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LMFBR Models for the ORIGEN2 Computer Code

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CONTENTS

Page

GLOSSARY v

PREFACE vii

ABSTRACT 1

1. INTRODUCTION AND SUMMARY 1

1.1 Introduction 1

1.1.1 Background 1
1.1.2 Scope 2

2. THE GENERATION OF THE MASTER, MULTIGROUP CROSS SECTION DATA BASE . 5

3. MULTIGROUP NEUTRON SPECTRUM AND DEPLETION CALCULATIONS 8

3.1 Spectrum and Depletion Calculations for ORIGEN2 Commercial LMFBR Models 8

3.1.1 Energy self-shielding 8
3.1.2 Spatial self-shielding and collapse to a few groups 10
3.1.3 Characteristic multigroup neutron spectrum calculation 10
3.1.4 Determination of neutron-spectrum-averaged parameters 11

3.2 Spectrum Calculation for the FFTF 11

3.3 Summary of Relevant Calculated Results 12

3.3.1 Characteristic 126-energy-group spectra 12
3.3.2 1-energy-group, effective cross sections 12
3.3.3 Burnup-dependent cross sections for major actinides . 12
3.3.4 ORIGEN2 flux parameters THERM, RES, and FAST 13

4. DESCRIPTION OF REACTOR MODELS 13

4.1 LMFBR Fuel Assembly Description and Composition 13

4.2 LMFBR Fuel Composition 16

4.3 Summary Description of the ORIGEN2 LMFBR Models 16

4.4 Discharge Compositions of Selected LMFBR Fuels 29

5. REFERENCES 32

Page

APPENDIX A: 126-ENERGY-GROUP NEUTRON SPECTRA GRAPHS AND LISTINGS 35

APPENDIX B: ONE-GROUP, SPECTRUM-AVERAGED CROSS SECTIONS FOR THE AMOPUUUX, AMO2TTTX, AND FFTF LMFBRS 55

APPENDIX C: LISTINGS OF ONE-GROUP, BURNUP-DEPENDENT CROSS SECTIONS FOR THE AMOPUUUX AND AMO2TTTX LMFBRS 63

GLOSSARY

GWd	Gigawatt-days = 10^9 watt-days
MWd	Megawatt-days = 10^6 watt-days
MTIHM	Metric tons (10^6 g) of initial heavy metal
Depletion calculation	Calculation of the fresh reactor fuel irradiation that predicts the discharged fuel composition
Fuel element	The smallest structurally discrete part of a fuel assembly that has nuclear fuel as the principal constituent; also called a fuel pin or a fuel rod
Fuel assembly	A grouping of fuel elements that remains intact during the charging and discharging of a reactor core
Pin cell	A cylindrical model of a fuel element used in a reactor physics calculation
Assembly cell	A cylindrical model of a fuel assembly used in a reactor physics calculation
Fuel channel	Hexagonal, sheet-metal can surrounding each fuel assembly to prevent cross-flow of coolant between assemblies
LMFBR	Liquid metal (cooled), fast-breeder reactor. "Fast" refers to the fact that the neutron spectrum is high-energy, i.e., not thermal.
FFTF	Fast-Flux Test Facility in Richland, Washington

PREFACE

This revision is being issued to correct a significant error that occurred in generating the cross sections for the ORIGEN2 LMFBR reactor models described in the original report. Specifically, the weighting of the multigroup cross section library with a multigroup neutron energy spectrum to yield a one-group cross-section library was done improperly because the nuclide concentrations were not correct. This error was propogated throughout much of the data presented in the appendixes, thus necessitating a completely new version of this portion of the report. In addition, some minor changes have been made based on information obtained after the original report had been issued. The most notable of these are: (1) the FFTF irradiation parameters have been updated; (2) Table B.1, in which the values in the first column were shifted, has been corrected; and (3) an error in the specific power for the radial blanket in the AMORUUUX and EMOPUUUX reactor models has been eliminated.

The impact of these changes on the principal actinide nuclides (e.g., uranium, plutonium) is negligible since they are dependent on variable cross sections which were not affected by the multigroup cross-section processing errors. However, the changes in the one-group cross sections will affect virtually all other nuclides to varying degrees. It should be noted that the cross-section processing errors described above do not affect the FFTF model in this report or the CRBRP model described in NUREG/CR-2762.

LMFBR MODELS FOR THE ORIGEN2 COMPUTER CODE

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ABSTRACT

Reactor physics calculations have led to the development of nine liquid-metal fast breeder reactor (LMFBR) models for the ORIGEN2 computer code. Four of the models are based on the U-Pu fuel cycle, two are based on the Th-U-Pu fuel cycle, and three are based on the Th-^{233}U fuel cycle. The reactor models are based on cross sections taken directly from the reactor physics codes. Descriptions of the reactor models as well as values for the ORIGEN2 flux parameters THERM, RES, and FAST are given.

1. INTRODUCTION AND SUMMARY

1.1 Introduction

1.1.1 Background

The ORIGEN[1] computer code is a versatile tool used for calculating the buildup and depletion of isotopes in nuclear materials. This computer code was written in the late 1960s and early 1970s by the ORNL Chemical Technology Division. At that time, the required nuclear data libraries (half-lives, cross sections, fission product yields, etc.) and reactor models (PWR-U, PWR-Pu, LMFBR, HTGR, and MSBR) were also developed. The code was principally intended for use in generating spent fuel and waste characteristics (composition, thermal power, etc.) that would form the basis for the study and design of fuel reprocessing plants, spent fuel shipping casks, waste treatment and disposal facilities, and waste shipping casks. Since fuel cycle operations were being examined generically in order to accommodate a wide range of fuel characteristics, it was only necessary that the ORIGEN results be representative of this range. A satisfactory result was obtained by simply adjusting the resonance integrals of the major fissile and fertile species to obtain agreement with a spent fuel composition from an exogenous source.

Soon after the ORIGEN computer code was documented, it was made available to other users through the Radiation Shielding Information Center at ORNL. Because of the relative simplicity of ORIGEN and its convenient and detailed output, many organizations acquired it; some began using ORIGEN for applications that were more specific and that required greater precision in the calculated results than the generic fuel cycle studies for which the code was originally developed. (For example, environmental impact studies required relatively precise calculations of minor isotopes such as ^{3}H, ^{14}C, ^{232}U, and $^{242,244}Cm$.) In response to these requirements, attempts were made to update specific aspects of ORIGEN and its data bases;[2,3] however, inconsistencies and numerous data bases resulted from these efforts.

To remedy these problems, a concerted program was initiated in 1975 to update the ORIGEN computer code and its associated data bases and reactor models. This is one of several reports describing the various aspects of the ORIGEN update effort. Previously issued reports describe (1) a revised version of the ORIGEN computer code,[4,5] designated ORIGEN2, (2) updated decay and photon data libraries,[6] (3) updated U-Pu cycle PWR and BWR models,[7] and (4) alternative-fuel-cycle (thorium cycles and extended burnup) PWR models,[8] and CANDU reactor models.[9]

1.1.2 Scope

This report describes nine model LMFBRs. Eight of these are commercial designs based on the Prototype Large Breeder Reactor study[10] and the ninth is based on the currently operating FFTF reactor[11] in the Richland, Washington area. A characteristic description of the fuel cycles considered in these reactor models is given in Table 1.

Table 1. Fuel cycles considered for ORIGEN2 LMFBR models

Core fissile material	Fertile material: Core	Fertile material: Axial blanket	Fertile material: Radial blanket	Core burnup (GWd/MTHM)	MNEMONIC
LWR PuO_2	UO_2	UO_2	UO_2	100	AMOPUUUX
LWR PuO_2	UO_2	UO_2	UO_2	68	EMOPUUUX
Recycle PuO_2	UO_2	UO_2	UO_2	100	AMORUUUX
LWR PuO_2	UO_2	UO_2	ThO_2	100	AMOPUUTX
LWR PuO_2	ThO_2	ThO_2	ThO_2	100	AMOPTTTX
Recycle $^{233}UO_2$	ThO_2	ThO_2	ThO_2	100	AMOOTTTX
14% denatured $^{233}UO_2$	ThO_2	ThO_2	ThO_2	100	AMO1TTTX
40% denatured $^{233}UO_2$	ThO_2	ThO_2	ThO_2	100	AMO2TTTX
High-grade Pu	UO_2			45	FFTF

The fundamental objective of this work was to develop LMFBR models based on existing cross section data[12,13] rather than the arbitrary adjustment of cross sections that typified previous ORIGEN reactor models. The generation of the information required for these reactor models began with the gathering and initial processing of the existing cross section data into a library of 126 neutron energy groups that could be used by a modular system of reactor physics codes (AMPX)[14] at ORNL (Sect. 2). Two separate libraries were created: (1) a smaller one containing nuclides whose presence in the reactor would have the greatest effects on the neutron spectrum and depletion characteristics, and (2) a larger library containing many nuclides of interest in ORIGEN2 with negligible effects on the neutron spectrum and depletion. Only the smaller library was considered in the subsequent multigroup fuel-depletion calculations.

Following these initial steps, composition-dependent cross sections that accounted for spatial and energy self-shielding effects were generated for each of the commercial reactors (Sect. 3). The libraries resulting from this procedure contained nine neutron energy groups, which were then used in a diffusion-theory depletion code to predict the spent fuel composition and to supply some of the cross sections required by ORIGEN2. The 126-group cross sections were then collapsed to 1-group cross sections, using a typical neutron spectrum that was derived from the depletion calculation. Fission product yields were obtained by spectrum-weighting energy-dependent yields, using this same neutron spectrum. Additional calculations were then performed that yielded new values of the ORIGEN2 flux parameters — THERM, RES, AND FAST.

Finally, an investigation was undertaken to determine appropriate input parameters for the reactor models. The parameters investigated included the actinide and impurity composition of the fresh fuel and the structural material type and composition of a fuel assembly.

2. THE GENERATION OF THE MASTER, MULTIGROUP CROSS-SECTION DATA BASE

This section describes the sources of the unprocessed cross-section data used to develop the LMFBR models and the initial processing of these cross sections into an AMPX master cross-section library. The 126-energy-group library structure (of which two groups were in the thermal energy range) is shown in Appendix A.

Cross sections that were used for the ORIGEN2 LMFBR models were collected into two groups. Group 1 contains all fission product isotopes having cross-section data available for processing. Data for the group 1 nuclides (listed in Table 2) were obtained from ENDF/B-IV and are documented in ref. 15. These data were processed with the AMPX modules NPTXS and XLACS2.

Nuclides in group 2, initially divided into subgroups 2A and 2B, include the activation products, actinides, coolant, and structural materials considered in this work. Subgroup 2A consists of nuclides that are important in the reactor physics calculations. Most of the cross-section data for subgroup 2A was derived from ENDF/B-IV[12] and its processing[16,17] was accomplished with the MINX[18] computer code. Data for a few of the nuclides in this subgroup were obtained from a preliminary version of ENDF/B-V[13] and were processed into the master, multigroup format using the AMPX modules NPTXS and XLACS2 (or, in the case of ^{233}U, the NJOY[19] computer code). Data for the nuclides in subgroup 2A, which are summarized in Table 3, were used through the entire sequence of fuel depletion calculations.

Subgroup 2B contains nuclides for which data were obtained from ENDF/B-IV, through the processing sequence defined in refs. 16 and 17. Data for these nuclides (which include the light nuclides, such as ^{1}H, and the minor actinides, such as ^{233}Pa) were not used in the physics calculations for the LMFBR models, but were intended for subsequent weighting with a representative spectrum. However, during the course of this study the more complete cross-section data from ENDF/B-V became available, superseding the ENDF/B-IV data. As a result, multigroup cross-section data were calculated for all of the individual nuclides

Table 2. ORIGEN2 group 1 (fission-product) nuclides[a]

^{72}Ge	^{73}Ge	^{74}Ge	^{75}As	^{76}Ge	^{76}Se	^{77}Se	^{78}Se
^{79}Br	^{80}Se	^{80}Kr	^{81}Br	^{82}Se	^{82}Kr	^{83}Kr	^{84}Kr
^{85}Kr	^{85}Rb	^{86}Kr	^{86}Rb	^{86}Sr	^{87}Rb	^{87}Sr	^{88}Sr
^{89}Sr	^{89}Y	^{90}Sr	^{90}Y	^{90}Zr	^{91}Y	^{91}Zr	^{92}Zr
^{93}Zr	^{93}Nb	^{94}Zr	^{94}Nb	^{94}Mo	^{95}Zr	^{95}Nb	^{95}Mo
^{96}Zr	^{96}Mo	^{97}Mo	^{98}Mo	^{99}Mo	^{99}Tc	^{99}Ru	^{100}Mo
^{100}Ru	^{101}Ru	^{102}Ru	^{103}Ru	^{103}Rh	^{104}Ru	^{104}Pd	^{105}Ru
^{105}Rh	^{105}Pd	^{106}Ru	^{106}Pd	^{107}Pd	^{107}Ag	^{108}Pd	^{108}Cd
^{109}Ag	^{110}Pd	^{110}Cd	^{111}Ag	^{111}Cd	^{112}Cd	^{113}Cd	^{113}In
^{114}Cd	^{115m}Cd	^{115}In	^{115}Sn	^{116}Cd	^{116}Sn	^{117}Sn	^{118}Sn
^{119}Sn	^{120}Sn	^{121}Sb	^{122}Sn	^{122}Te	^{123}Sn	^{123}Sb	^{123}Te
^{124}Sn	^{124}Sb	^{124}Te	^{125}Sn	^{125}Sb	^{125}Te	^{126}Sn	^{126}Sb
^{126}Te	^{127m}Te	^{127}I	^{128}Te	^{128}Xe	^{129m}Te	^{129}I	^{129}Xe
^{130}Te	^{130}I	^{130}Xe	^{131}I	^{131}Xe	^{132}Te	^{132}Xe	^{133}Xe
^{133}Cs	^{134}Xe	^{134}Cs	^{134}Ba	^{135}I	^{135}Xe	^{135}Cs	^{135}Ba
^{136}Xe	^{136}Cs	^{136}Ba	^{137}Cs	^{137}Ba	^{138}Ba	^{139}La	^{140}Ba
^{140}La	^{140}Ce	^{141}Ce	^{141}Pr	^{142}Ce	^{142}Pr	^{142}Nd	^{143}Ce
^{143}Pr	^{143}Nd	^{144}Ce	^{144}Nd	^{145}Nd	^{146}Nd	^{147}Nd	^{147}Pm
^{147}Sm	^{148}Nd	^{148}Pm	^{148m}Pm	^{148}Sm	^{149}Pm	^{149}Sm	^{150}Nd
^{150}Sm	^{151}Pm	^{151}Sm	^{151}Eu	^{152}Sm	^{152}Eu	^{153}Sm	^{153}Eu
^{154}Sm	^{154}Eu	^{154}Gd	^{155}Eu	^{155}Gd	^{156}Eu	^{156}Gd	^{157}Eu
^{157}Gd	^{158}Gd	^{159}Tb	^{160}Gd	^{160}Tb	^{160}Dy	^{161}Dy	^{162}Dy
^{163}Dy	^{164}Dy	^{165}Ho	^{166}Er	^{167}Er			

[a]All cross sections are taken from ref. 12 and documented in ref. 15.

Table 3. ORIGEN2 subgroup 2A nuclides (included in reactor physics calculations)

Nuclide	Ref. Nos.	Nuclide	Ref. Nos.
^{16}O	12, 16, 17	^{238}Np	13
Na	12, 16, 17	^{238}Pu	12, 16, 17
Stainless steel	12, 16, 17	^{239}Pu	12, 16, 17
Control rod	12, 16, 17	^{240}Pu	12, 16, 17
Lumped fission product	12, 16, 17	^{241}Pu	12, 16, 17
^{232}Th	12, 16, 17	^{242}Pu	12, 16, 17
^{233}Pa	12, 16, 17	^{241}Am	13
^{233}U	13	^{242}Am	13
^{234}U	12, 16, 17	^{242m}Am	13
^{235}U	12, 16, 17	^{243}Am	13
^{236}U	12, 16, 17	^{242}Cm	13
^{238}U	12, 16, 17	^{243}Cm	13
^{237}Np	12, 16, 17	^{244}Cm	13

in group 2, and for some additional actinides, using ENDF/B-V as the data source. Cross sections for this new grouping of nuclides (designated as group 3 and listed in Table 4) were introduced into the sequence of reactor physics codes after the depletion calculation had been performed using the ENDF/B-IV cross sections. The collapse of these cross sections to 1-group values is discussed further in Sect. 3.1.4.

3. MULTIGROUP NEUTRON SPECTRUM AND DEPLETION CALCULATIONS

The 126-energy-group AMPX master cross-section library, described in Sect. 2 of this report, contains cross-section information of a general nature for solving LMFBR neutronics problems. This section describes the processing of this general multigroup library into problem-dependent, multigroup libraries used in the sophisticated reactor physics codes and then into a problem-dependent, 1-group library for use in ORIGEN2. Section 3.1 describes the approach used for the eight commercial LMFBR models, and Sect. 3.2 describes the somewhat simplified procedure used for the FFTF.

3.1 Spectrum and Depletion Calculations for ORIGEN2 Commercial LMFBR Models

3.1.1 Energy self-shielding

The first step in the sequence of calculations leading to the desired ORIGEN2 cross-section library is to account for the energy self-shielding effects in the resonances of various nuclides. In effect, the master library is transformed into a 126-energy group problem-dependent library via the BONAMI module of the AMPX system. This module accesses problem-independent master cross-section data that contain Bondarenko factors (from MINX), performs a resonance self-shielding calculation based on the iterative Bondarenko method,[20] and produces problem-dependent master cross-section data. A BONAMI calculation is performed for each of the five zones (i.e., inner core, outer core, inner axial blanket, outer axial blanket, and radial blanket) in each of the eight commercial LMFBR models considered in this work. The input to this calculation includes a simplified system geometry and approximate composition for each zone.

Table 4. ORIGEN2 group 3 nuclides (non-fission-product and ENDF/B-V Nuclides)[a]

^{1}H	^{234}U	^{242m}Am
^{10}B	^{235}U	^{243}Am
^{11}B	^{236}U	^{241}Cm
^{12}C	^{237}U	^{242}Cm
^{14}N	^{238}U	^{243}Cm
^{15}N	^{237}Np	^{244}Cm
^{16}O	^{238}Np	^{245}Cm
^{17}O	^{236}Pu	^{246}Cm
^{23}Na	^{238}Pu	^{247}Cm
^{55}Mn	^{239}Pu	^{248}Cm
^{59}Co	^{240}Pu	^{249}Bk
^{230}Th	^{241}Pu	^{249}Cf
^{232}Th	^{242}Pu	^{250}Cf
^{231}Pa	^{243}Pu	^{251}Cf
^{233}Pa	^{244}Pu	^{252}Cf
^{232}U	^{241}Am	^{253}Cf
^{233}U	^{242}Am	^{253}Es

[a]All data from ref. 13.

3.1.2 Spatial self-shielding and collapse to a few groups

The five 126-energy-group, problem-dependent libraries from the BONAMI code are then employed in one-dimensional calculations using the XSDRNPM module of the AMPX system. The purpose of this calculation is (1) to account for the spatial self-shielding effects in each of the zones and (2) to collapse the cross-section library from 126 energy groups to a 9-energy-group structure that will be used in subsequent depletion calculations. Three XSDRNPM calculations are required: one in the radial direction along the core midplane and two in the axial direction (one for the inner core/axial blanket and one for the outer core/axial blanket). The radial calculation is performed using cylindrical geometry with outer radii as follows: inner core, 101.6 cm; outer core, 142.0 cm; radial blanket, 180.6 cm; radial shield, 195.0 cm. The axial calculations are performed using slab geometry with distances from the core midplane as follows: core, 53.9 cm; axial blanket, 87.2 cm; axial shield, 100.0 cm. Other input data required include the approximate composition of each zone, based on prior experience. A 9-energy-group cross-section library, containing all of the nuclides in Table 3, is output for each zone of each reactor.

3.1.3 Fuel depletion calculation

The fuel depletion calculation was performed with the CITATION[21] computer code, using a two-dimensional R-Z geometry model and the 9-energy-group cross sections from the previous step. Each CITATION calculation was begun with approximate compositions and was continued until equilibrium discharge concentrations were reached. The middle-of-cycle equilibrium compositions were then volume-averaged over the CITATION model zones for use in XSDRNPM. Also produced in this step were burnup-dependent cross sections for some of the major actinides in Table 3.

3.1.4 Determination of neutron-spectrum-averaged parameters

The final step is to use a characteristic neutron energy spectrum as a weighting function to yield average parameters for use in ORIGEN2. This is done by calculating a 126-energy-group neutron spectrum for each zone of the reactor using the XSDRNPM module of AMPX and the exact equilibrium fuel composition from the previous step. The resulting neutron spectra, which are determined using the ENDF/B-V cross sections in Table 4, are used to collapse the 126-energy-group cross sections in Tables 2 and 4 to 1-energy-group cross sections that can be used directly in ORIGEN2. The spectra are also used to collapse energy-dependent fission product yields from ENDF/B-IV[12] to give average yields that can be used in ORIGEN2. Finally, the spectra are cast into two 2-energy-group structures which yield values for the ORIGEN2 flux parameters THERM, RES, and FAST when the methods described in ref. 4 are applied.

3.2 Spectrum Calculation for the FFTF

Because the FFTF is a test reactor rather than a commercial power reactor, it has several unusual properties:

1. It has no axial or radial blankets.
2. It has many test positions, as well as loops that can contain a wide variety of materials that are unknowable at the present time.
3. The fissile and/or fertile materials in the reactor (currently high-grade plutonium in UO_2) may be changed to other materials in the future.
4. The fuel management and longevity in the reactor are subject to change, depending on performance and other requirements.

These considerations make it very difficult to do a generic depletion calculation; its value is vanishingly small, since the variability in items 2-4 above can change the neutron spectrum drastically. The lack of blankets also eliminates much of the value of the depletion calculation. Therefore, the approach taken here was to perform the energy-self-shielding calculations as described previously (i.e., using BONAMI) and then to use XSDRNPM to (1) account for the spatial self-shielding effects, (2) calculate the characteristic 126-energy-group neutron spectrum, (3) calculate effective, 1-energy-group cross sections for ORIGEN2, and (4) calculate the ORIGEN2 flux parameters. The depletion calculation using CITATION was not performed for the FFTF.

3.3 Summary of Relevant Calculated Results

The relevant results of the foregoing sophisticated reactor physics calculations are summarized below.

3.3.1 Characteristic 126-energy-group neutron spectra

A listing of the energy-group structures and the neutron spectra is given in Appendix A for all reactors considered. A graphical representation is also given in Appendix A for the core, axial blanket, and radial blanket regions of the AMOPUUUX and AMO2TTTX, and for the core of the FFTF.

3.3.2 1-energy-group, effective cross sections

The collapse of the multigroup cross sections for the nuclides in Tables 2 and 4, using the 126-energy-group neutron spectrum as a weighting function, yielded 1-group, effective cross sections for these nuclides. A listing of these 1-group cross sections for the core, axial blanket, and radial blanket regions of the AMOPUUUX and the AMO2TTTX, and for the FFTF core is given in Appendix B.

3.3.3 Burnup-dependent cross sections for major actinides

The depletion calculations performed with CITATION yielded the 1-energy-group, effective cross sections (from ENDF/B-IV) for about a dozen actinides (depending on the reactor) at several different sequential burnups during fuel irradiation. These are output and are incorporated into ORIGEN2 to improve the accuracy of the actinide buildup and depletion calculation. Tables containing these burnup-dependent cross sections for the core, axial blanket, and radial blanket of the AMOPUUUX and the AMO2TTTX and for the core of the FFTF are given in Appendix C.

3.3.4 ORIGEN2 flux parameters THERM, RES, and FAST

The XSDRNPM module of AMPX is used to perform two 2-energy-group calculations for each region of each reactor. When properly manipulated, these yield the ORIGEN2 flux parameters THERM, RES, and FAST. A list of these parameters for the nine LMFBRs considered in this work is given in Table 5.

4. DESCRIPTION OF REACTOR MODELS

This section summarizes the input and output information for the nine LMFBR models that comprise this work. Specifically, the following four aspects of the models are addressed:

1. a description of the fuel assemblies, including the composition of structural materials,
2. the composition of the oxide fuel in each region of each reactor,
3. a summary description of each reactor, and
4. the composition of the discharged fuel from selected regions and reactors.

4.1 LMFBR Fuel Assembly Description and Composition

The eight commercial LMFBRs considered in this work have the same fuel assembly design, although the designs of the radial blanket assembly and the core/axial blanket assembly within each reactor are different (the radial blanket assembly has fewer fuel elements, with a larger diameter). The FFTF assembly design differs from that of the commercial reactors and, of course, has no blankets. A physical description of these assemblies is given in Table 6.

Table 5. ORIGEN2 flux parameters for LMFBR models

Reactor MNEMONIC[a]	Reactor region	THERM	RES	FAST	Neutron flux (neutrons cm^{-2} sec^{-1})
AMOPUUUX	Core	2.888E-11	1.533E-03	0.1508	5.11E + 15
	Ax.Blan.	3.126E-08	2.253E-03	0.0702	1.33E + 15
	Rad.Blan.	6.647E-08	2.328E-03	0.0866	7.27E + 14
EMOPUUUX	Core	3.924E-11	1.615E-03	0.1444	5.37E + 15
	Ax.Blan.	3.287E-08	2.601E-03	0.0681	1.39E + 15
	Rad.Blan.	6.903E-08	2.383E-03	0.0848	6.81E + 14
AMORUUUX	Core	2.679E-11	1.543E-03	0.1481	5.15E + 15
	Ax.Blan.	3.315E-08	2.569E-03	0.0687	1.37E + 15
	Rad.Blan.	8.222E-08	2.335E-03	0.0855	7.17E + 14
AMOPUUTX	Core	8.746E-11	1.577E-03	0.1459	5.25E + 15
	Ax.Blan.	3.242E-08	2.532E-03	0.0688	1.36E + 15
	Rad.Blan.	1.099E-06	2.479E-03	0.0693	1.17E + 15
AMOPTTTX	Core	2.847E-11	1.521E-03	0.1406	6.51E + 15
	Ax.Blan.	5.413E-08	2.456E-03	0.0646	2.28E + 15
	Rad.Blan.	3.524E-07	2.325E-03	0.0759	1.22E + 15
AMOOTTTX	Core	1.168E-10	1.272E-03	0.1705	4.01E + 15
	Ax.Blan.	4.674E-08	2.264E-03	0.0711	1.03E + 15
	Rad.Blan.	4.362E-07	2.157E-03	0.0809	5.10E + 14
AMO1TTTX	Core	9.134E-11	1.448E-03	0.1546	4.59E + 15
	Ax.Blan.	4.630E-08	2.369E-03	0.0703	1.19E + 15
	Rad.Blan.	4.581E-07	2.267E-03	0.0764	5.73E + 15
AMO2TTTX	Core	1.044E-10	1.266E-03	0.1706	4.17E + 15
	Ax.Blan.	4.978E-08	2.311E-03	0.0687	1.07E + 15
	Rad.Blan.	4.185E-07	2.131E-03	0.0815	5.42E + 15
FFTF	Core	7.301E-11	1.300E-03	0.1737	5.00E + 15

[a]See Table 1 of this document for a description.

Table 6. Physical characteristics of LMFBR fuel assemblies

	Commercial LMFBR[a]		
	Core/axial blanket	Radial blanket	FFTF[b]
Assembly component lengths, cm			
Upper end hardware	91	91	30
Gas plenum	191	191	107
Upper axial blanket	33		17[c]
Core or radial blanket	122	188	91
Lower axial blanket	33		27[c]
Lower end hardware	102	102	94
Overall total	572	572	366
Fuel element total	379	379	242
Assembly shape	hexagonal	hexagonal	hexagonal
Assembly flats, cm	13.78	13.78	11.62
Fuel element arrangement	triangular	triangular	triangular
Fuel elements per assembly	271	91	217
Fuel element OD, cm	0.650	1.270	0.584
Fuel pellet OD, cm	0.573	1.180	0.508
Fuel element pitch, cm	0.795	1.369	0.726
Cladding thickness, cm	0.030	0.038	0.038
Channel thickness, cm	0.221	0.221	0.305
Channel height, cm	495	495	~300
Circumscribed volume/assembly, m^3	0.114	0.114	0.052
Heavy metal/assembly, kg	117.7	172.7	33.2
MO_2 assembly, kg[d]	133.4	195.9	37.6
Stainless steel/assembly, kg	115.1	97.5	125.7
Inconel 600/assembly, kg			8.9
Assembly total weight, kg	257.7	300.3	172.2

[a]Based on data in ref. 10.

[b]Based on data in refs. 11 and 22.

[c]UO_2 insulator pellet and Inconel 600 reflector.

[d]$(Pu,U)O_2$ in the core/axial blanket and UO_2 in the radial blanket.

Virtually the entire construction of all of the fuel assemblies is stainless steel 316, with the exception of the FFTF assembly, which contains some Inconel 600. The compositions of these metals, including the anticipated trace impurities, are given in Table 7.

4.2 LMFBR Fuel Composition

The LMFBR fuel pellets contain two groups of elements: the actinides and the nonactinides, which include oxygen and impurities. The initial actinide compositions of the LMFBR core fuels are given in Table 8. These fuel compositions are based on the CITATION calculations described in Sect. 3. The initial composition of the FFTF fuel is based on data in refs. 11, 26, and 27.

The initial actinide compositions of the fuel blankets is as follows: uranium blankets — 2000 g ^{235}U/MTIHM and 998,000 g ^{238}U/MTIHM; thorium blankets — 100 g ^{230}Th/MTIHM and 999,900 g ^{232}Th/MTIHM. The ^{230}Th in the thorium blankets is an important precursor of ^{232}U, which is the parent of a highly gamma-active decay chain.

The assumed nonactinide composition of the oxide reactor fuels is given in Table 9. Since specific data are not yet available for the fuels considered in this work, the values in Table 9 are the same as those for light water reactor (LWR) oxide fuels.

4.3 Summary Description of the ORIGEN2 LMFBR Models

Fuel depletion calculations were performed for the nine LMFBRs considered in this work with ORIGEN2, using the input compositions given in Sects. 4.1 and 4.2. Results of these calculations, including irradiation conditions and measurements of the uranium, plutonium, and thorium contents of the fresh and spent fuels, are presented in Tables 10-18. All values have been normalized so that the total reactor power is 3956 MW(t). This corresponds to a net electrical power of 1250 MW(e), using the 31.6% thermal efficiency given in ref. 10. These tables can be readily applied to more advanced designs involving higher thermal efficiencies (assuming the fuel assembly design remains unchanged) by simply

Table 7. Typical compositions of stainless steel 316 and Inconel 600

Element	Atomic number	Amount, $g/10^6$ g metal: Stainless steel 316[a]	Amount, $g/10^6$ g metal: Inconel 600[b]
B	5	5	5
C	6	610	400
N	7	320	45
Al	13	165	0
Si	14	5,700	2,000
P	15	204	0
S	16	150	70
Ti	22	150	0
Cr	24	170,500	158,000
Mn	25	18,500	2,000
Fe	26	643,726	72,000
Co	27	150	500
Ni	28	135,500	763,870
Cu	29	900	1,000
Nb	41	100	100
Mo	42	23,400	0
Sn	50	40	0
Pb	82	30	0
Density, g/cm^3		8.02	8.33

[a]Data from ref. 23.

[b]Data from refs. 24 and 25.

Table 8. Heavy metal composition of 1000 kg of LMFBR core fuel

	Reactor type[a]										
									FFTF[b]		
	AMOPUUUX	EMOPUUUX	AMORUUUX	AMOPUUTX	AMOPTTTX	AMOOTTTX	AMO1TTTX	AMO2TTTX	Inner core	Outer core	Weighted average
^{230}Th, g					81	79		60			
^{232}Th, g					809,377	793,036		603,293			
Total thorium, g					809,458	793,115		603,353			
^{232}U, g						402	315	375			
^{233}U, g						172,227	134,816	160,665			
^{234}U, g						29,800	23,323	27,795	43	40	41
^{235}U, g	1,676	2,054	1,674	1,675		4,455	3,492	4,161	5,503	5,142	5,283
^{236}U, g						1	1	1			
^{238}U, g	813,656	831,650	821,912	821,470			838,053	203,650	769,523	719,044	738,827
Total uranium, g	815,332	833,704	823,586	823,145		206,885	1,000,000	396,647	775,069	724,226	744,151
^{236}Pu, g	0.023	0.021	0.0029	0.022	0.024				0.003	0.074	0.004
^{238}Pu, g	2,586	2,317	324	2,476	2,668				337	413	383
^{239}Pu, g	101,567	91,159	128,592	97,275	104,803				192,407	235,787	218,787
^{240}Pu, g	46,738	41,944	39,793	44,755	48,218				25,777	31,715	29,388
^{241}Pu, g	24,557	22,593	5,209	23,511	25,331				5,623	6,894	6,396
^{242}Pu, g	9,220	8,283	2,496	8,838	9,522				787	965	895
Total plutonium, g	184,668	166,296	176,414	176,855	190,542				224,931	275,774	255,849
Total heavy metal, g	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000

[a]See Table 1 of this document for mnemonic identification.

[b]Fuel should be decayed from 1/71 before irradiation.

Table 9. Assumed nonactinide composition of LMFBR oxide fuels[a]

Element	Atomic number	Concentration (g/MTIHM)[b]	Element	Atomic number	Concentration (g/MTIHM)[a]
Li	3	1.0	Mn	25	1.7
B	5	1.0	Fe	26	18.0
C	6	89.4	Co	27	1.0
N	7	25.0	Ni	28	24.0
O	8	134,454[c]	Cu	29	1.0
F	9	10.7	Zn	30	40.3
Na	11	15.0	Mo	42	10.0
Mg	12	2.0	Ag	47	0.1
Al	13	16.7	Cd	48	25.0
Si	14	12.1	In	49	2.0
P	15	35.0	Sn	50	4.0
Cl	17	5.3	Gd	64	2.5
Ca	20	2.0	W	74	2.0
Ti	22	1.0	Pb	82	1.0
V	23	3.0	Bi	83	0.4
Cr	24	4.0			

[a]Data obtained from refs. 28 to 32.

[b]Parts of element per million parts of heavy metal.

[c]Stoichiometric quantity for $(Pu,U)O_2$ fuel; use 137,931 g/MTIHM for thorium-based fuels.

Table 10. Summary characteristics for an AMOPUUUX[a]

Parameter	Fuel region(s)[b]				
	CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1154	34	62	1188	1250
Thermal power, MW(t)	3652	108	197	3760	3957
Average specific power,[c] MW(t)/MTIHM	123.25	6.89	3.59	83.10	39.56
Average fuel burnup, MWd/MTIHM	101,289	5660	5900	68,280	44,758
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	16.5	10.4	18.2	26.9	45.1
Total uranium	8052	5207	9130	13,259	22,389
Fissile plutonium[e]	1246	0	0	1246	1246
Total plutonium	1824	0	0	1824	1824
Total (Th + U + Pu)	9876	5207	9130	15,083	24,213
Discharge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	6.9	7.6	13.2	14.5	27.7
Total uranium	7125	5010	8776	12,135	20,911
Fissile plutonium[e]	1102	160	287	1262	1549
Total plutonium	1695	167	298	1862	2160
Total (Th + U + Pu)	8820	5177	9074	13,997	23,071

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB = axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 11. Summary characteristics for an EMOPUUUX[a]

Parameter	Fuel region(s)[b] CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1165	30	55	1195	1250
Thermal power, MW(t)	3689	94	173	3783	3956
Average specific power,[c] MW(t)/MTIHM	124.1	6.03	3.15	83.37	39.46
Average fuel burnup, MWd/MTIHM	67,992	3300	5180	45,677	34,041
Irradiation duration, full-power days	547.9	547.9	1643.6	547.9	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	30.6	15.6	18.3	46.2	64.5
Total uranium	12,386	7826	9147	20,212	29,359
Fissile plutonium[e]	1694	0	0	1694	1694
Total plutonium	2476	0	0	2476	2476
Total (Th + U + Pu)	14,862	7826	9147	22,688	31,835
Discharge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	16.3	12.5	13.6	28.8	42.4
Total uranium	11,358	7615	8820	18,973	27,793
Fissile plutonium[e]	1628	179	267	1807	2074
Total plutonium	2433	183	277	2616	2893
Total (Th + U + Pu)	13,791	7798	9097	21,589	30,686

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB = axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 12. Summary characteristics for an AMORUUUX[a]

Parameter	Fuel region(s)[b]				
	CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1154	35	61	1189	1250
Thermal power, MW(t)	3652	112	192	3764	3956
Average specific power,[c] MW(t)/MTIHM	123.25	7.18	3.51	83.21	39.57
Average fuel burnup, MWd/MTIHM	101,289	5900	5770	68,385	44,783
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	16.5	10.4	18.2	26.9	45.1
Total uranium	8133	5202	9122	13,335	22,457
Fissile plutonium[e]	1321	0	0	1321	1321
Total plutonium	1743	0	0	1743	1743
Total (Th + U + Pu)	9876	5202	9122	15,078	24,200
Discharge, kg/refueling cycle					
Thorium	0	0	0	0	0
Fissile uranium[d]	6.8	7.5	13.2	14.3	27.5
Total uranium	7194	4999	8772	12,193	20,965
Fissile plutonium[e]	1158	164	284	1322	1606
Total plutonium	1648	171	295	1819	2114
Total (Th + U + Pu)	8842	5170	9067	14,012	23,079

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB + axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 13. Summary characteristics for an AMOPUUTX[a]

Parameter	Fuel region(s)[b]				
	CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1144	33	73	1177	1250
Thermal power, MW(t)	3620	105	231	3725	3956
Average specific power,[c] MW(t)/MTIHM	122.52	6.75	4.43	82.53	40.71
Average fuel burnup, MWd/MTIHM	100,689	5550	7280	67,825	45,693
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	0	0	8670	0	8670
Fissile uranium[d]	16.5	10.4	0	26.9	26.9
Total uranium	8108	5198	0	13,306	13,306
Fissile plutonium[e]	1190	0	0	1190	1190
Total plutonium	1742	0	0	1742	1742
Total (Th + U + Pu)	9850	5198	8670	15,048	23,718
Discharge, kg/refueling cycle					
Thorium	0	0	8301	0	8301
Fissile uranium[d]	6.7	7.7	296	14.4	310
Total uranium	7154	5010	304	12,164	12,468
Fissile plutonium[e]	1079	154	0	1233	1233
Total plutonium	1652	161	0	1813	1813
Total (Th + U + Pu)	8841	5171	8606	14,012	22,618

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB = axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 14. Summary characteristics for an AMOPTTTX[a]

Parameter	Fuel region(s)[b] CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1145	34	71	1179	1250
Thermal power, MW(t)	3624	107	225	3731	3956
Average specific power,[c] MW(t)/MTIHM	129.55	7.28	4.37	87.38	41.97
Average fuel burnup, MWd/MTIHM	106,467	5980	7180	71,806	47,478
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	7547	4909	8592	12,456	21,048
Fissile uranium[d]	0	0	0	0	0
Total uranium	0	0	0	0	0
Fissile plutonium[e]	1213	0	0	1213	1213
Total plutonium	1776	0	0	1776	1776
Total (Th + U + Pu)	932.3	4909	8592	14,232	22,824
Discharge, kg/refueling cycle					
Thorium	6795	4729	8237	11,524	19,761
Fissile uranium[d]	414	148	283	562	845
Total uranium	479	153	291	632	923
Fissile plutonium[e]	535	0	0	535	535
Total plutonium	1021	0	0	1021	1021
Total (Th + U + Pu)	8319	4882	8529	13,201	21,730

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB = axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 15. Summary characteristics for an AMOOTTTX[a]

Parameter	Fuel region(s)[b]				
	CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1194	20	36	1214	1250
Thermal power, MW(t)	3780	62	114	3842	3956
Average specific power,[c] MW(t)/MTIHM	135.28	4.15	2.18	89.57	41.51
Average fuel burnup, MWd/MTIHM	111,176	3410	3583	73,608	47,049
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	7386	4984	8736	12,370	21,106
Fissile uranium[d]	1645	0	0	1645	1645
Total uranium	1927	0	0	1927	1927
Fissile plutonium[e]	0	0	0	0	0
Total plutonium	0	0	0	0	0
Total (Th + U + Pu)	9313	4984	8736	14,297	23,033
Discharge, kg/refueling cycle					
Thorium	6706	4829	8456	11,535	19,991
Fissile uranium[d]	1226	136	242	1362	1604
Total uranium	1537	138	246	1675	1921
Fissile plutonium[e]	0	0	0	0	0
Total plutonium	0	0	0	0	0
Total (Th + U + Pu)	8246	4968	8702	13,214	21,916

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB + axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 16. Summary characteristics for an AM01TTTX[a]

Parameter	Fuel region(s)[b] CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1168	38	44	1206	1250
Thermal power, MW(t)	3698	119	139	3817	3956
Average specific power,[c] MW(t)/MTIHM	125.38	7.64	2.54	84.65	39.65
Average fuel burnup, MWd/MTIHM	103,040	6270	4175	69,566	44,880
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	0	5199	9115	5199	14,314
Fissile uranium[d]	1360	0	0	1360	1360
Total uranium	9831	0	0	9831	9831
Fissile plutonium[e]	0	0	0	0	0
Total plutonium	0	0	0	0	0
Total (Th + U + Pu)	9831	5199	9115	15,030	24,145
Discharge, kg/refueling cycle					
Thorium	0	4945	8806	4945	13,751
Fissile uranium[d]	575	220	265	795	1060
Total uranium	8270	224	270	8494	8767
Fissile plutonium[e]	478	0	0	478	478
Total plutonium	512	0	0	512	512
Total (Th + U + Pu)	8785	5169	9077	13,954	23,031

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB + axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 17. Summary characteristics for an AM02TTTX[a]

Parameter	Fuel region(s)[b] CO	AB	RB	CO + AB	CO + AB + RB
Electric power, MW(e)	1191	20	39	1211	1250
Thermal power, MW(t)	3768	64	124	3832	3956
Average specific power,[c] MW(t)/MTIHM	131.60	4.26	2.36	87.95	41.23
Average fuel burnup, MWd/MTIHM	108,151	3500	3879	72,278	46,603
Irradiation duration, full-power days	821.8	821.8	1643.6	821.8	
Refueling cycle length, full-power days	273.9	273.9	273.9	273.9	273.9
Charge, kg/refueling cycle					
Thorium	5760	4979	8729	10,739	19,468
Fissile uranium[d]	1573	0	0	1573	1573
Total uranium	3786	0	0	3786	3786
Fissile plutonium[e]	0	0	0	0	0
Total plutonium	0	0	0	0	0
Total (Th + U + Pu)	9546	4979	8729	14,525	23,254
Discharge, kg/refueling cycle					
Thorium	5218	4827	8446	10,045	18,491
Fissile uranium[d]	1083	134	244	1217	1461
Total uranium	3149	136	249	3285	3534
Fissile plutonium[e]	106	0	0	106	106
Total plutonium	113	0	0	113	113
Total (Th + U + Pu)	8482	4963	8695	13,445	22,140

[a]See Table 1 for mnemonic definition.

[b]CO = core, AB + axial blanket, RB = radial blanket.

[c]Based on full power and fuel charged.

[d]$^{233}U + ^{235}U + ^{233}Pa$.

[e]$^{239}Pu + ^{241}Pu + ^{239}Np$.

Table 18. Summary characteristics for an FFTF[a]

Parameter	Fuel region(s): Inner core	Outer core	Total
Electric power, MW(e)	0	0	0
Thermal power, MW(t)	138	214	352
Average specific power,[b] MW(t)/MTIHM	143	143	143
Average fuel burnup, MWd/MTIHM	45,000	45,000	45,000
Irradiation duration, full-power days	315	315	315
Refueling cycle length, full-power days	105	105	105
Charge, kg/refueling cycle			
Thorium	0	0	0
Fissile uranium[c]	1.8	2.6	4.4
Total uranium	249	361	610
Fissile plutonium[d]	64	121	185
Total plutonium	72	137	209
Total (Th + U + Pu)	321	498	819
Discharge, kg/refueling cycle			
Thorium			0
Fissile uranium[c]			3.5
Total uranium			587
Fissile plutonium[d]			163
Total plutonium			193
Total (Th + U + Pu)			780

[a]See Table 1 for mnemonic definition.

[b]Based on full power and fuel charged.

[c]$^{233}U + ^{235}U + ^{233}Pa$.

[d]$^{239}Pu + ^{241}Pu + ^{239}Np$.

increasing the amount of electricity produced to a value greater than the 3956 MW(t) that forms the basis of the reactor models. Thus, the fuel being charged and discharged to the reactor and its irradiation conditions would be essentially unchanged, but increased temperatures would allow more electricity to be produced from the fuel.

4.4 Discharge Compositions of Selected LMFBR Fuels

The actinide discharge composition of the three U-Pu cycle commercial LMFBR core fuels and the average FFTF fuel are given in Table 19. The effect of recycling plutonium in the LMFBR may be seen by comparison of the AMOPUUUX and AMORUUUX discharge compositions, which indicate that the production of the heavier plutonium and transplutonium nuclides is substantially reduced in the latter. The discharge compositions for all of the blankets are somewhat similar.

The discharge compositions for typical U-Pu cycle axial and radial blankets, as represented by the AMOPUUUX, are given in Table 20.

Table 19. Discharge fuel composition for 1000 kg (one tonne) of selected core fuels[a]

Nuclide	Discharge fuel composition (g/MTIHM)			
	AMOPUUUX[b]	AMORUUUX[b]	EMOPUUUX[b]	FFTF average
^{235}U	696	692	1096	4277
^{236}U	210	208	210	251
^{238}U	720,400	727,400	762,800	712,000
Total uranium	721,400	728,400	764,200	716,600
^{237}Np	389	382	293	209
^{238}Pu	1553	308	1538	407
^{239}Pu (+ ^{239}Np)	98,748	110,929	95,811	194,843
^{240}Pu	49,410	46,970	44,420	34,600
^{241}Pu	12,840	6374	13,760	4170
^{242}Pu	9335	2696	8569	1027
Total plutonium	171,886	167,277	164,098	235,047
^{241}Am	1304	450	974	2159
^{243}Am	1511	409	1052	35.4
^{242}Cm	127	40	84	120
^{244}Cm	248	67	134	1.43
Total heavy metal	896,900	897,000	930,800	954,200
Burnup, GWd/MTIHM	100	100	68	45

[a]See Table 8 for initial compositions.

[b]See Table 1 for mnemonic definitions.

Table 20. Charge and discharge composition of AMOPUUUX[a] blankets

Nuclide	Charge composition (g/MTIHM)	Discharge composition (g/MTIHM)	
		Axial blanket	Radial blanket
^{235}U	2000	1460	1446
^{236}U		134	139
^{238}U	998,000	960,500	959,600
Total uranium	1,000,000	962,100	961,200
^{237}Np		68.8	86.9
^{238}Pu		8.0	9.4
^{239}Pu (+ ^{239}Np)		30,782	31,404
^{240}Pu		1336	1347
^{241}Pu		35.7	36.6
^{242}Pu		0.6	0.7
Total plutonium		32,162	32,798
^{241}Am		0.98	1.1
^{243}Am		0.012	0.013
^{242}Cm		0.02	0.03
^{244}Cm		0.00037	0.00044
Total heavy metal	1,000,000	994,300	994,100
Burnup, GWd/MTIHM	0	5.7	5.9

[a]See Table 1 for mnemonic definition.

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APPENDIX A:

126-ENERGY-GROUP NEUTRON SPECTRA GRAPHS AND LISTINGS

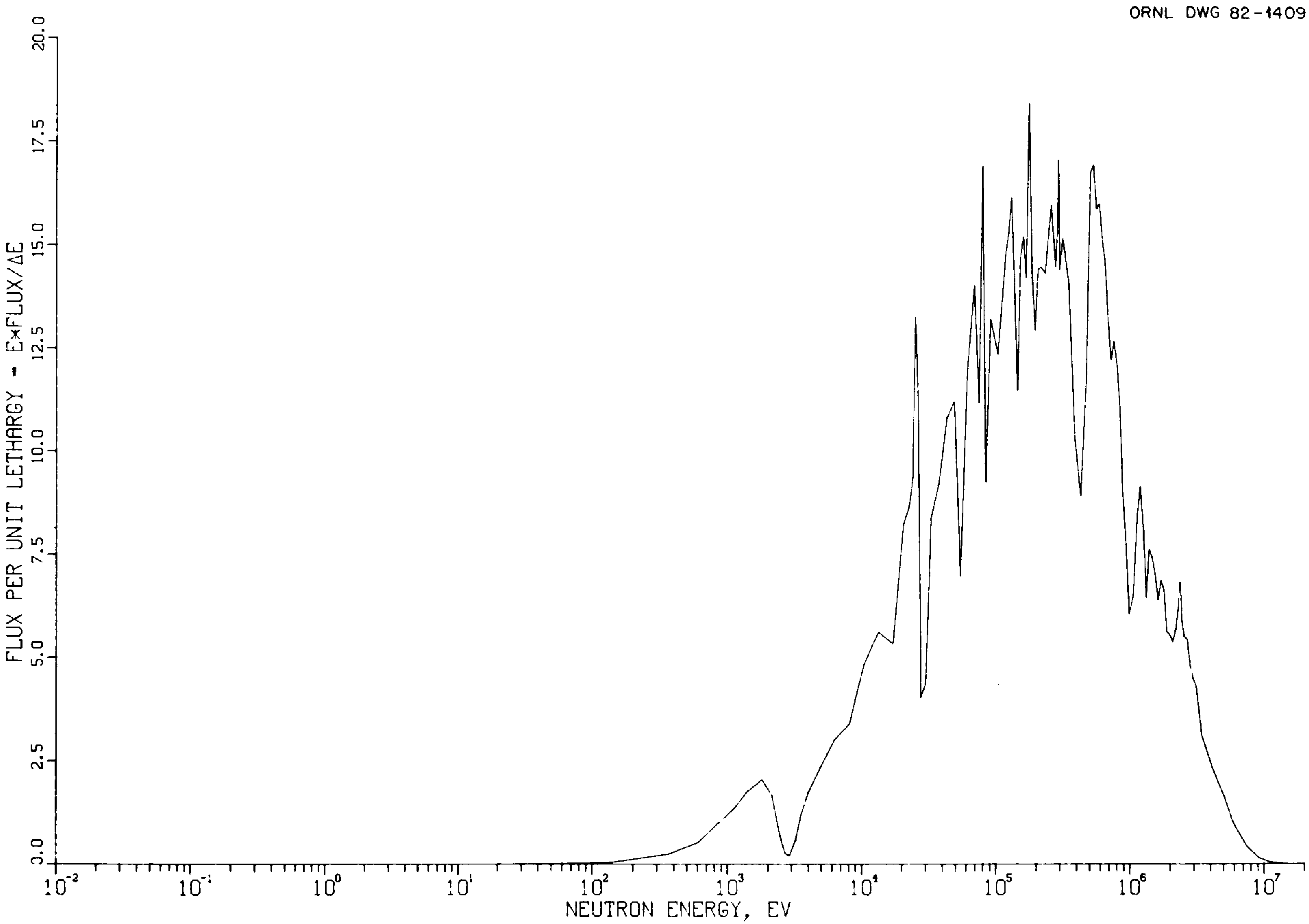

Fig. A.1. Neutron energy spectrum in AMOPUUUX core fuel.

ORNL DWG 82-1407

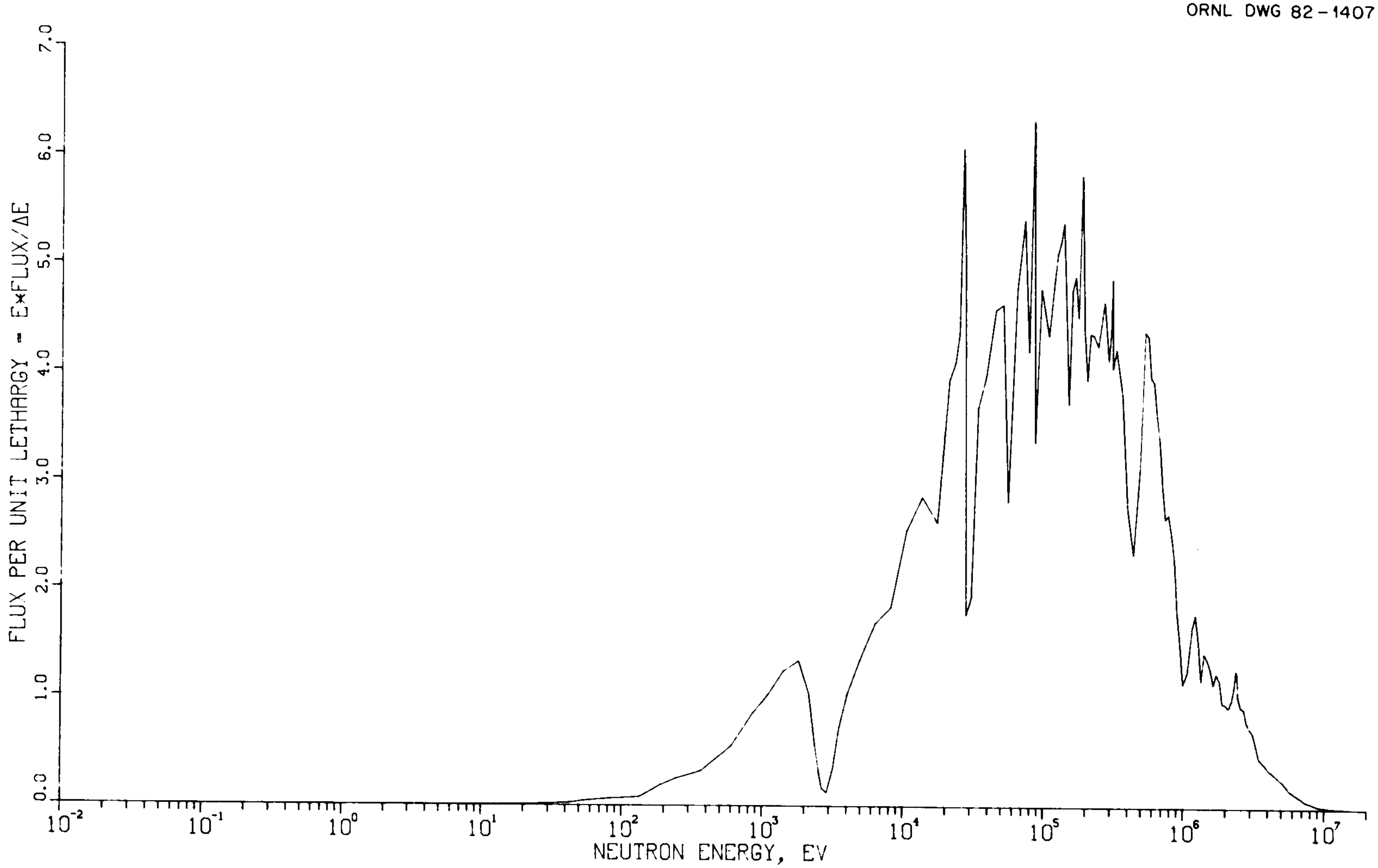

Fig. A.2. Neutron energy spectrum in AMOPUUUX axial blanket fuel.

ORNL DWG 82-1408

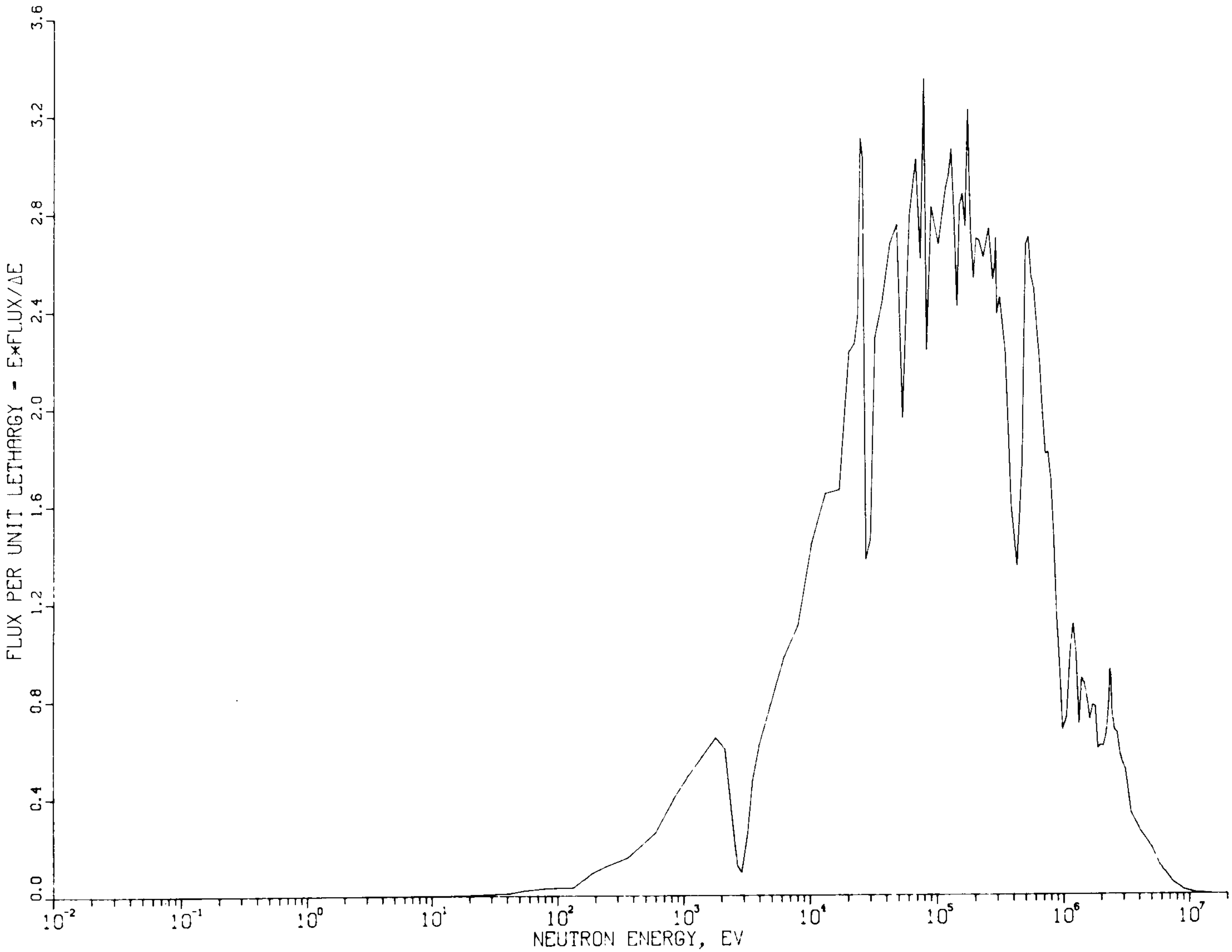

Fig. A.3. Neutron energy spectrum in AMOPUUUX radial blanket fuel.

ORNL DWG 82-1413

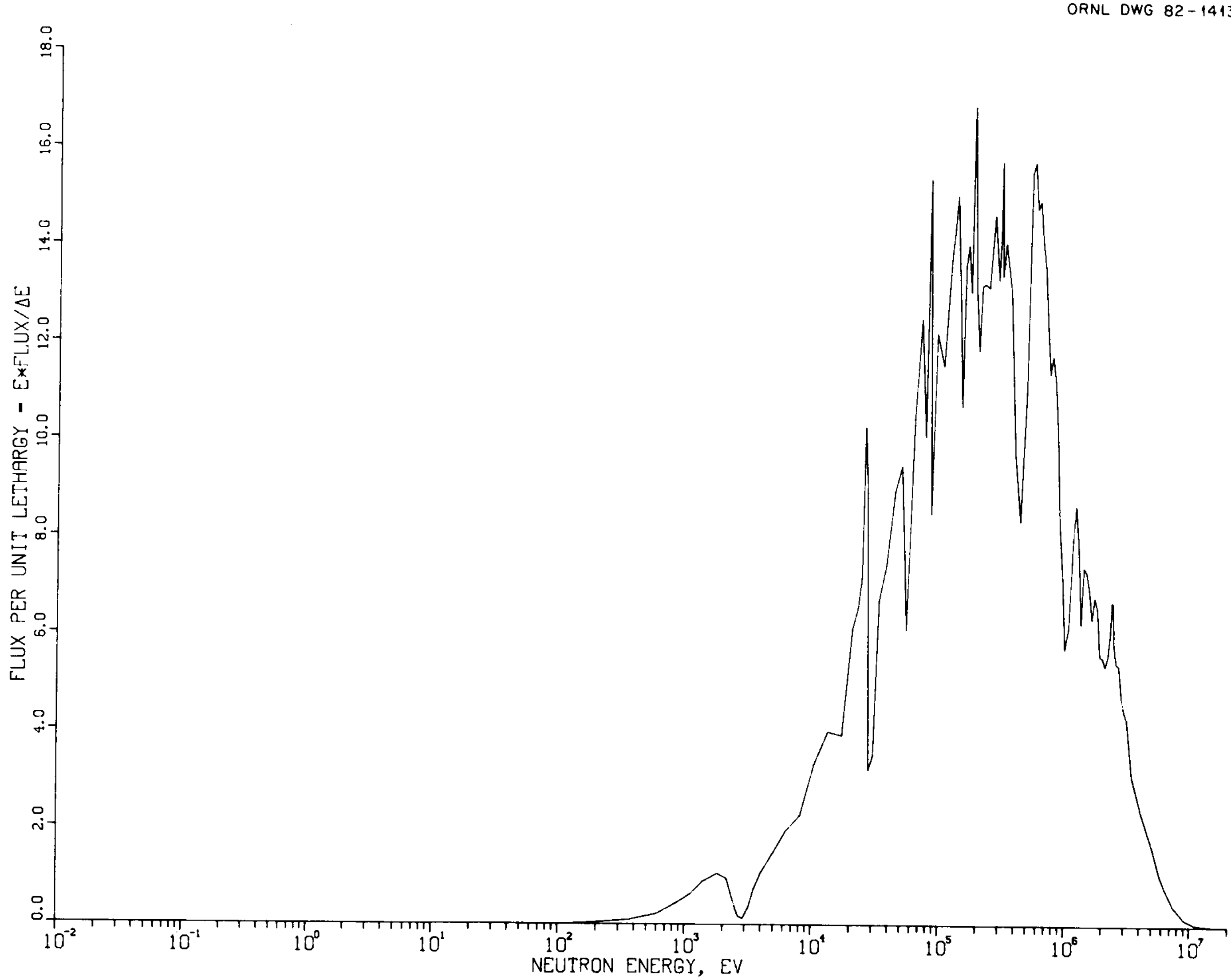

Fig. A.4. Neutron energy spectrum in AMO2TTTX core fuel.

ORNL DWG 82-1415

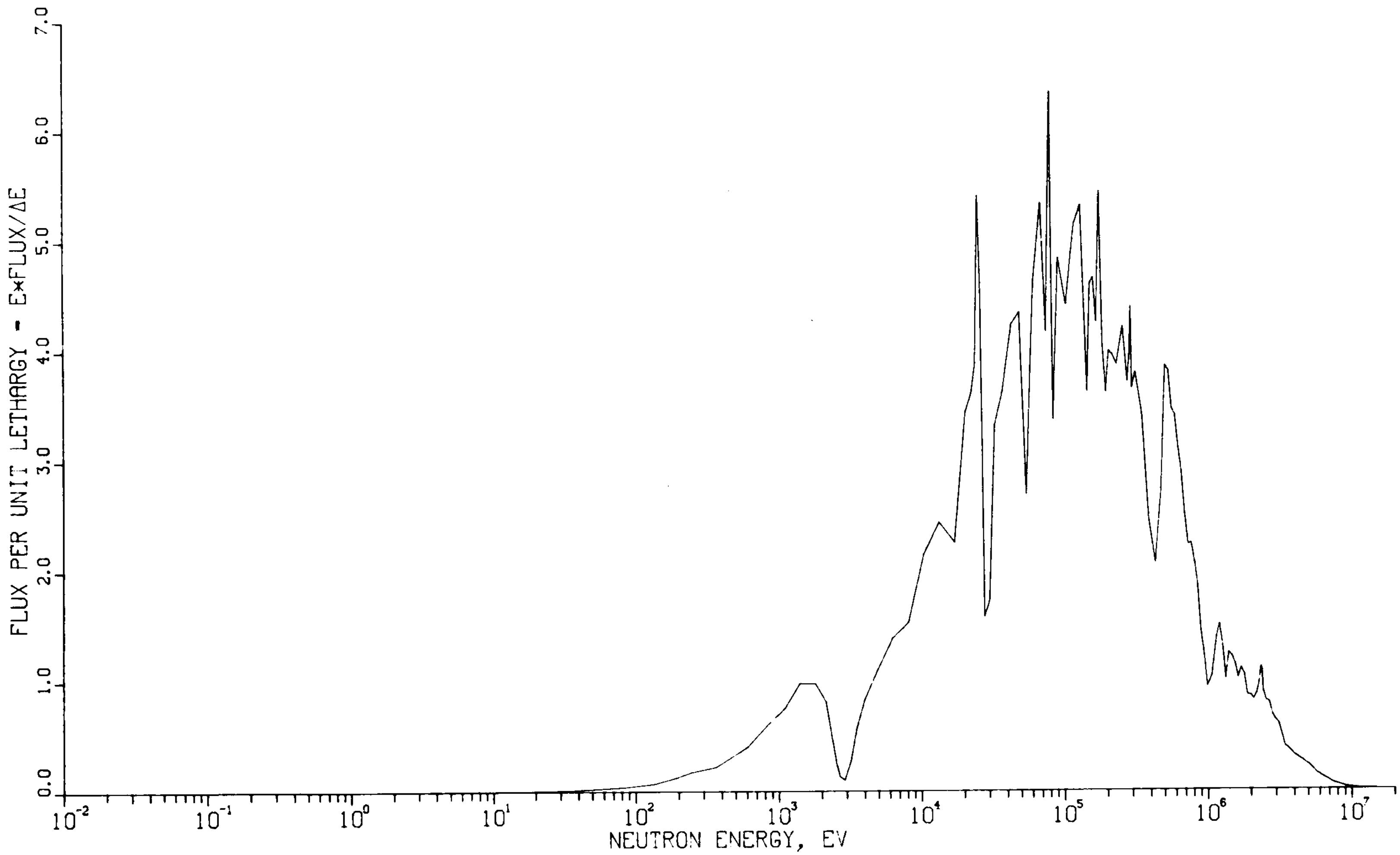

Fig. A.5. Neutron energy spectrum in AMO2TTTX axial blanket fuel.

ORNL DWG 82-1414

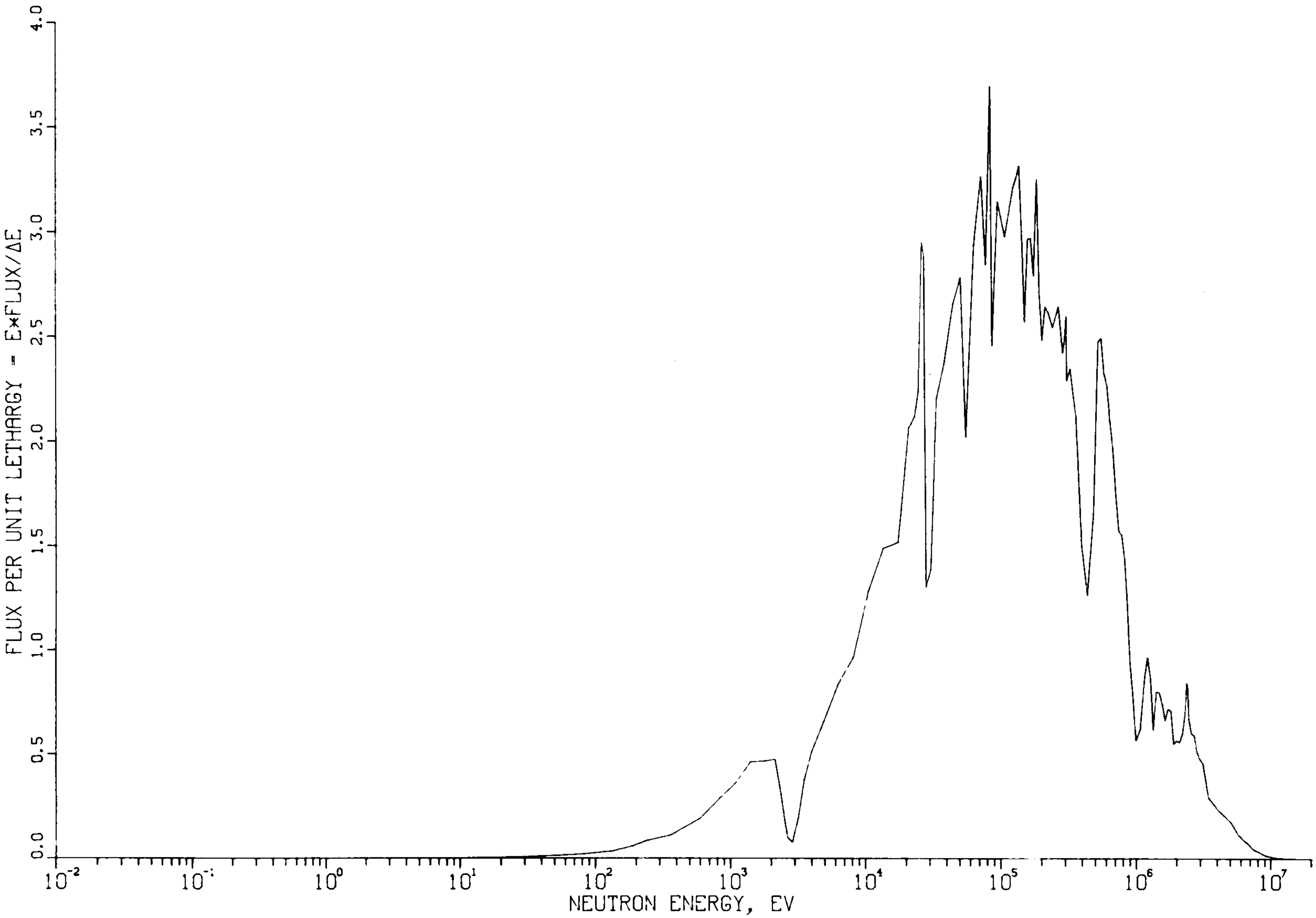

Fig. A.6. Neutron energy spectrum in AMO2TTTX radial blanket fuel.

ORNL DWG 81-999

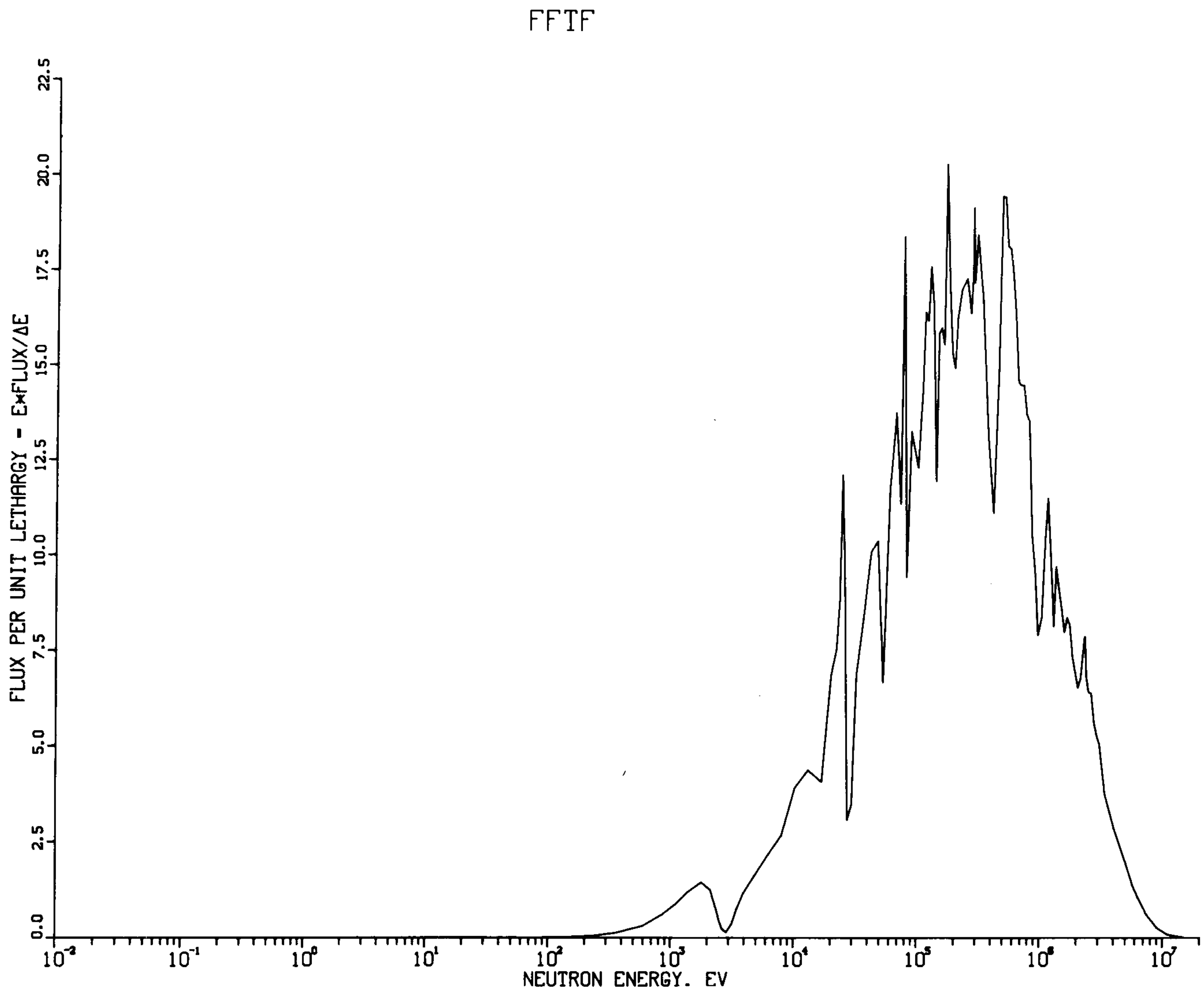

Fig. A.7. Neutron energy spectrum in FFTF core fuel.

Table A.1. Flux per unit lethargy for the AMOPUUUX and AMORUUUX LMFBR fuels

Energy group	Group energy boundaries, eV: Upper	Group energy boundaries, eV: Lower	AMOPUUUX: Core	AMOPUUUX: Axial blanket	AMOPUUUX: Radial blanket	AMORUUUX: Core	AMORUUUX: Axial blanket	AMORUUUX: Radial blanket
1	1.73330E 07	1.22140E 07	1.11786E-02	2.11759E-03	1.09654E-03	1.09043E-02	1.74119E-03	1.49790E-03
2	1.22140E 07	1.00000E 07	6.80366E-02	1.25141E-02	6.63736E-03	6.62286E-02	1.03872E-02	9.02516E-03
3	1.00000E 07	8.18730E 06	2.10623E-01	3.81210E-02	2.08840E-02	2.04875E-01	3.23444E-02	2.83548E-02
4	8.18730E 06	6.70320E 06	5.08535E-01	9.03824E-02	5.12313E-02	4.94339E-01	7.84693E-02	6.97609E-02
5	6.70320E 06	6.06530E 06	8.86060E-01	1.52109E-01	9.36658E-02	8.61768E-01	1.39759E-01	1.28829E-01
6	6.06530E 06	5.48810E 06	1.14368E 00	1.99214E-01	1.17039E-01	1.11041E 00	1.77131E-01	1.60885E-01
7	5.48810E 06	4.49330E 06	1.72883E 00	2.97415E-01	1.81430E-01	1.67835E 00	2.72120E-01	2.51724E-01
8	4.49330E 06	3.67880E 06	2.39114E 00	4.26211E-01	2.36010E-01	2.31626E 00	3.65694E-01	3.27135E-01
9	3.67880E 06	3.16640E 06	3.14050E 00	5.74864E-01	3.01901E-01	3.03996E 00	4.80488E-01	4.19631E-01
10	3.16640E 06	3.01190E 06	4.37901E 00	7.58449E-01	4.76089E-01	4.25319E 00	7.26802E-01	6.73506E-01
11	3.01190E 06	2.86500E 06	4.54933E 00	7.97628E-01	4.99710E-01	4.42182E 00	7.66117E-01	7.09324E-01
12	2.86500E 06	2.72530E 06	4.87588E 00	8.53505E-01	5.37339E-01	4.74003E 00	8.27160E-01	7.66535E-01
13	2.72530E 06	2.59240E 06	5.53247E 00	9.69289E-01	6.18987E-01	5.38290E 00	9.58240E-01	8.92367E-01
14	2.59240E 06	2.46600E 06	5.57406E 00	9.76275E-01	6.28986E-01	5.42405E 00	9.68051E-01	9.08405E-01
15	2.46600E 06	2.38520E 06	5.94611E 00	1.03297E 00	6.98275E-01	5.79091E 00	1.05798E 00	1.01766E 00
16	2.38520E 06	2.36530E 06	6.88306E 00	1.20253E 00	8.50682E-01	6.71619E 00	1.28826E 00	1.26372E 00
17	2.36530E 06	2.30690E 06	6.93526E 00	1.21602E 00	8.81586E-01	6.77169E 00	1.31825E 00	1.30512E 00
18	2.30690E 06	2.23130E 06	6.36485E 00	1.20674E 00	7.39585E-01	6.20301E 00	1.18120E 00	1.07157E 00
19	2.23130E 06	2.12250E 06	5.71664E 00	1.12905E 00	6.18093E-01	5.55934E 00	1.02306E 00	8.85374E-01
20	2.12250E 06	2.01900E 06	5.46920E 00	1.10266E 00	5.71317E-01	5.31182E 00	9.56950E-01	8.08822E-01
21	2.01900E 06	1.92050E 06	5.70247E 00	1.21511E 00	5.80288E-01	5.53534E 00	1.00389E 00	8.15116E-01
22	1.92050E 06	1.82680E 06	5.91815E 00	1.35652E 00	5.83715E-01	5.74237E 00	1.04715E 00	8.15861E-01
23	1.82680E 06	1.73770E 06	6.83874E 00	1.38927E 00	7.40384E-01	6.65207E 00	1.24542E 00	1.05277E 00
24	1.73770E 06	1.65300E 06	6.92793E 00	1.48145E 00	7.31462E-01	6.73674E 00	1.26989E 00	1.03192E 00
25	1.65300E 06	1.57240E 06	6.60873E 00	1.42543E 00	6.91942E-01	6.42371E 00	1.19881E 00	9.69087E-01
26	1.57240E 06	1.49570E 06	7.13215E 00	1.56657E 00	7.50058E-01	6.93684E 00	1.31667E 00	1.04986E 00
27	1.49570E 06	1.42270E 06	7.61083E 00	1.64871E 00	8.16146E-01	7.40976E 00	1.41798E 00	1.14554E 00
28	1.42270E 06	1.35340E 06	7.93778E 00	1.83527E 00	8.46756E-01	7.73354E 00	1.50659E 00	1.17890E 00
29	1.35340E 06	1.28730E 06	6.52263E 00	1.68883E 00	6.52554E-01	6.34289E 00	1.19643E 00	8.86135E-01
30	1.28730E 06	1.22460E 06	8.35369E 00	1.86709E 00	9.34391E-01	8.14733E 00	1.59283E 00	1.28272E 00
31	1.22460E 06	1.16480E 06	9.43605E 00	2.26523E 00	1.06066E 00	9.21593E 00	1.86721E 00	1.44904E 00
32	1.16480E 06	1.10800E 06	8.60801E 00	2.21052E 00	9.58747E-01	8.40488E 00	1.70690E 00	1.28414E 00
33	1.10800E 06	1.00260E 06	6.68915E 00	2.08476E 00	6.96328E-01	6.51574E 00	1.28548E 00	8.97437E-01
34	1.00260E 06	9.61640E 05	6.30288E 00	2.13710E 00	6.44387E-01	6.13652E 00	1.19797E 00	8.23918E-01
35	9.61640E 05	9.07180E 05	7.86445E 00	2.35383E 00	8.72477E-01	7.67762E 00	1.54512E 00	1.12465E 00
36	9.07180E 05	8.62940E 05	8.91206E 00	2.43171E 00	1.05815E 00	8.71830E 00	1.79744E 00	1.35400E 00
37	8.62940E 05	8.20850E 05	1.15078E 01	2.99126E 00	1.40613E 00	1.12818E 01	2.39971E 00	1.80858E 00
38	8.20850E 05	7.80820E 05	1.21312E 01	2.77083E 00	1.58197E 00	1.19085E 01	2.53210E 00	2.02961E 00
39	7.80820E 05	7.42740E 05	1.28535E 01	3.05716E 00	1.70553E 00	1.26326E 01	2.75023E 00	2.16969E 00
40	7.42740E 05	7.06510E 05	1.26991E 01	3.14169E 00	1.73184E 00	1.25012E 01	2.78057E 00	2.18191E 00
41	7.06510E 05	6.72060E 05	1.29118E 01	3.29976E 00	1.82091E 00	1.27254E 01	2.89061E 00	2.27534E 00
42	6.72060E 05	6.39280E 05	1.43552E 01	3.97194E 00	2.04320E 00	1.41690E 01	3.32799E 00	2.54267E 00
43	6.39280E 05	6.08100E 05	1.53329E 01	4.51869E 00	2.20874E 00	1.51548E 01	3.65569E 00	2.73463E 00
44	6.08100E 05	5.78440E 05	1.59038E 01	4.88803E 00	2.33051E 00	1.57385E 01	3.88162E 00	2.86816E 00
45	5.78440E 05	5.50230E 05	1.62009E 01	5.17608E 00	2.42488E 00	1.60524E 01	4.04719E 00	2.95965E 00
46	5.50230E 05	5.23400E 05	1.72429E 01	5.91759E 00	2.58143E 00	1.71044E 01	4.42229E 00	3.13797E 00
47	5.23400E 05	4.97870E 05	1.72901E 01	6.39854E 00	2.58549E 00	1.71614E 01	4.51701E 00	3.11473E 00
48	4.97870E 05	4.50490E 05	1.27130E 01	6.26585E 00	1.81001E 00	1.26013E 01	3.33038E 00	2.11202E 00
49	4.50490E 05	4.07620E 05	9.61455E 00	4.98831E 00	1.37374E 00	9.52237E 00	2.51118E 00	1.57265E 00
50	4.07620E 05	3.68830E 05	1.12615E 01	5.91002E 00	1.60303E 00	1.11589E 01	3.00303E 00	1.83493E 00
51	3.68830E 05	3.33730E 05	1.48214E 01	6.80640E 00	2.21469E 00	1.47225E 01	4.04354E 00	2.56720E 00
52	3.33730E 05	3.01970E 05	1.63478E 01	7.36473E 00	2.48918E 00	1.62736E 01	4.59183E 00	2.88892E 00
53	3.01970E 05	2.98500E 05	1.54118E 01	6.66991E 00	2.43344E 00	1.53581E 01	4.36110E 00	2.81817E 00
54	2.98500E 05	2.97200E 05	1.61427E 01	7.06317E 00	2.51303E 00	1.60872E 01	4.59520E 00	2.93176E 00
55	2.97200E 05	2.94520E 05	1.71813E 01	7.73696E 00	2.62746E 00	1.71197E 01	4.92721E 00	3.08421E 00

Table A.1 (continued)

Energy group	Group energy boundaries, eV		AMOPUUUX			AMORUUUX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
56	2.94520E 05	2.87250E 05	1.61980E 01	6.95463E 00	2.58307E 00	1.61476E 01	4.63279E 00	2.99769E 00
57	2.87250E 05	2.73240E 05	1.55747E 01	6.28777E 00	2.56017E 00	1.55365E 01	4.46596E 00	2.96087E 00
58	2.73240E 05	2.47240E 05	1.62755E 01	6.50068E 00	2.69895E 00	1.62644E 01	4.76260E 00	3.13336E 00
59	2.47240E 05	2.23710E 05	1.61893E 01	6.42206E 00	2.76238E 00	1.62046E 01	4.84418E 00	3.20890E 00
60	2.23710E 05	2.12800E 05	1.57943E 01	6.20526E 00	2.75675E 00	1.58272E 01	4.79403E 00	3.20553E 00
61	2.12800E 05	2.02420E 05	1.47083E 01	5.51854E 00	2.66503E 00	1.47480E 01	4.48096E 00	3.08827E 00
62	2.02420E 05	1.92550E 05	1.54086E 01	5.86710E 00	2.78560E 00	1.54569E 01	4.74730E 00	3.23619E 00
63	1.92550E 05	1.83160E 05	1.69111E 01	6.84920E 00	2.96355E 00	1.69778E 01	5.28909E 00	3.45701E 00
64	1.83160E 05	1.74220E 05	1.91994E 01	8.68901E 00	3.25445E 00	1.93049E 01	6.14821E 00	3.82770E 00
65	1.74220E 05	1.65730E 05	1.56484E 01	6.67337E 00	2.86363E 00	1.57462E 01	5.03827E 00	3.32326E 00
66	1.65730E 05	1.57640E 05	1.60415E 01	6.79083E 00	2.94974E 00	1.61558E 01	5.22268E 00	3.44985E 00
67	1.57640E 05	1.49960E 05	1.59996E 01	6.68359E 00	2.97342E 00	1.61295E 01	5.27119E 00	3.48187E 00
68	1.49960E 05	1.42640E 05	1.29157E 01	4.77551E 00	2.60378E 00	1.30225E 01	4.24266E 00	3.01985E 00
69	1.42640E 05	1.35690E 05	1.68921E 01	6.92132E 00	3.12460E 00	1.70515E 01	5.67184E 00	3.68036E 00
70	1.35690E 05	1.29070E 05	1.72848E 01	7.64794E 00	3.20415E 00	1.74709E 01	5.91318E 00	3.76445E 00
71	1.29070E 05	1.22770E 05	1.65404E 01	7.53527E 00	3.14342E 00	1.67424E 01	5.75792E 00	3.68406E 00
72	1.22770E 05	1.16790E 05	1.66991E 01	7.89006E 00	3.18272E 00	1.69224E 01	5.91096E 00	3.73808E 00
73	1.16790E 05	1.11090E 05	1.51667E 01	6.81671E 00	3.02962E 00	1.53823E 01	5.40237E 00	3.54155E 00
74	1.11090E 05	9.80370E 04	1.37053E 01	5.52415E 00	2.89290E 00	1.39221E 01	4.94364E 00	3.37688E 00
75	9.80370E 04	8.65170E 04	1.46475E 01	6.32039E 00	3.08175E 00	1.49171E 01	5.45390E 00	3.59877E 00
76	8.65170E 04	8.25000E 04	1.11134E 01	4.41390E 00	2.56048E 00	1.13242E 01	4.16012E 00	2.94711E 00
77	8.25000E 04	7.95000E 04	1.89980E 01	9.53427E 00	3.72875E 00	1.94024E 01	7.39813E 00	4.45991E 00
78	7.95000E 04	7.20000E 04	1.31145E 01	5.81643E 00	2.94792E 00	1.34067E 01	5.10357E 00	3.41269E 00
79	7.20000E 04	6.73790E 04	1.52949E 01	7.50773E 00	3.29543E 00	1.56678E 01	6.11413E 00	3.86569E 00
80	6.73790E 04	5.65620E 04	1.34604E 01	6.43291E 00	3.07973E 00	1.38320E 01	5.56143E 00	3.60437E 00
81	5.65620E 04	5.24750E 04	8.47403E 00	3.21768E 00	2.24225E 00	8.72309E 00	3.52517E 00	2.58946E 00
82	5.24750E 04	4.63090E 04	1.25322E 01	5.68476E 00	3.01079E 00	1.29231E 01	5.38196E 00	3.54657E 00
83	4.63090E 04	4.08680E 04	1.21630E 01	5.96666E 00	2.96176E 00	1.25751E 01	5.36755E 00	3.48305E 00
84	4.08680E 04	3.43070E 04	1.03470E 01	4.65841E 00	2.70223E 00	1.07354E 01	4.68833E 00	3.19164E 00
85	3.43070E 04	3.18280E 04	9.38494E 00	4.09083E 00	2.53084E 00	9.74951E 00	4.30514E 00	2.99719E 00
86	3.18280E 04	2.85000E 04	5.22319E 00	1.82280E 00	1.66857E 00	5.42709E 00	2.39415E 00	1.95678E 00
87	2.85000E 04	2.70000E 04	4.67569E 00	1.54239E 00	1.54744E 00	4.85880E 00	2.14674E 00	1.82056E 00
88	2.70000E 04	2.60580E 04	1.26855E 01	5.08041E 00	3.31677E 00	1.32050E 01	5.93748E 00	4.09735E 00
89	2.60580E 04	2.47880E 04	1.47467E 01	7.84740E 00	3.45260E 00	1.53955E 01	7.13421E 00	4.23071E 00
90	2.47880E 04	2.35790E 04	1.06364E 01	6.13778E 00	2.67433E 00	1.11268E 01	5.24047E 00	3.20750E 00
91	2.35790E 04	2.18750E 04	9.66946E 00	5.40368E 00	2.51503E 00	1.01335E 01	4.83433E 00	3.07085E 00
92	2.18750E 04	1.93050E 04	9.19892E 00	4.61920E 00	2.48748E 00	9.67473E 00	4.68401E 00	3.07353E 00
93	1.93050E 04	1.50340E 04	6.15867E 00	2.47482E 00	1.88759E 00	6.50008E 00	3.21241E 00	2.35705E 00
94	1.50340E 04	1.17090E 04	6.28066E 00	2.80075E 00	1.86148E 00	6.66805E 00	3.41884E 00	2.39456E 00
95	1.17090E 04	9.11880E 03	5.44680E 00	2.43945E 00	1.65080E 00	5.82207E 00	3.10312E 00	2.18702E 00
96	9.11880E 03	7.10170E 03	3.79739E 00	1.49035E 00	1.26190E 00	4.08025E 00	2.22842E 00	1.71493E 00
97	7.10170E 03	5.53080E 03	3.28606E 00	1.30757E 00	1.10180E 00	3.55369E 00	2.00218E 00	1.54681E 00
98	5.53080E 03	4.30740E 03	2.46853E 00	9.40942E-01	8.70698E-01	2.68673E 00	1.56094E 00	1.26016E 00
99	4.30740E 03	3.70740E 03	1.77990E 00	6.43436E-01	6.63260E-01	1.94434E 00	1.15027E 00	9.77600E-01
100	3.70740E 03	3.35460E 03	1.15755E 00	3.91290E-01	4.68999E-01	1.26762E 00	7.58975E-01	6.90114E-01
101	3.35460E 03	3.03540E 03	5.29957E-01	1.65899E-01	2.33245E-01	5.80850E-01	3.50250E-01	3.44847E-01
102	3.03540E 03	2.74650E 03	2.22503E-01	6.69004E-02	1.04574E-01	2.44035E-01	1.48141E-01	1.54575E-01
103	2.74650E 03	2.61260E 03	3.46962E-01	1.06106E-01	1.59757E-01	3.80479E-01	2.31906E-01	2.38732E-01
104	2.61260E 03	2.48520E 03	5.92179E-01	1.86796E-01	2.65594E-01	6.49245E-01	3.96814E-01	3.98263E-01
105	2.48520E 03	2.24870E 03	1.02859E 00	3.49484E-01	4.15376E-01	1.12771E 00	6.91821E-01	6.43479E-01
106	2.24870E 03	2.03470E 03	1.73861E 00	6.81226E-01	6.40904E-01	1.91220E 00	1.19624E 00	9.97397E-01
107	2.03470E 03	1.58460E 03	2.04885E 00	9.89417E-01	6.62892E-01	2.27333E 00	1.49482E 00	1.10857E 00
108	1.58460E 03	1.23410E 03	1.70913E 00	8.75867E-01	5.65827E-01	1.92180E 00	1.35688E 00	1.00157E 00
109	1.23410E 03	9.61120E 02	1.26303E 00	6.70556E-01	4.86453E-01	1.44171E 00	1.12579E 00	8.67127E-01
110	9.61120E 02	7.48520E 02	8.80790E-01	4.68783E-01	3.74315E-01	1.02499E 00	8.83552E-01	7.12286E-01

Table A.1 (continued)

Energy group	Group energy boundaries, eV		AMOPUUUX			AMORUUUX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
111	7.48520E 02	4.54000E 02	4.67506E-01	2.54360E-01	2.46547E-01	5.59344E-01	5.97069E-01	5.34122E-01
112	4.54000E 02	2.75360E 02	1.78188E-01	1.01228E-01	1.25418E-01	2.21331E-01	3.00563E-01	3.08593E-01
113	2.75360E 02	2.14450E 02	8.22562E-02	5.56226E-02	7.31495E-02	1.04253E-01	1.78497E-01	1.92581E-01
114	2.14450E 02	1.67020E 02	4.88294E-02	3.95727E-02	5.59457E-02	6.41051E-02	1.34193E-01	1.53882E-01
115	1.67020E 02	1.01300E 02	1.40265E-02	1.39749E-02	2.06076E-02	1.93180E-02	5.58819E-02	7.29467E-02
116	1.01300E 02	6.14420E 01	4.81099E-03	1.03744E-02	1.61157E-02	7.11362E-03	3.72439E-02	5.22446E-02
117	6.14420E 01	4.78510E 01	1.53046E-03	5.53413E-03	9.25742E-03	2.36602E-03	1.98305E-02	2.92727E-02
118	4.78510E 01	3.72670E 01	4.71289E-04	2.51574E-03	4.42579E-03	7.97763E-04	9.87112E-03	1.64031E-02
119	3.72670E 01	2.26030E 01	2.35558E-04	2.26684E-03	3.28905E-03	4.81942E-04	6.89249E-03	1.31978E-02
120	2.26030E 01	1.06770E 01	2.17422E-05	6.76891E-04	6.92569E-04	5.03084E-05	1.72679E-03	3.36179E-03
121	1.06770E 01	5.04350E 00	1.62274E-06	2.03979E-04	1.15550E-04	4.20095E-06	3.94864E-04	6.69724E-04
122	5.04350E 00	2.37239E 00	6.81776E-07	1.37041E-04	1.33257E-04	2.25029E-06	2.18699E-04	6.11413E-04
123	2.37239E 00	1.12540E 00	2.18815E-07	4.14767E-05	6.20329E-05	6.42351E-07	6.90882E-05	3.31814E-04
124	1.12540E 00	4.13990E-01	1.77656E-08	5.87450E-06	1.25199E-05	2.97420E-08	9.96113E-06	4.72489E-05
125	4.13990E-01	1.00000E-01	7.40016E-09	1.91692E-07	3.49671E-07	7.42229E-09	3.47840E-07	1.22207E-06
126	1.00000E-01	1.00000E-05	5.43688E-10	8.34406E-09	1.24730E-08	5.68503E-10	1.44885E-08	6.89637E-08

Table A.2. Flux per unit lethargy for the EMOPUUUX and AMOPUUTX LMFBR fuels

Energy group	Group energy boundaries, eV: Upper	Group energy boundaries, eV: Lower	EMOPUUUX: Core	EMOPUUUX: Axial blanket	EMOPUUUX: Radial blanket	AMOPUUTX: Core	AMOPUUTX: Axial blanket	AMOPUUTX: Radial blanket
1	1.73330E 07	1.22140E 07	1.10944E-02	1.54914E-03	9.50658E-04	1.06381E-02	1.34765E-03	9.44260E-04
2	1.22140E 07	1.00000E 07	6.75535E-02	9.17351E-03	5.74819E-03	6.47451E-02	7.93769E-03	5.64019E-03
3	1.00000E 07	8.18730E 06	2.09302E-01	2.83939E-02	1.80950E-02	2.00592E-01	2.45453E-02	1.76061E-02
4	8.18730E 06	6.70320E 06	5.06122E-01	6.87279E-02	4.43878E-02	4.84439E-01	5.93658E-02	4.29806E-02
5	6.70320E 06	6.06530E 06	8.85377E-01	1.22693E-01	8.13059E-02	8.44964E-01	1.06242E-01	7.88573E-02
6	6.06530E 06	5.48810E 06	1.14084E 00	1.55977E-01	1.01359E-01	1.08930E 00	1.34752E-01	9.83976E-02
7	5.48810E 06	4.49330E 06	1.72769E 00	2.40813E-01	1.57231E-01	1.64785E 00	2.08679E-01	1.53398E-01
8	4.49330E 06	3.67880E 06	2.38134E 00	3.26007E-01	2.03801E-01	2.27413E 00	2.81569E-01	1.99620E-01
9	3.67880E 06	3.16640E 06	3.12237E 00	4.31240E-01	2.60385E-01	2.98473E 00	3.73015E-01	2.56978E-01
10	3.16640E 06	3.01190E 06	4.38763E 00	6.54720E-01	4.12948E-01	4.18051E 00	5.74066E-01	4.11587E-01
11	3.01190E 06	2.86500E 06	4.56188E 00	6.93402E-01	4.34596E-01	4.34518E 00	6.09399E-01	4.34956E-01
12	2.86500E 06	2.72530E 06	4.88649E 00	7.49614E-01	4.67734E-01	4.65936E 00	6.59655E-01	4.68665E-01
13	2.72530E 06	2.59240E 06	5.54635E 00	8.70720E-01	5.39538E-01	5.29361E 00	7.69241E-01	5.43059E-01
14	2.59240E 06	2.46600E 06	5.58287E 00	8.79945E-01	5.48808E-01	5.33199E 00	7.77445E-01	5.52040E-01
15	2.46600E 06	2.38520E 06	5.96385E 00	9.65337E-01	6.10762E-01	5.69446E 00	8.55837E-01	6.17432E-01
16	2.38520E 06	2.36530E 06	6.93131E 00	1.18018E 00	7.46734E-01	6.61322E 00	1.05462E 00	7.62178E-01
17	2.36530E 06	2.30690E 06	6.99430E 00	1.20841E 00	7.75621E-01	6.66620E 00	1.08255E 00	7.92134E-01
18	2.30690E 06	2.23130E 06	6.36410E 00	1.08171E 00	6.49443E-01	6.10133E 00	9.67054E-01	6.59699E-01
19	2.23130E 06	2.12250E 06	5.67630E 00	9.37625E-01	5.40872E-01	5.46588E 00	8.34829E-01	5.48709E-01
20	2.12250E 06	2.01900E 06	5.40998E 00	8.75751E-01	4.98889E-01	5.22099E 00	7.77369E-01	5.04573E-01
21	2.01900E 06	1.92050E 06	5.61957E 00	9.19513E-01	5.06390E-01	5.44311E 00	8.18246E-01	5.13381E-01
22	1.92050E 06	1.82680E 06	5.81705E 00	9.58935E-01	5.08987E-01	5.64670E 00	8.55512E-01	5.16137E-01
23	1.82680E 06	1.73770E 06	6.77991E 00	1.14483E 00	6.47505E-01	6.53932E 00	1.02459E 00	6.60863E-01
24	1.73770E 06	1.65300E 06	6.84781E 00	1.16875E 00	6.39959E-01	6.62211E 00	1.04815E 00	6.53034E-01
25	1.65300E 06	1.57240E 06	6.50856E 00	1.10373E 00	6.05131E-01	6.31084E 00	9.88337E-01	6.15649E-01
26	1.57240E 06	1.49570E 06	7.03415E 00	1.21188E 00	6.56385E-01	6.81750E 00	1.08848E 00	6.70522E-01
27	1.49570E 06	1.42270E 06	7.51824E 00	1.30846E 00	7.14826E-01	7.28015E 00	1.17670E 00	7.32324E-01
28	1.42270E 06	1.35340E 06	7.81895E 00	1.39434E 00	7.42384E-01	7.59784E 00	1.25712E 00	7.62861E-01
29	1.35340E 06	1.28730E 06	6.39065E 00	1.10383E 00	5.70942E-01	6.22360E 00	9.89953E-01	5.81202E-01
30	1.28730E 06	1.22460E 06	8.24831E 00	1.47358E 00	8.19204E-01	8.00040E 00	1.32722E 00	8.40479E-01
31	1.22460E 06	1.16480E 06	9.31944E 00	1.73470E 00	9.32243E-01	9.05540E 00	1.57012E 00	9.62239E-01
32	1.16480E 06	1.10800E 06	8.46636E 00	1.58609E 00	8.43139E-01	8.25512E 00	1.43599E 00	8.68546E-01
33	1.10800E 06	1.00260E 06	6.52066E 00	1.19068E 00	6.10905E-01	6.40162E 00	1.07351E 00	6.23375E-01
34	1.00260E 06	9.61640E 05	6.15120E 00	1.10836E 00	5.64762E-01	6.02989E 00	9.97465E-01	5.76535E-01
35	9.61640E 05	9.07180E 05	7.74994E 00	1.43359E 00	7.66177E-01	7.55067E 00	1.29529E 00	7.86176E-01
36	9.07180E 05	8.62940E 05	8.80769E 00	1.66924E 00	9.31496E-01	8.57500E 00	1.51216E 00	9.57605E-01
37	8.62940E 05	8.20850E 05	1.14518E 01	2.23281E 00	1.24048E 00	1.11042E 01	2.03021E 00	1.28039E 00
38	8.20850E 05	7.80820E 05	1.20875E 01	2.35987E 00	1.39728E 00	1.17097E 01	2.14367E 00	1.44114E 00
39	7.80820E 05	7.42740E 05	1.28146E 01	2.56699E 00	1.50925E 00	1.24296E 01	2.33747E 00	1.55966E 00
40	7.42740E 05	7.06510E 05	1.26988E 01	2.60417E 00	1.53596E 00	1.23003E 01	2.37322E 00	1.59130E 00
41	7.06510E 05	6.72060E 05	1.30062E 01	2.71634E 00	1.61790E 00	1.25286E 01	2.47944E 00	1.68188E 00
42	6.72060E 05	6.39280E 05	1.44800E 01	3.13141E 00	1.81950E 00	1.39691E 01	2.86938E 00	1.89718E 00
43	6.39280E 05	6.08100E 05	1.55156E 01	3.44617E 00	1.97111E 00	1.49530E 01	3.16810E 00	2.06126E 00
44	6.08100E 05	5.78440E 05	1.60051E 01	3.66641E 00	2.08380E 00	1.55404E 01	3.37902E 00	2.18472E 00
45	5.78440E 05	5.50230E 05	1.63379E 01	3.81763E 00	2.17196E 00	1.58617E 01	3.52692E 00	2.27628E 00
46	5.50230E 05	5.23400E 05	1.74850E 01	4.17711E 00	2.31613E 00	1.69219E 01	3.87261E 00	2.43451E 00
47	5.23400E 05	4.97870E 05	1.75061E 01	4.26777E 00	2.32266E 00	1.69893E 01	3.96789E 00	2.44389E 00
48	4.97870E 05	4.50490E 05	1.27660E 01	3.14522E 00	1.62586E 00	1.24878E 01	2.92757E 00	1.70096E 00
49	4.50490E 05	4.07620E 05	9.60783E 00	2.37108E 00	1.23386E 00	9.43374E 00	2.20607E 00	1.29130E 00
50	4.07620E 05	3.68830E 05	1.13068E 01	2.83726E 00	1.44145E 00	1.10668E 01	2.64497E 00	1.51464E 00
51	3.68830E 05	3.33730E 05	1.50185E 01	3.82909E 00	1.99555E 00	1.46117E 01	3.58204E 00	2.10596E 00
52	3.33730E 05	3.01970E 05	1.65978E 01	4.35341E 00	2.24861E 00	1.61630E 01	4.08520E 00	2.37768E 00
53	3.01970E 05	2.98500E 05	1.57049E 01	4.14456E 00	2.20049E 00	1.52554E 01	3.89123E 00	2.33135E 00
54	2.98500E 05	2.97200E 05	1.64579E 01	4.36854E 00	2.27306E 00	1.59878E 01	4.10714E 00	2.41174E 00
55	2.97200E 05	2.94520E 05	1.76073E 01	4.68291E 00	2.37707E 00	1.70332E 01	4.41111E 00	2.52620E 00

Table A.2 (continued)

Energy group	Group energy boundaries, eV		EMOPUUUX			AMOPUUTX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
56	2.94520E 05	2.87250E 05	1.66368E 01	4.40012E 00	2.33797E 00	1.60558E 01	4.14349E 00	2.47983E 00
57	2.87250E 05	2.73240E 05	1.59817E 01	4.24104E 00	2.31917E 00	1.54428E 01	3.99380E 00	2.45721E 00
58	2.73240E 05	2.47240E 05	1.66552E 01	4.53472E 00	2.45018E 00	1.61800E 01	4.27936E 00	2.60332E 00
59	2.47240E 05	2.23710E 05	1.65507E 01	4.61985E 00	2.51381E 00	1.61330E 01	4.36919E 00	2.67616E 00
60	2.23710E 05	2.12800E 05	1.64489E 01	4.57581E 00	2.51261E 00	1.57662E 01	4.33291E 00	2.67845E 00
61	2.12800E 05	2.02420E 05	1.52381E 01	4.28094E 00	2.43144E 00	1.46909E 01	4.05585E 00	2.59220E 00
62	2.02420E 05	1.92550E 05	1.57160E 01	4.53769E 00	2.54397E 00	1.54142E 01	4.30599E 00	2.71687E 00
63	1.92550E 05	1.83160E 05	1.73862E 01	5.05372E 00	2.70947E 00	1.69453E 01	4.80297E 00	2.89619E 00
64	1.83160E 05	1.74220E 05	1.97856E 01	5.89097E 00	2.98096E 00	1.92907E 01	5.61286E 00	3.20031E 00
65	1.74220E 05	1.65730E 05	1.62921E 01	4.82479E 00	2.62686E 00	1.57192E 01	4.59975E 00	2.81277E 00
66	1.65730E 05	1.57640E 05	1.69877E 01	5.00884E 00	2.70847E 00	1.61451E 01	4.78150E 00	2.90771E 00
67	1.57640E 05	1.49960E 05	1.60866E 01	5.05782E 00	2.73373E 00	1.61288E 01	4.83445E 00	2.93768E 00
68	1.49960E 05	1.42640E 05	1.33873E 01	4.07176E 00	2.39558E 00	1.30135E 01	3.89174E 00	2.57100E 00
69	1.42640E 05	1.35690E 05	1.79178E 01	5.44271E 00	2.87751E 00	1.70760E 01	5.21040E 00	3.09719E 00
70	1.35690E 05	1.29070E 05	1.75579E 01	5.68900E 00	2.95635E 00	1.75071E 01	5.45585E 00	3.19076E 00
71	1.29070E 05	1.22770E 05	1.72867E 01	5.54062E 00	2.90575E 00	1.67845E 01	5.32256E 00	3.13647E 00
72	1.22770E 05	1.16790E 05	1.72711E 01	5.69207E 00	2.94633E 00	1.69810E 01	5.47649E 00	3.18513E 00
73	1.16790E 05	1.11090E 05	1.58726E 01	5.20636E 00	2.80796E 00	1.54370E 01	5.01368E 00	3.03662E 00
74	1.11090E 05	9.80370E 04	1.42996E 01	4.76874E 00	2.68663E 00	1.39810E 01	4.59930E 00	2.90843E 00
75	9.80370E 04	8.65170E 04	1.54262E 01	5.26968E 00	2.87093E 00	1.50101E 01	5.09598E 00	3.11749E 00
76	8.65170E 04	8.25000E 04	1.16023E 01	4.02085E 00	2.38831E 00	1.13945E 01	3.89074E 00	2.59189E 00
77	8.25000E 04	7.95000E 04	2.02934E 01	7.15948E 00	3.48235E 00	1.96071E 01	6.94456E 00	3.80651E 00
78	7.95000E 04	7.20000E 04	1.39285E 01	4.94114E 00	2.76030E 00	1.35179E 01	4.79700E 00	3.00521E 00
79	7.20000E 04	6.73790E 04	1.66586E 01	5.92888E 00	3.09160E 00	1.58355E 01	5.76749E 00	3.37989E 00
80	6.73790E 04	5.65620E 04	1.41409E 01	5.40060E 00	2.90074E 00	1.40002E 01	5.26828E 00	3.17691E 00
81	5.65620E 04	5.24750E 04	9.02603E 00	3.42686E 00	2.11626E 00	8.82849E 00	3.34654E 00	2.30191E 00
82	5.24750E 04	4.63090E 04	1.34211E 01	5.23658E 00	2.84821E 00	1.31153E 01	5.12343E 00	3.13015E 00
83	4.63090E 04	4.08680E 04	1.30842E 01	5.22895E 00	2.81154E 00	1.27776E 01	5.12639E 00	3.09642E 00
84	4.08680E 04	3.43070E 04	1.12279E 01	4.57376E 00	2.57445E 00	1.09210E 01	4.49422E 00	2.84120E 00
85	3.43070E 04	3.18280E 04	1.02340E 01	4.20325E 00	2.41602E 00	9.92767E 00	4.13418E 00	2.66926E 00
86	3.18280E 04	2.85000E 04	5.72301E 00	2.33816E 00	1.59427E 00	5.52306E 00	2.30148E 00	1.76050E 00
87	2.85000E 04	2.70000E 04	5.00700E 00	2.09671E 00	1.47875E 00	4.94483E 00	2.06423E 00	1.63374E 00
88	2.70000E 04	2.60580E 04	1.40231E 01	5.80160E 00	3.16898E 00	1.34605E 01	5.70579E 00	3.51337E 00
89	2.60580E 04	2.47880E 04	1.65872E 01	6.97453E 00	3.30959E 00	1.56977E 01	6.86451E 00	3.66804E 00
90	2.47880E 04	2.35790E 04	1.16981E 01	5.12660E 00	2.57099E 00	1.13440E 01	5.05789E 00	2.84827E 00
91	2.35790E 04	2.18750E 04	1.07820E 01	4.73115E 00	2.42057E 00	1.03379E 01	4.66984E 00	2.68523E 00
92	2.18750E 04	1.93050E 04	1.05158E 01	4.58905E 00	2.39969E 00	9.87342E 00	4.53343E 00	2.66704E 00
93	1.93050E 04	1.50340E 04	8.04643E 00	3.15124E 00	1.82809E 00	6.63431E 00	3.11790E 00	2.03314E 00
94	1.50340E 04	1.17090E 04	7.29078E 00	3.35876E 00	1.81072E 00	6.79783E 00	3.32196E 00	2.01462E 00
95	1.17090E 04	9.11880E 03	5.84467E 00	3.05311E 00	1.61334E 00	5.91808E 00	3.01335E 00	1.79117E 00
96	9.11880E 03	7.10170E 03	4.09501E 00	2.19520E 00	1.23680E 00	4.13357E 00	2.16472E 00	1.37116E 00
97	7.10170E 03	5.53080E 03	3.60817E 00	1.97472E 00	1.08302E 00	3.57464E 00	1.93689E 00	1.19203E 00
98	5.53080E 03	4.30740E 03	2.75855E 00	1.54139E 00	8.57896E-01	2.68017E 00	1.50228E 00	9.35060E-01
99	4.30740E 03	3.70740E 03	1.95834E 00	1.13660E 00	6.54146E-01	1.93078E 00	1.10559E 00	7.09952E-01
100	3.70740E 03	3.35460E 03	1.26772E 00	7.50135E-01	4.62938E-01	1.25559E 00	7.30295E-01	5.01928E-01
101	3.35460E 03	3.03540E 03	5.79110E-01	3.46111E-01	2.30261E-01	5.75232E-01	3.37334E-01	2.49731E-01
102	3.03540E 03	2.74650E 03	2.43506E-01	1.46367E-01	1.03235E-01	2.41415E-01	1.42592E-01	1.12120E-01
103	2.74650E 03	2.61260E 03	3.80029E-01	2.29150E-01	1.57635E-01	3.76399E-01	2.23151E-01	1.71248E-01
104	2.61260E 03	2.48520E 03	6.48145E-01	3.92190E-01	2.62082E-01	6.39410E-01	3.79574E-01	2.80307E-01
105	2.48520E 03	2.24870E 03	1.12135E 00	6.83968E-01	4.09770E-01	1.11068E 00	6.62491E-01	4.40203E-01
106	2.24870E 03	2.03470E 03	1.91034E 00	1.18344E 00	6.32192E-01	1.86372E 00	1.13220E 00	6.67077E-01
107	2.03470E 03	1.58460E 03	2.25631E 00	1.48015E 00	6.55088E-01	2.07204E 00	1.30569E 00	6.17452E-01
108	1.58460E 03	1.23410E 03	1.89585E 00	1.34577E 00	5.60362E-01	1.69225E 00	1.14101E 00	5.05508E-01
109	1.23410E 03	9.61120E 02	1.41533E 00	1.12020E 00	4.83136E-01	1.21618E 00	9.04625E-01	4.06246E-01
110	9.61120E 02	7.48520E 02	9.93794E-01	8.81344E-01	3.72551E-01	7.79486E-01	6.26310E-01	2.63333E-01

Table A.2 (continued)

Energy group	Group energy boundaries, eV		EMOPUUUX			AMOPUUTX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
111	7.48520E 02	4.54000E 02	5.33556E-01	5.99915E-01	2.45377E-01	3.46331E-01	3.24522E-01	1.20877E-01
112	4.54000E 02	2.75360E 02	2.06714E-01	3.04490E-01	1.24038E-01	1.15251E-01	1.32917E-01	4.55186E-02
113	2.75360E 02	2.14450E 02	9.67394E-02	1.82339E-01	7.20402E-02	4.25985E-02	5.80801E-02	1.72327E-02
114	2.14450E 02	1.67020E 02	5.83979E-02	1.37952E-01	5.49641E-02	1.45051E-02	2.04367E-02	4.90727E-03
115	1.67020E 02	1.01300E 02	1.67797E-02	5.77863E-02	2.00570E-02	1.82325E-03	3.34969E-03	6.17284E-04
116	1.01300E 02	6.14420E 01	6.11315E-03	3.93840E-02	1.54472E-02	6.76103E-04	2.47394E-03	4.89105E-04
117	6.14420E 01	4.78510E 01	1.98559E-03	2.13586E-02	8.80126E-03	2.10423E-04	2.55219E-03	6.70353E-04
118	4.78510E 01	3.72670E 01	6.24572E-04	1.07137E-02	4.11005E-03	6.25722E-05	1.56643E-03	4.08154E-04
119	3.72670E 01	2.26030E 01	3.28503E-04	7.37896E-03	2.98056E-03	5.38756E-06	1.71795E-04	3.56672E-05
120	2.26030E 01	1.06770E 01	3.04748E-05	1.84914E-03	6.10861E-04	2.97898E-07	5.05563E-05	1.06416E-05
121	1.06770E 01	5.04350E 00	2.25081E-06	4.05556E-04	9.85423E-05	7.44319E-08	1.53827E-05	3.40147E-06
122	5.04350E 00	2.37239E 00	8.74558E-07	2.18036E-04	1.15602E-04	4.33462E-07	8.99087E-05	6.85708E-05
123	2.37239E 00	1.12540E 00	2.75266E-07	6.93178E-05	4.97106E-05	2.16895E-07	3.61037E-05	5.29815E-05
124	1.12540E 00	4.13990E-01	1.95156E-08	1.08581E-05	1.03157E-05	1.95701E-08	6.41352E-06	1.53613E-05
125	4.13990E-01	1.00000E-01	8.09937E-09	3.83479E-07	2.73171E-07	7.26768E-09	2.48648E-07	5.17688E-07
126	1.00000E-01	1.00000E-05	6.77840E-10	1.53388E-08	8.55605E-09	6.18153E-10	9.96479E-09	3.59488E-08

Table A.3. Flux per unit lethargy for the AMOPTTTX and AMOOTTTX LMFBR fuels

Energy group	Group energy boundaries, eV		AMOPTTTX			AMOOTTTX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
1	1.73330E 07	1.22140E 07	1.11761E-02	1.43247E-03	9.65755E-04	6.83175E-03	8.31472E-04	4.51018E-04
2	1.22140E 07	1.00000E 07	6.79804E-02	8.42842E-03	5.75251E-03	4.18184E-02	4.93402E-03	2.69126E-03
3	1.00000E 07	8.18730E 06	2.13074E-01	2.70227E-02	1.85128E-02	1.44187E-01	1.69747E-02	9.28292E-03
4	8.18730E 06	6.70320E 06	5.21418E-01	6.82042E-02	4.68019E-02	3.93094E-01	4.62953E-02	2.53499E-02
5	6.70320E 06	6.06530E 06	9.15537E-01	1.24895E-01	8.75419E-02	7.37251E-01	8.91517E-02	4.96074E-02
6	6.06530E 06	5.48810E 06	1.18175E 00	1.59757E-01	1.09370E-01	9.92588E-01	1.16797E-01	6.40520E-02
7	5.48810E 06	4.49330E 06	1.78748E 00	2.48897E-01	1.70753E-01	1.55776E 00	1.87503E-01	1.02859E-01
8	4.49330E 06	3.67880E 06	2.45465E 00	3.35124E-01	2.19698E-01	2.19857E 00	2.53159E-01	1.35764E-01
9	3.67880E 06	3.16640E 06	3.22170E 00	4.45925E-01	2.83525E-01	2.93619E 00	3.38279E-01	1.78767E-01
10	3.16640E 06	3.01190E 06	4.53199E 00	6.89578E-01	4.60077E-01	4.11985E 00	5.36706E-01	2.90514E-01
11	3.01190E 06	2.86500E 06	4.73132E 00	7.37135E-01	4.91477E-01	4.30574E 00	5.71153E-01	3.13150E-01
12	2.86500E 06	2.72530E 06	5.09976E 00	8.05053E-01	5.35790E-01	4.64317E 00	6.23984E-01	3.42395E-01
13	2.72530E 06	2.59240E 06	5.82644E 00	9.47272E-01	6.28789E-01	5.30133E 00	7.36655E-01	4.03101E-01
14	2.59240E 06	2.46600E 06	5.90180E 00	9.66376E-01	6.47273E-01	5.38011E 00	7.52973E-01	4.15057E-01
15	2.46600E 06	2.38520E 06	6.35162E 00	1.07444E 00	7.35191E-01	5.78427E 00	8.39923E-01	4.72578E-01
16	2.38520E 06	2.36530E 06	7.43091E 00	1.33483E 00	9.21331E-01	6.74239E 00	1.04910E 00	5.95117E-01
17	2.36530E 06	2.30690E 06	7.51696E 00	1.37615E 00	9.65425E-01	6.81401E 00	1.09004E 00	6.20010E-01
18	2.30690E 06	2.23130E 06	6.89737E 00	1.23650E 00	8.07409E-01	6.27076E 00	9.61377E-01	5.27254E-01
19	2.23130E 06	2.12250E 06	6.21055E 00	1.07864E 00	6.78706E-01	5.67605E 00	8.31726E-01	4.45248E-01
20	2.12250E 06	2.01900E 06	5.95720E 00	1.01288E 00	6.28728E-01	5.46738E 00	7.80450E-01	4.12265E-01
21	2.01900E 06	1.92050E 06	6.24804E 00	1.07633E 00	6.46760E-01	5.73747E 00	8.28464E-01	4.26886E-01
22	1.92050E 06	1.82680E 06	6.52058E 00	1.13670E 00	6.57173E-01	5.97172E 00	8.70721E-01	4.35988E-01
23	1.82680E 06	1.73770E 06	7.62557E 00	1.37714E 00	8.56128E-01	6.99250E 00	1.06538E 00	5.66999E-01
24	1.73770E 06	1.65300E 06	7.79100E 00	1.42757E 00	8.59100E-01	7.11949E 00	1.10075E 00	5.71573E-01
25	1.65300E 06	1.57240E 06	7.50226E 00	1.36799E 00	8.26569E-01	6.78734E 00	1.04662E 00	5.47554E-01
26	1.57240E 06	1.49570E 06	8.22057E 00	1.53725E 00	9.23668E-01	7.50710E 00	1.19063E 00	6.12842E-01
27	1.49570E 06	1.42270E 06	8.81880E 00	1.67017E 00	1.01280E 00	8.05168E 00	1.29270E 00	6.73625E-01
28	1.42270E 06	1.35340E 06	9.24321E 00	1.79118E 00	1.05833E 00	8.41809E 00	1.36919E 00	7.13105E-01
29	1.35340E 06	1.28730E 06	7.58324E 00	1.42082E 00	8.10643E-01	6.88497E 00	1.07367E 00	5.45716E-01
30	1.28730E 06	1.22460E 06	9.78335E 00	1.90249E 00	1.17332E 00	8.88632E 00	1.46696E 00	7.81866E-01
31	1.22460E 06	1.16480E 06	1.11925E 01	2.27147E 00	1.36073E 00	1.01146E 01	1.72744E 00	9.21547E-01
32	1.16480E 06	1.10800E 06	1.02041E 01	2.07803E 00	1.22548E 00	9.19634E 00	1.57621E 00	8.29876E-01
33	1.10800E 06	1.00260E 06	7.90865E 00	1.56068E 00	8.81247E-01	7.02148E 00	1.16621E 00	5.93653E-01
34	1.00260E 06	9.61640E 05	7.42855E 00	1.44810E 00	8.12714E-01	6.66690E 00	1.08440E 00	5.46448E-01
35	9.61640E 05	9.07180E 05	9.28995E 00	1.86866E 00	1.10192E 00	8.29044E 00	1.39801E 00	7.43206E-01
36	9.07180E 05	8.62940E 05	1.05078E 01	2.16349E 00	1.33070E 00	9.37509E 00	1.64347E 00	8.89075E-01
37	8.62940E 05	8.20850E 05	1.36411E 01	2.90653E 00	1.78451E 00	1.21441E 01	2.20103E 00	1.19965E 00
38	8.20850E 05	7.80820E 05	1.43554E 01	3.05623E 00	2.00209E 00	1.27576E 01	2.33372E 00	1.33232E 00
39	7.80820E 05	7.42740E 05	1.52337E 01	3.32912E 00	2.16571E 00	1.34678E 01	2.55248E 00	1.43968E 00
40	7.42740E 05	7.06510E 05	1.50071E 01	3.35079E 00	2.18601E 00	1.32039E 01	2.50969E 00	1.47919E 00
41	7.06510E 05	6.72060E 05	1.51562E 01	3.45851E 00	2.27760E 00	1.32745E 01	2.60083E 00	1.53445E 00
42	6.72060E 05	6.39280E 05	1.68269E 01	3.97562E 00	2.55179E 00	1.46541E 01	2.99258E 00	1.71926E 00
43	6.39280E 05	6.08100E 05	1.78935E 01	4.34463E 00	2.74573E 00	1.55012E 01	3.26103E 00	1.85167E 00
44	6.08100E 05	5.78440E 05	1.85018E 01	4.59766E 00	2.88696E 00	1.59527E 01	3.43980E 00	1.94895E 00
45	5.78440E 05	5.50230E 05	1.87708E 01	4.75926E 00	2.98327E 00	1.61100E 01	3.58234E 00	2.00118E 00
46	5.50230E 05	5.23400E 05	1.98973E 01	5.18243E 00	3.16389E 00	1.70024E 01	3.89826E 00	2.12307E 00
47	5.23400E 05	4.97870E 05	1.98141E 01	5.25634E 00	3.14471E 00	1.68494E 01	3.98201E 00	2.09692E 00
48	4.97870E 05	4.50490E 05	1.44640E 01	3.84872E 00	2.16926E 00	1.18446E 01	2.84216E 00	1.45699E 00
49	4.50490E 05	4.07620E 05	1.08794E 01	2.88417E 00	1.64023E 00	9.04764E 00	2.14264E 00	1.09483E 00
50	4.07620E 05	3.68830E 05	1.27755E 01	3.45282E 00	1.92434E 00	1.08021E 01	2.53632E 00	1.29646E 00
51	3.68830E 05	3.33730E 05	1.67927E 01	4.64892E 00	2.66897E 00	1.41486E 01	3.44795E 00	1.78166E 00
52	3.33730E 05	3.01970E 05	1.84868E 01	5.26747E 00	2.99584E 00	1.54107E 01	3.86174E 00	2.00960E 00
53	3.01970E 05	2.98500E 05	1.74627E 01	5.00728E 00	2.93811E 00	1.44992E 01	3.63976E 00	1.97732E 00
54	2.98500E 05	2.97200E 05	1.83847E 01	5.31697E 00	3.05715E 00	1.52596E 01	3.89736E 00	2.04639E 00
55	2.97200E 05	2.94520E 05	1.96651E 01	5.74736E 00	3.22675E 00	1.62766E 01	4.27601E 00	2.13822E 00

Table A.3 (continued)

Energy group	Group energy boundaries, eV		AMOPTTTX			AMOOTTTX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
56	2.94520E 05	2.87250E 05	1.83201E 01	5.32187E 00	3.12506E 00	1.51434E 01	4.00953E 00	2.04547E 00
57	2.87250E 05	2.73240E 05	1.75422E 01	5.09599E 00	3.07299E 00	1.44739E 01	3.83817E 00	2.00650E 00
58	2.73240E 05	2.47240E 05	1.83804E 01	5.44922E 00	3.25366E 00	1.50590E 01	4.02257E 00	2.15274E 00
59	2.47240E 05	2.23710E 05	1.83005E 01	5.54556E 00	3.33841E 00	1.48612E 01	4.08924E 00	2.19723E 00
60	2.23710E 05	2.12800E 05	1.78508E 01	5.48052E 00	3.33292E 00	1.44014E 01	4.03546E 00	2.18689E 00
61	2.12800E 05	2.02420E 05	1.65915E 01	5.10770E 00	3.21369E 00	1.33468E 01	3.79878E 00	2.08550E 00
62	2.02420E 05	1.92550E 05	1.73876E 01	5.41617E 00	3.36687E 00	1.39237E 01	4.08148E 00	2.16111E 00
63	1.92550E 05	1.83160E 05	1.91477E 01	6.06201E 00	3.60826E 00	1.52504E 01	4.48445E 00	2.34753E 00
64	1.83160E 05	1.74220E 05	2.18561E 01	7.09939E 00	3.99860E 00	1.72622E 01	5.12049E 00	2.64359E 00
65	1.74220E 05	1.65730E 05	1.77035E 01	5.76742E 00	3.48761E 00	1.39184E 01	4.25688E 00	2.24663E 00
66	1.65730E 05	1.57640E 05	1.82296E 01	6.00639E 00	3.61429E 00	1.42586E 01	4.42933E 00	2.32475E 00
67	1.57640E 05	1.49960E 05	1.81895E 01	6.05663E 00	3.64606E 00	1.41534E 01	4.45275E 00	2.34383E 00
68	1.49960E 05	1.42640E 05	1.46014E 01	4.83669E 00	3.17091E 00	1.13426E 01	3.68614E 00	1.97005E 00
69	1.42640E 05	1.35690E 05	1.92212E 01	6.50990E 00	3.84183E 00	1.48386E 01	4.70734E 00	2.49788E 00
70	1.35690E 05	1.29070E 05	1.96591E 01	6.78553E 00	3.94418E 00	1.50632E 01	4.87250E 00	2.56149E 00
71	1.29070E 05	1.22770E 05	1.89368E 01	6.64376E 00	3.89223E 00	1.44031E 01	4.78280E 00	2.50559E 00
72	1.22770E 05	1.16790E 05	1.90732E 01	6.79633E 00	3.93010E 00	1.44154E 01	4.85802E 00	2.53088E 00
73	1.16790E 05	1.11090E 05	1.72545E 01	6.17483E 00	3.72220E 00	1.29850E 01	4.49001E 00	2.35516E 00
74	1.11090E 05	9.80370E 04	1.55773E 01	5.62506E 00	3.53958E 00	1.16199E 01	4.14740E 00	2.20234E 00
75	9.80370E 04	8.65170E 04	1.64955E 01	6.11752E 00	3.72237E 00	1.21468E 01	4.41520E 00	2.33530E 00
76	8.65170E 04	8.25000E 04	1.24274E 01	4.61866E 00	3.05747E 00	9.11097E 00	3.43531E 00	1.85543E 00
77	8.25000E 04	7.95000E 04	2.15271E 01	8.31816E 00	4.53025E 00	1.56240E 01	5.70653E 00	2.94311E 00
78	7.95000E 04	7.20000E 04	1.46241E 01	5.62707E 00	3.50690E 00	1.05585E 01	4.05639E 00	2.16616E 00
79	7.20000E 04	6.73790E 04	1.71491E 01	6.76462E 00	3.94292E 00	1.22536E 01	4.74080E 00	2.47870E 00
80	6.73790E 04	5.65620E 04	1.50597E 01	6.10710E 00	3.66833E 00	1.05751E 01	4.28049E 00	2.27083E 00
81	5.65620E 04	5.24750E 04	9.49269E 00	3.85136E 00	2.64315E 00	6.83014E 00	2.68116E 00	1.63370E 00
82	5.24750E 04	4.63090E 04	1.42203E 01	5.97522E 00	3.66664E 00	9.79853E 00	4.16691E 00	2.24783E 00
83	4.63090E 04	4.08680E 04	1.38337E 01	5.96310E 00	3.62683E 00	9.31084E 00	4.16438E 00	2.18814E 00
84	4.08680E 04	3.43070E 04	1.18250E 01	5.20633E 00	3.33200E 00	7.82153E 00	3.67161E 00	1.96424E 00
85	3.43070E 04	3.18280E 04	1.07337E 01	4.77388E 00	3.12708E 00	7.00929E 00	3.38341E 00	1.81895E 00
86	3.18280E 04	2.85000E 04	5.97837E 00	2.64865E 00	2.05455E 00	3.88906E 00	2.00965E 00	1.11299E 00
87	2.85000E 04	2.70000E 04	5.35397E 00	2.37305E 00	1.90526E 00	3.47444E 00	1.82926E 00	1.01594E 00
88	2.70000E 04	2.60580E 04	1.47503E 01	6.67286E 00	4.19502E 00	9.48488E 00	4.63474E 00	2.49835E 00
89	2.60580E 04	2.47880E 04	1.72013E 01	8.05358E 00	4.38202E 00	1.09014E 01	5.18915E 00	2.73746E 00
90	2.47880E 04	2.35790E 04	1.23076E 01	5.86501E 00	3.36625E 00	7.70513E 00	3.84057E 00	2.02895E 00
91	2.35790E 04	2.18750E 04	1.12281E 01	5.42071E 00	3.18587E 00	6.95937E 00	3.60317E 00	1.88022E 00
92	2.18750E 04	1.93050E 04	1.07273E 01	5.25504E 00	3.17089E 00	6.54244E 00	3.48760E 00	1.85923E 00
93	1.93050E 04	1.50340E 04	7.21179E 00	3.58680E 00	2.41047E 00	4.28253E 00	2.46909E 00	1.34425E 00
94	1.50340E 04	1.17090E 04	7.39398E 00	3.82346E 00	2.40257E 00	4.23838E 00	2.52162E 00	1.35915E 00
95	1.17090E 04	9.11880E 03	6.44240E 00	3.46873E 00	2.15121E 00	3.55635E 00	2.23477E 00	1.21003E 00
96	9.11880E 03	7.10170E 03	4.48876E 00	2.47895E 00	1.64747E 00	2.40815E 00	1.62489E 00	8.97154E-01
97	7.10170E 03	5.53080E 03	3.88640E 00	2.22328E 00	1.44784E 00	2.02519E 00	1.41255E 00	7.96254E-01
98	5.53080E 03	4.30740E 03	2.91564E 00	1.72573E 00	1.14714E 00	1.48182E 00	1.06795E 00	6.35535E-01
99	4.30740E 03	3.70740E 03	2.09072E 00	1.26003E 00	8.63809E-01	1.04880E 00	7.58949E-01	4.87049E-01
100	3.70740E 03	3.35460E 03	1.36356E 00	8.30391E-01	6.08031E-01	6.79248E-01	4.87969E-01	3.49961E-01
101	3.35460E 03	3.03540E 03	6.27267E-01	3.84069E-01	3.04004E-01	3.11239E-01	2.22980E-01	1.77468E-01
102	3.03540E 03	2.74650E 03	2.63846E-01	1.62090E-01	1.35841E-01	1.30782E-01	9.37690E-02	7.97216E-02
103	2.74650E 03	2.61260E 03	4.09500E-01	2.52830E-01	2.06589E-01	2.02134E-01	1.47984E-01	1.19517E-01
104	2.61260E 03	2.48520E 03	6.97666E-01	4.33101E-01	3.43523E-01	3.42963E-01	2.58385E-01	1.94303E-01
105	2.48520E 03	2.24870E 03	1.23341E 00	7.77737E-01	5.71246E-01	6.00866E-01	4.77630E-01	3.13489E-01
106	2.24870E 03	2.03470E 03	2.00921E 00	1.29605E 00	8.26455E-01	9.73278E-01	7.88978E-01	4.59763E-01
107	2.03470E 03	1.58460E 03	2.22792E 00	1.53234E 00	8.16175E-01	1.03314E 00	9.17328E-01	4.55351E-01
108	1.58460E 03	1.23410E 03	1.97080E 00	1.50447E 00	7.99320E-01	8.80037E-01	8.89671E-01	4.40497E-01
109	1.23410E 03	9.61120E 02	1.35066E 00	1.15073E 00	6.25587E-01	5.79271E-01	6.73901E-01	3.40665E-01
110	9.61120E 02	7.48520E 02	9.57309E-01	9.24025E-01	5.09064E-01	3.86656E-01	5.29224E-01	2.76130E-01

Table A.3 (continued)

Energy group	Group energy boundaries, eV		AMOPTTTX			AMOOTTTX		
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket
111	7.48520E 02	4.54000E 02	5.00147E-01	6.30390E-01	3.67070E-01	1.81155E-01	3.46919E-01	1.99483E-01
112	4.54000E 02	2.75360E 02	1.75335E-01	2.94732E-01	1.86202E-01	5.45948E-02	1.56562E-01	1.02437E-01
113	2.75360E 02	2.14450E 02	7.64116E-02	1.70549E-01	1.11007E-01	2.11102E-02	8.79230E-02	6.22247E-02
114	2.14450E 02	1.67020E 02	3.89724E-02	1.11151E-01	7.45277E-02	9.55794E-03	5.59919E-02	4.25604E-02
115	1.67020E 02	1.01300E 02	1.33205E-02	6.44120E-02	4.63411E-02	3.87980E-03	3.24521E-02	2.71010E-02
116	1.01300E 02	6.14420E 01	3.23418E-03	3.55945E-02	2.79276E-02	1.19190E-03	1.83711E-02	1.67181E-02
117	6.14420E 01	4.78510E 01	9.23892E-04	1.79717E-02	1.48557E-02	3.56574E-04	9.33076E-03	9.05561E-03
118	4.78510E 01	3.72670E 01	4.13009E-04	1.27967E-02	1.18644E-02	2.05735E-04	6.87099E-03	7.15062E-03
119	3.72670E 01	2.26030E 01	1.63394E-04	6.60791E-03	6.49493E-03	5.23413E-05	3.60914E-03	4.02001E-03
120	2.26030E 01	1.06770E 01	1.99823E-05	2.32967E-03	2.21237E-03	7.91751E-06	1.34594E-03	1.41431E-03
121	1.06770E 01	5.04350E 00	3.81981E-06	9.51581E-04	8.73399E-04	1.49728E-06	5.88515E-04	5.61173E-04
122	5.04350E 00	2.37239E 00	1.66148E-06	3.34236E-04	5.20840E-04	8.37496E-07	2.09541E-04	3.23809E-04
123	2.37239E 00	1.12540E 00	2.85225E-07	7.06009E-05	1.17850E-04	9.08648E-08	4.51807E-05	8.28441E-05
124	1.12540E 00	4.13990E-01	3.00916E-08	1.45544E-05	3.89583E-05	8.62851E-08	9.23348E-06	2.63940E-05
125	4.13990E-01	1.00000E-01	8.06679E-09	7.20799E-07	2.40349E-06	1.70814E-08	4.53837E-07	1.69416E-06
126	1.00000E-01	1.00000E-05	5.72139E-10	2.35823E-08	9.37007E-08	6.04996E-10	1.46544E-08	7.06901E-08

Table A.4. Flux per unit lethargy for the AM01TTTX, AM02TTTX, and FFTF LMFBR fuels

Energy group	Group energy boundaries, eV		AM01TTTX			AM02TTTX			
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket	FFTF
1	1.73330E 07	1.22140E 07	7.45285E-03	1.00061E-03	5.22681E-04	6.86029E-03	7.89666E-04	5.53321E-04	1.37677E-02
2	1.22140E 07	1.00000E 07	4.54624E-02	5.93161E-03	3.11406E-03	4.18965E-02	4.65842E-03	3.30533E-03	8.30170E-02
3	1.00000E 07	8.18730E 06	1.51767E-01	1.91720E-02	1.05711E-02	1.43669E-01	1.59018E-02	1.13925E-02	2.54620E-01
4	8.18730E 06	6.70320E 06	4.00681E-01	4.88980E-02	2.84549E-02	3.89994E-01	4.30460E-02	3.11320E-02	6.09340E-01
5	6.70320E 06	6.06530E 06	7.39663E-01	9.04980E-02	5.55200E-02	7.30229E-01	8.23728E-02	6.11845E-02	1.04299E 00
6	6.06530E 06	5.48810E 06	9.88415E-01	1.17342E-01	7.12860E-02	9.82978E-01	1.08002E-01	7.88357E-02	1.35353E 00
7	5.48810E 06	4.49330E 06	1.54379E 00	1.85615E-01	1.14629E-01	1.54197E 00	1.72935E-01	1.26897E-01	2.02678E 00
8	4.49330E 06	3.67880E 06	2.18273E 00	2.54066E-01	1.50220E-01	2.17956E 00	2.35915E-01	1.66099E-01	2.85239E 00
9	3.67880E 06	3.16640E 06	2.89769E 00	3.39004E-01	1.95607E-01	2.89757E 00	3.16665E-01	2.16462E-01	3.78745E 00
10	3.16640E 06	3.01190E 06	4.06236E 00	5.23849E-01	3.21110E-01	4.06636E 00	4.97021E-01	3.55566E-01	5.10669E 00
11	3.01190E 06	2.86500E 06	4.22993E 00	5.56951E-01	3.43160E-01	4.24611E 00	5.33129E-01	3.80544E-01	5.31877E 00
12	2.86500E 06	2.72530E 06	4.54227E 00	6.03646E-01	3.73434E-01	4.57554E 00	5.83316E-01	4.15061E-01	5.68972E 00
13	2.72530E 06	2.59240E 06	5.16133E 00	7.04585E-01	4.37976E-01	5.21865E 00	6.88822E-01	4.87980E-01	6.44016E 00
14	2.59240E 06	2.46600E 06	5.21245E 00	7.13178E-01	4.50127E-01	5.29245E 00	7.03648E-01	5.02742E-01	6.46849E 00
15	2.46600E 06	2.38520E 06	5.58011E 00	7.86996E-01	5.11537E-01	5.68893E 00	7.85561E-01	5.72766E-01	6.86081E 00
16	2.38520E 06	2.36530E 06	6.46908E 00	9.70751E-01	6.41865E-01	6.61976E 00	9.81709E-01	7.20339E-01	7.92774E 00
17	2.36530E 06	2.30690E 06	6.52344E 00	9.96947E-01	6.71565E-01	6.68848E 00	1.01388E 00	7.54636E-01	7.88029E 00
18	2.30690E 06	2.23130E 06	5.98574E 00	8.90513E-01	5.60273E-01	6.15415E 00	9.08807E-01	6.30350E-01	7.46323E 00
19	2.23130E 06	2.12250E 06	5.38444E 00	7.69031E-01	4.68898E-01	5.56172E 00	7.90014E-01	5.28670E-01	6.82446E 00
20	2.12250E 06	2.01900E 06	5.16161E 00	7.16779E-01	4.33211E-01	5.35264E 00	7.40492E-01	4.89497E-01	6.58661E 00
21	2.01900E 06	1.92050E 06	5.38696E 00	7.55078E-01	4.45375E-01	5.61363E 00	7.88204E-01	5.04730E-01	6.98497E 00
22	1.92050E 06	1.82680E 06	5.58871E 00	7.89398E-01	4.51885E-01	5.85433E 00	8.33368E-01	5.13480E-01	7.39478E 00
23	1.82680E 06	1.73770E 06	6.47355E 00	9.47208E-01	5.87756E-01	6.81714E 00	1.01377E 00	6.70142E-01	8.24004E 00
24	1.73770E 06	1.65300E 06	6.55558E 00	9.69196E-01	5.87666E-01	6.94685E 00	1.05149E 00	6.72233E-01	8.42375E 00
25	1.65300E 06	1.57240E 06	6.25692E 00	9.14202E-01	5.62598E-01	6.67952E 00	1.00611E 00	6.45552E-01	8.04345E 00
26	1.57240E 06	1.49570E 06	6.75218E 00	1.00698E 00	6.25460E-01	7.28129E 00	1.13188E 00	7.21285E-01	8.66416E 00
27	1.49570E 06	1.42270E 06	7.21019E 00	1.08904E 00	6.84555E-01	7.79307E 00	1.23061E 00	7.90545E-01	9.19422E 00
28	1.42270E 06	1.35340E 06	7.52087E 00	1.16394E 00	7.14882E-01	8.14541E 00	1.32153E 00	8.26783E-01	9.76266E 00
29	1.35340E 06	1.28730E 06	6.16991E 00	9.15678E-01	5.46225E-01	6.69875E 00	1.04378E 00	6.31171E-01	8.19410E 00
30	1.28730E 06	1.22460E 06	7.92436E 00	1.22977E 00	7.91228E-01	8.60654E 00	1.40336E 00	9.16058E-01	1.00507E 01
31	1.22460E 06	1.16480E 06	8.95985E 00	1.45579E 00	9.15726E-01	9.77778E 00	1.67913E 00	1.06304E 00	1.15534E 01
32	1.16480E 06	1.10800E 06	8.16963E 00	1.33133E 00	8.23498E-01	8.90135E 00	1.53472E 00	9.55966E-01	1.05500E 01
33	1.10800E 06	1.00260E 06	6.34576E 00	9.94119E-01	5.90782E-01	6.90869E 00	1.14717E 00	6.84868E-01	8.41031E 00
34	1.00260E 06	9.61640E 05	5.98045E 00	9.23238E-01	5.44607E-01	6.49561E 00	1.06265E 00	6.30789E-01	7.95567E 00
35	9.61640E 05	9.07180E 05	7.47826E 00	1.20029E 00	7.38968E-01	8.09170E 00	1.37493E 00	8.56437E-01	9.68624E 00
36	9.07180E 05	8.62940E 05	8.47907E 00	1.40241E 00	8.92954E-01	9.12704E 00	1.59514E 00	1.03436E 00	1.05883E 01
37	8.62940E 05	8.20850E 05	1.09495E 01	1.88326E 00	1.19691E 00	1.17909E 01	2.14746E 00	1.38760E 00	1.36075E 01
38	8.20850E 05	7.80820E 05	1.15564E 01	1.98986E 00	1.34239E 00	1.24040E 01	2.25850E 00	1.55496E 00	1.37760E 01
39	7.80820E 05	7.42740E 05	1.22343E 01	2.17031E 00	1.45236E 00	1.31129E 01	2.46368E 00	1.68243E 00	1.45564E 01
40	7.42740E 05	7.06510E 05	1.21073E 01	2.20491E 00	1.46736E 00	1.28920E 01	2.48160E 00	1.69790E 00	1.45570E 01
41	7.06510E 05	6.72060E 05	1.23163E 01	2.30441E 00	1.53146E 00	1.30042E 01	2.56438E 00	1.76906E 00	1.46254E 01
42	6.72060E 05	6.39280E 05	1.36782E 01	2.66544E 00	1.71780E 00	1.43741E 01	2.95213E 00	1.98173E 00	1.63370E 01
43	6.39280E 05	6.08100E 05	1.45951E 01	2.94068E 00	1.85075E 00	1.52348E 01	3.22926E 00	2.13127E 00	1.74700E 01
44	6.08100E 05	5.78440E 05	1.51311E 01	3.13437E 00	1.94797E 00	1.57044E 01	3.41944E 00	2.23934E 00	1.81536E 01
45	5.78440E 05	5.50230E 05	1.54000E 01	3.26896E 00	2.01532E 00	1.58903E 01	3.54176E 00	2.31245E 00	1.82182E 01
46	5.50230E 05	5.23400E 05	1.63619E 01	3.58487E 00	2.14070E 00	1.67858E 01	3.85982E 00	2.45146E 00	1.95158E 01
47	5.23400E 05	4.97870E 05	1.63721E 01	3.66883E 00	2.13179E 00	1.66859E 01	3.91767E 00	2.43629E 00	1.95421E 01
48	4.97870E 05	4.50490E 05	1.20291E 01	2.70455E 00	1.47258E 00	1.21915E 01	2.86594E 00	1.68023E 00	1.49585E 01
49	4.50490E 05	4.07620E 05	9.11258E 00	2.03745E 00	1.11517E 00	9.19534E 00	2.14709E 00	1.27037E 00	1.11664E 01
50	4.07620E 05	3.68830E 05	1.06882E 01	2.44091E 00	1.30994E 00	1.07561E 01	2.56968E 00	1.48881E 00	1.31913E 01
51	3.68830E 05	3.33730E 05	1.40119E 01	3.30000E 00	1.81637E 00	1.40287E 01	3.46016E 00	2.06035E 00	1.68012E 01
52	3.33730E 05	3.01970E 05	1.53990E 01	3.75573E 00	2.03881E 00	1.53209E 01	3.91801E 00	2.30640E 00	1.85132E 01
53	3.01970E 05	2.98500E 05	1.45283E 01	3.57644E 00	1.99879E 00	1.44262E 01	3.72345E 00	2.25924E 00	1.72542E 01
54	2.98500E 05	2.97200E 05	1.51903E 01	3.77266E 00	2.07869E 00	1.51483E 01	3.95382E 00	2.34994E 00	1.80930E 01
55	2.97200E 05	2.94520E 05	1.61225E 01	4.04773E 00	2.19230E 00	1.61452E 01	4.27410E 00	2.47915E 00	1.92351E 01

Table A.4 (continued)

Energy group	Group energy boundaries, eV: Upper	Group energy boundaries, eV: Lower	AM01TTTX: Core	AM01TTTX: Axial blanket	AM01TTTX: Radial blanket	AM02TTTX: Core	AM02TTTX: Axial blanket	AM02TTTX: Radial blanket	FFTF
56	2.94520E 05	2.87250E 05	1.52014E 01	3.80263E 00	2.12551E 00	1.50729E 01	3.95871E 00	2.40053E 00	1.74701E 01
57	2.87250E 05	2.73240E 05	1.46132E 01	3.66445E 00	2.09053E 00	1.44247E 01	3.79009E 00	2.35844E 00	1.64447E 01
58	2.73240E 05	2.47240E 05	1.52554E 01	3.92104E 00	2.21248E 00	1.50128E 01	4.05064E 00	2.49102E 00	1.73556E 01
59	2.47240E 05	2.23710E 05	1.51318E 01	3.99650E 00	2.26773E 00	1.48320E 01	4.11890E 00	2.54768E 00	1.70812E 01
60	2.23710E 05	2.12800E 05	1.47447E 01	3.95892E 00	2.26241E 00	1.44008E 01	4.06800E 00	2.53772E 00	1.63206E 01
61	2.12800E 05	2.02420E 05	1.37290E 01	3.70452E 00	2.18096E 00	1.33597E 01	3.79054E 00	2.44388E 00	1.49970E 01
62	2.02420E 05	1.92550E 05	1.43418E 01	3.92855E 00	2.28368E 00	1.39419E 01	4.01825E 00	2.55636E 00	1.53830E 01
63	1.92550E 05	1.83160E 05	1.56846E 01	4.37544E 00	2.44461E 00	1.52593E 01	4.49369E 00	2.73394E 00	1.72937E 01
64	1.83160E 05	1.74220E 05	1.77477E 01	5.10132E 00	2.70481E 00	1.72632E 01	5.25590E 00	3.02066E 00	2.03822E 01
65	1.74220E 05	1.65730E 05	1.44425E 01	4.17766E 00	2.35825E 00	1.39528E 01	4.26775E 00	2.63031E 00	1.56169E 01
66	1.65730E 05	1.57640E 05	1.47896E 01	4.33769E 00	2.44126E 00	1.42929E 01	4.44156E 00	2.72036E 00	1.60675E 01
67	1.57640E 05	1.49960E 05	1.47225E 01	4.38014E 00	2.46024E 00	1.41953E 01	4.47522E 00	2.73850E 00	1.59200E 01
68	1.49960E 05	1.42640E 05	1.18913E 01	3.52623E 00	2.13924E 00	1.14024E 01	3.57376E 00	2.37977E 00	1.20001E 01
69	1.42640E 05	1.35690E 05	1.55059E 01	4.71201E 00	2.58789E 00	1.48994E 01	4.80381E 00	2.87543E 00	1.66361E 01
70	1.35690E 05	1.29070E 05	1.58238E 01	4.92425E 00	2.65350E 00	1.51408E 01	5.00070E 00	2.94341E 00	1.76767E 01
71	1.29070E 05	1.22770E 05	1.51087E 01	4.79481E 00	2.61340E 00	1.44732E 01	4.88941E 00	2.89606E 00	1.62458E 01
72	1.22770E 05	1.16790E 05	1.52164E 01	4.92432E 00	2.63576E 00	1.45036E 01	4.99537E 00	2.91628E 00	1.64746E 01
73	1.16790E 05	1.11090E 05	1.38053E 01	4.50397E 00	2.49504E 00	1.30851E 01	4.53603E 00	2.75719E 00	1.44897E 01
74	1.11090E 05	9.80370E 04	1.24540E 01	4.12465E 00	2.36890E 00	1.17357E 01	4.12717E 00	2.61277E 00	1.23478E 01
75	9.80370E 04	8.65170E 04	1.32528E 01	4.55453E 00	2.48730E 00	1.23094E 01	4.47824E 00	2.73218E 00	1.33181E 01
76	8.65170E 04	8.25000E 04	1.00460E 01	3.47509E 00	2.04210E 00	9.25901E 00	3.37960E 00	2.24062E 00	9.47029E 00
77	8.25000E 04	7.95000E 04	1.71051E 01	6.17868E 00	3.01833E 00	1.58345E 01	6.06946E 00	3.30304E 00	1.84649E 01
78	7.95000E 04	7.20000E 04	1.17805E 01	4.26450E 00	2.33703E 00	1.07481E 01	4.10427E 00	2.55228E 00	1.13924E 01
79	7.20000E 04	6.73790E 04	1.36872E 01	5.11124E 00	2.62255E 00	1.24695E 01	4.92295E 00	2.85636E 00	1.38155E 01
80	6.73790E 04	5.65620E 04	1.19713E 01	4.64744E 00	2.43214E 00	1.07937E 01	4.42884E 00	2.63798E 00	1.18078E 01
81	5.65620E 04	5.24750E 04	7.55555E 00	2.94991E 00	1.74963E 00	6.77018E 00	2.78979E 00	1.89533E 00	6.70992E 00
82	5.24750E 04	4.63090E 04	1.10614E 01	4.49739E 00	2.41583E 00	9.96603E 00	4.31343E 00	2.61065E 00	1.04242E 01
83	4.63090E 04	4.08680E 04	1.06438E 01	4.47915E 00	2.37787E 00	9.53939E 00	4.28747E 00	2.56176E 00	1.01313E 01
84	4.08680E 04	3.43070E 04	8.99562E 00	3.90913E 00	2.17283E 00	8.01711E 00	3.72829E 00	2.33423E 00	8.34074E 00
85	3.43070E 04	3.18280E 04	8.10630E 00	3.58731E 00	2.03266E 00	7.19595E 00	3.41125E 00	2.18015E 00	6.90682E 00
86	3.18280E 04	2.85000E 04	4.51590E 00	1.99672E 00	1.33467E 00	4.00127E 00	1.89242E 00	1.43171E 00	3.49436E 00
87	2.85000E 04	2.70000E 04	4.04147E 00	1.79069E 00	1.23722E 00	3.57692E 00	1.69531E 00	1.32713E 00	3.09880E 00
88	2.70000E 04	2.60580E 04	1.09002E 01	4.93845E 00	2.71436E 00	9.72608E 00	4.75683E 00	2.90830E 00	9.73495E 00
89	2.60580E 04	2.47880E 04	1.25436E 01	5.91471E 00	2.81889E 00	1.11672E 01	5.71427E 00	3.01335E 00	1.21585E 01
90	2.47880E 04	2.35790E 04	8.97938E 00	4.34315E 00	2.15861E 00	7.92030E 00	4.14750E 00	2.30319E 00	8.91061E 00
91	2.35790E 04	2.18750E 04	8.12341E 00	3.99814E 00	2.03691E 00	7.15569E 00	3.82316E 00	2.17079E 00	7.57065E 00
92	2.18750E 04	1.93050E 04	7.66869E 00	3.86504E 00	2.01747E 00	6.73290E 00	3.69223E 00	2.14612E 00	6.92543E 00
93	1.93050E 04	1.50340E 04	5.08600E 00	2.64423E 00	1.52286E 00	4.42230E 00	2.50709E 00	1.61556E 00	4.09161E 00
94	1.50340E 04	1.17090E 04	5.08338E 00	2.79537E 00	1.50215E 00	4.38287E 00	2.65180E 00	1.58762E 00	4.39836E 00
95	1.17090E 04	9.11880E 03	4.31917E 00	2.51430E 00	1.32996E 00	3.68656E 00	2.38480E 00	1.40018E 00	3.93133E 00
96	9.11880E 03	7.10170E 03	2.96749E 00	1.79748E 00	1.01158E 00	2.50455E 00	1.69609E 00	1.06255E 00	2.67905E 00
97	7.10170E 03	5.53080E 03	2.52736E 00	1.60020E 00	8.82086E-01	2.10877E 00	1.51260E 00	9.24038E-01	2.16671E 00
98	5.53080E 03	4.30740E 03	1.87706E 00	1.23660E 00	6.94408E-01	1.54522E 00	1.16878E 00	7.25783E-01	1.62763E 00
99	4.30740E 03	3.70740E 03	1.34746E 00	9.08913E-01	5.21437E-01	1.09612E 00	8.51888E-01	5.44440E-01	1.18006E 00
100	3.70740E 03	3.35460E 03	8.77137E-01	6.00298E-01	3.66640E-01	7.11485E-01	5.61170E-01	3.82790E-01	7.62272E-01
101	3.35460E 03	3.03540E 03	4.02862E-01	2.77367E-01	1.83267E-01	3.26749E-01	2.59595E-01	1.91407E-01	3.42738E-01
102	3.03540E 03	2.74650E 03	1.69743E-01	1.17271E-01	8.18804E-02	1.37496E-01	1.09574E-01	8.55381E-02	1.42356E-01
103	2.74650E 03	2.61260E 03	2.64326E-01	1.83519E-01	1.24524E-01	2.13311E-01	1.70910E-01	1.30086E-01	2.26793E-01
104	2.61260E 03	2.48520E 03	4.49417E-01	3.12118E-01	2.07047E-01	3.62424E-01	2.92721E-01	2.16248E-01	4.09977E-01
105	2.48520E 03	2.24870E 03	7.74383E-01	5.44385E-01	3.43920E-01	6.35308E-01	5.25320E-01	3.59157E-01	7.99655E-01
106	2.24870E 03	2.03470E 03	1.29415E 00	9.29175E-01	4.96767E-01	1.02915E 00	8.74095E-01	5.17889E-01	1.26369E 00
107	2.03470E 03	1.58460E 03	1.47309E 00	1.06951E 00	4.88521E-01	1.09919E 00	1.02706E 00	5.05841E-01	1.45540E 00
108	1.58460E 03	1.23410E 03	1.19767E 00	9.31469E-01	4.72978E-01	9.11481E-01	9.98989E-01	4.88093E-01	1.20668E 00
109	1.23410E 03	9.61120E 02	8.82993E-01	7.37929E-01	3.68854E-01	6.17449E-01	7.59437E-01	3.78129E-01	8.60078E-01
110	9.61120E 02	7.48520E 02	6.07661E-01	5.12308E-01	2.97983E-01	4.14117E-01	6.05020E-01	3.04056E-01	5.94457E-01

Table A.4 (continued)

Energy group	Group energy boundaries, eV		AM01TTTX			AM02TTTX			
	Upper	Lower	Core	Axial blanket	Radial blanket	Core	Axial blanket	Radial blanket	FFTF
111	7.48520E 02	4.54000E 02	3.19340E-01	2.68915E-01	2.12913E-01	1.99558E-01	4.08576E-01	2.15957E-01	3.07685E-01
112	4.54000E 02	2.75360E 02	1.21361E-01	1.11413E-01	1.07911E-01	6.48102E-02	1.90405E-01	1.09012E-01	1.20691E-01
113	2.75360E 02	2.14450E 02	5.84086E-02	4.94097E-02	6.44040E-02	2.75699E-02	1.10152E-01	6.49291E-02	4.93779E-02
114	2.14450E 02	1.67020E 02	3.42831E-02	1.77798E-02	4.33093E-02	1.31416E-02	7.18386E-02	4.35686E-02	2.78573E-02
115	1.67020E 02	1.01300E 02	1.02740E-02	3.01249E-03	2.67765E-02	4.09943E-03	4.18347E-02	2.71862E-02	8.24889E-03
116	1.01300E 02	6.14420E 01	4.15999E-03	2.21683E-03	1.62537E-02	1.24906E-03	2.34746E-02	1.66535E-02	2.33709E-03
117	6.14420E 01	4.78510E 01	1.50119E-03	2.25116E-03	8.65924E-03	4.08375E-04	1.19488E-02	8.92884E-03	5.87919E-04
118	4.78510E 01	3.72670E 01	6.02553E-04	1.36736E-03	6.90654E-03	2.16358E-04	8.56439E-03	7.18967E-03	2.01945E-04
119	3.72670E 01	2.26030E 01	1.99748E-04	1.47544E-04	3.78834E-03	5.69945E-05	4.46830E-03	3.99596E-03	1.21854E-04
120	2.26030E 01	1.06770E 01	1.94001E-05	4.24033E-05	1.30925E-03	7.31025E-06	1.60463E-03	1.41750E-03	1.45234E-05
121	1.06770E 01	5.04350E 00	1.83439E-06	1.28431E-05	5.17834E-04	1.41263E-06	6.69292E-04	5.88470E-04	7.04249E-06
122	5.04350E 00	2.37239E 00	9.14399E-07	7.48579E-05	3.10709E-04	8.04493E-07	2.33503E-04	3.57272E-04	1.00392E-05
123	2.37239E 00	1.12540E 00	1.10007E-07	3.00548E-05	7.78112E-05	8.85669E-08	5.06734E-05	9.16377E-05	2.41081E-06
124	1.12540E 00	4.13990E-01	8.10654E-08	5.37057E-06	2.53803E-05	8.26383E-08	1.01821E-05	3.00933E-05	6.48793E-08
125	4.13990E-01	1.00000E-01	1.40312E-08	2.09827E-07	1.58314E-06	1.63569E-08	5.02846E-07	1.92663E-06	7.59713E-09
126	1.00000E-01	1.00000E-05	6.24785E-10	8.37382E-09	6.28890E-08	6.25750E-10	1.64719E-08	7.90473E-08	7.73024E-10

APPENDIX B:

ONE-GROUP, SPECTRUM-AVERAGED CROSS SECTIONS FOR THE AMOPUUUX, AMO2TTTX, AND FFTF LMFBRS

Table B.1. One-group, spectrum-averaged cross sections for AMOPUUUX, AMO2TTTX, and FFTF LMFBR fuels

Isotope	Cross section type[a]	Cross section (barns)						
		AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
H - 1	N,G	1.89E-04	3.36E-04	3.07E-04	1.49E-04	3.03E-04	2.76E-04	1.55E-04
B - 10	N,A	2.51E 00	4.22E 00	3.88E 00	2.06E 00	3.86E 00	3.55E 00	2.11E 00
B - 11	N,G	3.75E-05	5.25E-05	5.01E-05	3.21E-05	5.09E-05	4.84E-05	3.07E-05
C - 12	N,G	3.07E-06	3.75E-06	3.56E-06	2.85E-06	3.38E-06	3.18E-06	3.02E-06
N - 14	N,P	1.41E-02	9.91E-03	1.04E-02	1.50E-02	9.53E-03	9.83E-03	1.53E-02
N - 15	N,G	1.23E-05	1.01E-05	1.03E-05	1.30E-05	1.02E-05	1.05E-05	1.31E-05
O - 16	N,A	1.13E-03	4.90E-04	6.20E-04	1.28E-03	4.85E-04	5.92E-04	1.36E-03
O - 17	N,G	6.58E-05	4.29E-05	4.54E-05	7.10E-05	4.16E-05	4.31E-05	7.34E-05
NA- 23	N,G	1.41E-03	2.22E-03	2.23E-03	1.13E-03	2.03E-03	2.00E-03	1.20E-03
MN- 55	N,G	6.19E-02	1.66E-01	1.41E-01	3.61E-02	1.36E-01	1.11E-01	4.39E-02
CO- 59	N,G	5.43E-02	2.23E-01	1.72E-01	3.13E-02	2.18E-01	1.78E-01	3.79E-02
GE- 72	N,G	5.08E-02	5.91E-02	5.94E-02	4.80E-02	5.85E-02	5.85E-02	4.72E-02
GE- 73	N,G	3.22E-01	7.69E-01	6.57E-01	2.21E-01	6.63E-01	5.60E-01	2.43E-01
GE- 74	N,G	2.99E-02	3.51E-02	3.54E-02	2.81E-02	3.50E-02	3.52E-02	2.74E-02
GE- 76	N,G	1.86E-02	3.92E-02	3.31E-02	1.36E-02	3.39E-02	2.85E-02	1.52E-02
AS- 75	N,G	3.49E-01	6.91E-01	6.14E-01	2.63E-01	6.10E-01	5.40E-01	2.79E-01
SE- 76	N,G	1.51E-01	2.75E-01	2.47E-01	1.17E-01	2.42E-01	2.15E-01	1.24E-01
SE- 77	N,G	3.46E-01	6.03E-01	5.47E-01	2.73E-01	5.42E-01	4.87E-01	2.81E-01
SE- 78	N,G	6.03E-02	1.11E-01	1.01E-01	4.78E-02	9.81E-02	8.82E-02	5.01E-02
SE- 80	N,G	5.26E-02	7.10E-02	6.74E-02	4.54E-02	6.72E-02	6.32E-02	4.55E-02
SE- 82	N,G	9.10E-03	9.71E-03	9.71E-03	8.97E-03	9.88E-03	9.93E-03	8.78E-03
BR- 79	N,G	6.14E-01	1.18E 00	1.06E 00	4.72E-01	1.04E 00	9.28E-01	4.97E-01
BR- 81	N,G	3.33E-01	5.93E-01	5.38E-01	2.71E-01	5.44E-01	4.95E-01	2.76E-01
KR- 80	N,G	1.83E-01	4.04E-01	3.41E-01	1.40E-01	3.85E-01	3.32E-01	1.49E-01
KR- 82	N,G	1.39E-01	3.14E-01	2.91E-01	1.15E-01	2.91E-01	2.88E-01	1.22E-01
KR- 83	N,G	4.76E-01	7.88E-01	7.41E-01	3.87E-01	7.21E-01	6.78E-01	4.02E-01
KR- 84	N,G	4.90E-02	1.10E-01	9.14E-02	3.17E-02	9.24E-02	7.52E-02	3.71E-02
KR- 85	N,G	3.66E-02	5.80E-02	5.35E-02	2.88E-02	5.31E-02	4.83E-02	2.95E-02
KR- 86	N,G	3.30E-03	3.83E-03	4.02E-03	3.13E-03	3.80E-03	3.94E-03	3.11E-03
RB- 85	N,G	2.01E-01	3.14E-01	2.93E-01	1.65E-01	2.91E-01	2.71E-01	1.66E-01
RB- 86	N,G	1.60E-01	3.79E-01	3.27E-01	1.09E-01	3.21E-01	2.71E-01	1.18E-01
RB- 87	N,G	1.44E-02	3.55E-02	3.11E-02	1.02E-02	2.98E-02	2.56E-02	1.11E-02
SR- 86	N,G	6.77E-02	1.33E-01	1.15E-01	5.02E-02	1.16E-01	9.95E-02	5.49E-02
SR- 87	N,G	9.56E-02	1.59E-01	1.47E-01	7.60E-02	1.46E-01	1.35E-01	8.08E-02
SR- 88	N,G	1.14E-03	1.07E-03	1.09E-03	1.15E-03	1.07E-03	1.09E-03	1.15E-03
SR- 89	N,G	2.03E-02	2.72E-02	2.65E-02	1.77E-02	2.60E-02	2.51E-02	1.75E-02
SR- 90	N,G	1.28E-02	1.47E-02	1.47E-02	1.22E-02	1.46E-02	1.46E-02	1.20E-02
Y - 89	N,G	2.19E-02	2.73E-02	2.79E-02	2.00E-02	2.67E-02	2.69E-02	1.98E-02
Y - 90	N,G	1.22E-01	1.85E-01	1.74E-01	1.02E-01	1.73E-01	1.62E-01	1.02E-01
Y - 91	N,G	3.94E-02	6.14E-02	5.66E-02	3.17E-02	5.63E-02	5.14E-02	3.26E-02
ZR- 90	N,G	2.24E-02	2.72E-02	2.76E-02	2.03E-02	2.63E-02	2.63E-02	2.01E-02
ZR- 91	N,G	7.83E-02	1.49E-01	1.34E-01	5.88E-02	1.30E-01	1.15E-01	6.20E-02
ZR- 93	N,G	8.58E-02	2.22E-01	1.86E-01	5.96E-02	1.97E-01	1.65E-01	6.47E-02
ZR- 94	N,G	2.01E-02	2.65E-02	2.65E-02	1.76E-02	2.55E-02	2.52E-02	1.74E-02
ZR- 95	N,G	1.46E-01	2.36E-01	2.17E-01	1.17E-01	2.15E-01	1.95E-01	1.20E-01
ZR- 96	N,G	4.30E-02	9.57E-02	8.43E-02	3.20E-02	8.01E-02	6.90E-02	3.54E-02
NB- 93	N,G	1.98E-01	3.31E-01	3.03E-01	1.56E-01	3.00E-01	2.71E-01	1.61E-01
NB- 93	N,G	2.00E-01	3.35E-01	3.06E-01	1.57E-01	3.03E-01	2.73E-01	1.62E-01
NB- 94	N,G	2.23E-01	4.32E-01	3.89E-01	1.68E-01	3.87E-01	3.50E-01	1.76E-01

Table B.1 (continued)

Isotope	Cross section type[a]	Cross section (barns)						
		AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
NB- 95	N,G	3.31E-01	5.80E-01	5.25E-01	2.63E-01	5.23E-01	4.69E-01	2.70E-01
MO- 94	N,G	4.69E-02	6.37E-02	6.04E-02	4.03E-02	6.02E-02	5.64E-02	4.10E-02
MO- 95	N,G	2.75E-01	5.06E-01	4.66E-01	2.21E-01	4.65E-01	4.37E-01	2.29E-01
MO- 96	N,G	5.55E-02	1.18E-01	1.02E-01	4.46E-02	1.16E-01	1.03E-01	4.63E-02
MO- 97	N,G	2.60E-01	4.30E-01	3.95E-01	2.11E-01	3.92E-01	3.58E-01	2.15E-01
MO- 99	N,G	4.47E-01	6.85E-01	6.42E-01	3.80E-01	6.42E-01	6.02E-01	3.79E-01
MO-100	N,G	7.48E-02	1.30E-01	1.17E-01	5.78E-02	1.16E-01	1.03E-01	6.10E-02
TC- 99	N,G	4.49E-01	7.85E-01	7.18E-01	3.57E-01	7.17E-01	6.60E-01	3.70E-01
RU- 99	N,G	4.55E-01	8.32E-01	7.55E-01	3.65E-01	7.58E-01	6.89E-01	3.75E-01
RU-100	N,G	1.54E-01	2.71E-01	2.42E-01	1.20E-01	2.41E-01	2.14E-01	1.25E-01
RU-101	N,G	4.93E-01	7.89E-01	7.39E-01	4.17E-01	7.34E-01	6.90E-01	4.18E-01
RU-102	N,G	1.76E-01	2.41E-01	2.28E-01	1.52E-01	2.29E-01	2.15E-01	1.53E-01
RU-103	N,G	4.04E-01	6.79E-01	6.31E-01	3.40E-01	6.26E-01	5.85E-01	3.41E-01
RU-104	N,G	1.30E-01	2.19E-01	2.00E-01	1.05E-01	1.98E-01	1.79E-01	1.07E-01
RU-105	N,G	3.25E-01	4.59E-01	4.42E-01	2.83E-01	4.42E-01	4.25E-01	2.76E-01
RU-106	N,G	7.50E-02	1.13E-01	1.08E-01	5.97E-02	1.03E-01	9.66E-02	6.14E-02
RH-103	N,G	6.46E-01	1.03E 00	9.64E-01	5.39E-01	9.53E-01	8.86E-01	5.49E-01
RH-105	N,G	5.30E-01	8.30E-01	8.75E-01	4.59E-01	7.76E-01	7.92E-01	5.09E-01
PD-104	N,G	2.56E-01	4.36E-01	3.98E-01	2.11E-01	3.87E-01	3.51E-01	2.15E-01
PD-105	N,G	7.67E-01	1.17E 00	1.11E 00	6.52E-01	1.10E 00	1.03E 00	6.53E-01
PD-106	N,G	1.52E-01	2.47E-01	2.28E-01	1.25E-01	2.23E-01	2.04E-01	1.28E-01
PD-107	N,G	5.27E-01	8.08E-01	7.60E-01	4.56E-01	7.59E-01	7.16E-01	4.56E-01
PD-108	N,G	1.58E-01	3.88E-01	3.60E-01	1.23E-01	3.28E-01	3.12E-01	1.43E-01
PD-110	N,G	1.40E-01	2.66E-01	2.29E-01	9.96E-02	2.31E-01	1.95E-01	1.09E-01
AG-107	N,G	6.51E-01	1.05E 00	9.75E-01	5.43E-01	9.64E-01	8.97E-01	5.49E-01
AG-109	N,G	4.55E-01	9.09E-01	8.31E-01	3.56E-01	8.21E-01	7.80E-01	3.96E-01
AG-111	N,G	6.14E-01	1.38E 00	1.18E 00	4.30E-01	1.18E 00	1.00E 00	4.70E-01
CD-108	N,G	1.89E-01	2.51E-01	2.40E-01	1.68E-01	2.38E-01	2.27E-01	1.68E-01
CD-110	N,G	2.49E-01	4.14E-01	3.84E-01	2.12E-01	3.69E-01	3.42E-01	2.16E-01
CD-111	N,G	3.86E-01	6.46E-01	5.91E-01	3.17E-01	5.93E-01	5.42E-01	3.24E-01
CD-112	N,G	2.21E-01	3.33E-01	3.10E-01	1.90E-01	3.05E-01	2.84E-01	1.92E-01
CD-113	N,G	3.66E-01	6.91E-01	6.25E-01	2.83E-01	6.14E-01	5.78E-01	2.94E-01
CD-114	N,G	2.74E-01	4.54E-01	4.08E-01	2.22E-01	4.14E-01	3.71E-01	2.31E-01
CD-115	N,G	6.18E-01	1.63E 00	1.36E 00	3.88E-01	1.36E 00	1.12E 00	4.49E-01
CD-116	N,G	1.05E-01	1.47E-01	1.38E-01	9.04E-02	1.37E-01	1.28E-01	9.17E-02
IN-113	N,G	5.67E-01	8.18E-01	7.77E-01	5.03E-01	7.70E-01	7.36E-01	5.11E-01
IN-115	N,G	4.19E-01	6.64E-01	6.56E-01	3.58E-01	6.11E-01	5.88E-01	3.85E-01
SN-115	N,G	4.49E-02	8.64E-02	7.70E-02	3.38E-02	7.60E-02	6.72E-02	3.61E-02
SN-116	N,G	5.71E-02	1.05E-01	9.13E-02	4.63E-02	1.01E-01	8.83E-02	4.86E-02
SN-117	N,G	1.91E-01	3.09E-01	2.86E-01	1.57E-01	2.85E-01	2.63E-01	1.60E-01
SN-118	N,G	1.09E-01	1.70E-01	1.56E-01	9.20E-02	1.53E-01	1.40E-01	9.51E-02
SN-119	N,G	5.22E-02	9.14E-02	8.26E-02	3.98E-02	8.23E-02	7.34E-02	4.12E-02
SN-122	N,G	2.20E-02	2.89E-02	2.71E-02	1.95E-02	2.71E-02	2.52E-02	1.98E-02
SN-123	N,G	1.06E-01	1.58E-01	1.47E-01	8.67E-02	1.46E-01	1.34E-01	8.84E-02
SN-124	N,G	2.76E-02	4.73E-02	4.52E-02	2.44E-02	4.15E-02	3.98E-02	2.50E-02
SN-125	N,G	2.66E-01	5.64E-01	4.76E-01	1.62E-01	4.77E-01	3.89E-01	1.90E-01
SN-126	N,G	7.01E-03	7.10E-03	7.16E-03	7.01E-03	7.20E-03	7.28E-03	6.90E-03
SB-121	N,G	4.42E-01	6.93E-01	6.49E-01	3.75E-01	6.48E-01	6.10E-01	3.82E-01
SB-123	N,G	2.49E-01	4.21E-01	3.87E-01	2.04E-01	3.87E-01	3.59E-01	2.10E-01
SB-124	N,G	6.30E-01	9.35E-01	8.89E-01	5.36E-01	8.88E-01	8.43E-01	5.28E-01

Table B.1 (continued)

Isotope	Cross section type[a]	Cross section (barns) AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
SB-125	N,G	2.70E-01	4.61E-01	4.17E-01	2.17E-01	4.16E-01	3.74E-01	2.24E-01
SB-126	N,G	3.92E-01	7.22E-01	6.51E-01	3.06E-01	6.47E-01	5.80E-01	3.15E-01
TE-122	N,G	3.22E-01	6.26E-01	5.63E-01	2.60E-01	5.38E-01	4.83E-01	2.73E-01
TE-123	N,G	4.54E-01	8.81E-01	8.68E-01	3.66E-01	7.99E-01	7.86E-01	4.48E-01
TE-124	N,G	2.27E-01	3.17E-01	2.96E-01	1.97E-01	2.96E-01	2.75E-01	2.00E-01
TE-125	N,G	3.32E-01	5.94E-01	5.36E-01	2.58E-01	5.33E-01	4.76E-01	2.66E-01
TE-126	N,G	9.87E-02	1.78E-01	1.61E-01	8.22E-02	1.54E-01	1.39E-01	8.32E-02
TE-127	N,G	3.43E-01	6.23E-01	5.61E-01	2.71E-01	5.57E-01	4.99E-01	2.80E-01
TE-128	N,G	9.11E-02	1.23E-01	1.16E-01	8.09E-02	1.15E-01	1.09E-01	8.15E-02
TE-129	N,G	1.12E-01	2.01E-01	1.81E-01	8.52E-02	1.80E-01	1.60E-01	8.86E-02
TE-130	N,G	1.44E-02	1.98E-02	1.90E-02	1.23E-02	1.86E-02	1.76E-02	1.23E-02
TE-132	N,G	4.08E-04	3.04E-04	3.14E-04	4.36E-04	3.06E-04	3.14E-04	4.50E-04
I -127	N,G	5.09E-01	9.90E-01	8.95E-01	3.98E-01	8.80E-01	7.99E-01	4.15E-01
I -129	N,G	3.54E-01	6.09E-01	5.52E-01	2.80E-01	5.51E-01	4.96E-01	2.89E-01
I -130	N,G	5.13E-01	1.25E 00	1.08E 00	3.46E-01	1.06E 00	9.08E-01	3.85E-01
I -131	N,G	1.32E-01	2.57E-01	2.26E-01	9.34E-02	2.24E-01	1.93E-01	1.01E-01
I -135	N,G	5.91E-04	6.53E-04	6.60E-04	5.75E-04	6.63E-04	6.71E-04	5.54E-04
XE-128	N,G	1.62E-01	2.78E-01	2.51E-01	1.34E-01	2.50E-01	2.25E-01	1.36E-01
XE-129	N,G	3.88E-01	7.55E-01	6.73E-01	2.99E-01	6.69E-01	5.99E-01	3.15E-01
XE-130	N,G	1.05E-01	1.29E-01	1.27E-01	9.67E-02	1.26E-01	1.24E-01	9.56E-02
XE-131	N,G	2.00E-01	4.28E-01	4.01E-01	1.62E-01	4.02E-01	4.07E-01	1.87E-01
XE-132	N,G	6.38E-02	8.81E-02	8.35E-02	5.68E-02	8.34E-02	7.91E-02	5.70E-02
XE-133	N,G	1.10E-01	4.31E-01	3.76E-01	6.68E-02	3.54E-01	3.20E-01	8.89E-02
XE-134	N,G	3.16E-02	3.87E-02	3.85E-02	2.90E-02	3.77E-02	3.73E-02	2.86E-02
XE-135	N,G	5.22E-03	8.55E-02	1.81E-01	3.90E-03	1.15E-01	8.38E-01	3.00E-02
XE-136	N,G	2.72E-03	3.76E-03	3.55E-03	2.31E-03	3.52E-03	3.28E-03	2.35E-03
CS-133	N,G	4.55E-01	8.30E-01	7.55E-01	3.63E-01	7.54E-01	6.93E-01	3.77E-01
CS-134	N,G	[illegible]	9.92E-01	8.85E-01	3.68E-01	8.76E-01	7.78E-01	3.91E-01
		6.61E-02	1.74E-01	1.53E-01	4.62E-02	1.46E-01	1.29E-01	5.16E-02
CS-135	N,G	2.46E-01	5.15E-01	4.52E-01	1.80E-01	4.51E-01	3.93E-01	1.91E-01
CS-137	N,G	1.22E-02	2.00E-02	1.87E-02	9.00E-03	1.78E-02	1.61E-02	9.63E-03
BA-134	N,G	1.04E-01	1.95E-01	1.71E-01	8.59E-02	1.86E-01	1.66E-01	8.92E-02
BA-135	N,G	3.20E-01	6.89E-01	6.09E-01	2.39E-01	5.99E-01	5.28E-01	2.57E-01
BA-136	N,G	4.42E-02	7.31E-02	6.55E-02	3.61E-02	6.58E-02	5.87E-02	3.78E-02
BA-137	N,G	5.21E-02	9.40E-02	8.44E-02	3.99E-02	8.35E-02	7.40E-02	4.21E-02
BA-138	N,G	5.79E-03	4.77E-03	4.88E-03	6.10E-03	4.86E-03	4.97E-03	6.17E-03
BA-140	N,G	4.49E-02	1.67E-01	1.38E-01	2.08E-02	1.31E-01	1.04E-01	2.82E-02
LA-139	N,G	3.78E-02	7.38E-02	6.74E-02	2.99E-02	6.40E-02	5.83E-02	3.09E-02
LA-140	N,G	2.86E-01	7.20E-01	6.09E-01	1.86E-01	6.07E-01	5.04E-01	2.10E-01
CE-140	N,G	1.71E-02	1.86E-02	1.87E-02	1.64E-02	1.84E-02	1.84E-02	1.62E-02
CE-141	N,G	1.31E-01	2.23E-01	2.04E-01	1.06E-01	2.01E-01	1.83E-01	1.09E-01
CE-142	N,G	3.18E-02	3.78E-02	3.76E-02	2.97E-02	3.71E-02	3.67E-02	2.93E-02
CE-143	N,G	2.44E-01	6.13E-01	5.14E-01	1.49E-01	5.18E-01	4.23E-01	1.72E-01
CE-144	N,G	4.92E-02	8.75E-02	7.55E-02	3.55E-02	7.67E-02	6.46E-02	3.86E-02
PR-141	N,G	1.48E-01	3.06E-01	2.70E-01	1.09E-01	2.65E-01	2.31E-01	1.14E-01
PR-142	N,G	3.79E-01	8.12E-01	7.20E-01	2.75E-01	7.08E-01	6.26E-01	2.95E-01
PR-143	N,G	3.34E-01	7.42E-01	6.55E-01	2.45E-01	6.42E-01	5.66E-01	2.67E-01
ND-142	N,G	3.73E-02	5.05E-02	4.82E-02	3.31E-02	4.73E-02	4.48E-02	3.36E-02
ND-143	N,G	2.89E-01	6.22E-01	5.45E-01	2.15E-01	5.40E-01	4.69E-01	2.30E-01
ND-144	N,G	9.13E-02	1.43E-01	1.29E-01	7.69E-02	1.29E-01	1.16E-01	8.01E-02

59

Table B.1 (continued)

Isotope	Cross section type[a]	Cross section (barns)						
		AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
ND-145	N,G	3.23E-01	6.91E-01	6.04E-01	2.35E-01	6.09E-01	5.34E-01	2.57E-01
ND-146	N,G	1.20E-01	1.60E-01	1.52E-01	1.07E-01	1.52E-01	1.44E-01	1.08E-01
ND-147	N,G	6.41E-01	1.46E 00	1.28E 00	4.57E-01	1.27E 00	1.12E 00	5.07E-01
ND-148	N,G	1.74E-01	2.86E-01	2.57E-01	1.49E-01	2.63E-01	2.37E-01	1.54E-01
ND-150	N,G	2.14E-01	3.52E-01	3.23E-01	1.77E-01	3.19E-01	2.92E-01	1.81E-01
PM-147	N,G	1.19E 00	2.46E 00	2.20E 00	8.78E-01	2.18E 00	1.99E 00	9.67E-01
PM-148	N,G	6.76E 00	1.22E 01	1.13E 01	5.30E 00	1.09E 01	1.00E 01	2.84E 00
PM-149	N,G	2.94E 00	5.45E 00	4.88E 00	2.27E 00	4.84E 00	4.30E 00	2.39E 00
PM-151	N,G	3.23E-02	1.66E-01	1.68E-01	2.16E-02	1.61E-01	2.05E-01	6.44E-02
SM-147	N,G	7.68E-01	1.67E 00	1.49E 00	5.79E-01	1.47E 00	1.32E 00	6.31E-01
SM-148	N,G	3.27E-01	5.10E-01	4.65E-01	2.81E-01	4.63E-01	4.21E-01	2.90E-01
SM-149	N,G	1.35E 00	2.87E 00	2.55E 00	1.02E 00	2.51E 00	2.27E 00	1.09E 00
SM-150	N,G	3.88E-01	7.14E-01	6.42E-01	3.15E-01	6.37E-01	5.79E-01	3.37E-01
SM-151	N,G	2.09E 00	4.39E 00	3.89E 00	1.52E 00	3.83E 00	3.39E 00	1.66E 00
SM-152	N,G	3.90E-01	8.56E-01	7.83E-01	3.06E-01	7.84E-01	7.87E-01	3.72E-01
SM-153	N,G	4.94E-02	3.96E-01	3.69E-01	2.16E-02	3.58E-01	4.14E-01	9.13E-02
SM-154	N,G	2.02E-01	3.87E-01	3.45E-01	1.58E-01	3.37E-01	2.98E-01	1.66E-01
EU-151	N,G	3.41E 00	6.62E 00	5.92E 00	2.57E 00	5.85E 00	5.21E 00	2.74E 00
EU-152	N,G	4.30E 00	7.92E 00	7.17E 00	3.36E 00	7.10E 00	6.41E 00	3.52E 00
EU-153	N,G	2.16E 00	4.16E 00	3.74E 00	1.65E 00	3.69E 00	3.31E 00	1.75E 00
EU-154	N,G	2.58E 00	4.93E 00	4.44E 00	1.97E 00	4.39E 00	3.94E 00	2.08E 00
EU-155	N,G	2.40E 00	4.65E 00	4.13E 00	1.81E 00	4.07E 00	3.58E 00	1.94E 00
EU-156	N,G	5.67E-02	1.78E-01	1.73E-01	3.87E-02	1.64E-01	1.81E-01	6.83E-02
EU-157	N,G	3.66E-02	1.20E-01	1.21E-01	2.64E-02	1.15E-01	1.35E-01	5.19E-02
GD-154	N,G	9.30E-01	1.77E 00	1.56E 00	7.22E-01	1.57E 00	1.38E 00	7.70E-01
GD-155	N,G	1.86E 00	3.44E 00	3.15E 00	1.44E 00	3.09E 00	2.83E 00	1.51E 00
GD-156	N,G	4.28E-01	8.32E-01	7.43E-01	3.30E-01	7.25E-01	6.43E-01	3.55E-01
GD-157	N,G	3.44E 00	8.76E 00	7.21E 00	1.98E 00	7.25E 00	5.80E 00	2.42E 00
GD-158	N,G	2.68E-01	4.87E-01	4.33E-01	2.08E-01	4.33E-01	3.83E-01	2.20E-01
GD-160	N,G	1.93E-01	3.07E-01	2.80E-01	1.60E-01	2.79E-01	2.53E-01	1.64E-01
TB-159	N,G	1.32E 00	2.81E 00	2.45E 00	9.39E-01	2.44E 00	2.11E 00	1.02E 00
TB-160	N,G	1.33E-01	3.35E-01	3.06E-01	9.03E-02	2.96E-01	2.84E-01	1.18E-01
DY-160	N,G	1.85E 00	3.71E 00	3.29E 00	1.41E 00	3.24E 00	2.87E 00	1.54E 00
DY-161	N,G	2.03E 00	4.42E 00	3.88E 00	1.42E 00	3.83E 00	3.33E 00	1.55E 00
DY-162	N,G	8.02E-01	1.70E 00	1.52E 00	6.14E-01	1.48E 00	1.38E 00	7.04E-01
DY-163	N,G	8.94E-01	1.94E 00	1.70E 00	6.27E-01	1.67E 00	1.45E 00	6.92E-01
DY-164	N,G	2.40E-01	4.00E-01	3.58E-01	2.01E-01	3.72E-01	3.35E-01	2.11E-01
HO-165	N,G	1.44E 00	3.05E 00	2.68E 00	1.03E 00	2.64E 00	2.29E 00	1.12E 00
ER-166	N,G	4.26E-01	8.08E-01	7.25E-01	3.34E-01	7.05E-01	6.29E-01	3.55E-01
ER-167	N,G	1.35E 00	2.98E 00	2.62E 00	9.53E-01	2.58E 00	2.28E 00	1.06E 00
TH-230	N,G	1.78E-01	4.77E-01	4.30E-01	1.27E-01	4.08E-01	3.72E-01	1.48E-01
TH-230	N,F	3.59E-02	1.82E-02	2.04E-02	4.00E-02	1.78E-02	1.92E-02	4.13E-02
TH-232	N,G	3.61E-01	6.48E-01	5.88E-01	2.65E-01	3.81E-01	3.65E-01	3.04E-01
TH-232	N,F	1.25E-02	5.97E-03	6.96E-03	1.40E-02	5.88E-03	6.61E-03	1.43E-02
PA-231	N,G	2.81E 00	4.31E 00	4.06E 00	2.40E 00	4.05E 00	3.82E 00	2.40E 00
PA-231	N,F	2.85E-01	1.66E-01	1.80E-01	3.11E-01	1.61E-01	1.69E-01	3.23E-01
PA-233	N,G	4.97E-01	8.93E-01	8.15E-01	3.87E-01	8.00E-01	7.26E-01	4.05E-01
PA-233	N,F	8.02E-02	3.88E-02	4.49E-02	9.02E-02	3.82E-02	4.26E-02	9.17E-02
PA-233	N,GX	4.97E-01	8.93E-01	8.15E-01	3.87E-01	8.00E-01	7.26E-01	4.05E-01
U -232	N,G	6.23E-01	9.84E-01	9.22E-01	5.26E-01	9.18E-01	8.67E-01	5.33E-01

Table B.1 (continued)

Isotope	Cross section type[a]	Cross section (barns)						
		AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
U -232	N,F	2.26E 00	2.81E 00	2.65E 00	2.12E 00	2.61E 00	2.46E 00	2.20E 00
U -233	N,G	2.58E-01	3.82E-01	3.58E-01	2.24E-01	3.57E-01	3.35E-01	2.28E-01
U -233	N,F	2.67E 00	3.41E 00	3.25E 00	2.47E 00	3.23E 00	3.09E 00	2.51E 00
U -234	N,G	5.78E-01	1.03E 00	9.36E-01	4.68E-01	9.23E-01	8.15E-01	5.02E-01
U -234	N,F	3.83E-01	2.34E-01	2.52E-01	4.17E-01	2.27E-01	2.38E-01	4.30E-01
U -235	N,G	5.30E-01	8.67E-01	7.99E-01	4.43E-01	7.98E-01	7.37E-01	4.52E-01
U -235	N,F	1.86E 00	2.53E 00	2.39E 00	1.69E 00	2.38E 00	2.24E 00	1.71E 00
U -236	N,G	5.25E-01	8.71E-01	8.00E-01	4.42E-01	7.95E-01	7.37E-01	4.60E-01
U -236	N,F	1.24E-01	7.09E-02	7.72E-02	1.36E-01	6.80E-02	7.20E-02	1.40E-01
U -237	N,G	4.55E-01	9.59E-01	8.46E-01	3.37E-01	8.34E-01	7.35E-01	3.66E-01
U -237	N,F	6.20E-01	5.85E-01	5.93E-01	6.30E-01	5.91E-01	5.98E-01	6.30E-01
U -238	N,G	2.79E-01	3.75E-01	3.62E-01	2.55E-01	5.77E-01	5.32E-01	2.95E-01
U -238	N,F	5.22E-02	2.53E-02	2.92E-02	5.87E-02	2.49E-02	2.78E-02	5.97E-02
NP-237	N,G	1.43E 00	2.50E 00	2.28E 00	1.15E 00	2.27E 00	2.06E 00	1.19E 00
NP-237	N,F	3.91E-01	2.30E-01	2.49E-01	4.26E-01	2.23E-01	2.35E-01	4.40E-01
NP-238	N,G	8.05E-02	2.00E-01	1.72E-01	4.75E-02	1.68E-01	1.41E-01	5.63E-02
NP-238	N,F	5.36E-01	1.32E 00	1.15E 00	3.22E-01	1.11E 00	9.49E-01	3.80E-01
PU-236	N,G	3.66E-01	6.99E-01	6.30E-01	2.85E-01	6.23E-01	5.63E-01	3.03E-01
PU-236	N,F	1.52E 00	1.63E 00	1.59E 00	1.49E 00	1.55E 00	1.51E 00	1.52E 00
PU-237	N,G	1.86E-01	3.11E-01	2.87E-01	1.52E-01	2.84E-01	2.62E-01	1.57E-01
PU-237	N,F	3.64E 00	4.54E 00	4.33E 00	3.41E 00	4.31E 00	4.12E 00	3.47E 00
PU-238	N,G	6.93E-01	1.16E 00	1.06E 00	5.77E-01	1.06E 00	9.71E-01	5.90E-01
PU-238	N,F	1.19E 00	1.16E 00	1.14E 00	1.18E 00	1.11E 00	1.09E 00	1.21E 00
PU-239	N,G	4.68E-01	9.15E-01	8.17E-01	3.65E-01	8.51E-01	7.59E-01	3.86E-01
PU-239	N,F	1.82E 00	2.20E 00	2.11E 00	1.74E 00	2.13E 00	2.04E 00	1.77E 00
PU-240	N,G	4.85E-01	1.01E 00	9.24E-01	4.24E-01	9.30E-01	8.57E-01	4.46E-01
PU-240	N,F	4.24E-01	2.79E-01	2.95E-01	4.57E-01	2.70E-01	2.80E-01	4.70E-01
PU-241	N,G	4.39E-01	7.26E-01	6.69E-01	3.64E-01	6.64E-01	6.13E-01	3.74E-01
PU-241	N,F	2.44E 00	3.30E 00	3.12E 00	2.22E 00	3.11E 00	2.95E 00	2.25E 00
PU-242	N,G	4.05E-01	7.30E-01	6.89E-01	3.38E-01	6.64E-01	6.36E-01	3.74E-01
PU-242	N,F	3.07E-01	1.78E-01	1.93E-01	3.35E-01	1.72E-01	1.81E-01	3.47E-01
PU-243	N,G	3.56E-01	6.28E-01	5.75E-01	2.84E-01	5.69E-01	5.19E-01	2.95E-01
PU-243	N,F	8.44E-01	1.17E 00	1.09E 00	7.64E-01	1.07E 00	1.00E 00	7.94E-01
PU-244	N,G	2.11E-01	5.10E-01	4.42E-01	1.44E-01	4.34E-01	3.75E-01	1.59E-01
PU-244	N,F	2.59E-01	1.45E-01	1.58E-01	2.83E-01	1.40E-01	1.48E-01	2.93E-01
AM-241	N,G	1.32E 00	2.14E 00	1.98E 00	1.11E 00	1.97E 00	1.82E 00	1.13E 00
AM-241	N,F	3.45E-01	1.98E-01	2.15E-01	3.78E-01	1.91E-01	2.01E-01	3.90E-01
AM-241	N,GX	3.30E-01	5.36E-01	4.95E-01	2.76E-01	4.93E-01	4.56E-01	2.83E-01
AM-242	N,G	7.20E-02	1.79E-01	1.53E-01	4.25E-02	1.50E-01	1.26E-01	5.01E-02
AM-242	N,F	4.80E-01	1.18E 00	1.02E 00	2.89E-01	9.95E-01	8.47E-01	3.38E-01
AM-242	N,G	3.65E-01	7.05E-01	6.36E-01	2.72E-01	6.28E-01	5.64E-01	2.85E-01
AM-242	N,F	3.90E 00	5.73E 00	5.34E 00	3.42E 00	5.30E 00	4.94E 00	3.51E 00
AM-243	N,G	5.03E-02	9.48E-02	8.63E-02	3.87E-02	8.50E-02	7.70E-02	4.09E-02
AM-243	N,F	2.72E-01	1.48E-01	1.63E-01	2.99E-01	1.44E-01	1.53E-01	3.10E-01
AM-243	N,GX	9.55E-01	1.80E 00	1.64E 00	7.35E-01	1.61E 00	1.46E 00	7.77E-01
CM-241	N,G	1.87E-01	3.00E-01	2.78E-01	1.57E-01	2.78E-01	2.59E-01	1.60E-01
CM-241	N,F	3.12E 00	3.95E 00	3.76E 00	2.90E 00	3.74E 00	3.56E 00	2.96E 00
CM-242	N,G	3.08E-01	6.99E-01	6.12E-01	2.18E-01	6.06E-01	5.29E-01	2.38E-01
CM-242	N,F	1.98E-01	1.03E-01	1.16E-01	2.21E-01	1.00E-01	1.09E-01	2.27E-01
CM-243	N,G	2.28E-01	4.30E-01	3.90E-01	1.77E-01	3.86E-01	3.51E-01	1.87E-01

Table B.1 (continued)

Isotope	Cross section type[a]	Cross section (barns)						
		AMOPUUUC	AMOPUUUA	AMOPUUUR	AMO2TTTC	AMO2TTTA	AMO2TTTR	FFTFC
CM-243	N,F	2.60E 00	3.65E 00	3.42E 00	2.33E 00	3.38E 00	3.17E 00	2.42E 00
CM-244	N,G	7.94E-01	1.29E 00	1.20E 00	6.69E-01	1.19E 00	1.12E 00	6.85E-01
CM-244	N,F	4.87E-01	3.09E-01	3.30E-01	5.25E-01	2.98E-01	3.10E-01	5.42E-01
CM-245	N,G	2.98E-01	4.48E-01	4.24E-01	2.56E-01	4.21E-01	4.00E-01	2.56E-01
CM-245	N,F	2.59E 00	3.28E 00	3.14E 00	2.42E 00	3.13E 00	3.00E 00	2.45E 00
CM-246	N,G	2.21E-01	3.99E-01	3.61E-01	1.77E-01	3.56E-01	3.21E-01	1.86E-01
CM-246	N,F	3.20E-01	1.73E-01	1.91E-01	3.52E-01	1.66E-01	1.77E-01	3.65E-01
CM-247	N,G	2.92E-01	4.53E-01	4.28E-01	2.50E-01	4.23E-01	4.01E-01	2.52E-01
CM-247	N,F	1.93E 00	1.95E 00	1.95E 00	1.94E 00	1.94E 00	1.94E 00	1.95E 00
CM-248	N,G	2.32E-01	4.70E-01	4.34E-01	1.84E-01	4.12E-01	3.87E-01	1.99E-01
CM-248	N,F	3.56E-01	2.14E-01	2.30E-01	3.87E-01	2.05E-01	2.16E-01	4.01E-01
BK-249	N,G	8.76E-01	2.27E 00	1.96E 00	5.58E-01	1.91E 00	1.65E 00	6.69E-01
BK-249	N,F	1.90E-01	1.03E-01	1.14E-01	2.09E-01	1.01E-01	1.08E-01	2.15E-01
CF-249	N,G	3.43E-01	5.98E-01	5.48E-01	2.77E-01	5.40E-01	4.94E-01	2.88E-01
CF-249	N,F	2.57E 00	3.49E 00	3.29E 00	2.33E 00	3.29E 00	3.11E 00	2.37E 00
CF-250	N,G	3.90E-01	8.22E-01	7.44E-01	2.97E-01	7.21E-01	6.63E-01	3.21E-01
CF-250	N,F	1.13E 00	8.45E-01	8.75E-01	1.21E 00	8.57E-01	8.80E-01	1.23E 00
CF-251	N,G	2.97E-01	4.86E-01	4.53E-01	2.50E-01	4.46E-01	4.19E-01	2.57E-01
CF-251	N,F	2.27E 00	2.76E 00	2.68E 00	2.16E 00	2.67E 00	2.62E 00	2.17E 00
CF-252	N,G	2.77E-01	4.43E-01	4.12E-01	2.34E-01	4.10E-01	3.83E-01	2.36E-01
CF-252	N,F	7.59E-01	8.29E-01	7.89E-01	7.40E-01	7.47E-01	7.03E-01	7.75E-01
CF-253	N,G	1.75E-01	4.78E-01	4.05E-01	9.66E-02	3.96E-01	3.28E-01	1.21E-01
CF-253	N,F	6.26E-01	1.53E 00	1.34E 00	3.81E-01	1.30E 00	1.11E 00	4.47E-01
ES-253	N,G	1.32E-01	4.46E-01	3.82E-01	6.82E-02	3.65E-01	3.18E-01	9.69E-02
ES-253	N,GX	9.18E-02	3.10E-01	2.66E-01	4.74E-02	2.54E-01	2.21E-01	6.73E-02
1/V	N,G	6.90E-04	1.13E-03	1.05E-03	5.70E-04	1.04E-03	9.59E-04	5.85E-04

[a]N,G = (n,gamma) to a ground state.
N,F = (n,fission).
N,GX = (n,gamma) to an excited state.
N,A = (n,alpha).
N,P = (n,proton).

APPENDIX C:

LISTINGS OF ONE-GROUP, BURNUP-DEPENDENT CROSS SECTIONS FOR THE AMOPUUUX AND AMO2TTTX LMFBRS

Table C.1. Cross sections as a function of burnup for the core of an AMOPUUUX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of:											
		0.0	3.120	6.144	9.080	9.080	10.955	12.787	14.582	14.582	17.480	20.272	22.968
TH232	N,G	3.89E-01	3.89E-01	3.89E-01	3.90E-01	3.89E-01	3.89E-01	3.89E-01	3.90E-01	3.89E-01	3.89E-01	3.89E-01	3.90E-01
TH232	FISS	1.07E-02	1.06E-02	1.06E-02	1.06E-02	1.07E-02	1.06E-02	1.06E-02	1.06E-02	1.07E-02	1.06E-02	1.06E-02	1.06E-02
U233	N,G	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01	2.58E-01
U233	FISS	2.74E 00	2.74E 00	2.75E 00	2.75E 00	2.74E 00	2.74E 00	2.75E 00	2.75E 00	2.74E 00	2.74E 00	2.75E 00	2.75E 00
U234	N,G	5.68E-01	5.69E-01	5.69E-01	5.69E-01	5.68E-01	5.69E-01	5.69E-01	5.69E-01	5.68E-01	5.69E-01	5.69E-01	5.69E-01
U234	FISS	3.19E-01	3.18E-01	3.18E-01	3.17E-01	3.19E-01	3.18E-01	3.18E-01	3.17E-01	3.19E-01	3.18E-01	3.18E-01	3.17E-01
U235	N,G	5.56E-01	5.57E-01	5.57E-01	5.58E-01	5.56E-01	5.57E-01	5.57E-01	5.58E-01	5.56E-01	5.57E-01	5.57E-01	5.58E-01
U235	FISS	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00	1.90E 00
U238	N,G	2.87E-01	2.87E-01	2.87E-01	2.88E-01	2.87E-01	2.87E-01	2.87E-01	2.88E-01	2.87E-01	2.87E-01	2.87E-01	2.88E-01
U238	FISS	4.68E-02	4.67E-02	4.65E-02	4.64E-02	4.68E-02	4.67E-02	4.65E-02	4.64E-02	4.68E-02	4.67E-02	4.65E-02	4.64E-02
PU239	N,G	4.92E-01	4.93E-01	4.93E-01	4.94E-01	4.92E-01	4.93E-01	4.93E-01	4.94E-01	4.92E-01	4.93E-01	4.93E-01	4.94E-01
PU239	FISS	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00	1.79E 00
PU240	N,G	5.00E-01	5.00E-01	5.01E-01	5.01E-01	5.00E-01	5.00E-01	5.01E-01	5.01E-01	5.00E-01	5.00E-01	5.01E-01	5.01E-01
PU240	FISS	3.86E-01	3.85E-01	3.84E-01	3.83E-01	3.86E-01	3.85E-01	3.84E-01	3.83E-01	3.86E-01	3.85E-01	3.84E-01	3.83E-01
PU241	N,G	4.61E-01	4.62E-01	4.62E-01	4.62E-01	4.61E-01	4.62E-01	4.62E-01	4.62E-01	4.61E-01	4.62E-01	4.62E-01	4.62E-01
PU241	FISS	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00	2.46E 00
PU242	N,G	5.50E-01	5.50E-01	5.51E-01	5.51E-01	5.50E-01	5.50E-01	5.51E-01	5.51E-01	5.50E-01	5.50E-01	5.51E-01	5.51E-01
PU242	FISS	2.99E-01	2.98E-01	2.97E-01	2.97E-01	2.99E-01	2.98E-01	2.97E-01	2.97E-01	2.99E-01	2.98E-01	2.97E-01	2.97E-01
AM241	N,G	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00	1.37E 00
AM241	NGEX	2.48E-01	2.48E-01	2.47E-01	2.47E-01	2.48E-01	2.48E-01	2.47E-01	2.47E-01	2.48E-01	2.48E-01	2.47E-01	2.47E-01

[a]N,G = (n,gamma) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

Table C.2. Cross sections as a function of burnup for the axial blanket of an AMOPUUUX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of:											
		0.0	0.148	0.316	0.504	0.504	0.597	0.698	0.807	0.807	0.880	0.968	1.072
TH232	N,G	6.43E-01	6.35E-01	6.26E-01	6.19E-01	6.43E-01	6.35E-01	6.26E-01	6.19E-01	6.43E-01	6.35E-01	6.26E-01	6.19E-01
TH232	FISS	5.12E-03	5.28E-03	5.45E-03	5.61E-03	5.12E-03	5.28E-03	5.45E-03	5.61E-03	5.12E-03	5.28E-03	5.45E-03	5.61E-03
U233	N,G	3.64E-01	3.60E-01	3.57E-01	3.54E-01	3.64E-01	3.60E-01	3.57E-01	3.54E-01	3.64E-01	3.60E-01	3.57E-01	3.54E-01
U233	FISS	3.48E 00	3.46E 00	3.43E 00	3.41E 00	3.48E 00	3.46E 00	3.43E 00	3.41E 00	3.48E 00	3.46E 00	3.43E 00	3.41E 00
U234	N,G	9.27E-01	9.15E-01	9.03E-01	8.91E-01	9.27E-01	9.15E-01	9.03E-01	8.91E-01	9.27E-01	9.15E-01	9.03E-01	8.91E-01
U234	FISS	1.90E-01	1.94E-01	1.98E-01	2.01E-01	1.90E-01	1.94E-01	1.98E-01	2.01E-01	1.90E-01	1.94E-01	1.98E-01	2.01E-01
U235	N,G	8.73E-01	8.62E-01	8.52E-01	8.42E-01	8.73E-01	8.62E-01	8.52E-01	8.42E-01	8.73E-01	8.62E-01	8.52E-01	8.42E-01
U235	FISS	2.51E 00	2.49E 00	2.47E 00	2.45E 00	2.51E 00	2.49E 00	2.47E 00	2.45E 00	2.51E 00	2.49E 00	2.47E 00	2.45E 00
U238	N,G	3.85E-01	3.82E-01	3.79E-01	3.76E-01	3.85E-01	3.82E-01	3.79E-01	3.76E-01	3.85E-01	3.82E-01	3.79E-01	3.76E-01
U238	FISS	2.27E-02	2.34E-02	2.41E-02	2.48E-02	2.27E-02	2.34E-02	2.41E-02	2.48E-02	2.27E-02	2.34E-02	2.41E-02	2.48E-02
PU239	N,G	9.20E-01	9.06E-01	8.92E-01	8.78E-01	9.20E-01	9.06E-01	8.92E-01	8.78E-01	9.20E-01	9.06E-01	8.92E-01	8.78E-01
PU239	FISS	2.13E 00	2.12E 00	2.11E 00	2.10E 00	2.13E 00	2.12E 00	2.11E 00	2.10E 00	2.13E 00	2.12E 00	2.11E 00	2.10E 00
PU240	N,G	9.41E-01	9.24E-01	9.09E-01	8.94E-01	9.41E-01	9.24E-01	9.09E-01	8.94E-01	9.41E-01	9.24E-01	9.09E-01	8.94E-01
PU240	FISS	2.61E-01	2.65E-01	2.68E-01	2.72E-01	2.61E-01	2.65E-01	2.68E-01	2.72E-01	2.61E-01	2.65E-01	2.68E-01	2.72E-01
PU241	N,G	7.39E-01	7.30E-01	7.21E-01	7.13E-01	7.39E-01	7.30E-01	7.21E-01	7.13E-01	7.39E-01	7.30E-01	7.21E-01	7.13E-01
PU241	FISS	3.26E 00	3.24E 00	3.21E 00	3.19E 00	3.26E 00	3.24E 00	3.21E 00	3.19E 00	3.26E 00	3.24E 00	3.21E 00	3.19E 00
PU242	N,G	1.04E 00	1.03E 00	1.01E 00	9.94E-01	1.04E 00	1.03E 00	1.01E 00	9.94E-01	1.04E 00	1.03E 00	1.01E 00	9.94E-01
PU242	FISS	1.76E-01	1.80E-01	1.84E-01	1.87E-01	1.76E-01	1.80E-01	1.84E-01	1.87E-01	1.76E-01	1.80E-01	1.84E-01	1.87E-01
AM241	N,G	2.12E 00	2.10E 00	2.07E 00	2.05E 00	2.12E 00	2.10E 00	2.07E 00	2.05E 00	2.12E 00	2.10E 00	2.07E 00	2.05E 00
AM241	NGEX	1.44E-01	1.47E-01	1.50E-01	1.53E-01	1.44E-01	1.47E-01	1.50E-01	1.53E-01	1.44E-01	1.47E-01	1.50E-01	1.53E-01

[a]N,G = (n,gamma) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

Table C.3. Cross sections as a function of burnup for the radial blanket of an AMOPUUUX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.0	0.005	0.011	0.018	0.018	0.029	0.042	0.056	0.056	0.080	0.106	0.136
TH232	N,G	1.05E 00	1.03E 00	1.02E 00	1.00E 00	8.59E-01	8.45E-01	8.33E-01	8.20E-01	7.65E-01	7.53E-01	7.42E-01	7.31E-01
TH232	FISS	2.16E-03	2.32E-03	2.48E-03	2.64E-03	2.68E-03	2.87E-03	3.05E-03	3.23E-03	3.36E-03	3.57E-03	3.76E-03	3.96E-03
U233	N,G	5.18E-01	5.12E-01	5.06E-01	5.00E-01	4.51E-01	4.45E-01	4.40E-01	4.35E-01	4.15E-01	4.11E-01	4.06E-01	4.01E-01
U233	FISS	4.57E 00	4.53E 00	4.49E 00	4.45E 00	4.08E 00	4.04E 00	4.01E 00	3.97E 00	3.82E 00	3.79E 00	3.75E 00	3.72E 00
U234	N,G	1.54E 00	1.51E 00	1.49E 00	1.47E 00	1.25E 00	1.23E 00	1.21E 00	1.19E 00	1.11E 00	1.09E 00	1.07E 00	1.05E 00
U234	FISS	1.07E-01	1.11E-01	1.15E-01	1.20E-01	1.22E-01	1.27E-01	1.32E-01	1.36E-01	1.42E-01	1.47E-01	1.51E-01	1.56E-01
U235	N,G	1.33E 00	1.31E 00	1.29E 00	1.28E 00	1.12E 00	1.11E 00	1.09E 00	1.08E 00	1.02E 00	1.00E 00	9.87E-01	9.74E-01
U235	FISS	3.40E 00	3.36E 00	3.33E 00	3.29E 00	2.99E 00	2.96E 00	2.93E 00	2.90E 00	2.78E 00	2.75E 00	2.72E 00	2.70E 00
U238	N,G	5.00E-01	4.95E-01	4.90E-01	4.86E-01	4.57E-01	4.53E-01	4.48E-01	4.44E-01	4.29E-01	4.25E-01	4.21E-01	4.17E-01
U238	FISS	9.64E-03	1.04E-02	1.11E-02	1.18E-02	1.19E-02	1.28E-02	1.36E-02	1.43E-02	1.49E-02	1.58E-02	1.67E-02	1.75E-02
PU239	N,G	1.56E 00	1.53E 00	1.51E 00	1.48E 00	1.26E 00	1.24E 00	1.21E 00	1.19E 00	1.11E 00	1.09E 00	1.07E 00	1.05E 00
PU239	FISS	2.78E 00	2.75E 00	2.73E 00	2.71E 00	2.44E 00	2.42E 00	2.40E 00	2.38E 00	2.29E 00	2.27E 00	2.25E 00	2.24E 00
PU240	N,G	1.83E 00	1.80E 00	1.77E 00	1.74E 00	1.39E 00	1.36E 00	1.33E 00	1.31E 00	1.19E 00	1.16E 00	1.14E 00	1.12E 00
PU240	FISS	1.88E-01	1.92E-01	1.96E-01	2.00E-01	1.97E-01	2.02E-01	2.06E-01	2.10E-01	2.13E-01	2.18E-01	2.22E-01	2.27E-01
PU241	N,G	1.13E 00	1.11E 00	1.10E 00	1.08E 00	9.55E-01	9.41E-01	9.28E-01	9.15E-01	8.63E-01	8.50E-01	8.38E-01	8.27E-01
PU241	FISS	4.49E 00	4.44E 00	4.40E 00	4.35E 00	3.92E 00	3.88E 00	3.84E 00	3.80E 00	3.63E 00	3.60E 00	3.56E 00	3.53E 00
PU242	N,G	1.80E 00	1.77E 00	1.74E 00	1.71E 00	1.45E 00	1.42E 00	1.40E 00	1.37E 00	1.27E 00	1.24E 00	1.22E 00	1.20E 00
PU242	FISS	9.96E-02	1.04E-01	1.08E-01	1.11E-01	1.14E-01	1.18E-01	1.23E-01	1.27E-01	1.31E-01	1.36E-01	1.40E-01	1.45E-01
AM241	N,G	3.22E 00	3.17E 00	3.13E 00	3.09E 00	2.73E 00	2.69E 00	2.65E 00	2.62E 00	2.47E 00	2.43E 00	2.40E 00	2.37E 00
AM241	NGEX	8.48E-02	8.80E-02	9.11E-02	9.42E-02	9.30E-02	9.66E-02	1.00E-01	1.04E-01	1.06E-01	1.10E-01	1.13E-01	1.17E-01

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.136	0.188	0.245	0.309	0.309	0.419	0.540	0.672	0.672	0.901	1.148	1.412
TH232	N,G	6.90E-01	6.80E-01	6.70E-01	6.61E-01	6.16E-01	6.08E-01	6.00E-01	5.93E-01	5.36E-01	5.32E-01	5.28E-01	5.24E-01
TH232	FISS	4.25E-03	4.46E-03	4.67E-03	4.87E-03	5.48E-03	5.68E-03	5.87E-03	6.06E-03	7.38E-03	7.50E-03	7.62E-03	7.73E-03
U233	N,G	3.86E-01	3.81E-01	3.77E-01	3.73E-01	3.55E-01	3.51E-01	3.48E-01	3.45E-01	3.20E-01	3.18E-01	3.17E-01	3.15E-01
U233	FISS	3.61E 00	3.58E 00	3.55E 00	3.52E 00	3.39E 00	3.37E 00	3.34E 00	3.32E 00	3.15E 00	3.14E 00	3.13E 00	3.11E 00
U234	N,G	9.96E-01	9.81E-01	9.66E-01	9.52E-01	8.87E-01	8.76E-01	8.65E-01	8.54E-01	7.73E-01	7.67E-01	7.61E-01	7.55E-01
U234	FISS	1.65E-01	1.70E-01	1.75E-01	1.80E-01	1.97E-01	2.01E-01	2.05E-01	2.09E-01	2.41E-01	2.43E-01	2,45E-01	2.48E-01
U235	N,G	9.26E-01	9.14E-01	9.01E-01	8.90E-01	8.35E-01	8.25E-01	8.16E-01	8.07E-01	7.35E-01	7.29E-01	7.24E-01	7.19E-01
U235	FISS	2.61E 00	2.58E 00	2.56E 00	2.54E 00	2.43E 00	2.41E 00	2.39E 00	2.37E 00	2.24E 00	2.23E 00	2.22E 00	2.21E 00
U238	N,G	4.03E-01	3.99E-01	3.95E-01	3.92E-01	3.74E-01	3.71E-01	3.68E-01	3.65E-01	3.40E-01	3.38E-01	3.37E-01	3.35E-01
U238	FISS	1.88E-02	1.98E-02	2.07E-02	2.15E-02	2.42E-02	2.51E-02	2.59E-02	2.67E-02	3.25E-02	3.30E-02	3.36E-02	3.41E-02
PU239	N,G	9.84E-01	9.67E-01	9.51E-01	9.35E-01	8.61E-01	8.48E-01	8.36E-01	8.24E-01	7.31E-01	7.24E-01	7.17E-01	7.10E-01
PU239	FISS	2.18E 00	2.16E 00	2.15E 00	2.14E 00	2.07E 00	2.06E 00	2.05E 00	2.04E 00	1.97E 00	1.97E 00	1.96E 00	1.96E 00
PU240	N,G	1.04E 00	1.02E 00	1.00E 00	9.82E-01	9.00E-01	8.84E-01	8.70E-01	8.56E-01	7.56E-01	7.47E-01	7.40E-01	7.32E-01
PU240	FISS	2.35E-01	2.39E-01	2.44E-01	2.48E-01	2.64E-01	2.68E-01	2.72E-01	2.76E-01	3.07E-01	3.10E-01	3.12E-01	3.14E-01
PU241	N,G	7.85E-01	7.74E-01	7.64E-01	7.54E-01	7.06E-01	6.97E-01	6.89E-01	6.81E-01	6.19E-01	6.14E-01	6.10E-01	6.06E-01
PU241	FISS	3.40E 00	3.37E 00	3.34E 00	3.31E 00	3.16E 00	3.14E 00	3.12E 00	3.09E 00	2.91E 00	2.90E 00	2.89E 00	2.88E 00
PU242	N,G	1.12E 00	1.10E 00	1.08E 00	1.07E 00	9.77E-01	9.62E-01	9.47E-01	9.34E-01	8.22E-01	8.13E-01	8.05E-01	7.98E-01
PU242	FISS	1.53E-01	1.58E-01	1.62E-01	1.66E-01	1.82E-01	1.86E-01	1.90E-01	1.94E-01	2.23E-01	2.26E-01	2.28E-01	2.30E-01
AM241	N,G	2.26E 00	2.22E 00	2.20E 00	2.17E 00	2.04E 00	2.01E 00	1.99E 00	1.97E 00	1.79E 00	1.78E 00	1.77E 00	1.76E 00
AM241	NGEX	1.23E-01	1.27E-01	1.31E-01	1.35E-01	1.47E-01	1.51E-01	1.54E-01	1.57E-01	1.83E-01	1.85E-01	1.87E-01	1.89E-01

[a]N,G = (*n,gamma*) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

Table C.4. Cross sections as a function of burnup for the core of an AMO2TTTX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.0	3.570	7.046	10.431	10.431	12.362	14.300	16.241	16.241	18.581	20.906	23.212
TH232	N,G	3.18E-01	3.20E-01	3.21E-01	3.23E-01	3.18E-01	3.20E-01	3.21E-01	3.23E-01	3.18E-01	3.20E-01	3.21E-01	3.23E-01
TH232	FISS	1.18E-02	1.17E-02	1.16E-02	1.15E-02	1.18E-02	1.17E-02	1.16E-02	1.15E-02	1.18E-02	1.17E-02	1.16E-02	1.15E-02
U233	N,G	2.31E-01	2.32E-01	2.33E-01	2.34E-01	2.31E-01	2.32E-01	2.33E-01	2.34E-01	2.31E-01	2.32E-01	2.33E-01	2.34E-01
U233	FISS	2.56E 00	2.56E 00	2.57E 00	2.58E 00	2.56E 00	2.56E 00	2.57E 00	2.58E 00	2.56E 00	2.56E 00	2.57E 00	2.58E 00
U234	N,G	4.86E-01	4.89E-01	4.91E-01	4.93E-01	4.86E-01	4.89E-01	4.91E-01	4.93E-01	4.86E-01	4.89E-01	4.91E-01	4.93E-01
U234	FISS	3.61E-01	3.59E-01	3.56E-01	3.54E-01	3.61E-01	3.59E-01	3.56E-01	3.54E-01	3.61E-01	3.59E-01	3.56E-01	3.54E-01
U235	N,G	4.78E-01	4.81E-01	4.84E-01	4.86E-01	4.78E-01	4.81E-01	4.84E-01	4.86E-01	4.78E-01	4.81E-01	4.84E-01	4.86E-01
U235	FISS	1.75E 00	1.75E 00	1.76E 00	1.76E 00	1.75E 00	1.75E 00	1.76E 00	1.76E 00	1.75E 00	1.75E 00	1.76E 00	1.76E 00
U238	N,G	2.58E-01	2.59E-01	2.60E-01	2.62E-01	2.58E-01	2.59E-01	2.60E-01	2.62E-01	2.58E-01	2.59E-01	2.60E-01	2.62E-01
U238	FISS	5.23E-02	5.18E-02	5.13E-02	5.09E-02	5.23E-02	5.18E-02	5.13E-02	5.09E-02	5.23E-02	5.18E-02	5.13E-02	5.09E-02
PU239	N,G	4.01E-01	4.04E-01	4.07E-01	4.10E-01	4.01E-01	4.04E-01	4.07E-01	4.10E-01	4.01E-01	4.04E-01	4.07E-01	4.10E-01
PU239	FISS	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00	1.74E 00
PU240	N,G	4.21E-01	4.24E-01	4.26E-01	4.29E-01	4.21E-01	4.24E-01	4.26E-01	4.29E-01	4.21E-01	4.24E-01	4.26E-01	4.29E-01
PU240	FISS	4.27E-01	4.25E-01	4.22E-01	4.20E-01	4.27E-01	4.25E-01	4.22E-01	4.20E-01	4.27E-01	4.25E-01	4.22E-01	4.20E-01
PU241	N,G	3.93E-01	3.95E-01	3.98E-01	4.00E-01	3.93E-01	3.95E-01	3.98E-01	4.00E-01	3.93E-01	3.95E-01	3.98E-01	4.00E-01
PU241	FISS	2.27E 00	2.28E 00	2.28E 00	2.29E 00	2.27E 00	2.28E 00	2.28E 00	2.29E 00	2.27E 00	2.28E 00	2.28E 00	2.29E 00
PU242	N,G	4.37E-01	4.42E-01	4.45E-01	4.49E-01	4.37E-01	4.42E-01	4.45E-01	4.49E-01	4.37E-01	4.42E-01	4.45E-01	4.49E-01
PU242	FISS	3.37E-01	3.34E-01	3.32E-01	3.30E-01	3.37E-01	3.34E-01	3.32E-01	3.30E-01	3.37E-01	3.34E-01	3.32E-01	3.30E-01
AM241	N,G	1.18E 00	1.18E 00	1.19E 00	1.20E 00	1.18E 00	1.18E 00	1.19E 00	1.20E 00	1.18E 00	1.18E 00	1.19E 00	1.20E 00
AM241	NGEX	2.80E-01	2.78E-01	2.76E-01	2.74E-01	2.80E-01	2.78E-01	2.76E-01	2.74E-01	2.80E-01	2.78E-01	2.76E-01	2.74E-01

[a]N,G = (n,gamma) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

Table C.5. Cross sections as a function of burnup for the axial blanket of an AMO2TTTX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.0	0.021	0.062	0.124	0.124	0.155	0.194	0.241	0.241	0.331	0.435	0.555
TH232	N,G	4.33E-01	4.31E-01	4.28E-01	4.26E-01	4.33E-01	4.31E-01	4.28E-01	4.26E-01	4.33E-01	4.31E-01	4.28E-01	4.26E-01
TH232	FISS	5.26E-03	5.38E-03	5.52E-03	5.67E-03	5.26E-03	5.38E-03	5.52E-03	5.67E-03	5.26E-03	5.38E-03	5.52E-03	5.67E-03
U233	N,G	3.38E-01	3.36E-01	3.34E-01	3.31E-01	3.38E-01	3.36E-01	3.34E-01	3.31E-01	3.38E-01	3.36E-01	3.34E-01	3.31E-01
U233	FISS	3.29E 00	3.27E 00	3.26E 00	3.24E 00	3.29E 00	3.27E 00	3.26E 00	3.24E 00	3.29E 00	3.27E 00	3.26E 00	3.24E 00
U234	N,G	8.36E-01	8.29E-01	8.21E-01	8.13E-01	8.36E-01	8.29E-01	8.21E-01	8.13E-01	8.36E-01	8.29E-01	8.21E-01	8.13E-01
U234	FISS	2.10E-01	2.12E-01	2.16E-01	2.19E-01	2.10E-01	2.12E-01	2.16E-01	2.19E-01	2.10E-01	2.12E-01	2.16E-01	2.19E-01
U235	N,G	7.91E-01	7.84E-01	7.78E-01	7.71E-01	7.91E-01	7.84E-01	7.78E-01	7.71E-01	7.91E-01	7.84E-01	7.78E-01	7.71E-01
U235	FISS	2.34E 00	2.33E 00	2.32E 00	2.31E 00	2.34E 00	2.33E 00	2.32E 00	2.31E 00	2.34E 00	2.33E 00	2.32E 00	2.31E 00
U238	N,G	5.26E-01	5.20E-01	5.14E-01	5.09E-01	5.26E-01	5.20E-01	5.14E-01	5.09E-01	5.26E-01	5.20E-01	5.14E-01	5.09E-01
U238	FISS	2.35E-02	2.41E-02	2.47E-02	2.53E-02	2.35E-02	2.41E-02	2.47E-02	2.53E-02	2.35E-02	2.41E-02	2.47E-02	2.53E-02
PU239	N,G	8.15E-01	8.07E-01	7.97E-01	7.88E-01	8.15E-01	8.07E-01	7.97E-01	7.88E-01	8.15E-01	8.07E-01	7.97E-01	7.88E-01
PU239	FISS	2.04E 00	2.03E 00	2.02E 00	2.02E 00	2.04E 00	2.03E 00	2.02E 00	2.02E 00	2.04E 00	2.03E 00	2.02E 00	2.02E 00
PU240	N,G	8.39E-01	8.29E-01	8.19E-01	8.09E-01	8.39E-01	8.29E-01	8.19E-01	8.09E-01	8.39E-01	8.29E-01	8.19E-01	8.09E-01
PU240	FISS	2.77E-01	2.80E-01	2.83E-01	2.87E-01	2.77E-01	2.80E-01	2.83E-01	2.87E-01	2.77E-01	2.80E-01	2.83E-01	2.87E-01
PU241	N,G	6.66E-01	6.60E-01	6.55E-01	6.49E-01	6.66E-01	6.60E-01	6.55E-01	6.49E-01	6.66E-01	6.60E-01	6.55E-01	6.49E-01
PU241	FISS	3.05E 00	3.03E 00	3.02E 00	3.00E 00	3.05E 00	3.03E 00	3.02E 00	3.00E 00	3.05E 00	3.03E 00	3.02E 00	3.00E 00
PU242	N,G	9.20E-01	9.10E-01	8.99E-01	8.89E-01	9.20E-01	9.10E-01	8.99E-01	8.89E-01	9.20E-01	9.10E-01	8.99E-01	8.89E-01
PU242	FISS	1.93E-01	1.95E-01	1.98E-01	2.02E-01	1.93E-01	1.95E-01	1.98E-01	2.02E-01	1.93E-01	1.95E-01	1.98E-01	2.02E-01
AM241	N,G	1.93E 00	1.91E 00	1.90E 00	1.88E 00	1.93E 00	1.91E 00	1.90E 00	1.88E 00	1.93E 00	1.91E 00	1.90E 00	1.88E 00
AM241	NGEX	1.54E-01	1.56E-01	1.59E-01	1.62E-01	1.54E-01	1.56E-01	1.59E-01	1.62E-01	1.54E-01	1.56E-01	1.59E-01	1.62E-01

[a]N,G = (n,gamma) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

Table C.6. Cross sections as a function of burnup for the radial blanket of an AMO2TTTX LMFBR

Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.0	0.001	0.002	0.003	0.003	0.006	0.010	0.016	0.016	0.025	0.036	0.050
TH232	N,G	5.41E-01	5.36E-01	5.32E-01	5.28E-01	5.01E-01	4.96E-01	4.92E-01	4.88E-01	4.71E-01	4.67E-01	4.64E-01	4.60E-01
TH232	FISS	1.57E-03	1.72E-03	1.86E-03	2.01E-03	2.13E-03	2.30E-03	2.47E-03	2.64E-03	2.87E-03	3.07E-03	3.25E-03	3.44E-03
U233	N,G	5.05E-01	5.00E-01	4.95E-01	4.90E-01	4.36E-01	4.32E-01	4.27E-01	4.23E-01	3.98E-01	3.94E-01	3.90E-01	3.86E-01
U233	FISS	4.49E 00	4.45E 00	4.42E 00	4.38E 00	3.98E 00	3.95E 00	3.92E 00	3.88E 00	3.70E 00	3.67E 00	3.64E 00	3.62E 00
U234	N,G	1.51E 00	1.49E 00	1.47E 00	1.45E 00	1.19E 00	1.17E 00	1.16E 00	1.14E 00	1.03E 00	1.02E 00	1.00E 00	9.92E-01
U234	FISS	9.84E-02	1.03E-01	1.07E-01	1.11E-01	1.17E-01	1.22E-01	1.27E-01	1.31E-01	1.40E-01	1.45E-01	1.50E-01	1.55E-01
U235	N,G	1.29E 00	1.28E 00	1.26E 00	1.24E 00	1.08E 00	1.06E 00	1.05E 00	1.04E 00	9.62E-01	9.50E-01	9.38E-01	9.27E-01
U235	FISS	3.31E 00	3.28E 00	3.25E 00	3.22E 00	2.90E 00	2.87E 00	2.84E 00	2.82E 00	2.67E 00	2.64E 00	2.62E 00	2.60E 00
U238	N,G	1.07E 00	1.05E 00	1.04E 00	1.02E 00	8.01E-01	7.88E-01	7.75E-01	7.63E-01	6.74E-01	6.62E-01	6.52E-01	6.42E-01
U238	FISS	7.17E-03	7.81E-03	8.44E-03	9.09E-03	9.62E-03	1.04E-02	1.11E-02	1.19E-02	1.29E-02	1.38E-02	1.46E-02	1.54E-02
PU239	N,G	1.58E 00	1.56E 00	1.54E 00	1.51E 00	1.23E 00	1.21E 00	1.19E 00	1.17E 00	1.05E 00	1.03E 00	1.02E 00	1.00E 00
PU239	FISS	2.77E 00	2.75E 00	2.72E 00	2.70E 00	2.39E 00	2.37E 00	2.36E 00	2.34E 00	2.21E 00	2.20E 00	2.19E 00	2.17E 00
PU240	N,G	1.85E 00	1.82E 00	1.79E 00	1.76E 00	1.34E 00	1.32E 00	1.30E 00	1.27E 00	1.11E 00	1.09E 00	1.07E 00	1.05E 00
PU240	FISS	1.79E-01	1.83E-01	1.87E-01	1.91E-01	1.91E-01	1.95E-01	2.00E-01	2.04E-01	2.10E-01	2.15E-01	2.20E-01	2.25E-01
PU241	N,G	1.09E 00	1.08E 00	1.06E 00	1.05E 00	9.13E-01	9.01E-01	8.90E-01	8.79E-01	8.14E-01	8.03E-01	7.94E-01	7.84E-01
PU241	FISS	4.40E 00	4.35E 00	4.31E 00	4.27E 00	3.80E 00	3.76E 00	3.73E 00	3.69E 00	3.48E 00	3.45E 00	3.42E 00	3.39E 00
PU242	N,G	1.79E 00	1.77E 00	1.74E 00	1.71E 00	1.41E 00	1.38E 00	1.36E 00	1.34E 00	1.20E 00	1.18E 00	1.16E 00	1.14E 00
PU242	FISS	9.24E-02	9.62E-02	1.00E-01	1.04E-01	1.09E-01	1.13E-01	1.18E-01	1.22E-01	1.30E-01	1.34E-01	1.39E-01	1.43E-01
AM241	N,G	3.13E 00	3.09E 00	3.05E 00	3.01E 00	2.62E 00	2.59E 00	2.56E 00	2.52E 00	2.34E 00	2.31E 00	2.28E 00	2.26E 00
AM241	NGEX	7.59E-02	7.89E-02	8.19E-02	8.50E-02	8.57E-02	8.93E-02	9.28E-02	9.63E-02	1.01E-01	1.05E-01	1.09E-01	1.13E-01
Nuclide	Cross section type[a]	Cross sections (barns) for fuel burnup [MWd(t)/g-atom heavy metal present] of: 0.050	0.074	0.103	0.138	0.138	0.197	0.265	0.345	0.345	0.474	0.622	0.790
TH232	N,G	4.43E-01	4.39E-01	4.36E-01	4.33E-01	4.10E-01	4.08E-01	4.05E-01	4.03E-01	3.71E-01	3.70E-01	3.69E-01	3.68E-01
TH232	FISS	3.86E-03	4.07E-03	4.26E-03	4.45E-03	5.28E-03	5.48E-03	5.65E-03	5.82E-03	7.52E-03	7.66E-03	7.75E-03	7.85E-03
U233	N,G	3.67E-01	3.63E-01	3.60E-01	3.56E-01	3.35E-01	3.32E-01	3.29E-01	3.27E-01	2.98E-01	2.96E-01	2.95E-01	2.94E-01
U233	FISS	3.47E 00	3.45E 00	3.43E 00	3.40E 00	3.25E 00	3.23E 00	3.21E 00	3.20E 00	3.00E 00	2.99E 00	2.98E 00	2.97E 00
U234	N,G	9.19E-01	9.07E-01	8.96E-01	8.85E-01	8.11E-01	8.02E-01	7.95E-01	7.87E-01	6.96E-01	6.91E-01	6.88E-01	6.84E-01
U234	FISS	1.69E-01	1.74E-01	1.79E-01	1.84E-01	2.08E-01	2.12E-01	2.16E-01	2.20E-01	2.62E-01	2.65E-01	2.67E-01	2.69E-01
U235	N,G	8.69E-01	8.58E-01	8.49E-01	8.40E-01	7.75E-01	7.67E-01	7.60E-01	7.53E-01	6.69E-01	6.65E-01	6.62E-01	6.59E-01
U235	FISS	2.49E 00	2.47E 00	2.45E 00	2.43E 00	2.31E 00	2.29E 00	2.28E 00	2.27E 00	2.11E 00	2.10E 00	2.09E 00	2.09E 00
U238	N,G	5.87E-01	5.78E-01	5.70E-01	5.62E-01	5.08E-01	5.02E-01	4.96E-01	4.90E-01	4.26E-01	4.22E-01	4.20E-01	4.17E-01
U238	FISS	1.73E-02	1.82E-02	1.91E-02	1.99E-02	2.36E-02	2.45E-02	2.52E-02	2.60E-02	3.35E-02	3.40E-02	3.45E-02	3.49E-02
PU239	N,G	9.18E-01	9.03E-01	8.90E-01	8.77E-01	7.89E-01	7.78E-01	7.69E-01	7.59E-01	6.50E-01	6.44E-01	6.40E-01	6.35E-01
PU239	FISS	2.10E 00	2.09E 00	2.08E 00	2.07E 00	2.00E 00	1.99E 00	1.99E 00	1.98E 00	1.90E 00	1.90E 00	1.90E 00	1.89E 00
PU240	N,G	9.50E-01	9.34E-01	9.19E-01	9.05E-01	8.11E-01	7.99E-01	7.89E-01	7.79E-01	6.67E-01	6.62E-01	6.57E-01	6.52E-01
PU240	FISS	2.37E-01	2.42E-01	2.47E-01	2.51E-01	2.74E-01	2.79E-01	2.82E-01	2.86E-01	3.28E-01	3.31E-01	3.33E-01	3.36E-01
PU241	N,G	7.34E-01	7.24E-01	7.16E-01	7.08E-01	6.52E-01	6.45E-01	6.39E-01	6.33E-01	5.60E-01	5.57E-01	5.54E-01	5.51E-01
PU241	FISS	3.24E 00	3.21E 00	3.19E 00	3.16E 00	3.00E 00	2.98E 00	2.96E 00	2.95E 00	2.74E 00	2.73E 00	2.72E 00	2.72E 00
PU242	N,G	1.05E 00	1.03E 00	1.01E 00	9.99E-01	8.93E-01	8.81E-01	8.70E-01	8.59E-01	7.26E-01	7.20E-01	7.15E-01	7.10E-01
PU242	FISS	1.56E-01	1.61E-01	1.65E-01	1.69E-01	1.91E-01	1.95E-01	1.99E-01	2.03E-01	2.43E-01	2.45E-01	2.47E-01	2.49E-01
AM241	N,G	2.12E 00	2.09E 00	2.07E 00	2.05E 00	1.89E 00	1.87E 00	1.86E 00	1.84E 00	1.64E 00	1.63E 00	1.62E 00	1.61E 00
AM241	NGEX	1.22E-01	1.26E-01	1.30E-01	1.34E-01	1.52E-01	1.56E-01	1.59E-01	1.62E-01	1.97E-01	2.00E-01	2.01E-01	2.03E-01

[a]N,G = (n,gamma) to a ground state; NGEX = (n,gamma) to an excited state; FISS = (n,fission).

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