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ERRATA SHEET

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ORNL/NUREG/CSD-2/R1

SCALE - A Modular Code System for Performing Standardized Computer Analysis for Licensing Evaluation Book I, II and III

Published: January 1982

Performed by

Oak Ridge National Laboratory

for the

U. S. Nuclear Regulatory Commission

Attached are revised pages. The corrected pages should replace the identically numbered pages in the existing manual. See attached "List of Revisions" page xiii for insertions and deletions.

DIVISION OF TECHNICAL INFORMATION

AND DOCUMENT CONTROL

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P.O. BOX X, OAK RIDGE, TENNESSEE 37830

July 1, 1982

Recipients of the SCALE Manual, NUREG/CR-0200

Revision No. 1

The attached pages represent corrections in the SCALE Manual NUREG/CR-0200 as issued by the NRC in early April 1982. The corrected pages should replace the identically numbered pages in the existing manual. Note that there are three copies of the corrected Table of Contents -- one for each book of the manual. The title for Section C4 was changed to emphasize that the described control module has many applications other than the optimum pitch criticality search. A revision table has also been issued with these corrected pages to provide the user with a easy reference to the latest revisions.

If there are any questions concerning the corrections or any other portion of the SCALE Manual, please contact me at (615) 574-5280.

C. V. Parks
SCALE Project Leader
Nuclear Engineering
Applications Department

LIST OF REVISIONS for NUREG/CR-0200,
SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation

Page/Section	New/Revised	Date
Table of Contents	Revised	July, 1982
Sect. C1	Revised	January, 1982
Sect. C2	New	January, 1982
Sect. C4	New	January, 1982
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Sect. S3	New	January, 1982
Sect. F1	New	January, 1982
p. F1.6.2	Revised	July, 1982
p. F1.6.11	Revised	July, 1982
Sect. F2	New	January, 1982
pp. F2.3.33-34	Revised	July, 1982
p. F2.3.41	Revised	July, 1982
Sect. F5	New	January, 1982
Sect. F6	New	January, 1982
Sect. F7	New	January, 1982
Sect. F9	New	January, 1982
Sect. F10	New	January, 1982
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Sect. F12	New	January, 1982
Sect. M1	New	January, 1982
Sect. M2	New	January, 1982
Sect. M3	New	January, 1982
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p. M8.2.2	Revised	July, 1982
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p. M8.2.10-11	Revised	July, 1982
pp. M8.2.14-17	Revised	July, 1982
p. M8.2.24	Revised	July, 1982
p. M8.2.28	Revised	July, 1982
p. M8.2.31	Revised	July, 1982
p. M8.2.34	Revised	July, 1982
Sect. M9	New	January, 1982
Sect. M10	New	January, 1982
Sect. M11	New	January, 1982

TABLE OF CONTENTS

		Page*
ACKNOWLEDGMENTS		vii
ABSTRACT		ix
FOREWORD		xi
LIST OF REVISIONS		xiii
	VOLUME 1: CONTROL MODULES	
Section C1	CSAS1: A ONE-DIMENSIONAL CRITICALITY SAFETY ANALYSIS MODULE	C1.1.1
Section C2	CSAS2: A MULTIDIMENSIONAL CRITICALITY SAFETY ANALYSIS MODULE	C2.1.1
Section C3	CSAS3: AN OPTIMUM CONCENTRATION CRITICALITY SAFETY ANALYSIS MODULE (to be issued at later date)	C3.1.1
Section C4	CSAS4: AN ENHANCED CRITICALITY SAFETY ANALYSIS MODULE WITH AN OPTIMUM PITCH SEARCH OPTION	C4.1.1
Section S1	SAS1: A ONE-DIMENSIONAL SHIELDING ANALYSIS MODULE (to be issued at later date)	S1.1.1
Section S2	SAS2: A COUPLED ONE-DIMENSIONAL DEPLETION AND SHIELDING ANALYSIS MODULE (to be issued at later date)	S2.1.1
Section S3	SAS3: AN AUTOMATED MONTE CARLO SHIELDING ANALYSIS MODULE	S3.1.1
Section S4	SAS4: A COUPLED DEPLETION AND MONTE CARLO SHIELDING ANALYSIS MODULE (to be issued at later date)	S4.1.1
Section H1	HTAS1: A TWO-DIMENSIONAL HEAT TRANSFER ANALYSIS OF FUEL CASKS (to be issued at later date)	H1.1.1

*All section page numbers refer to the page where the section introduction begins.

VOLUME 2: FUNCTIONAL MODULES

		Page
Section F1	BONAMI-S: RESONANCE SELF-SHIELDING BY THE BONDARENKO METHOD	F1.1.1
Section F2	NITAWL-S: RESONANCE SELF-SHIELDING BY THE NORDHEIM METHOD	F2.1.1
Section F3	XSDRNPM-S: A ONE-DIMENSIONAL DISCRETE-ORDINATES TRANSPORT ANALYSIS . . . . . (to be issued at later date)	F3.1.1
Section F4	XSDOSE: A MODULE FOR CALCULATING FLUXES AND DOSE RATES AT POINTS OUTSIDE A SHIELD . . . . (to be issued at later date)	F4.1.1
Section F5	KENO-IV/S: AN IMPROVED MONTE CARLO CRITICALITY PROGRAM	F5.1.1
Section F6	COUPLE: SCALE SYSTEM MODULE TO PROCESS PROBLEM-DEPENDENT CROSS SECTIONS AND NEUTRON SPECTRAL DATA FOR ORIGEN-S ANALYSES	F6.1.1
Section F7	ORIGEN-S: SCALE SYSTEM MODULE TO CALCULATE FUEL DEPLETION, ACTINIDE TRANSMUTATION, FISSION PRODUCT BUILDUP AND DECAY, AND ASSOCIATED RADIATION SOURCE TERMS	F7.1.1
Section F8	ICE-S: A PROGRAM TO GENERATE MACROSCOPIC MULTI-GROUP CONSTANTS FOR TRANSPORT ANALYSES . . . . (to be issued at later date)	F8.1.1
Section F9	MORSE-SGC/S: A NEUTRON AND PHOTON MONTE CARLO TRANSPORT ANALYSIS WITH SUPER-GROUPING AND ADVANCED GEOMETRY FEATURES	F9.1.1
Section F10	HEATING6: A MULTIDIMENSIONAL HEAT CONDUCTION ANALYSIS WITH THE FINITE-DIFFERENCE FORMU-LATION	F10.1.1
Section F11	KENO-V: AN IMPROVED MONTE CARLO CRITICALITY PROGRAM WITH SUPER-GROUPING	F11.1.1
Section F12	JUNEBUG: A THREE-DIMENSIONAL GEOMETRY PLOTTING CODE	F12.1.1

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CSAS4: AN ENHANCED CRITICALITY SAFETY ANALYSIS MODULE WITH AN OPTIMUM PITCH SEARCH OPTION

N. F. Landers
L. M. Petrie

Sponsor: C. F. Whitesides

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COMPUTER SCIENCES
at Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

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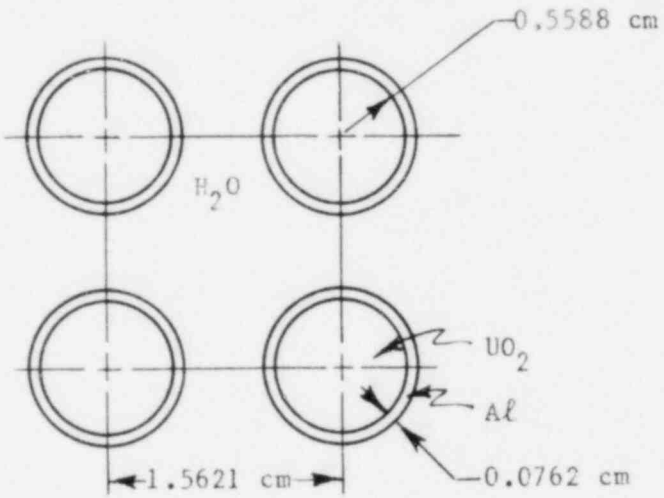
F1.6 SAMPLE PROBLEMS

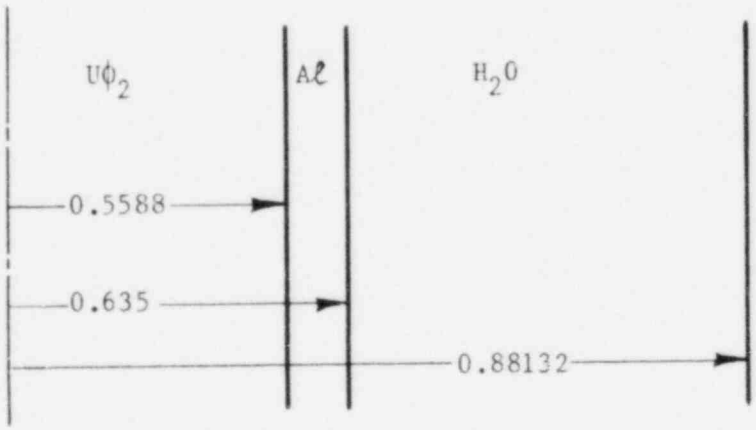
In most cases the input data to BONAMI-S are simple and obvious since the complicated parameters are determined internally based on the options selected. The user describes his geometry, the materials contained therein, the temperatures and a few options.

F1.6.1 SAMPLE PROBLEM 1

This problem is for a system of aluminum-clad $U\phi_2$ fuel pins arranged in a square lattice in a water pool.



Following common practice and determining a cylinder whose area is that for the "squares", the following system is to be calculated:



Our number densities are:

UO_2:

$N_{U^{235}} = 4.881 \times 10^{-4}$

$N_{U^{238}} = 2.00026 \times 10^{-2}$

$N_O = 4.09815 \times 10^{-2}$

Clad:

$N_{A\ell} = 6.0245 \times 10^{-2}$

Water:

$N_H = 6.6743 \times 10^{-2}$

$N_O = 3.33371 \times 10^{-2}$

$N^*_{Pb} = 1.0 \times 10^{-2}$

For the problem, we choose ISSOPT=2 (Sauer's approximation for a cylindrical rod in a square lattice) to account for lattice effects.

Note that we have run the AMPX AJAX module prior to BONAMI in order to select only those nuclides used in our problem. A 16-group library is used.

An abbreviated, annotated copy of the output from this case follows:

---

*Lead is mixed in a trace quantity in order to obtain an infinite dilution set at 300K.

F1.6.2 Sample Problem 2

In the second sample case, we calculate the same system described for sample problem 1, except we use the homogeneous option (ISSOPT=0). In this case there will be no lattice effects and dimensioning geometries, etc., do not matter.

For number densities, we have volume weighted those from the first problem:

$$N_{U^{235}} = 1.962 \times 10^{-4}$$

$$N_{U^{238}} = 8.04141 \times 10^{-3}$$

$$N_{O} = 3.25059 \times 10^{-2}$$

$$N_{A\ell} = 7.05570 \times 10^{-3}$$

$$N_{H} = 3.2094 \times 10^{-2}$$

$$N_{Pb} = 4.81 \times 10^{-9}$$

The case output follows:

```
 MODULE BONAMI2  HAS BEEN CALLED

* SAMPLE PROBLEM FOR HOMOGENEOUS OPTION                                  00000215
0$$ 2 0 18 1     1$$ 1 1 0 1 1 0 T                                      00000220
3$$       1           1           1           1           1           1  00000230
4$$   92235       92238       8016       13027       1301       82000  00000240
5** 1.962-4 8.04141-3 3.25059-2  7.0557-3  3.2094-2  4.81-9            00000250
6$$       1                                                            00000260
7**1                                                                   00000270
8**     300                                                            00000280
1                                                                      00000290

 MODULE BONAMI2  IS FINISHED.
 CPU TIME      1.16 (SECONDS).  I/O'S      124 USER CODE 0000   SYSTEM CODE 000
```

1. Zero

2. NBLK, the number of blocks of resolved data,

3. Zero

4. Zero

5. Zero

6. Zero

Following these six words are NBLK six-word groups which are used to specify information concerning blocks of resonance data that apply to, for example, different isotopes, different energy regions, different kinds of data (s-wave or p-wave resonances), etc. These are stacked as follows:

1. AWRI, the mass ratio associated with the block of data,

2. ABUN, the abundance for the block of data,

3. NRE, the number of resonances in the block,

4. ℓ, the value of spin for the resonances in the block,

5. EL, the low energy cut-off for resonances in the block,

6. EH, the upper energy cut-off for resonances in the block,

.
.
.

After these NBLK groups of six words, comes the six-word sets of resonance parameters arranged as follows:

1. E_0 , the resonance energy,
2. Γ_n , the neutron width of the resonance,
3. Γ_γ , the gamma width of the resonance,
4. Γ_f , the fission width of the resonance,
5. r , a factor used in the Nordheim treatment for determining the range of calculation
6. g , the statistical factor for the resonance.

The following chart illustrates the structure just described schematically:

	1	2	3	4	5	6
	0	NBLK	0	0	0	0
	$AWRI_1$	$ABUN_1$	NRE_1	ℓ_1	EL_1	EH_1
	$AWRI_2$	$ABUN_2$	NRE_2	ℓ_2	EL_2	EH_2
	.					
	.					
	.					
	$AWRI_{NBLK}$	$ABUN_{NBLK}$	NRE_{NBLK}	ℓ_{NBLK}	EL_{NBLK}	EH_{NBLK}
	E_0	Γ_n	Γ_γ	Γ_f	r	g
first	.	.	.	.	.	.
block	.	.	.	.	.	.
	.	.	.	.	.	.

After the resolved resonance parameters, the points at which the unresolved cross section should be evaluated are specified. There are NUNR of these points arranged low-to-high in energy:

(EUNR(I), I=1, NUNR)

The structure of the records of a nuclide is:

	Record Type
Nuclide Directory Record	3
Bondarenko Data	
Resonance Parameter Data	4
Temperature-Independent, Group-Averaged Neutron Cross Sections	9
Scattering Matrix Data for Neutrons	
Group-Averaged Gamma Cross Sections	9
Scattering Matrix Data for Gammas	

The internal structure for Bondarenko data is:

	Record Type
(σ_0(I),I=1,NSIGO), (T(J),J=1,NT), EL, EH	5
Bondarenko Data Directory (MT(I), I=1, NB), (NF(I), I=1, NB), (NL(I), I=1, NB), (ORDER(I), I=1, NB), (IOFF(I), I=1, NB), (NZ(I), I=1, NB)	6
The following records are given in pairs for all NB Bondarenko processes.	
Infinite Dilution Values (σ^{∞}(I), I=NF, NL)	7
Bondarenko Factors (((BF(I,J,K), I=1, NSIGO), J=1, NT), K=NF, NL)	8

M8.2 THE STANDARD COMPOSITION LIBRARY

The Standard Composition Library describes the various compounds, alloys, elements and isotopes one may use in defining the material mixtures for a given problem.* Typically, one will use the alphanumeric description of one or more of these materials to define a material mixture as noted in Section C1.5 (cf., the Standard Composition Specification Card).

Often when formulating such a mixture, it is necessary to know the density (gms/cc) of the various constituent materials. For convenience, the reference values used by the code have been listed in Table M8.2.1. (Note that the reference values given represent the actual theoretical density, except in the case of some individual nuclides where a default value of 1.0 gm/cc was used.)

While the user is never required to enter the temperature of a given material, he is always allowed to enter it (cf., item 5 of the Standard Composition Specification Card). Indeed, the temperature probably should be entered if resonance data or Bondarenko data is available for the material, or if thermal scattering data is available at more than one temperature. YES/NO flags for both conditions are given in Table M8.2.1. [Note: The list of nuclides having resonance data differs from one master cross-section library to another. Table C1.A.4 lists those nuclides having resonance data on each of the master cross-section libraries. The list of nuclides having thermal scattering cross-section data at more than one temperature also differs from one library to another. Table C1.A.5 lists those nuclides (and the associated temperatures) for each of the master cross-section libraries. While the user may find this information interesting and/or helpful, he should have no direct need of it.]

Unfortunately, all nuclides are not presently available on all master cross-section libraries. Column 5 of Table M8.2.1 is designed to give a quick indication of whether all the nuclides in a given material are available on a given cross-section library. Thus, for example, one should not use P or CO in conjunction with the 123GROUPGMTH library. Column 5 does indicate, however, that both materials are available on the HANSEN-ROACH, the 27GROUPNDF4 and the 218GROUPNDF4 libraries. Nuclides not available on any cross-section library are used in connection with other SCALE data libraries, e.g., the ORIGEN-S data library.

Column 6 of Table M8.2.1 lists the nuclides in the standard composition by the ID numbers. Typicaly, the ID number is A + 1000 * Z where Z and A are the charge and mass numbers for the nuclide (i.e., 1001 for hydrogen and 8016 for oxygen, etc.). The nuclides in brackets are those for which the isotope weight percent can be specified (or else default to the value given in Table M8.4.1).

---

*In addition to the various materials listed here, one is also free to use any of the solutions found in the Sect. M8.3.

Revised 7/82

To more fully document the composition of each material and/or to document the assumptions used in producing the associated cross-section data, a brief description of each material in Table M8.2.1 is included here:

1.	BORON	Boron; natural isotope distribution obtained by default
2.	B4C	Boron carbide: B_4C; natural isotope distribution obtained by default
3.	H2O	Water; cross-sections developed using 1/E weighting everywhere
4.	H2O-X(E)-HR	Water; cross-sections developed using fission spectrum weighting at high energies and 1/E at lower energies
5.	D2O	Heavy water: D_2O
6.	ZIRCALLOY	Zircalloy-2 as tabulated in ENDF/B-IV ($\sim$ 97.91 wt % zirconium, 1.59 wt % tin, 0.5 wt % iron); Note: the thermal capture cross section and the resonance capture integrals of zirc-2 and zirc-4 are equal within the experimental measurement uncertainties and the variance on the contents of the alloying agents used in zirc-2 and zirc-4.
7.	SS304	Stainless steel - 304: 69.5 wt % iron, 19 wt % chromium, 9.5 wt % nickel, 2 wt % manganese
8.	SS316	Stainless steel - 316: 65.42 wt % iron, 17 wt % chromium, 12 wt % nickel, 2.5 wt % molybdenum, 2 wt % manganese, 1 wt % silicon, 0.08 wt % carbon
9.	INCONEL	Inconel: 73 wt % nickel, 15 wt % chronium, 7 wt % iron, 2.5 wt % titanium, 2.5 wt % silicon
10.	CARBONSTEEL	Carbon steel: 99 wt % iron, 1 wt % carbon; cross-sections developed using 1/E weighting
11.	ORCONCRETE	Oak Ridge Concrete: 41.02 wt % oxygen, 32.13 wt % calcium, 17.52 wt % carbon, 3.448 wt % silicon, 3.261 wt % magnesium, 1.083 wt % aluminum, 0.7784 wt. % iron, 0.6187 wt % hydrogen, 0.1138 wt % potassium, 0.0271 wt % sodium
12.	RFCONCRETE	Rocky Flats Concrete: 48.49 wt % oxygen, 23 wt % calcium, 15.5 wt % silicon, 5.52 wt % carbon, 2.17 wt % aluminum, 1.37 wt % potassium, 1.25 wt % magnesium, 1.01 wt % iron, 0.75 wt % hydrogen, 0.63 wt % sodium, 0.19 wt % sulfur, 0.1 wt % titanium, 0.02 wt % nitrogen
13.	MGCONCRETE	Magnuson's Concrete: 45.84 wt % oxygen, 20.77 wt % calcium, 9.674 wt % carbon, 8.666 wt % potassium, 8.644 wt % magnesium, 3.863 wt % silicon, 0.721 wt % aluminum, 0.5134 wt % iron, 0.4146 wt % zinc, 0.3046 wt % hydrogen, 0.2285 wt % sulfur, 0.1366 wt % titanium, 0.1294 wt % sodium, 0.048 wt % chlorine, 0.0469 wt % manganese

87.	BR-79	Bromine-79
88.	BR-81	Bromine-81
89.	KR-80	Krypton-80
90.	KR-82	Krypton-82
91.	KR-83	Krypton-83
92.	KR-84	Krypton-84
93.	KR-85	Krypton-85
94.	KR-86	Krypton-86
95.	RB-85	Rubidium-85
96.	RB-86	Rubidium-86
97.	RB-87	Rubidium-87
98.	SR-86	Strontium-86
99.	SR-87	Strontium-87
100.	SR-88	Strontium-88
101.	SR-89	Strontium-89
102.	SR-90	Strontium-90
103.	Y-89	Yttrium-89
104.	Y-90	Yttrium-90
105.	Y-91	Yttrium-91
106.	ZR	Zirconium: Zr
107.	ZR-90	Zirconium-90
108.	ZR-91	Zirconium-91
109.	ZR-92	Zirconium-92
110.	ZR-93	Zirconium-93
111.	ZR-94	Zirconium-94
112.	ZR-95	Zirconium-95
113.	ZR-96	Zirconium-96
114.	NB	Niobium: Nb
115.	NB-93	Niobium-93
116.	NB-94	Niobium-94
117.	NB-95	Niobium-95
118.	MO	Molybdenum: Mo
119.	MO-94	Molybdenum-94
120.	MO-95	Molybdenum-95
121.	MO-96	Molybdenum-96
122.	MO-97	Molybdenum-97
123.	MO-98	Molybdenum-98
124.	MO-99	Molybdenum-99
125.	MO-100	Molybdenum-100
126.	TC-99	Technetium-99
127.	RU-99	Ruthenium-99
128.	RU-100	Ruthenium-100
129.	RU-101	Ruthenium-101
130.	RU-102	Ruthenium-102
131.	RU-103	Ruthenium-103
132.	RU-104	Ruthenium-104
133.	RU-105	Ruthenium-105
134.	RU-106	Ruthenium-106
135.	RH-103	Rhodium-103

Revised 7/82

136.	RH-105	Rhodium-105
137.	PD-104	Palladium-104
138.	PD-105	Palladium-105
139.	PD-106	Palladium-106
140.	PD-107	Palladium-107
141.	PD-108	Palladium-108
142.	PD-110	Palladium-110
143.	AG-107	Silver-107
144.	AG-109	Silver-109
145.	AG-111	Silver-111
146.	CD	Cadmium (natural)
147.	CD-108	Cadmium-108
148.	CD-110	Cadmium-110
149.	CD-111	Cadmium-111
150.	CD-112	Cadmium-112
151.	CD-113	Cadmium-113
152.	CD-114	Cadmium-114
153.	CD-115M	Cadmium-115 (metastable)
154.	CD-116	Cadmium-116
155.	IN-113	Indium-113
156.	IN-115	Indium-115
157.	SN	Tin: Sn
158.	SN-115	Tin-115
159.	SN-116	Tin-116
160.	SN-117	Tin-117
161.	SN-118	Tin-118
162.	SN-119	Tin-119
163.	SN-120	Tin-120
164.	SN-122	Tin-122
165.	SN-123	Tin-123
166.	SN-124	Tin-124
167.	SN-125	Tin-125
168.	SN-126	Tin-126
169.	SB-121	Antimony-121
170.	SB-123	Antimony-123
171.	SB-124	Antimony-124
172.	SB-125	Antimony-125
173.	SB-126	Antimony-126
174.	TE-122	Tellurium-122
175.	TE-123	Tellurium-123
176.	TE-124	Tellurium-124
177.	TE-125	Tellurium-125
178.	TE-126	Tellurium-126
179.	TE-127M	Tellurium-127 (metastable)
180.	TE-128	Tellurium-128
181.	TE-129M	Tellurium-129 (metastable)
182.	TE-130	Tellurium-130
183.	TE-132	Tellurium-132
184.	I-127	Iodine-127
185.	I-129	Iodine-129

Revised 7/82

186.	I-130	Iodine-130
187.	I-131	Iodine-131
188.	I-135	Iodine-135
189.	XE-128	Xenon-128
190.	XE-129	Xenon-129
191.	XE-130	Xenon-130
192.	XE-131	Xenon-131
193.	XE-132	Xenon-132
194.	XE-133	Xenon-133
195.	XE-134	Xenon-134
196.	XE-135	Xenon-135
197.	XE-136	Xenon-136
198.	CS-133	Cesium-133
199.	CS-134	Cesium-134
200.	CS-135	Cesium-135
201.	CS-136	Cesium-136
202.	CS-137	Cesium-137
203.	BA-134	Barium-134
204.	BA-135	Barium-135
205.	BA-136	Barium-136
206.	BA-137	Barium-137
207.	BA-138	Barium-138
208.	BA-140	Barium-140
209.	LA-139	Lanthanum-139
210.	LA-140	Lanthanum-140
211.	CE-140	Cerium-140
212.	CE-141	Cerium-141
213.	CE-142	Cerium-142
214.	CE-143	Cerium-143
215.	CE-144	Cerium-144
216.	PR-141	Praseodymium-141
217.	PR-142	Praseodymium-142
218.	PR-143	Praseodymium-143
219.	ND-142	Neodymium-142
220.	ND-143	Neodymium-143
221.	ND-144	Neodymium-144
222.	ND-145	Neodymium-145
223.	ND-146	Neodymium-146
224.	ND-147	Neodymium-147
225.	ND-148	Neodymium-148
226.	ND-150	Neodymium-150
227.	PM-147	Promethium-147
228.	PM-148	Promethium-148
229.	PM-148M	Promethium-148 (metastable)
230.	PM-149	Promethium-149
231.	PM-151	Promethium-151
232.	SM-147	Samarium-147
233.	SM-148	Samarium-148
234.	SM-149	Samarium-149
235.	SM-150	Samarium-150

236.	SM-151	Samarium-151
237.	SM-152	Samarium-152
238.	SM-153	Samarium-153
239.	SM-154	Samarium-154
240.	EU-151	Europium-151
241.	EU-152	Europium-152
242.	EU-153	Europium-153
243.	EU-154	Europium-154
244.	EU-155	Europium-155
245.	EU-156	Europium-156
246.	EU-157	Europium-157
247.	GD	Gadolinium: Gd
248.	GD-154	Gadolinium-154
249.	GD-155	Gadolinium-155
250.	GD-156	Gadolinium-156
251.	GD-157	Gadolinium-157
252.	GD-158	Gadolinium-158
253.	GD-160	Gadolinium-160
254.	TB-159	Terbium-159
255.	TB-160	Terbium-160
256.	DY-160	Dysprosium-160
257.	DY-161	Dysprosium-161
258.	DY-162	Dysprosium-162
259.	DY-163	Dysprosium-163
260.	DY-164	Dysprosium-164
261.	HO-165	Holmium-165
262.	ER-166	Erbium-166
263.	ER-167	Erbium-167
264.	LU-175	Lutetium-175
265.	LU-176	Lutetium-176
266.	HF	Hafnium: Hf
267.	TA-181	Tantalum-181
268.	W-182	Tungsten-182
269.	W-183	Tungsten-183
270.	W-184	Tungsten-184
271.	W-186	Tungsten-186
272.	RE-185	Rhenium-185
273.	RE-187	Rhenium-187
274.	AU	Gold: Au
275.	PB	Lead: Pb
276.	TH-232	Thorium-232
277.	PA-233	Protactinium-233
278.	U-233	Uranium-233
279.	U-234	Uranium-234
280.	U-235	Uranium-235
281.	U-236	Uranium-236
282.	U-238	Uranium-238
283.	NP-237	Neptunium-237
284.	PU-238	Plutonium-238
285.	PU-239	Plutonium-239

286.	PU-240	Plutonium-240
287.	PU-241	Plutonium-241
288.	PU-242	Plutonium-242
289.	AM-241	Americium-241
290.	AM-243	Americium-243
291.	CM-244	Curium-244

Table M8.2.1: THE STANDARD COMPOSITION LIBRARY

ALPHANUMERIC DESCRIPTION STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
BORON	2.5350	NO	YES	16 27 123 218	{5010 5011}
B4C	2.5200	NO	YES	16 27 123 218	{5010 5011} 6012
H2O	0.9982	NO	YES	16 27 123 218	1001 8016
H2O-X(E)-HR	0.9982	NO	YES	16 -- --- ---	1301 8016
D2O	1.1053	NO	YES	16 27 123 218	1002 8016
ZIRCALLOY	6.4400	YES	NO	16 27 123 218	40302
SS304	7.9200	YES	NO	16 27 123 218	24304 25055 26304 28304
SS316	7.7500	YES	YES	16 27 123 218	6012 14028 24304 25055 26304 28304 42000
INCONEL	8.3000	NO	NO	16 27 123 218	14028 22000 24404 26404 28404
CARBONSTEEL	7.8212	YES	YES	16 27 123 218	6012 26000

Table M8.2.1: (Continued)

APHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
ORCONCRETE	2.2994	YES	YES	16 27 123 218	1001 6012 8016 11023 12000 13027 14028 19039 20040 26000
RFCONCRETE	2.3210	YES	YES	16 27 123 218	1001 6012 7014 8016 11023 12000 13027 14028 16032 19039 20040 22000 26000
MGCONCRETE	2.3298	YES	YES	16 -- --- ---	1001 6012 8016 11023 12000 13027 14028 16032 17000 19039 20040 22000 25055 26000 30000
REG-CONCRETE	2.3000	YES	YES	16 27 123 218	1001 8016 11023 13027 14028 20040 26000
PLEXIGLASS	1.1800	NO	YES	16 27 123 218	1001 6012 8016
POLYETHYLENE	0.9200	NO	YES	16 27 123 218	1001 6012
PARAFFIN	0.9300	NO	YES	16 27 123 218	1001 6012
HNO3	1.0000	NO	YES	16 27 123 218	1001 7014 8016
HFACID	1.0000	NO	YES	16 27 123 218	1001 9019

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
UO2	10.9600	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 8016
U3O8	8.3000	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 8016
UC	13.6300	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 6012
UN	14.3100	YES	NO	16 27 123 218	{92233 92234 92235 92236 92238} 7014
UF4	6.7000	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 9019
UF6	4.8500	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 9019
UO2F2	6.3700	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 8016 9019
UO2(NO3)2	2.2030	YES	YES	16 27 123 218	{92233 92234 92235 92236 92238} 7014 8016

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
URANIUM	19.0500	YES	NO	16 27 123 218	{92233 92234 92235 92236 92238}
U(.27)METAL	19.0500	YES	NO	16 27 123 218	92235 92238
PUO2	11.4600	YES	YES	16 27 123 218	{94238 94239 94240 94241 94242} 8016
PUC	13.6000	YES	YES	16 27 123 218	{94238 94239 94240 94241 94242} 6012
PUN	14.2500	YES	NO	16 27 123 218	{94238 94239 94240 94241 94242} 7014
PUF4	7.0000	YES	YES	16 27 123 218	{94238 94239 94240 94241 94242} 9019
PU(NO3)4	2.4470	YES	YES	16 27 123 218	{94238 94239 94240 94241 94242} 7014 8016
PLUTONIUMALP	19.8400	YES	NO	16 27 123 218	{94238 94239 94240 94241 94242}
PLUTONIUMDLT	15.9200	YES	NO	16 27 123 218	{94238 94239 94240 94241 94242}

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
1/VASORBER	1.0000	NO	NO	16 27 123 218	999
H	1.0000	NO	YES	16 27 123 218	1001
H-X(E)-HR	1.0000	NO	NO	16 -- --- ---	1301
D	1.0000	NO	YES	16 27 123 218	1002
HE	1.0000	NO	NO	16 27 --- 218	2004
LI-6	1.0000	NO	YES	16 27 123 218	3006
LI-7	1.0000	NO	YES	16 27 123 218	3007
BE	1.8480	NO	YES	16 27 123 218	4009
BEBOUND	1.8480	NO	NO	-- -- --- ---	4309
B-10	2.1950	NO	YES	16 27 123 218	5010
B-11	2.4130	NO	YES	16 27 123 218	5011

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
C	2.3000	NO	YES	16 27 123 218	6012
N	1.0000	NO	NO	16 27 123 218	7014
O	1.0000	NO	YES	16 27 123 218	8016
F	1.0000	NO	YES	16 27 123 218	9019
NA	1.0000	YES	YES	16 27 123 218	11023
MG	1.0000	NO	NO	16 27 123 218	12000
AL	2.6989	NO	YES	16 27 123 218	13027
SI	1.0000	NO	NO	16 27 123 218	14028
P	1.0000	NO	NO	16 27 123 218	15031
S	1.0000	NO	NO	16 27 123 218	16032
CL	1.0000	NO	NO	16 27 123 218	17000

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
K	1.0000	NO	NO	16 27 123 218	19039
CA	1.0000	NO	NO	16 27 123 218	20040
TI	4.5400	NO	NO	16 27 123 218	22000
V	6.1100	NO	NO	16 27 --- 218	23051
CR	7.1900	NO	YES	16 27 123 218	24000
CRSS	7.1900	NO	NO	16 27 123 218	24304
CR INCONEL	7.1900	NO	NO	16 27 123 218	24404
MN	7.4400	YES	NO	16 27 123 218	25055
MNSS	7.4400	NO	NO	-- -- --- ---	25304
FE	7.8740	YES	YES	16 27 123 218	26000
FESS	7.8740	NO	NO	16 27 123 218	26304

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
FEINCONEL	7.8740	NO	NO	16 27 123 218	26404
CO	8.9000	YES	NO	16 27 --- 218	27059
NI	8.9020	NO	YES	16 27 123 218	28000
NISS	8.9020	NO	NO	16 27 123 218	28304
NIINCONEL	8.9020	NO	NO	16 27 123 218	28404
CU	8.9600	YES	YES	16 27 123 218	29000
ZN	7.1330	NO	NO	16 -- --- ---	30000

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
GE-72	1.0000	NO	NO	-- -- --- ---	32072
GE-73	1.0000	NO	NO	-- -- --- ---	32073
GE-74	1.0000	NO	NO	-- -- --- ---	32074
GE-76	1.0000	NO	NO	-- -- --- ---	32076
AS-75	1.0000	NO	NO	-- -- --- ---	33075
SE-76	1.0000	NO	NO	-- -- --- ---	34076
SE-77	1.0000	NO	NO	-- -- --- ---	34077
SE-78	1.0000	NO	NO	-- -- --- ---	34078
SE-80	1.0000	NO	NO	-- -- --- ---	34080
SE-82	1.0000	NO	NO	-- -- --- ---	34082

Table M8.2.1. (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY pth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
MO-100	1.0000	NO	NO	-- -- --- ---	42100
TC-99	1.0000	NO	NO	-- -- 123 ---	43099
RU-99	1.0000	NO	NO	-- -- --- ---	44099
RU-100	1.0000	NO	NO	-- -- 123 ---	44100
RU-101	1.0000	NO	NO	-- -- 123 ---	44101
RU-102	1.0000	NO	NO	-- -- 123 ---	44102
RU-103	1.0000	NO	NO	-- -- --- ---	44103
RU-104	1.0000	NO	NO	-- -- --- ---	44104
RU-105	1.0000	NO	NO	-- -- --- ---	44105
RU-106	1.0000	NO	NO	-- -- 123 ---	44106
RH-103	12.5000	NO	NO	-- -- 123 ---	45103
RH-105	12.5000	NO	NO	-- -- 123 ---	45105

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
PD-104	1.0000	NO	NO	-- -- --- ---	46104
PD-105	1.0000	NO	NO	-- -- 123 ---	46105
PD-106	1.0000	NO	NO	-- -- 123 ---	46106
PD-107	1.0000	NO	NO	-- -- 123 ---	46107
PD-108	1.0000	NO	NO	-- -- 123 ---	46108
PD-110	1.0000	NO	NO	-- -- --- ---	46110
AG-107	10.4060	YES	NO	16 27 --- 218	47107
AG-109	10.6010	YES	NO	16 27 123 218	47109
AG-111	1.0000	NO	NO	-- -- --- ---	47111
CD	8.6500	NO	NO	16 27 --- 218	48000
CD-108	1.0000	NO	NO	-- -- --- ---	48108
CD-110	1.0000	NO	NO	-- -- --- ---	48110

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
SB-124	1.0000	NO	NO	-- -- --- ---	51124
SB-125	1.0000	NO	NO	-- -- --- ---	51125
SB-126	1.0000	NO	NO	-- -- --- ---	51126
TE-122	1.0000	NO	NO	-- -- --- ---	52122
TE-123	1.0000	NO	NO	-- -- --- ---	52123
TE-124	1.0000	NO	NO	-- -- --- ---	52124

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
TE-125	1.0000	NO	NO	-- -- --- ---	52125
TE-126	1.0000	NO	NO	-- -- --- ---	52126
TE-127M	1.0000	NO	NO	-- -- --- ---	52601
TE-128	1.0000	NO	NO	-- -- --- ---	52128
TE-129M	1.0000	NO	NO	-- -- --- ---	52611
TE-130	1.0000	NO	NO	-- -- --- ---	52130
TE-132	1.0000	NO	NO	-- -- --- ---	52132
I-127	1.0000	NO	NO	-- -- --- ---	53127
I-129	1.0000	NO	NO	-- -- 123 ---	53129
I-130	1.0000	NO	NO	-- -- --- ---	53130
I-131	1.0000	NO	NO	-- -- 123 ---	53131

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth in GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
BA-140	1.0000	NO	NO	-- -- --- ---	56140
LA-139	1.0000	NO	NO	-- -- 123 ---	57139
LA-140	1.0000	NO	NO	-- -- --- ---	57140
CE-140	1.0000	NO	NO	-- -- --- ---	58140
CE-141	1.0000	NO	NO	-- -- --- ---	58141
CE-142	1.0000	NO	NO	-- -- --- ---	58142
CE-143	1.0000	NO	NO	-- -- --- ---	58143
CE-144	1.0000	NO	NO	-- -- --- ---	58144
PR-141	1.0000	NO	NO	-- -- 123 ---	59141
PR-142	1.0000	NO	NO	-- -- --- ---	59142
PR-143	1.0000	NO	NO	-- -- 123 ---	59143

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
ND-142	1.0000	NO	NO	-- -- --- ---	60142
ND-143	6.9600	NO	NO	-- -- 123 ---	60143
ND-144	1.0000	NO	NO	-- -- 123 ---	60144
ND-145	6.9600	NO	NO	-- -- 123 ---	60145
ND-146	1.0000	NO	NO	-- -- --- ---	60146
ND-147	1.0000	NO	NO	-- -- --- ---	60147
ND-148	1.0000	NO	NO	-- -- 123 ---	60148
ND-150	1.0000	NO	NO	-- -- --- ---	60150
PM-147	1.0000	NO	NO	-- -- 123 ---	61147
PM-148	1.0000	NO	NO	-- -- 123 ---	61148
PM-148M	1.0000	NO	NO	-- -- --- ---	61601

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
PM-149	1.0000	NO	NO	-- -- --- ---	61149
PM-151	1.0000	NO	NO	-- -- --- ---	61151
SM-147	1.0000	NO	NO	-- -- 123 ---	62147
SM-148	1.0000	NO	NO	-- -- 123 ---	62148
SM-149	7.7000	NO	NO	-- -- 123 ---	62149
SM-150	7.7000	NO	NO	-- -- 123 ---	62150
SM-151	7.7000	NO	NO	-- -- 123 ---	62151
SM-152	7.7000	NO	NO	-- -- 123 ---	62152
SM-153	1.0000	NO	NO	-- -- --- ---	62153
SM-154	1.0000	NO	NO	-- -- 123 ---	62154
EU-151	1.0000	NO	NO	-- -- --- ---	63151

Table M8.2.1: (Continued)

ALPHANUMERIC DESCRIPTION OF THE STANDARD COMPOSITION	THEORETICAL DENSITY ρth IN GRAMS/CC	RESONANCE DATA OR BONDARENKO DATA AVAILABLE?	SCATTERING X-SECT DATA AVAILABLE AT MULTIPLE TEMPERATURES?	X-SECT LIBRARIES FOR WHICH THIS STD. COMPOSITION IS AVAILABLE	LIST OF NUCLIDES IN THIS STD. COMPOSITION (WITH ISOTOPES THE USER MAY SPECIFY SHOWN IN BRACKETS)
EU-152	1.0000	NO	NO	-- -- --- ---	63152
EU-153	5.2400	NO	NO	-- -- 123 ---	63153
EU-154	5.2400	NO	NO	-- -- 123 ---	63154
EU-155	5.2400	NO	NO	-- -- 123 ---	63155
EU-156	1.0000	NO	NO	-- -- --- ---	63156
EU-157	1.0000	NO	NO	-- -- --- ---	63157
GD	1.0000	YES	NO	16 27 123 218	64000
GD-154	1.0000	NO	NO	-- -- --- ---	64154
GD-155	1.0000	NO	NO	-- -- 123 ---	64155
GD-156	1.0000	NO	NO	-- -- --- ---	64156
GD-157	1.0000	NO	NO	-- -- 123 ---	64157