-12	3.374	1.8-10	1.51-9	1.684-9	5.174	1.32-9	1.57-8	1.699-8	6.974	3.82-9	4.28-8	4.663-8	8.774	7.79-9	8.13-8	8.911-8
1.599	1.4-13	1.1-12	1.23-12	3.399	1.8-10	1.56-9	1.739-9	5.199	1.35-9	1.60-8	1.732-8	6.999	3.87-9	4.33-8	4.713-8	8.799	7.86-9	8.19-8	8.979-8
1.624	1.6-13	1.1-12	1.30-12	3.424	1.9-10	1.59-9	1.778-9	5.224	1.37-9	1.63-8	1.765-8	7.024	3.91-9	4.37-8	4.764-8	8.824	7.93-9	8.26-8	9.048-8
1.649	1.9-13	1.2-12	1.36-12	3.449	2.0-10	1.62-9	1.821-9	5.249	1.40-9	1.66-8	1.798-8	7.049	3.96-9	4.42-8	4.814-8	8.849	8.00-9	8.32-8	9.117-8
1.674	2.2-13	1.2-12	1.43-12	3.474	2.0-10	1.66-9	1.864-9	5.274	1.43-9	1.69-8	1.832-8	7.074	4.00-9	4.46-8	4.865-8	8.874	8.07-9	8.38-8	9.186-8
1.699	2.6-13	1.2-12	1.50-12	3.499	2.1-10	1.72-9	1.931-9	5.299	1.46-9	1.72-8	1.865-8	7.099	4.05-9	4.51-8	4.916-8	8.899	8.14-9	8.44-8	9.256-8
1.724	3.2-13	1.3-12	1.59-12	3.524	2.2-10	1.82-9	2.042-9	5.324	1.49-9	1.75-8	1.899-8	7.124	4.09-9	4.56-8	4.967-8	8.924	8.20-9	8.51-8	9.326-8
1.749	4.0-13	1.3-12	1.71-12	3.549	2.3-10	1.97-9	2.201-9	5.349	1.51-9	1.78-8	1.933-8	7.149	4.14-9	4.60-8	5.019-8	8.949	8.27-9	8.57-8	9.396-8
1.774	5.6-13	1.4-12	1.91-12	3.574	2.4-10	2.13-9	2.370-9	5.374	1.54-9	1.81-8	1.967-8	7.174	4.19-9	4.65-8	5.071-8	8.974	8.34-9	8.63-8	9.466-8
1.799	7.8-13	1.4-12	2.17-12	3.599	2.5-10	2.32-9	2.564-9	5.399	1.57-9	1.85-8	2.002-8	7.199	4.23-9	4.70-8	5.123-8	8.999	8.41-9	8.70-8	9.537-8
1.824	8.6-13	1.5-12	2.33-12	3.624	2.6-10	2.51-9	2.775-9	5.424	1.60-9	1.88-8	2.037-8	7.224	4.28-9	4.75-8	5.175-8	9.024	8.49-9	8.76-8	9.606-8
1.849	9.6-13	1.7-12	2.62-12	3.649	2.8-10	2.66-9	2.939-9	5.449	1.63-9	1.91-8	2.072-8	7.249	4.33-9	4.79-8	5.227-8	9.049	8.56-9	8.82-8	9.679-8
1.874	1.1-12	4.2-12	5.31-12	3.674	3.0-10	2.79-9	3.086-9	5.474	1.65-9	1.94-8	2.107-8	7.274	4.37-9	4.84-8	5.280-8	9.074	8.63-9	8.89-8	9.751-8
1.899	1.2-12	4.5-12	5.65-12	3.699	3.1-10	2.92-9	3.227-9	5.499	1.68-9	1.97-8	2.143-8	7.299	4.42-9	4.89-8	5.333-8	9.099	8.70-9	8.95-8	9.822-8
1.924	1.3-12	4.6-12	5.84-12	3.724	3.3-10	3.04-9	3.362-9	5.524	1.71-9	2.01-8	2.178-8	7.324	4.47-9	4.94-8	5.386-8	9.124	8.77-9	9.02-8	9.895-8
1.949	1.5-12	4.7-12	6.17-12	3.749	3.5-10	3.16-9	3.503-9	5.549	1.74-9	2.04-8	2.214-8	7.349	4.52-9	4.99-8	5.440-8	9.149	8.85-9	9.08-8	9.967-8
1.974	2.1-12	5.1-12	7.20-12	3.774	3.7-10	3.29-9	3.659-9	5.574	1.77-9	2.07-8	2.250-8	7.374	4.57-9	5.04-8	5.494-8	9.174	8.92-9	9.15-8	1.004-7
1.999	2.6-12	5.3-12	7.84-12	3.799	3.8-10	3.46-9	3.843-9	5.599	1.80-9	2.11-8	2.287-8	7.399	4.62-9	5.09-8	5.547-8	9.199	8.99-9	9.21-8	1.011-7
2.024	3.1-12	5.5-12	8.61-12	3.824	4.0-10	3.68-9	4.078-9	5.624	1.83-9	2.14-8	2.324-8	7.424	4.66-9	5.14-8	5.602-8	9.224	9.07-9	9.28-8	1.019-7
2.049	3.7-12	5.8-12	9.50-12	3.849	4.2-10	3.95-9	4.366-9	5.649	1.86-9	2.17-8	2.360-8	7.449	4.71-9	5.18-8	5.656-8	9.249	9.14-9	9.34-8	1.026-7
2.074	4.3-12	6.1-12	1.04-11	3.874	4.3-10	4.18-9	4.613-9	5.674	1.89-9	2.21-8	2.398-8	7.474	4.76-9	5.23-8	5.711-8	9.274	9.22-9	9.41-8	1.033-7
2.099	4.9-12	6.6-12	1.15-11	3.899	4.4-10	4.40-9	4.841-9	5.699	1.92-9	2.24-8	2.435-8	7.499	4.81-9	5.28-8	5.766-8	9.299	9.29-9	9.48-8	1.041-7
2.124	5.9-12	7.4-12	1.33-11	3.924	4.6-10	4.63-9	5.088-9	5.724	1.95-9	2.28-8	2.473-8	7.524	4.86-9	5.33-8	5.821-8	9.324	9.37-9	9.54-8	1.046-7
2.149	7.6-12	9.0-12	1.66-11	3.949	4.7-10	4.82-9	5.290-9	5.749	1.98-9	2.31-8	2.511-8	7.549	4.91-9	5.39-8	5.877-8	9.349	9.44-9	9.61-8	1.056-7
2.174	1.0-11	1.1-11	2.14-11	3.974	4.8-10	4.94-9	5.424-9	5.774	2.02-9	2.35-8	2.549-8	7.574	4.97-9	5.44-8	5.932-8	9.374	9.52-9	9.68-8	1.063-7
2.199	1.2-11	1.9-11	3.10-11	3.999	5.0-10	5.02-9	5.519-9	5.799	2.05-9	2.38-8	2.587-8	7.599	5.02-9	5.49-8	5.988-8	9.399	9.60-9	9.75-8	1.071-7
2.224	1.5-11	2.2-11	3.62-11	4.024	5.2-10	5.08-9	5.607-9	5.824	2.08-9	2.42-8	2.626-8	7.624	5.07-9	5.54-8	6.045-8	9.424	9.67-9	9.81-8	1.078-7
2.249	1.6-11	2.2-11	3.82-11	4.049	5.5-10	5.15-9	5.703-9	5.849	2.11-9	2.45-8	2.665-8	7.649	5.12-9	5.59-8	6.101-8	9.449	9.75-9	9.88-8	1.086-7
2.274	1.6-11	2.4-11	3.99-11	4.074	5.7-10	5.25-9	5.821-9	5.874	2.14-9	2.49-8	2.704-8	7.674	5.17-9	5.64-8	6.158-8	9.474	9.83-9	9.95-8	1.093-7
2.299	1.7-11	2.5-11	4.17-11	4.099	5.9-10	5.42-9	6.015-9	5.899	2.18-9	2.53-8	2.743-8	7.699	5.23-9	5.69-8	6.215-8	9.499	9.91-9	1.00-7	1.101-7
2.324	1.8-11	2.7-11	4.45-11	4.124	6.1-10	5.63-9	6.241-9	5.924	2.21-9	2.56-8	2.783-8	7.724	5.28-9	5.74-8	6.272-8	9.524	9.99-9	1.01-7	1.109-7
2.349	1.8-11	3.1-11	4.96-11	4.149	6.2-10	5.77-9	6.398-9	5.949	2.24-9	2.60-8	2.822-8	7.749	5.33-9	5.80-8	6.330-8	9.549	1.01-8	1.02-7	1.116-7
2.374	2.0-11	3.3-11	5.35-11	4.174	6.5-10	5.91-9	6.555-9	5.974	2.28-9	2.63-8	2.862-8	7.774	5.38-9	5.85-8	6.388-8	9.574	1.01-8	1.02-7	1.124-7
2.399	2.2-11	3.5-11	5.68-11	4.199	6.7-10	6.05-9	6.719-9	5.999	2.31-9	2.67-8	2.903-8	7.799	5.44-9	5.90-8	6.446-8	9.599	1.02-8	1.03-7	1.132-7
2.424	2.3-11	3.7-11	6.05-11	4.224	6.8-10	6.23-9	6.911-9	6.024	2.34-9	2.71-8	2.943-8	7.824	5.49-9	5.95-8	6.504-8	9.624	1.03-8	1.04-7	1.139-7
2.449	2.4-11	4.0-11	6.46-11	4.249	6.9-10	6.49-9	7.180-9	6.049	2.38-9	2.75-8	2.984-8	7.849	5.55-9	6.01-8	6.562-8	9.649	1.04-8	1.04-7	1.147-7
2.474	2.5-11	7.0-11	9.50-11	4.274	7.0-10	6.79-9	7.493-9	6.074	2.41-9	2.78-8	3.025-8	7.874	5.60-9	6.06-8	6.621-8	9.674	1.05-8	1.05-7	1.155-7
2.499	2.6-11	8.5-11	1.11-10	4.299	7.2-10	7.07-9	7.788-9	6.099	2.45-9	2.82-8	3.066-8	7.899	5.66-9	6.11-8	6.680-8	9.699	1.05-8	1.06-7	1.163-7
2.524	2.8-11	9.5-11	1.22-10	4.324	7.3-10	7.28-9	8.016-9	6.124	2.48-9	2.86-8	3.108-8	7.924	5.71-9	6.17-8	6.740-8	9.724	1.06-8	1.06-7	1.171-7
2.549	2.8-11	1.3-10	1.55-10	4.349	7.5-10	7.53-9	8.277-9	6.149	2.52-9	2.90-8	3.150-8	7.949	5.77-9	6.22-8	6.799-8	9.749	1.07-8	1.07-7	1.179-7
2.574	2.9-11	2.2-10	2.52-10	4.374	7.6-10	7.85-9	8.606-9	6.174	2.55-9	2.94-8	3.192-8	7.974	5.82-9	6.28-8	6.859-8	9.774	1.08-8	1.08-7	1.187-7
2.599	3.0-11	2.5-10	2.76-10	4.399	7.7-10	8.22-9	8.986-9	6.199	2.59-9	2.97-8	3.234-8	7.999	5.88-9	6.33-8	6.919-8	9.799	1.09-8	1.09-7	1.195-7
2.624	3.2-11	2.5-10	2.83-10	4.424	7.8-10	8.57-9	9.347-9	6.224	2.62-9	3.01-8	3.276-8	8.024	5.94-9	6.39-8	6.979-8	9.824	1.10-8	1.09-7	1.203-7
2.649	3.4-11	2.5-10	2.89-10	4.449	7.9-10	8.85-9	9.637-9	6.249	2.66-9	3.05-8	3.319-8	8.049	5.99-9	6.44-8	7.040-8	9.849	1.10-8	1.10-7	1.211-7
2.674	3.8-11	2.6-10	2.97-10	4.474	8.0-10	9.05-9	9.853-9	6.274	2.70-9	3.09-8	3.362-8	8.074	6.05-9	6.50-8	7.101-8	9.874	1.11-8	1.11-7	1.219-7
2.699	4.1-11	2.7-10	3.12-10	4.499	8.1-10	9.17-9	9.981-9	6.299	2.73-9	3.13-8	3.405-8	8.099	6.11-9	6.55-8	7.162-8	9.899	1.12-8	1.11-7	1.227-7
2.724	4.3-11	3.7-10	4.12-10	4.524	8.2-10	9.31-9	1.012-8	6.324	2.77-9	3.17-8	3.449-8	8.124	6.17-9	6.61-8	7.223-8	9.924	1.13-8	1.12-7	1.235-7
2.749	4.4-11	4.4-10	4.82-10	4.549	8.3-10	9.59-9	1.041-8	6.349	2.81-9	3.21-8	3.492-8	8.149	6.22-9	6.66-8	7.285-8	9.949	1.14-8	1.13-7	1.243-7
2.774	4.5-11	4.5-10	4.96-10	4.574	8.4-10	9.92-9	1.076-8	6.374	2.85-9	3.25-8	3.536-8	8.174	6.28-9	6.72-8	7.347-8	9.974	1.15-8	1.14-7	1.251-7
2.799	4.5-11	4.6-10	5.02-10	4.599	8.6-10	1.02-8	1.109-8	6.399	2.88-9	3.29-8	3.580-8	8.199	6.34-9	6.77-8	7.409-8	9.999	1.16-8	1.14-7	1.259-7

TABLE XII

$^{17,18}O(\alpha,n)$ NEUTRON PRODUCTION IN CLEAN $(U,Pu)O_2$ FUEL BY ALPHA PARTICLES BELOW 10 MeV

E,MEV	**NEUTRONS-PER-ALPHA* O-17	O-18	TOTAL
0.000	0.	0.	0.
1.139	0.	0.	0.
1.141	0.	0.	0.
1.161	0.0- 0	1.5-14	1.54-14
1.186	0.0- 0	1.8-14	1.79-14
1.211	0.0- 0	2.6-14	2.64-14
1.236	0.0- 0	2.6-14	2.64-14
1.261	0.0- 0	2.6-14	2.64-14
1.286	0.0- 0	3.1-14	3.06-14
1.309	0.0- 0	3.2-14	3.22-14
1.311	1.0-16	3.3-14	3.32-14
1.319	1.5-15	5.7-14	5.89-14
1.324	2.4-15	8.1-14	8.33-14
1.349	4.3-15	9.9-14	1.03-13
1.374	6.2-15	1.0-13	1.08-13
1.399	1.0-14	1.0-13	1.14-13
1.424	1.2-14	1.1-13	1.20-13
1.449	4.8-14	1.7-13	2.14-13
1.474	9.1-14	2.1-13	3.03-13
1.499	1.0-13	2.6-13	3.62-13
1.524	1.1-13	5.2-13	6.36-13
1.549	1.2-13	9.2-13	1.04-12
1.574	1.3-13	1.0-12	1.18-12
1.599	1.4-13	1.1-12	1.25-12
1.624	1.6-13	1.2-12	1.32-12
1.649	1.9-13	1.2-12	1.38-12
1.674	2.3-13	1.2-12	1.45-12
1.699	2.7-13	1.3-12	1.53-12
1.724	3.2-13	1.3-12	1.61-12
1.749	4.1-13	1.3-12	1.74-12
1.774	5.7-13	1.4-12	1.94-12
1.799	7.9-13	1.4-12	2.21-12
1.824	8.8-13	1.5-12	2.37-12
1.849	9.8-13	1.7-12	2.66-12
1.874	1.1-12	4.3-12	5.39-12
1.899	1.2-12	4.5-12	5.74-12
1.924	1.3-12	4.6-12	5.93-12
1.949	1.5-12	4.8-12	6.27-12
1.974	2.1-12	5.2-12	7.31-12
1.999	2.6-12	5.4-12	7.96-12
2.024	3.2-12	5.6-12	8.74-12
2.049	3.8-12	5.9-12	9.65-12
2.074	4.3-12	6.2-12	1.05-11
2.099	5.0-12	6.7-12	1.17-11
2.124	6.0-12	7.5-12	1.35-11
2.149	7.8-12	9.1-12	1.69-11
2.174	1.0-11	1.2-11	2.17-11
2.199	1.3-11	1.9-11	3.15-11
2.224	1.5-11	2.2-11	3.67-11
2.249	1.6-11	2.3-11	3.88-11
2.274	1.6-11	2.4-11	4.06-11
2.299	1.7-11	2.5-11	4.24-11
2.324	1.8-11	2.7-11	4.52-11
2.349	1.9-11	3.2-11	5.03-11
2.374	2.1-11	3.4-11	5.43-11
2.399	2.2-11	3.6-11	5.77-11
2.424	2.4-11	3.8-11	6.15-11
2.449	2.5-11	4.1-11	6.57-11
2.474	2.5-11	7.1-11	9.65-11
2.499	2.7-11	8.6-11	1.13-10
2.524	2.8-11	9.6-11	1.24-10
2.549	2.9-11	1.3-10	1.57-10
2.574	3.0-11	2.3-10	2.56-10
2.599	3.1-11	2.5-10	2.80-10
2.624	3.2-11	2.6-10	2.87-10
2.649	3.4-11	2.6-10	2.93-10
2.674	3.8-11	2.6-10	3.02-10
2.699	4.1-11	2.8-10	3.17-10
2.724	4.3-11	3.8-10	4.19-10
2.749	4.5-11	4.5-10	4.90-10
2.774	4.5-11	4.6-10	5.04-10
2.799	4.6-11	4.6-10	5.10-10

E,MEV	**NEUTRONS-PER-ALPHA* O-17	O-18	TOTAL
2.824	4.7-11	4.7-10	5.19-10
2.849	4.8-11	4.8-10	5.32-10
2.874	5.0-11	5.2-10	5.65-10
2.899	5.2-11	5.7-10	6.27-10
2.924	5.7-11	6.6-10	7.17-10
2.949	6.5-11	7.4-10	8.07-10
2.974	7.0-11	7.7-10	8.36-10
2.999	7.4-11	7.8-10	8.54-10
3.024	8.3-11	7.9-10	8.73-10
3.049	9.5-11	8.0-10	8.95-10
3.074	1.1-10	8.1-10	9.21-10
3.099	1.2-10	8.3-10	9.46-10
3.124	1.3-10	8.5-10	9.74-10
3.149	1.4-10	8.8-10	1.017-9
3.174	1.4-10	9.4-10	1.080-9
3.199	1.5-10	1.02-9	1.172-9
3.224	1.6-10	1.10-9	1.260-9
3.249	1.6-10	1.17-9	1.330-9
3.274	1.6-10	1.22-9	1.385-9
3.299	1.7-10	1.28-9	1.444-9
3.324	1.7-10	1.36-9	1.527-9
3.349	1.7-10	1.46-9	1.629-9
3.374	1.8-10	1.53-9	1.711-9
3.399	1.9-10	1.58-9	1.767-9
3.424	1.9-10	1.61-9	1.806-9
3.449	2.0-10	1.65-9	1.850-9
3.474	2.1-10	1.69-9	1.894-9
3.499	2.1-10	1.75-9	1.961-9
3.524	2.2-10	1.85-9	2.074-9
3.549	2.3-10	2.00-9	2.235-9
3.574	2.4-10	2.17-9	2.407-9
3.599	2.5-10	2.35-9	2.604-9
3.624	2.7-10	2.55-9	2.819-9
3.649	2.9-10	2.70-9	2.985-9
3.674	3.0-10	2.83-9	3.134-9
3.699	3.1-10	2.96-9	3.277-9
3.724	3.3-10	3.09-9	3.415-9
3.749	3.5-10	3.21-9	3.558-9
3.774	3.7-10	3.35-9	3.716-9
3.799	3.9-10	3.52-9	3.903-9
3.824	4.1-10	3.74-9	4.142-9
3.849	4.2-10	4.01-9	4.434-9
3.874	4.4-10	4.25-9	4.685-9
3.899	4.5-10	4.46-9	4.916-9
3.924	4.6-10	4.70-9	5.167-9
3.949	4.8-10	4.90-9	5.373-9
3.974	4.9-10	5.02-9	5.508-9
3.999	5.1-10	5.10-9	5.605-9
4.024	5.3-10	5.16-9	5.695-9
4.049	5.6-10	5.23-9	5.792-9
4.074	5.8-10	5.33-9	5.912-9
4.099	6.0-10	5.51-9	6.109-9
4.124	6.2-10	5.72-9	6.338-9
4.149	6.3-10	5.86-9	6.497-9
4.174	6.6-10	6.00-9	6.657-9
4.199	6.8-10	6.15-9	6.827-9
4.224	6.9-10	6.33-9	7.018-9
4.249	7.0-10	6.59-9	7.292-9
4.274	7.1-10	6.90-9	7.610-9
4.299	7.3-10	7.18-9	7.908-9
4.324	7.4-10	7.40-9	8.140-9
4.349	7.6-10	7.65-9	8.405-9
4.374	7.7-10	7.97-9	8.739-9
4.399	7.8-10	8.35-9	9.125-9
4.424	7.9-10	8.70-9	9.492-9
4.449	8.0-10	8.99-9	9.786-9
4.474	8.1-10	9.19-9	1.001-8
4.499	8.2-10	9.32-9	1.014-8
4.524	8.3-10	9.45-9	1.028-8
4.549	8.4-10	9.73-9	1.058-8
4.574	8.5-10	1.01-8	1.093-8
4.599	8.7-10	1.04-8	1.127-8

E,MEV	**NEUTRONS-PER-ALPHA* O-17	O-18	TOTAL
4.624	8.9-10	1.07-8	1.162-8
4.649	9.1-10	1.11-8	1.197-8
4.674	9.3-10	1.14-8	1.231-8
4.699	9.4-10	1.17-8	1.262-8
4.724	9.6-10	1.19-8	1.285-8
4.749	9.8-10	1.21-8	1.308-8
4.774	[illegible]	1.23-8	1.327-8
4.799	1.01-9	1.24-8	1.345-8
4.824	1.03-9	1.26-8	1.364-8
4.849	1.04-9	1.28-8	1.382-8
4.874	1.06-9	1.30-8	1.408-8
4.899	1.08-9	1.33-8	1.439-8
4.924	1.09-9	1.36-8	1.465-8
4.949	1.10-9	1.38-8	1.494-8
4.974	1.13-9	1.41-8	1.525-8
4.999	1.16-9	1.44-8	1.551-8
5.024	1.19-9	1.45-8	1.568-8
5.049	1.21-9	1.46-8	1.581-8
5.074	1.23-9	1.47-8	1.596-8
5.099	1.25-9	1.50-8	1.626-8
5.124	1.27-9	1.53-8	1.660-8
5.149	1.30-9	1.56-8	1.691-8
5.174	1.34-9	1.59-8	1.725-8
5.199	1.37-9	1.62-8	1.759-8
5.224	1.39-9	1.65-8	1.792-8
5.249	1.42-9	1.68-8	1.825-8
5.274	1.45-9	1.71-8	1.860-8
5.299	1.48-9	1.75-8	1.894-8
5.324	1.51-9	1.78-8	1.928-8
5.349	1.54-9	1.81-8	1.963-8
5.374	1.56-9	1.84-8	1.998-8
5.399	1.59-9	1.87-8	2.033-8
5.424	1.62-9	1.91-8	2.068-8
5.449	1.65-9	1.94-8	2.103-8
5.474	1.68-9	1.97-8	2.139-8
5.499	1.71-9	2.00-8	2.175-8
5.524	1.74-9	2.04-8	2.211-8
5.549	1.77-9	2.07-8	2.248-8
5.574	1.80-9	2.10-8	2.285-8
5.599	1.83-9	2.14-8	2.322-8
5.624	1.86-9	2.17-8	2.359-8
5.649	1.89-9	2.21-8	2.396-8
5.674	1.92-9	2.24-8	2.434-8
5.699	1.95-9	2.28-8	2.472-8
5.724	1.98-9	2.31-8	2.510-8
5.749	2.01-9	2.35-8	2.549-8
5.774	2.05-9	2.38-8	2.588-8
5.799	2.08-9	2.42-8	2.626-8
5.824	2.11-9	2.45-8	2.666-8
5.849	2.14-9	2.49-8	2.705-8
5.874	2.18-9	2.53-8	2.745-8
5.899	2.21-9	2.56-8	2.785-8
5.924	2.24-9	2.60-8	2.825-8
5.949	2.28-9	2.64-8	2.865-8
5.974	2.31-9	2.67-8	2.906-8
5.999	2.34-9	2.71-8	2.947-8
6.024	2.38-9	2.75-8	2.988-8
6.049	2.41-9	2.79-8	3.029-8
6.074	2.45-9	2.83-8	3.071-8
6.099	2.48-9	2.86-8	3.113-8
6.124	2.52-9	2.90-8	3.155-8
6.149	2.56-9	2.94-8	3.197-8
6.174	2.59-9	2.98-8	3.240-8
6.199	2.63-9	3.02-8	3.283-8
6.224	2.66-9	3.06-8	3.326-8
6.249	2.70-9	3.10-8	3.369-8
6.274	2.74-9	3.14-8	3.413-8
6.299	2.77-9	3.18-8	3.457-8
6.324	2.81-9	3.22-8	3.501-8
6.349	2.85-9	3.26-8	3.545-8
6.374	2.89-9	3.30-8	3.590-8
6.399	2.93-9	3.34-8	3.635-8

E,MEV	**NEUTRONS-PER-ALPHA* O-17	O-18	TOTAL
6.424	2.96-9	3.38-8	3.680-8
6.449	3.00-9	3.42-8	3.725-8
6.474	3.04-9	3.47-8	3.770-8
6.499	3.08-9	3.51-8	3.816-8
6.524	3.12-9	3.55-8	3.862-8
6.549	3.16-9	3.59-8	3.909-8
6.574	3.20-9	3.63-8	3.955-8
6.599	3.24-9	3.68-8	4.002-8
6.624	3.28-9	3.72-8	4.049-8
6.649	3.32-9	3.76-8	4.096-8
6.674	3.37-9	3.81-8	4.144-8
6.699	3.41-9	3.85-8	4.192-8
6.724	3.45-9	3.89-8	4.240-8
6.749	3.49-9	3.94-8	4.288-8
6.774	3.53-9	3.98-8	4.336-8
6.799	3.58-9	4.03-8	4.385-8
6.824	3.62-9	4.07-8	4.434-8
6.849	3.66-9	4.12-8	4.483-8
6.874	3.70-9	4.16-8	4.533-8
6.899	3.75-9	4.21-8	4.583-8
6.924	3.79-9	4.25-8	4.633-8
6.949	3.84-9	4.30-8	4.683-8
6.974	3.88-9	4.35-8	4.734-8
6.999	3.93-9	4.39-8	4.784-8
7.024	3.97-9	4.44-8	4.835-8
7.049	4.02-9	4.48-8	4.887-8
7.074	4.06-9	4.53-8	4.938-8
7.099	4.11-9	4.58-8	4.990-8
7.124	4.16-9	4.63-8	5.042-8
7.149	4.20-9	4.67-8	5.094-8
7.174	4.25-9	4.72-8	5.147-8
7.199	4.30-9	4.77-8	5.199-8
7.224	4.34-9	4.82-8	5.252-8
7.249	4.39-9	4.87-8	5.306-8
7.274	4.44-9	4.92-8	5.359-8
7.299	4.49-9	4.96-8	5.413-8
7.324	4.54-9	5.01-8	5.467-8
7.349	4.59-9	5.06-8	5.521-8
7.374	4.63-9	5.11-8	5.576-8
7.399	4.68-9	5.16-8	5.631-8
7.424	4.73-9	5.21-8	5.686-8
7.449	4.78-9	5.26-8	5.741-8
7.474	4.83-9	5.31-8	5.797-8
7.499	4.89-9	5.36-8	5.852-8
7.524	4.94-9	5.41-8	5.908-8
7.549	4.99-9	5.47-8	5.965-8
7.574	5.04-9	5.52-8	6.021-8
7.599	5.09-9	5.57-8	6.078-8
7.624	5.14-9	5.62-8	6.135-8
7.649	5.20-9	5.67-8	6.193-8
7.674	5.25-9	5.73-8	6.250-8
7.699	5.30-9	5.78-8	6.308-8
7.724	5.36-9	5.83-8	6.366-8
7.749	5.41-9	5.88-8	6.424-8
7.774	5.46-9	5.94-8	6.483-8
7.799	5.52-9	5.99-8	6.542-8
7.824	5.57-9	6.04-8	6.601-8
7.849	5.63-9	6.10-8	6.661-8
7.874	5.68-9	6.15-8	6.720-8
7.899	5.74-9	6.21-8	6.780-8
7.924	5.80-9	6.26-8	6.840-8
7.949	5.85-9	6.32-8	6.901-8
7.974	5.91-9	6.37-8	6.961-8
7.999	5.97-9	6.43-8	7.022-8
8.024	6.02-9	6.48-8	7.084-8
8.049	6.08-9	6.54-8	7.145-8
8.074	6.14-9	6.59-8	7.207-8
8.099	6.20-9	6.65-8	7.269-8
8.124	6.26-9	6.71-8	7.331-8
8.149	6.32-9	6.76-8	7.394-8
8.174	6.38-9	6.82-8	7.456-8
8.199	6.44-9	6.88-8	7.519-8

E,MEV	**NEUTRONS-PER-ALPHA* O-17	O-18	TOTAL
8.224	6.50-9	6.93-8	7.563-8
8.249	6.56-9	6.99-8	7.646-8
8.274	6.62-9	7.05-8	7.710-8
8.299	6.68-9	7.11-8	7.774-8
8.324	6.74-9	7.16-8	7.839-8
8.349	6.80-9	7.22-8	7.903-8
8.374	6.86-9	7.28-8	7.968-8
8.399	6.93-9	7.34-8	8.033-8
8.424	6.99-9	7.40-8	8.099-8
8.449	7.05-9	7.46-8	8.165-8
8.474	7.12-9	7.52-8	8.231-8
8.499	7.18-9	7.58-8	8.297-8
8.524	7.25-9	7.64-8	8.363-8
8.549	7.31-9	7.70-8	8.430-8
8.574	7.38-9	7.76-8	8.497-8
8.599	7.44-9	7.82-8	8.565-8
8.624	7.51-9	7.88-8	8.632-8
8.649	7.57-9	7.94-8	8.700-8
8.674	7.64-9	8.00-8	8.768-8
8.699	7.71-9	8.07-8	8.837-8
8.724	7.77-9	8.13-8	8.905-8
8.749	7.84-9	8.19-8	8.974-8
8.774	7.91-9	8.25-8	9.044-8
8.799	7.98-9	8.32-8	9.113-8
8.824	8.05-9	8.38-8	9.183-8
8.849	8.12-9	8.44-8	9.253-8
8.874	8.19-9	8.50-8	9.323-8
8.899	8.26-9	8.57-8	9.394-8
8.924	8.33-9	8.63-8	9.465-8
8.949	8.40-9	8.70-8	9.536-8
8.974	8.47-9	8.76-8	9.607-8
8.999	8.54-9	8.83-8	9.679-8
9.024	8.61-9	8.89-8	9.751-8
9.049	8.68-9	8.96-8	9.823-8
9.074	8.76-9	9.02-8	9.896-8
9.099	8.83-9	9.09-8	9.969-8
9.124	8.90-9	9.15-8	1.004-7
9.149	8.98-9	9.22-8	1.012-7
9.174	9.05-9	9.28-8	1.019-7
9.199	9.12-9	9.35-8	1.026-7
9.224	9.20-9	9.42-8	1.034-7
9.249	9.28-9	9.48-8	1.041-7
9.274	9.35-9	9.55-8	1.049-7
9.299	9.43-9	9.62-8	1.056-7
9.324	9.50-9	9.69-8	1.064-7
9.349	9.58-9	9.75-8	1.071-7
9.374	9.66-9	9.82-8	1.079-7
9.399	9.74-9	9.89-8	1.086-7
9.424	9.82-9	9.96-8	1.094-7
9.449	9.89-9	1.00-7	1.102-7
9.474	9.97-9	1.01-7	1.110-7
9.499	1.01-8	1.02-7	1.117-7
9.524	1.01-8	1.02-7	1.125-7
9.549	1.02-8	1.03-7	1.133-7
9.574	1.03-8	1.04-7	1.141-7
9.599	1.04-8	1.04-7	1.148-7
9.624	1.05-8	1.05-7	1.156-7
9.649	1.05-8	1.06-7	1.164-7
9.674	1.06-8	1.07-7	1.172-7
9.699	1.07-8	1.07-7	1.180-7
9.724	1.08-8	1.08-7	1.188-7
9.749	1.09-8	1.09-7	1.196-7
9.774	1.10-8	1.09-7	1.204-7
9.799	1.10-8	1.10-7	1.212-7
9.824	1.11-8	1.11-7	1.220-7
9.849	1.12-8	1.12-7	1.229-7
9.874	1.13-8	1.12-7	1.237-7
9.899	1.14-8	1.13-7	1.245-7
9.924	1.15-8	1.14-7	1.253-7
9.949	1.16-8	1.15-7	1.262-7
9.974	1.16-8	1.15-7	1.270-7
9.999	1.17-8	1.16-7	1.278-7

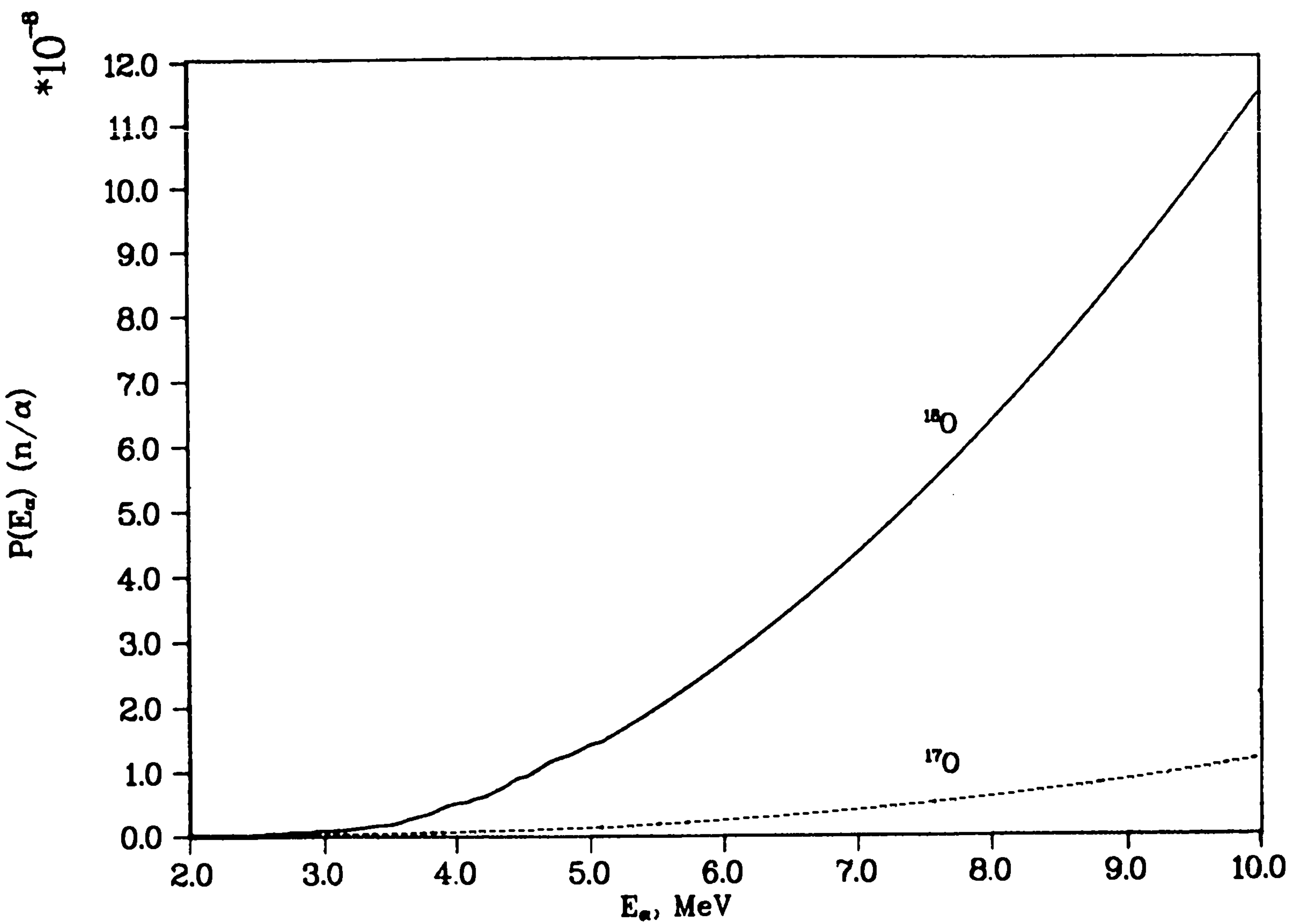

Fig. 5.

$^{17,18}O(\alpha,n)$ neutron production by decay alphas in LWR irradiated UO_2 fuel.

TABLE XIII

NEUTRON PRODUCTION FROM ACTINIDE DECAY IN UO_2 FUEL

NUCLIDE	HALF-LIFE (SECONDS)	DECAY ENERGY (MEV)	DE-CAY REF	****NEUTRONS PER DECAY**** ALPHA,N IN UO2	SPONT. FISSION	TOTAL
80-HG-206	4.89000+2	0.5274	A	0.	0.	0.
81-TL-206	2.50980+2	0.5402	A	0.	0.	0.
82-PB-206	STABLE	0.	-	0.	0.	0.
81-TL-207	2.87400+2	0.5194	A	0.	0.	0.
82-PB-207	STABLE	0.	-	0.	0.	0.
81-TL-208	1.84200+2	3.9702	B	0.	0.	0.
82-PB-208	STABLE	0.	-	0.	0.	0.
81-TL-209	1.32000+2	2.8315	A	0.	0.	0.
82-PB-209	1.17108+4	0.2234	A	0.	0.	0.
83-BI-209	6.3115+25	0.	A	0.	0.	0.
81-TL-210	7.80000+1	4.2765	A	0.	0.	7.00 -05
82-PB-210	7.02472+8	0.0441	A	5.68 -17	0.	5.68 -17
83-BI-210	4.33123+5	0.3899	A	1.56 -14	0.	1.16 -14
84-PO-210	1.19557+7	5.4076	A	1.87 -08	0.	1.87 -08
82-PB-211	2.16600+3	0.5353	A	0.	0.	0.
83-BI-211	1.29000+2	6.7881	A	3.88 -08	0.	3.88 -08
84-PO-211	0.5160000	7.5942	A	5.64 -08	0.	5.64 -08
82-PB-212	3.83040+4	0.3180	B	0.	0.	0.
83-BI-212	3.63600+3	2.9030	A	1.076-08	0.	1.076-08
84-PO-212	2.96000-7	8.9536	A	8.94 -08	0.	8.94 -08
83-BI-213	2.73540+3	0.7172	A	5.85 -10	0.	5.85 -10
84-PO-213	4.20000-6	8.5360	A	7.86 -08	0.	7.86 -08
82-PB-214	1.60800+3	0.5389	A	0.	0.	0.
83-BI-214	1.18200+3	2.1923	A	4.39 -12	0.	4.39 -12
84-PO-214	1.63700-4	7.8337	A	6.19 -08	0.	6.19 -08
83-BI-215	4.44000+2	0.8445	A	0.	0.	0.
84-PO-215	1.77800-3	7.5265	A	5.52 -08	0.	5.52 -08
85-AT-215	1.00000-4	8.1780	A	6.98 -08	0.	6.98 -08
84-PO-216	0.1500000	6.9064	B	4.28 -08	0.	4.28 -08
85-AT-217	0.0323000	7.2004	A	4.85 -08	0.	4.85 -08
86-RN-217	5.40000-4	7.8880	A	6.32 -08	0.	6.32 -08
84-PO-218	1.83000+2	6.1149	A	2.909-08	0.	2.909-08
85-AT-218	1.7500000	6.8830	A	4.14 -08	0.	4.14 -08
86-RN-218	0.0350000	7.2664	A	4.99 -08	0.	4.99 -08
85-AT-219	5.40000+1	6.2165	A	3.26 -08	0.	3.26 -08
86-RN-219	3.9600000	6.9463	A	4.25 -08	0.	4.25 -08
86-RN-220	5.56000+1	6.4048	B	3.39 -08	0.	3.39 -08
87-FR-221	2.88000+2	6.4580	A	3.45 -08	0.	3.45 -08
86-RN-222	3.30351+5	5.5905	A	2.129-08	0.	2.129-08
87-FR-222	8.64000+2	0.7450	A	2.45 -11	0.	2.45 -11
88-RA-222	3.80000+1	6.6760	A	3.846-08	0.	3.846-08
87-FR-223	1.30800+3	0.4559	A	7.65 -13	0.	7.65 -13
88-RA-223	9.87949+5	------	A	2.39 -08	0.	2.39 -08
88-RA-224	3.16224+5	5.7903	B	2.40 -08	0.	2.40 -08
88-RA-225	1.27872+6	0.1433	A	0.	0.	0.
89-AC-225	8.64000+5	5.9354	A	2.57 -08	0.	2.57 -08
88-RA-226	5.0461+10	4.8708	A	1.304-08	0.	1.304-08
89-AC-226	1.04400+5	0.4099	A	1.24 -12	0.	1.24 -12

TABLE XIII (cont.)

NUCLIDE	HALF-LIFE (SECONDS)	DECAY ENERGY (MEV)	DECAY REF	****NEUTRONS PER DECAY**** ALPHA,N IN UO2	SPONT. FISSION	TOTAL
90-TH-226	1.85400+3	6.4517	A	3.42 -08	0.	3.42 -08
89-AC-227	6.87097+8	0.0878	A	2.01 -10	0.	2.01 -10
90-TH-227	1.61720+6	6.1466	A	2.72 -08	0.	2.72 -08
88-RA-228	1.82087+8	0.0146	A	0.	0.	0.
89-AC-228	2.20680+4	1.3696	A	0.	0.	0.
90-TH-228	6.03725+7	5.5176	B	2.004-08	0.	2.004-08
90-TH-229	2.3163+11	5.1686	A	1.391-08	0.	1.391-08
90-TH-230	2.4299+12	4.7609	B	1.207-08	1.14 -12	1.21 -08
91-PA-230	1.52928+6	0.6577	A	6.03 -13	0.	6.03 -13
92- U-230	1.79712+6	5.9928	A	2.69 -08	0.	2.69 -08
90-TH-231	9.18720+4	0.1537	B	0.	0.	0.
91-PA-231	1.0338+12	5.0601	B	1.478-08	5.75 -12	1.48 -08
92- U-231	3.62880+5	0.1017	A	1.14 -12	0.	1.14 -12
90-TH-232	4.4337+17	4.0862	B	5.52 -09	3.02 -11	5.55 -09
91-PA-232	1.13184+5	1.098	B	0.	0.	0.
92- U-232	2.26263+9	5.4145	B	1.871-08	1.54 -12	1.87 -08
90-TH-233	1.33800+3	0.4422	B	0.	0.	0.
91-PA-233	2.33280+6	0.4080	B	0.	0.	0.
92- U-233	5.0232+12	4.8978	B	1.336-08	2.29 -12	1.34 -08
90-TH-234	2.08233+6	0.1473	A	0.	0.	0.
91-PA-234	2.43000+4	2.2453	A	0.	0.	0.
91-PA-234M	7.05000+1	0.8141	A	0.	0.	0.
92- U-234	7.7188+12	4.8685	B	1.299-08	2.17 -11	1.301-08
90-TH-235	4.14000+2	------	A	0.	0.	0.
91-PA-235	1.45200+3	------	A	0.	0.	0.
92- U-235	2.2210+16	4.6651	B	8.89 -09	3.74 -09	1.26 -08
92- U-235M	1.48080+3	0.0001	A	0.	0.	0.
93-NP-235	3.42230+7	0.0810	A	2.44 -13	0.	2.44 -13
94-PU-235	1.53600+3	5.8675	A	3.48 -12	0.	3.48 -12
92- U-236	7.3890+14	4.5809	B	9.89 -09	2.29 -09	1.218-08
93-NP-236	3.6290+12	0.3390	B	0.	0.	0.
93-NP-236M	8.10000+4	0.1353	B	0.	0.	0.
94-PU-236	8.99688+7	5.8634	B	2.517-08	1.73 -09	2.69 -08
92- U-237	5.83200+5	0.3103	B	0.	0.	0.
93-NP-237	6.7532+13	4.9470	B	1.303-08	4.39 -12	1.303-08
94-PU-237	3.94243+6	0.0628	B	6.72 -13	0.	6.72 -13
92- U-238	1.4100+17	4.2755	B	6.64 -09	1.095-06	1.102-06
93-NP-238	1.82908+5	0.7916	B	0.	0.	0.
94-PU-238	2.76912+9	5.5871	B	2.124-08	4.08 -09	2.532-08
92- U-239	1.41000+3	0.4650	B	0.	0.	0.
93-NP-239	2.03365+5	0.4180	B	0.	0.	0.
94-PU-239	7.6084+11	5.2396	B	1.664-08	9.37 -12	1.665-08
92- U-240	5.07600+4	0.1755	A	0.	0.	0.
93-NP-240	4.02000+3	1.5755	A	0.	0.	0.
93-NP-240M	4.50000+2	1.0407	A	0.	0.	0.
94-PU-240	2.0670+11	5.3274	B	1.676-08	1.08 -07	1.25 -07
95-AM-240	1.82880+5	1.0920	B	3.74 -14	0.	3.74 -14
96-CM-240	2.31552+6	6.3844	A	3.37 -08	9.23 -08	1.26 -07
94-PU-241	4.63886+8	0.0054	B	3.39 -13	0.	3.39 -13
95-AM-241	1.3639+10	5.6131	B	2.115-08	9.31 -12	2.116-08
96-CM-241	2.83392+6	1.1100	B	2.79 -10	0.	2.79 -10
94-PU-242	1.1875+13	4.9812	B	1.406-08	1.18 -05	1.18 -05
95-AM-242	5.76360+4	0.1944	B	0.	0.	0.
95-AM-242M	4.79665+9	0.0631	B	9.22 -11	3.74 -10	4.56 -10

TABLE XIII (cont.)

NUCLIDE	HALF-LIFE (SECONDS)	DECAY ENERGY (MEV)	DE-CAY REF	****NEUTRONS PER DECAY**** ALPHA,N IN UO2	SPONT. FISSION	TOTAL
96-CM-242	1.40745+7	6.2169	B	3.07 -08	1.714-07	2.02 -07
94-PU-243	1.78452+4	0.1957	B	0.	0.	0.
95-AM-243	2.3289+11	5.4224	B	1.82 -08	5.32 -10	1.87 -08
96-CM-243	8.99372+8	6.1598	B	2.62 -08	0.	2.62 -08
94-PU-244	2.5877+15	4.6510	B	1.083-08	2.875-03	2.88 -03
95-AM-244	3.63600+4	1.1177	B	0.	0.	0.
95-AM-244M	1.56000+3	0.5088	B	0.	0.	0.
96-CM-244	5.71495+8	5.9010	B	2.582-08	3.623-06	3.65 -06
94-PU-245	3.78280+4	0.8103	A	0.	0.	0.
95-AM-245	7.38000+3	0.3199	A	0.	0.	0.
96-CM-245	2.6744+11	5.5881	B	1.948-08	0.	1.95 -08
94-PU-246	9.37440+5	0.2514	A	0.	0.	0.
95-AM-246M	1.50000+3	1.4433	A	0.	0.	0.
96-CM-246	1.4926+11	5.4714	B	1.971-08	8.313-04	8.31 -04
96-CM-247	4.9229+14	5.3522	B	1.466-08	0.	1.47 -08
96-CM-248	1.0720+13	4.7270	B	1.441-08	2.569-01	2.57 -01
97-BK-248	2.84018+8	------	A	--------	--------	--------
97-BK-248M	8.46000+4	0.1684	A	0.	0.	0.
98-CF-248	2.88144+7	6.3613	A	3.336-08	9.519-05	9.52 -05
96-CM-249	3.84900+3	0.2932	B	0.	0.	0.
97-BK-249	2.76480+7	0.0331	B	2.906-13	1.656-09	1.66 -09
98-CF-249	1.1064+10	6.2903	B	2.646-08	1.712-08	4.36 -08
96-CM-250	3.5660+11	------	C	--------	2.32 +00	2.32 +00
97-BK-250	1.15812+4	1.1829	B	0.	0.	0.
98-CF-250	4.12764+8	6.1227	B	2.941-08	2.718-03	2.72 -03
96-CM-251	1.00800+3	0.5925	A	0.	0.	0.
97-BK-251	3.33600+3	0.4988	A	0.	0.	0.
98-CF-251	2.8338+10	6.0260	B	2.532-08	0.	2.53 -08
98-CF-252	8.32471+7	6.0317	B	2.996-08	1.164-01	1.164-01
98-CF-253	1.53878+6	0.0980	B	8.89 -11	0.	8.89 -11
99-ES-253	1.76860+6	6.7367	B	3.995-08	3.419-07	3.82 -07
98-CF-254	5.22720+6	0.0184	A	8.167-11	3.88 +00	3.88 +00
99-ES-254	2.38205+7	6.6172	A	3.627-08	1.193-07	1.56 -07
99-ES-254M	1.41480+5	0.7351	A	1.138-10	1.778-07	1.78 -07
100-FM-254	1.16640+4	7.2996	A	5.08 -08	2.34 -03	2.34 -03
98-CF-255	6.84000+3	------	A	0.	0.	0.
99-ES-255	3.30912+6	0.5956	A	2.72 -09	1.59 -04	1.59 -04
100-FM-255	7.22520+4	7.2407	A	4.75 -08	8.54 -07	9.02 -07
99-ES-256	1.32000+3	0.6169	A	0.	0.	0.
100-FM-256	9.45720+3	7.0250	A	4.55 -08	3.69 +00	3.69 +00
100-FM-257	8.68320+6	6.8640	A	3.81 -08	8.09 -03	8.09 -03
100-FM-258	3.80000-4	------	A	0.	4.03 +00	4.03 +00

DECAY DATA REFERENCES
A=TABLE OF ISOTOPES
B=ENDF/B-V
C=A.TOBIAS,U.K.,PRIVATE COMMUNICATION

ADDITIONAL NOTES
MISSING DATA NOTED AS ------
81-TL-210, NEUTRONS FROM DELAYED NEUTRON EMISSION FROM 82-PB-210 LEVELS PRODUCED IN BETA DECAY.
92- U-235, SPONTANEOUS FISSION BRANCHING IN ENDF/B-V IS ZERO BY OMISSION. S.F. BRANCHING(2.011-9) TAKEN FROM REFERENCE A.
97-BK-248 DECAY CHARACTERISTICS UNKNOWN.

These values of R_k may be used with detailed calculated activity inventory to determine total neutron production within oxide fuel, using Eq. (22).

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of P. A. Ombrellaro of Hanford Engineering Development Laboratory in providing information and helpful discussions about the methodology and data used; he, with D. L. Johnson and R. E. Schenter, provided low-energy $^{17,18}O(\alpha,n)$ cross-section values used in earlier calculations. We also appreciate conversations with J. K. Bair and J. Gomez del Campo of Oak Ridge National Laboratory and L. F. Hansen of Lawrence Livermore National Laboratory concerning their $O(\alpha,n)$ cross-section measurements and related observations.

At Los Alamos, M. E. Battat, R. J. LaBauve, and T. R. England worked on the accumulation of alpha-decay and spontaneous-fission decay data for the actinide nuclides. R. W. Hardie posed the problem and furnished fast-reactor fuel information. D. M. McClellan painstakingly took cross-section values from graphical form, and N. L. Whittemore prepared tables and figures. We sincerely appreciate their contributions.

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