LSNReviews

From: Dennis Galvin [DJG3@nrc.gov]
Sent: Tuesday, November 04, 2003 2:23 PM
To: Oleg Povetko
Subject: Fwd: Burnup Results
Attachments: Burnup Results (60.7 KB)

Properties Page

Return-path: <DJG3@nrc.gov>
Received: from mail.cnwra.swri.edu (mail.cnwra.swri.edu [129.162.205.6])
by rogain.cnwra.swri.edu (iPlanet Messaging Server 5.2 (built Feb 21 2002))
with ESMTP id <0HNU00L73DVLUD@rogain.cnwra.swri.edu> for
opovetko@ims-ms-daemon (ORCPT opovetko@rogain.cnwra.swri.edu); Tue,
04 Nov 2003 13:23:45 -0600 (CST)
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for <OPOVETKO@cnwra.swri.edu>; Tue, 04 Nov 2003 13:24:34 -0600 (CST)
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Received: from GWIA-Message_Server by nrcgwia.nrc.govwith Novell_GroupWise;
Tue, 04 Nov 2003 14:23:14 -0500
Date: Tue, 04 Nov 2003 14:23:01 -0500
From: Dennis Galvin <DJG3@nrc.gov>
Subject: Fwd: Burnup Results
To: OPOVETKO@cnwra.swri.edu
Message-id: <sfa7b652.085@nrcgwia.nrc.gov>
MIME-version: 1.0
X-Mailer: Novell GroupWise 5.5.4
Content-type: message/rfc822

LSNReviews

From: Veronica Klein [VMK1@nrc.gov]
Sent: Tuesday, October 07, 2003 2:51 PM
To: Dennis Galvin
Subject: Burnup Results
Attachments: burnup.xls

Hi Dennis,

I went to town on the burnup calculations I did. The results are in the following spreadsheet. The "U" tab has the Uranium isotope concentrations as a funciton of burnup. Likewise the "Pu" tab has the plutonium results. Pu-244 showed up in the 50 and 60GWd/MTU cases. However the absorption/fission cross section is either unknown or extrememly small because I couldn't find it. It was also not included in DOE's list of isotopes so I didn't include it in any of my data. The concentrations are in number densities of atoms/barn-cm, the units can easily be changed, the only reason I chose it was because it seems to be the unit of choice for MCNP and KENO.

Then I got interested in decay over time and figured out what the time steps were and plotted that up for 10GWd/MTU and 60GWd/MTU. I figured the behavior looked the same, there was no point in looking at the 20 - 50 GWd/MTU range, except for different numbers. These results are in the "TIME" tab. The charts are not very clear so you'll have to fiddle with the range and the isotopes to display.

Enjoy!

Veronica

Enrichment U235	0.02	0.03	0.04	0.05
atomic weight U	237.9899	237.9595	237.9290	237.8986
Atomic weight O	15.9994	15.9994	15.9994	15.9994
Atomic weight UO2	269.9887	269.9583	269.9278	269.8974
N UO2 (molec/barn*cm)	2.2764E-02	2.2767E-02	2.2769E-02	2.2772E-02
N O	4.5528E-02	4.5533E-02	4.5538E-02	4.5544E-02
N U	2.2764E-02	2.2767E-02	2.2769E-02	2.2772E-02
N U235	**4.6099E-04**	**6.9147E-04**	**9.2195E-04**	**1.1524E-03**
N U238	**2.2303E-02**	**2.2075E-02**	**2.1847E-02**	**2.1619E-02**
Total	6.8292E-02	6.8300E-02	6.8308E-02	6.8315E-02
MTU/assembly	0.464			
MW/assembly	7.25			

MWD/MTU	EFPD
10000	640.00
20000	1280.00
30000	1920.00
40000	2560.00
50000	3200.00
60000	3840.00

rod volume	247.9578853	
conversion factor	0.6022	atoms-cm^2/barn-mole

10GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	3.31E-01	1.59E-03	233.039627	1.6584E-08
U234	1.77E+02	8.51E-01	234.040945	8.8304E-06
U235	1.84E+04	8.85E+01	235.043922	9.1405E-04
U236	1.22E+03	5.87E+00	236.045561	6.0348E-05
U238	4.38E+05	2.11E+03	238.050785	2.1483E-02

20GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	1.15E+00	5.53E-03	233.039627	5.7619E-08
U234	1.71E+02	8.22E-01	234.040945	8.5311E-06
U235	1.44E+04	6.92E+01	235.043922	7.1534E-04
U236	2.20E+03	1.06E+01	236.045561	1.0882E-04
U238	4.35E+05	2.09E+03	238.050785	2.1336E-02

30GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	2.08E+00	1.00E-02	233.039627	1.0422E-07
U234	1.86E+02	8.94E-01	234.040945	9.2794E-06
U235	1.10E+04	5.29E+01	235.043922	5.4644E-04
U236	3.00E+03	1.44E+01	236.045561	1.4840E-04
U238	4.32E+05	2.08E+03	238.050785	2.1189E-02

40GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	2.94E+00	1.41E-02	233.039627	1.4730E-07
U234	2.25E+02	1.08E+00	234.040945	1.1225E-05
U235	8.19E+03	3.94E+01	235.043922	4.0685E-04
U236	3.62E+03	1.74E+01	236.045561	1.7907E-04
U238	4.29E+05	2.06E+03	238.050785	2.1042E-02

50GWD/MTU

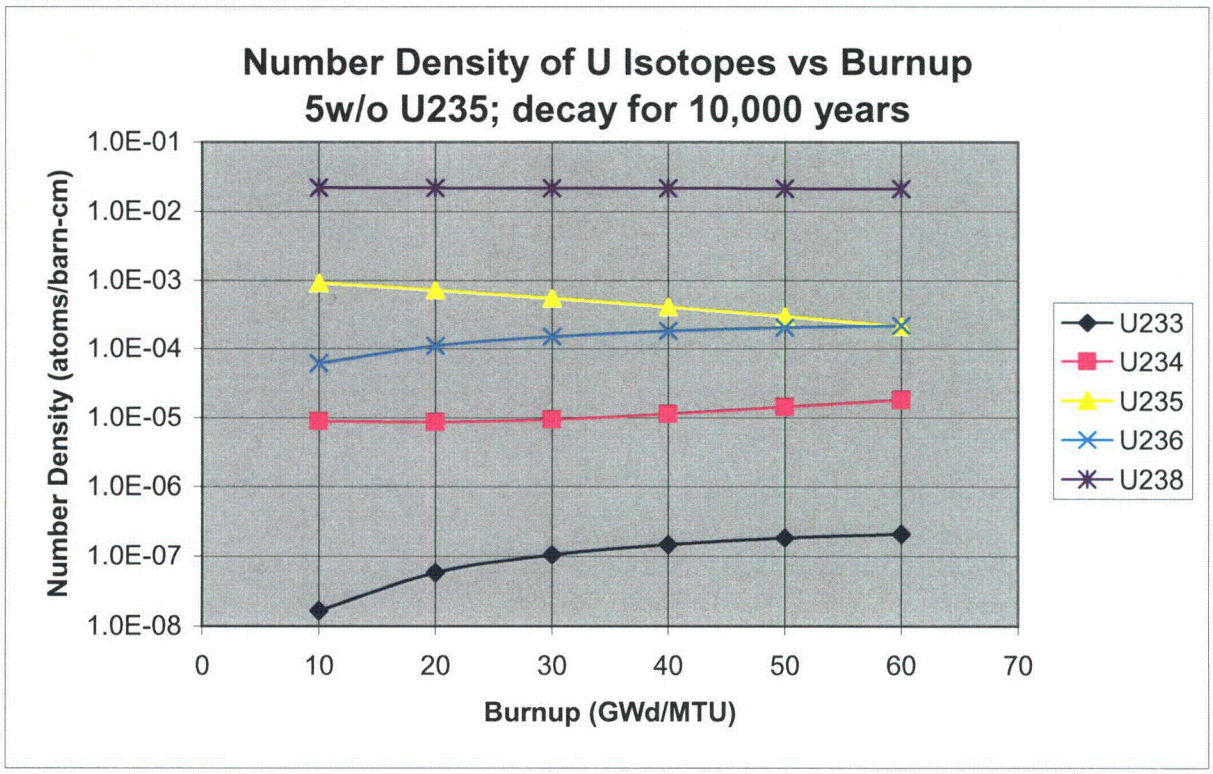
	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	3.65E+00	1.75E-02	233.039627	1.8288E-07
U234	2.86E+02	1.38E+00	234.040945	1.4268E-05
U235	5.95E+03	2.86E+01	235.043922	2.9557E-04
U236	4.07E+03	1.96E+01	236.045561	2.0133E-04
U238	4.25E+05	2.04E+03	238.050785	2.0846E-02

60GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
U233	4.17E+00	2.00E-02	233.039627	2.0893E-07
U234	3.61E+02	1.74E+00	234.040945	1.8010E-05
U235	4.24E+03	2.04E+01	235.043922	2.1063E-04
U236	4.37E+03	2.10E+01	236.045561	2.1616E-04
U238	4.21E+05	2.02E+03	238.050785	2.0650E-02

No. density v. burnup U233

Burnup (GWD/MTU	U233	U234	U235	U236	U238
10	1.6584E-08	8.8304E-06	9.1405E-04	6.0348E-05	2.1483E-02
20	5.7619E-08	8.5311E-06	7.1534E-04	1.0882E-04	2.1336E-02
30	1.0422E-07	9.2794E-06	5.4644E-04	1.4840E-04	2.1189E-02
40	1.4730E-07	1.1225E-05	4.0685E-04	1.7907E-04	2.1189E-02
50	1.8288E-07	1.4268E-05	2.9557E-04	2.0133E-04	2.0846E-02
60	2.0893E-07	1.8010E-05	2.1063E-04	2.1616E-04	2.0650E-02


Number Density of U Isotopes vs Burnup
5w/o U235; decay for 10,000 years
Number Density (atoms/barn-cm)
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
0
10
20
30
40
50
60
70
Burnup (GWd/MTU)
U233
U234
U235
U236
U238

rod volume	247.9578853	
conversion factor	0.6022	atoms-cm^2/barn-mole

10GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	1.19E+03	5.72E+00	239.052156	5.8124E-05
PU240	6.80E+01	3.27E-01	240.053808	3.3075E-06
PU241	9.37E-08	4.50E-10	241.056737	4.5386E-15
PU242	4.28E+00	2.06E-02	242.058737	2.0645E-07

20GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	1.78E+03	8.56E+00	239.052156	8.6941E-05
PU240	1.78E+02	8.56E-01	240.053808	8.6579E-06
PU241	7.53E-06	3.62E-08	241.056737	3.6473E-13
PU242	3.60E+01	1.73E-01	242.058737	1.7365E-06

30GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	2.07E+03	9.95E+00	239.052156	1.0111E-04
PU240	2.88E+02	1.38E+00	240.053808	1.4008E-05
PU241	8.14E-05	3.91E-07	241.056737	3.9428E-12
PU242	1.07E+02	5.14E-01	242.058737	5.1613E-06

40GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	2.20E+03	1.06E+01	239.052156	1.0746E-04
PU240	3.88E+02	1.87E+00	240.053808	1.8872E-05
PU241	3.92E-04	1.88E-06	241.056737	1.8987E-11
PU242	2.14E+02	1.03E+00	242.058737	1.0323E-05

50GWD/MTU

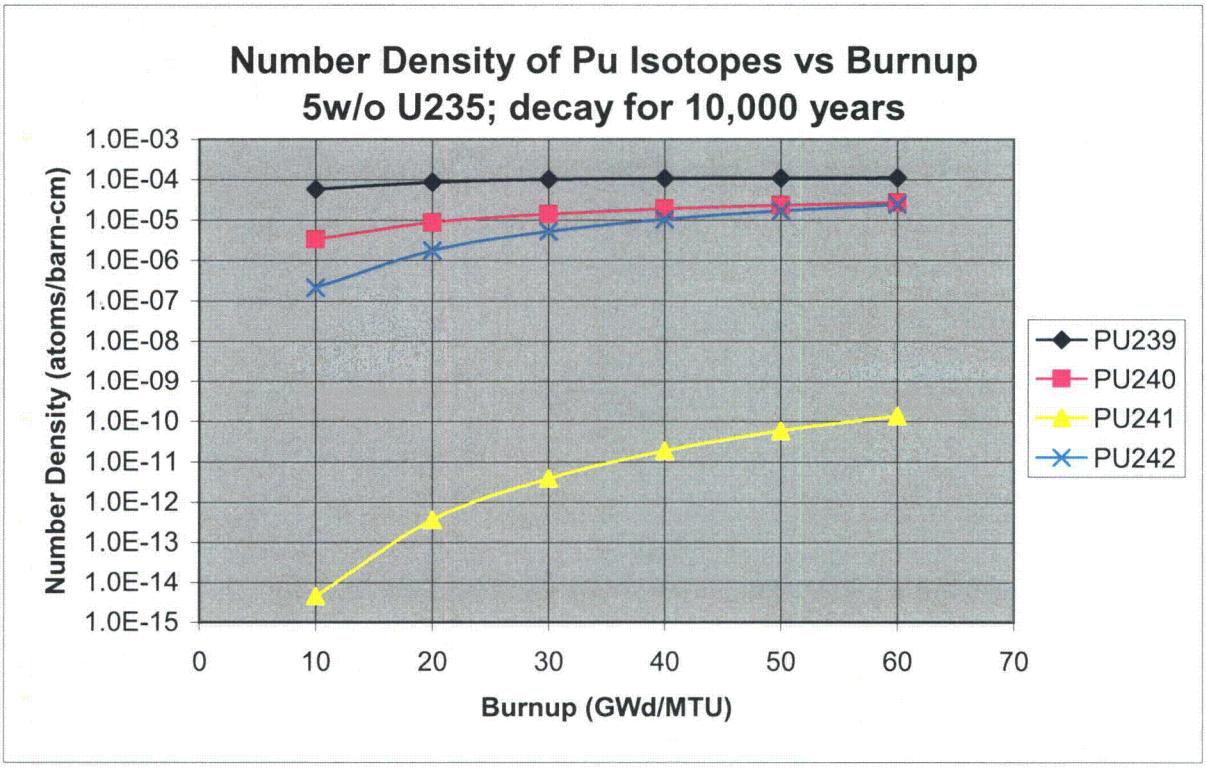
	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	2.26E+03	1.09E+01	239.052156	1.1039E-04
PU240	4.75E+02	2.28E+00	240.053808	2.3104E-05
PU241	1.21E-03	5.82E-06	241.056737	5.8609E-11
PU242	3.50E+02	1.68E+00	242.058737	1.6883E-05

60GWD/MTU

	grams/assembly	g/rod	g/mol (lookup)	No. density
PU239	2.27E+03	1.09E+01	239.052156	1.1087E-04
PU240	5.50E+02	2.64E+00	240.053808	2.6752E-05
PU241	2.81E-03	1.35E-05	241.056737	1.3611E-10
PU242	5.06E+02	2.43E+00	242.058737	2.4408E-05

No. density v. burnup U233

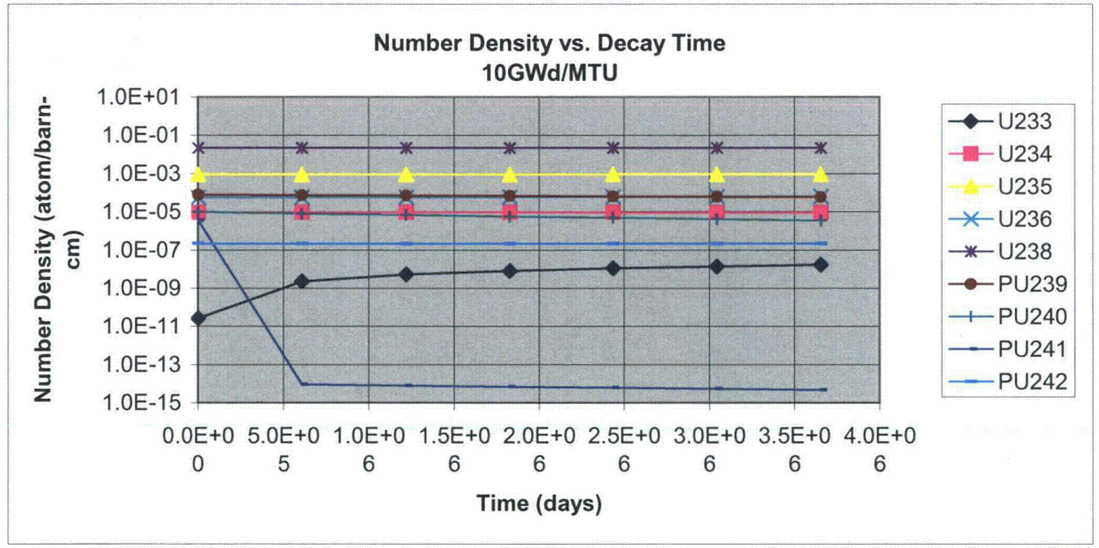
Burnup (GWD/MTU	PU239	PU240	PU241	PU242
10	5.8124E-05	3.3075E-06	4.5386E-15	2.0645E-07
20	8.6941E-05	8.6579E-06	3.6473E-13	1.7365E-06
30	1.0111E-04	1.4008E-05	3.9428E-12	5.1613E-06
40	1.0746E-04	1.8872E-05	1.8987E-11	1.0323E-05
50	1.1039E-04	2.3104E-05	5.8609E-11	1.6883E-05
60	1.1087E-04	2.6752E-05	1.3611E-10	2.4408E-05

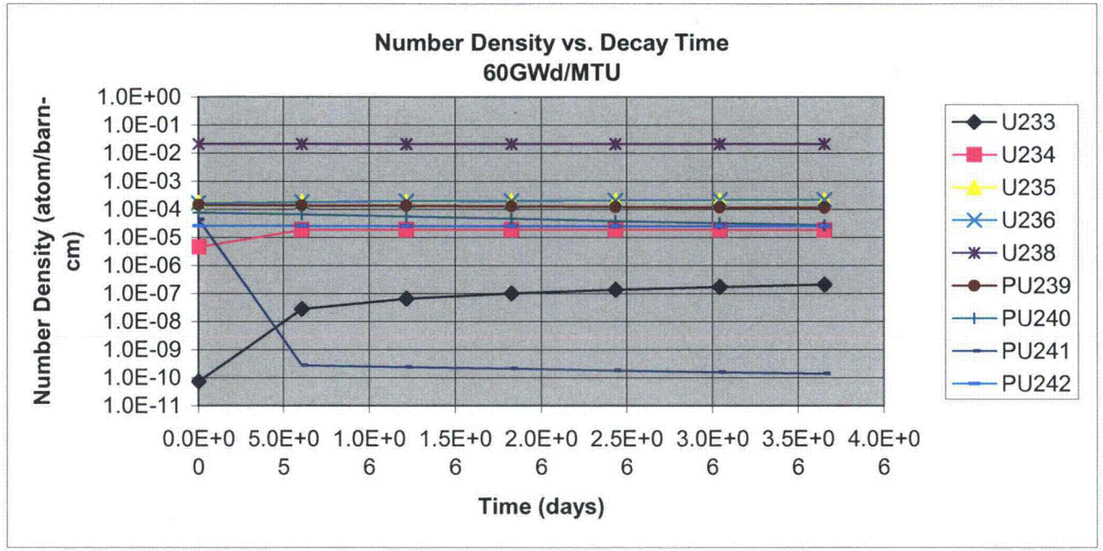

Number Density of Pu Isotopes vs Burnup
5w/o U235; decay for 10,000 years
Number Density (atoms/barn-cm)
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
1.0E-12
1.0E-13
1.0E-14
1.0E-15
0
10
20
30
40
50
60
70
Burnup (GWd/MTU)
PU239
PU240
PU241
PU242

TOTAL DAYS	3.65E+06
INTERVAL	6.09E+05
INITIAL	0
TIME1	6.0875E+05
TIME2	1.2175E+06
TIME3	1.8263E+06
TIME4	2.4350E+06
TIME5	3.0438E+06
TIME6	3.6525E+06

10GWD/MTU

TIME ->	0	6.0875E+05	1.2175E+06	1.8263E+06	2.4350E+06	3.0438E+06	3.6525E+06
ISOTOPES			GRAMS/ASSEMBLY				
U233	5.15E-04	4.54E-02	1.03E-01	1.60E-01	2.17E-01	2.74E-01	3.31E-01
U234	1.78E+02	1.80E+02	1.80E+02	1.79E+02	1.78E+02	1.77E+02	1.77E+02
U235	1.80E+04	1.81E+04	1.82E+04	1.82E+04	1.83E+04	1.83E+04	1.84E+04
U236	1.10E+03	1.13E+03	1.16E+03	1.18E+03	1.20E+03	1.21E+03	1.22E+03
U238	4.38E+05	4.38E+05	4.38E+05	4.38E+05	4.38E+05	4.38E+05	4.38E+05
PU239	1.57E+03	1.51E+03	1.44E+03	1.37E+03	1.31E+03	1.24E+03	1.19E+03
PU240	1.96E+02	1.64E+02	1.38E+02	1.15E+02	9.67E+01	8.11E+01	6.80E+01
PU241	7.11E+01	1.85E-07	1.61E-07	1.41E-07	1.23E-07	1.07E-07	9.37E-08
PU242	4.36E+00	4.35E+00	4.34E+00	4.32E+00	4.31E+00	4.30E+00	4.28E+00
			ATOMS/BARN-CM				
U233	2.58E-11	2.27E-09	5.16E-09	8.02E-09	1.09E-08	1.37E-08	1.66E-08
U234	8.88E-06	8.98E-06	8.98E-06	8.93E-06	8.88E-06	8.83E-06	8.83E-06
U235	8.94E-04	8.99E-04	9.04E-04	9.04E-04	9.09E-04	9.09E-04	9.14E-04
U236	5.44E-05	5.59E-05	5.74E-05	5.84E-05	5.94E-05	5.99E-05	6.03E-05
U238	2.15E-02	2.15E-02	2.15E-02	2.15E-02	2.15E-02	2.15E-02	2.15E-02
PU239	7.67E-05	7.38E-05	7.03E-05	6.69E-05	6.40E-05	6.06E-05	5.81E-05
PU240	9.53E-06	7.98E-06	6.71E-06	5.59E-06	4.70E-06	3.94E-06	3.31E-06
PU241	3.44E-06	8.96E-15	7.80E-15	6.83E-15	5.96E-15	5.18E-15	4.54E-15
PU242	2.10E-07	2.10E-07	2.09E-07	2.08E-07	2.08E-07	2.07E-07	2.06E-07



60GWD/MTU

TIME ->	0	6.0875E+05	1.2175E+06	1.8263E+06	2.4350E+06	3.0438E+06	3.6525E+06
ISOTOPES			GRAMS/ASSEMBLY				
U233	1.46E-03	5.64E-01	1.29E+00	2.02E+00	2.74E+00	3.46E+00	4.17E+00
U234	8.98E+01	3.69E+02	3.68E+02	3.66E+02	3.64E+02	3.63E+02	3.61E+02
U235	3.51E+03	3.64E+03	3.77E+03	3.90E+03	4.01E+03	4.13E+03	4.24E+03
U236	3.36E+03	3.61E+03	3.82E+03	3.99E+03	4.14E+03	4.27E+03	4.37E+03
U238	4.21E+05	4.21E+05	4.21E+05	4.21E+05	4.21E+05	4.21E+05	4.21E+05
PU239	2.90E+03	2.81E+03	2.69E+03	2.58E+03	2.48E+03	2.37E+03	2.27E+03
PU240	1.51E+03	1.33E+03	1.11E+03	9.33E+02	7.82E+02	6.56E+02	5.50E+02
PU241	8.71E+02	5.54E-03	4.83E-03	4.22E-03	3.68E-03	3.21E-03	2.81E-03
PU242	5.14E+02	5.13E+02	5.12E+02	5.10E+02	5.09E+02	5.07E+02	5.06E+02
			ATOMS/BARN-CM				
U233	7.32E-11	2.83E-08	6.46E-08	1.01E-07	1.37E-07	1.73E-07	2.09E-07
U234	4.48E-06	1.84E-05	1.84E-05	1.83E-05	1.82E-05	1.81E-05	1.80E-05
U235	1.74E-04	1.81E-04	1.87E-04	1.94E-04	1.99E-04	2.05E-04	2.11E-04
U236	1.66E-04	1.79E-04	1.89E-04	1.97E-04	2.05E-04	2.11E-04	2.16E-04
U238	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02
PU239	1.42E-04	1.37E-04	1.31E-04	1.26E-04	1.21E-04	1.16E-04	1.11E-04
PU240	7.34E-05	6.47E-05	5.40E-05	4.54E-05	3.80E-05	3.19E-05	2.68E-05
PU241	4.22E-05	2.68E-10	2.34E-10	2.04E-10	1.78E-10	1.55E-10	1.36E-10
PU242	2.48E-05	2.47E-05	2.47E-05	2.46E-05	2.46E-05	2.45E-05	2.44E-05