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SOME ESTIMATES OF THE TOTAL NUCLIDE INVENTORY IN THE YEAR 2100 FROM SWEDISH NUCLEAR POWER PRODUCTION

by

J. O. Liljenzin

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SUMMARY

The total nuclide inventory in spent fuel from the swedish nuclear power programme has been estimated for three cases.

1. All reactors were arrumed to operate until the year 2010 and then shut down simultaneously. All fuel used was assumed to be based on enriched natural uranium.

2. The reactors were assumed to shut down after 25 years of commercial operation, but not later than in the year 2010. Also in this case all fuel was assumed to be based on natural uranium.

3. All reactors were assumed to operate until the year 2010 and shut down simultaneously. Fuel for two large boiling water reactors, F3 and O3, was assumed to be based mainly on reenriched uranium from reprocessed LWR fuel after 1995.

In addition some yearly production rates are compared for standard natural uranium fuel and re-enriched recycled uranium from reprocessing of spent fuel.

The main effort was concentrated on obtaining good estimates for the heavy element content in spent fuel. The fission product inventories were obtained in a less stringent way by interpolation in available tables computed for enriched natural uranium based fuel only and at a few typical burnup values.

Burnup calculations were made using the code, BURNUP, originally developed for actinide recycle and burnup calculations. The cross section and decay library was updated and the results from the code were validated by comparing the results for a test case with published results from the CASMO, BEGAFIP and ORIGEN codes for the same case. The agreement was satisfactory.

Data on average burnup, enrichment and unloaded fuel for past years were assembled from tables published in various reports. The future development was extrapolated from current trends in enrichment and burnup. Fuel from shut down reactors in the 25 years of operation scenario was assumed to be transferred to the still operating reactors as far as reasonable with regard to fuel compatability, enrichment and burnup.

The composition of recovered uranium from reprocessing of LWR fuel was assumed to be the typical uranium isotope mixture computed by ORIGEN for a PWR fuel with 33 MWd/kg burnup. The effect of uranium reenrichment on isotopic composition was computed by means of a code, ANRIKA, developed for this purpose. The proper working of ANRIKA was tested by comparing its results with some published values. Almost identical results were obtained for all cases.

Data on the composition of unloaded fuel for each reactor and year of operation were recalculated to the mid of year 2100 using the GDF code and summed nuclide by nuclide for all years and reactors to obtain the final inventory for each of the three scenarios.

1. INTRODUCTION

The swedish nuclear power programme is usually assumed to end not later than in the year 2010. Sweden has also deferred reprocessing of spent fuel and plans to store the unreprocessed fuel in a final repository. This makes it possible to estimate the total inventory of spent nuclear fuel and its composition within some limits given by the possible scenarios in the given time frame.

The aim of the present work was to estimate the total nuclide inventory in the final repository taking a few likely developments into account such as different shut down schedules for the swedish reactors and expected fuel development. The resulting data should be useful for preliminary safety evaluation exercises.

According to present plans, the final repository will be operated between the years 2020 and 2060. Hence, a suitable date for the inventory was assumed to be 2100. Before this time most of the radio nuclides with short and moderate halflives will have decayed away, exceptions being those with longlived precursors.

2. FUEL BURNUP

Most calculations of nuclide inventories for spent power reactor fuel have assumed rather low specific burnup values. Typical data are 27 MWd/kg initial heavy metal, IHM, and 33 MWd/kg IHM for BWR:s and PWR:s respectively. Today, the typical burnup values are much higher. Values of 35 to 40 MWd/kg IHM are common for modern BWR fuel (1). Similarly the average burnup of PWR fuel has increased to between 40 and 50 MWd/kg IHM (1). The design goal for the new SVEA-96 and SVEA-100 fuels for BWR:s is about 45 MWd/kg IHM average burnup (2). The current design goal for PWR:fuel is even higher, about 60 MWd/kg IHM (3).

The increased burnup is usually accomplished by using higher initial enrichment, graded enrichment along fuel pins and between fuel pins in each fuel element, inclusion of burnable poison in the pins and by use of more and thinner pins in a fuel bundle etc. This is exemplified by the development of BWR fuel from the classical 8x8 pin grid to 9x9 and to 10x10 grids with correspondingly thinner pins. These factors complicates a detailed calculation of fuel burnup to a high degree, especially since the reactor cores all the time will contain a mixture of different fuel types of varying age and history. To make the present calculations feasable it was necessary to make the simplifying assumption that each batch of fresh fuel was unloaded simultaneously after receiving the same burnup.

The enrichment necessary to obtain the desired burnup was estimated from diagrams for Westinghouse PWR:s operated with zone-scatter refueling given by Pigford et al. (4). The curves were assumed to be shifted in such a way that each swedish reactor could operate in the way it does with its current fueling scheme and then used to predict future enrichment needs. Of cource, this procedure is very approximate, especially for the BWR:s, and the initial average enrichments needed in future fuel batches are correspondingly uncertain. Furthermore, the present practice to grade the enrichment

along and between individual fuel pins makes the use of average enrichent data and burnup calculations based on these somewhat questionable.

Tables 2 to 13 contain the amount of yearly unloaded fuel, its initial enrichment and average burnup for each of the twelve swedish power reactors when operating up to the year 2010. The average burnups were calculated with a spreadsheet programme from refueling cycle length, initial enrichment and expected average yearly electricity production. Average data for the expected total load factors, 0.78 for BWR:s and 0.73 for PWR:s, were taken from reference (1). The number of significant figures for data in this report is considerably less than the number of figures given in the tables, but no rounding was made as these data were used, or intended for use, as input to further calculations.

3. RECYCLING OF URANIUM

Large scale recovery of uranium from spent fuel has been carried out for many years, mainly in the UK. Current estimates give the amount of recovered uranium as > 30 000 tonnes, mainly from spent Magnox and GCR fuel. BNFL has stated that more than 15 000 tonnes of this uranium have been re-enriched and fabricated into new fuel, mainly for AGR:s (5). France has also recycled more than 5 000 tonnes of uranium (5). Some of these recycling operations also include the fabrication of LWR fuel, see Figure 1. However, it is unknown how much recycled uranium actually goes into production of LWR fuel. Furthermore, UK, France, Germany, Japan, India and the Soviet Union have special plants for handling of recycled uranium and are using or have firm plans to use recovered uranium as LWR fuel. Recycled uranium has also been re-enriched in the US as there are reports mentioning doses to workers from technetium in some US gaseous diffusion plants. It is also known that UF_6 manufactured by Comurhex from recovered uranium has been returned to the US (6). (Technetium is always present as an impurity in recovered uranium.) The special facility for production of UF_6 from recycled uranium at Pierrelatte operated 1988 at a capacity of 350 tonnes U/year (6) and larger plants are under construction in the UK and in the Soviet Union.

Recovered uranium from reprocessing of spent fuel consists of a series of uranium isotopes, i.e. U-232, U-233, U-234, U-235, U-236 and U-238, all in significant quantities. To be able to compute the isotopic composition after re-enrichment it was necessary to develop a computer code, ANRIKA, that could optimize an isotope separation plant for a mixture of many isotopes and compute the composition of its product from a given feed. ANRIKA is based on the key-weight concept (7, 8) and designs a plant either for a minimum cost product or for a specified tails content of U-235.

The content of U-236 in re-enriched uranium necessitates the use of a correspondingly higher enrichment. ANRIKA uses the equivalent enrichment concept as described by Gresley and Kehoe (9).

The major drawback from recycled re-enriched uranium is the rather fast buildup of gamma emmitting daughters to U-232 which makes it mandatory to reduce storage time for uranium and fuel as much as possible to avoid shielded handling.

The isotopic composition of recycled uranium was assumed to be that of a typical spent PWR fuel with initial enrichment 3.3% and an average burnup of 33 MWd/kg IHM. Second generation recycled uranium was not considered, nor uranium recovered from MOX fuel or breeder blankets.

Table 1 shows examples of the isotopic composition in re-enriched uranium as function of equivalent enrichment assuming an U-236 penalty factor of 0.3.

In the current analysis it was assumed that recycled and re-enriched uranium enters the swedish fuel supply system at about 1995 and mainly is used to prepare fuel for two of our large BWR:s, F3 and O3, see tables 2 to 13.

4. BURNUP CALCULATIONS

The BURNUP program was originally developed in the early seventies for used in conjunction with the AKA program and further developed in the late seventies for use in the minor actinide burnup calculations required by a research project for actinide separation and transmutation. Some remarks on this code and its library are given below.

As the cross section and decay libraries were more than 10 years old, they were checked and updated using data from several sources (e.g. 10 and 11). To test the program and its updated library the composition of a reference fuel described in ref. 12 was computed. The resulting composition was then compared to the corresponding published results obtained by the CASMO, BEGAFIP and ORIGEN codes, see table 14. As can be seen from this table the results from BURNUP compare fairly well with those from the other codes, especially if it is recognized that some parameters and cross sections were adjusted in the BEGAFIP and ORIGEN runs to obtain more realistic results.

Cross sections are computed at the start of each irradiation cycle using two neutron energy groups and the same type of modified Westcott formalism as used in BEGAFIP. Self shielding corrections are applied for the major actinides using a modified version of the empirical correlation employed in BEGAFIP. Fission energies for the actinides are computed using a correlation between A, Z and E(fiss) adopted from ORIGEN-2.

The BURNUP code uses a linear time approximation to solve the system of differential equations, i.e. the amounts of all other nuclides than the one being computed and the neutron flux are assumed to vary linearly with time within the current time step and the differential equation for the nuclide being considered is then possible to integrate analytically giving a better guess of the current amount. This procedure is performed iteratively for all nuclides until a consistent set of nuclide concentrations and neutron flux at the end of the current time step is obtained. For a typical timestep, less than one hour, the calculation converges already after about three iterations. The procedure used makes it simple to include alpha decays between the actinide isotopes, corresponding to closed loops

in the s-process, which may give computation difficulties in many other codes. On the other hand, the accuracy at short times of the amount of shortlived nuclides is relatively poor.

The fuel is assumed to operate with a prescribed specific power level for a specified length of time. The total fission rate is then computed from the prescribed power density in the fuel and indirectly yields the neutron flux for the current fuel composition. This means that the neutron flux increases with burnup for the considered fuel types.

The burnup calculations were performed for a matrix of specific burnups (MWd/kg IHM corresponding to about one year of operation including summer recess) and initial enrichments in steps of 0.3% assuming natural or recycled uranium based fuel. To save time and reduce the size of the generated data sets, only the amounts of heavy elements were computed and stored for the recycled uranium cases. These groups of calculations were performed using typical data for swedish BWR:s and PWR:s respectively, generating data sets for spent BWR and PWR fuels.

5. FUEL COMPOSITION CALCULATIONS

A small code was written which read the appropriate fuel composition matrix, interpolated these data to the desired initial enrichment and final burnup. The resulting composition (g/metric tonne IHM) was then multiplied by the amount of fuel (as metric tonnes IHM) withdrawn from the reactor the actual year and saved as an intermediate data set. In case of recycled uranium fuel, the fission product amounts were interpolated from the corresponding matrix valid for natural uranium based fuel. Hence, the fission product amounts given for recycled uranium fuel are only zeroth order approximations. The largest errors should be expected for nuclides belonging to the low mass fission yield peak, see Figure 2.

To reduce the volume of insignificant data, the amount of all nuclides in each batch of unloaded fuel was recalculated to a common date in the future, mid of the year 2100. This calculation used a code GDF, originating from hazard index calculations for reprocessing wastes. Output from this code is both amount and activity of each nuclide. Amounts are given in grams and activities in Bq.

6. INVENTORY FILES

The data files obtained are fairly large, a couple of megabytes for each scenario. To reduce storage space, the fuelling data and amounts of nuclides in the yearly spent fuel batches from each reactor were compressed using the ARC code, see README.DOC files on the data diskettes.

Three diskettes hold all the data generated in these calculations. Each diskette contains data for one scenario. The respective files are named NATULONG.ARC (natural uranium fuel, all reactors operating until the year 2010), NATUSHRT.ARC (natural uranium fuel, all reactors operating for 25 years but no longer than to the year 2010)

and RECULONG.ARC (natural and recycled uranium fuel, all reactors operating until the year 2010).

Each file contains the separate data files for each reactor. The files B1, B2, F1, F2, F3, O1, O2, O3, R1, R2, R3 and R4 contain the fuelling data for respective reactor and the given scenario using natural uranium based fuel. The 25 years of maximum operation scenario involves reshuffling of some partially spent fuel to still operating reactors. The corresponding files for this scenario are designated B1SHRT, B2SHRT etc. Fuel and burnup data for two cases with re-enriched uranium fuel, F3 and O3, are available in the files F3RU and O3RU. The amounts of nuclides and their total activity in the year 2100 for each unloaded fuel batch is contained in files named XXUnnnnY.INV or XXRnnnnY.INV for natural uranium based fuel or recycled uranium based fuel respectively. XX is the reactor (B1, B2 etc) and nnnn is the year the fuel was unloaded (1981, 1982 etc). When more than one batch with a common burnup history was unloaded during a specific year Y is used to separate these (Y = space first batch, Y = A second batch, Y = B third batch etc). One record is used per nuclide in these files. Each record begins with the nuclide designation (7 ASCII characters) followed by the amount in grams and the activity in bequerels (10 characters each in floating point format).

7. DATA EXTRACTION

To extract desired information for any scenario, begin by unpacking the corresponding file with the ARCE.COM code, see instructions in README.DOC file on the diskettes. As the resulting files occupy considerable disk space, they should be unpacked onto a hard disk. Then use any suitable wordprocessor or advanced spreadsheet program to view the files, to extract desired data or to make calculations based on these data.

8. TYPICAL RESULTS

Some typical results for a medium sized (F1) and a large (O3) BWR and one PWR (R2) are given in tables 15, 16 and 17 in grams/tonne IHM and Bq/tonne IHM. Nuclides with a very small concentration and an activity below 1 Bq were normally omitted.

To facilitate the use of statistical methods, minimum, average and maximum concentrations and specific activities are given in table 18, 19 and 20 for the total amount of spent fuel in 2100 and the three scenarios used in this report.

9. REFERENCES

1. SKB Plan 89 and SKB Plan 88.

2. S. Helmersson, H. Nerman and L. Paulsson, SVEA-96: BWR Fuel for the 1990s, Nuclear Europe, 1-2 (1989) 37.

3. C. Lewiner and R. Schärer, Mutual Influences of Reactor Operation & Fuel Cycle Management, Nuclear Europe, 1-2 (1989) 11.

4. M. Benedict, T. H. Pigford and H. W. Levi, Nuclear Chemical Engineering, 2nd Ed, ISBN 0-07-004531-3, McGraw-Hill 1981.

5. R. K. Webster, Trends in reprocessing technology, Nuclear Technology International 1988, 83.

6. J. P. Rougeau and L. F. Durret, UREP: Gateway to Uranium Recycling, Nuclear Europe, 1-2 (1988) 19.

7. A. de la Garza, Chem. Eng. Sci., 18 (1963) 73.

8. A. de la Garza, G. A. Garrett and J. E. Murphy, Chem. Eng. Sci., 15 (1961) 188.

9. J. A. B. Gresley and R. B. Kehoe, Uranium Recycling: the Value of Reprocessed Uranium, Nuclear Europe 1-2 (1988) 11.

10. E. Browne, R. B. Firestone and V. S. Shirley, Table of Radioactive Isotopes, Wiley 1986.

11. A. G. Croff, R. L. Haese and N. B. Gove, Updated Decay and Photon Libraries for the ORIGEN code, ORNL/TM-6055 (Feb. 1979).

12. G. Olsson, P. Hägglöf och S. Svensson, BEGAFIP. Programvård, utveckling och benchmarkberäkningar, Studsvik K2-80/383, 1980.

13. C. D. Forsey, Developments in BNFL's Uranium Recycle Strategy, Nuclear Europe, 1-2 (1988) 15.

14. J. R. Stanbridge, Oxide fuel design and manufacture in BNFL, Nuclear Technology International 1987, 112.

Table 1. Examples of the isotopic composition (%) of re-enriched uranium fuel for different equivalent enrichments. Feed was assumed to be recovered uranium from spent PWR fuel with an average burnup of 33 MWd/kg IHM. At a cost for natural uranium of 53 $/Lb and a cost of recovered uranium of 5 $/kg, all cases shown below give a cheaper fuel from re-enriched uranium than from natural uranium feed even though handling, conversion and manufacturing costs are considerably higher for the re-enriched fuel. These costs and various unit operation costs were taken from references 9 and 13.

Isotope	Equivalent Enrichment (%)						
	2.2	2.6	3.0	3.4	3.8	4.2	4.6
U-232	7.84E-8	9.38E-8	1.09E-7	1.25E-7	1.40E-7	1.56E-7	1.71E-7
U-233	7.60E-7	9.09E-7	1.06E-6	1.21E-6	1.36E-6	1.50E-6	1.66E-6
U-234	6.81E-2	8.12E-2	9.42E-2	1.07E-1	1.20E-1	1.33E-1	1.47E-1
U-235	2.48E+0	2.92E+0	3.37E+0	3.81E+0	4.25E+0	4.68E+0	5.13E+0
U-236	9.70E-1	1.11E+0	1.25E+0	1.38E+0	1.51E+0	1.65E+0	1.78E+0
U-238	9.65E+1	9.59E+1	9.53E+1	9.47E+1	9.41E+1	9.35E+1	9.29E+1

Tails 0.25% U-235

Table 2. Fuelling data for B1 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1977	18.73	2.10	12.243	18.73	2.10	12.243	18.73	2.10	12.243
1978	18.73	2.10	18.494	18.73	2.10	18.494	18.73	2.10	18.494
1979	18.73	2.30	22.329	18.73	2.30	22.329	18.73	2.30	22.329
1980	18.73	2.50	22.998	18.73	2.50	22.998	18.73	2.50	22.998
1981	18.73	2.70	24.860	18.73	2.70	24.860	18.73	2.70	24.860
1982	18.73	2.70	24.812	18.73	2.70	24.812	18.73	2.70	24.812
1983	18.73	2.70	24.812	18.73	2.70	24.812	18.73	2.70	24.812
1984	18.73	2.70	24.812	18.73	2.70	24.812	18.73	2.70	24.812
1985	14.98	2.70	31.015	14.98	2.70	31.015	14.98	2.70	31.015
1986	14.98	2.70	31.015	14.98	2.70	31.015	14.98	2.70	31.015
1987	14.98	2.76	31.015	14.98	2.76	31.015	14.98	2.76	31.015
1988	14.98	2.76	31.654	14.98	2.76	31.654	14.98	2.76	31.654
1989	14.98	2.78	32.294	14.98	2.78	32.294	14.98	2.78	32.294
1990	14.98	2.78	32.933	14.98	2.78	32.933	14.98	2.78	32.933
1991	14.98	3.00	33.572	14.98	3.00	33.572	14.98	3.00	33.572
1992	14.98	3.00	34.212	14.98	3.00	34.212	14.98	3.00	34.212
1993	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1994	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1995	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1996	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1997	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1998	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1999	10.70	3.40	47.896	10.70	3.40	47.896	10.70	3.40	47.896
2000	10.70	3.40	47.896	10.70	3.40	47.896	10.70	3.40	47.896
2000				10.70	3.40	41.054			
2000				10.70	3.40	34.212			
2000				10.70	3.40	27.369			
2000				10.70	3.40	20.527			
2000				10.70	3.40	13.684			
2000				10.70	3.40	6.842			
2001	10.70	3.40	47.896				10.70	3.40	47.896
2002	10.70	3.40	47.896				10.70	3.40	47.896
2003	10.70	3.40	47.896				10.70	3.40	47.896
2004	10.70	3.40	47.896				10.70	3.40	47.896
2005	10.70	3.40	47.896				10.70	3.40	47.896
2006	10.70	3.40	47.896				10.70	3.40	47.896
2007	10.70	3.40	47.896				10.70	3.40	47.896
2008	10.70	3.40	47.896				10.70	3.40	47.896
2009	10.70	3.40	47.896				10.70	3.40	47.896
2010	10.70	3.40	47.896				10.70	3.40	47.896
2010	10.70	3.40	41.054				10.70	3.40	41.054
2010	10.70	3.40	34.212				10.70	3.40	34.212
2010	10.70	3.40	27.369				10.70	3.40	27.369
2010	10.70	3.40	20.527				10.70	3.40	20.527
2010	10.70	3.40	13.684				10.70	3.40	13.684
2010	10.70	3.40	6.842				10.70	3.40	6.842

Table 3. Fuelling data for B2 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1978	18.73	2.10	9.969	18.73	2.10	9.969	18.73	2.10	9.969
1979	18.73	2.30	16.435	18.73	2.30	16.435	18.73	2.30	16.435
1980	18.73	2.40	22.900	18.73	2.40	22.900	18.73	2.40	22.900
1981	18.73	2.60	25.733	18.73	2.60	25.733	18.73	2.60	25.733
1982	18.73	2.70	25.862	18.73	2.70	25.862	18.73	2.70	25.862
1983	18.73	2.70	25.862	18.73	2.70	25.862	18.73	2.70	25.862
1984	18.73	2.70	25.862	18.73	2.70	25.862	18.73	2.70	25.862
1985	18.73	2.70	25.862	18.73	2.70	25.862	18.73	2.70	25.862
1986	14.98	2.70	32.328	14.98	2.70	32.328	14.98	2.70	32.328
1987	14.98	2.76	32.328	14.98	2.76	32.328	14.98	2.76	32.328
1988	14.98	2.76	32.705	14.98	2.76	32.705	14.98	2.76	32.705
1989	14.98	2.78	33.081	14.98	2.78	33.081	14.98	2.78	33.081
1990	14.98	2.78	33.458	14.98	2.78	33.458	14.98	2.78	33.458
1991	14.98	3.00	33.835	14.98	3.00	33.835	14.98	3.00	33.835
1992	14.98	3.00	34.212	14.98	3.00	34.212	14.98	3.00	34.212
1993	14.98	3.20	34.212	14.98	3.20	34.212	14.98	3.20	34.212
1994	14.98	3.20	34.212	14.98	3.20	34.212	14.98	3.20	34.212
1995	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1996	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1997	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1998	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
1999	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
2000	12.48	3.20	41.054	12.48	3.20	41.054	12.48	3.20	41.054
2001	10.70	3.40	47.896	10.70	3.40	47.896	10.70	3.40	47.896
2002	10.70	3.40	47.896	10.70	3.40	47.896	10.70	3.40	47.896
2002				10.70	3.40	41.054			
2002				10.70	3.40	34.212			
2002				10.70	3.40	27.369			
2002				10.70	3.40	20.527			
2002				10.70	3.40	13.684			
2002				10.70	3.40	6.842			
2003	10.70	3.40	47.896				10.70	3.40	47.896
2004	10.70	3.40	47.896				10.70	3.40	47.896
2005	10.70	3.40	47.896				10.70	3.40	47.896
2006	10.70	3.40	47.896				10.70	3.40	47.896
2007	10.70	3.40	47.896				10.70	3.40	47.896
2008	10.70	3.40	47.896				10.70	3.40	47.896
2009	10.70	3.40	47.896				10.70	3.40	47.896
2010	10.70	3.40	47.896				10.70	3.40	47.896
2010	10.70	3.40	41.054				10.70	3.40	41.054
2010	10.70	3.40	34.212				10.70	3.40	34.212
2010	10.70	3.40	27.369				10.70	3.40	27.369
2010	10.70	3.40	20.527				10.70	3.40	20.527
2010	10.70	3.40	13.684				10.70	3.40	13.684
2010	10.70	3.40	6.842				10.70	3.40	6.842

Table 4. Fuelling data for F1 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1983	30.44	2.10	20.239	30.44	2.10	20.239	30.44	2.10	20.239
1984	30.44	2.30	26.543	30.44	2.30	26.543	30.44	2.30	26.543
1985	30.44	2.50	26.543	30.44	2.50	26.543	30.44	2.50	26.543
1986	30.44	2.70	26.543	30.44	2.70	26.543	30.44	2.70	26.543
1987	30.44	2.76	26.543	30.44	2.76	26.543	30.44	2.76	26.543
1988	24.35	2.76	33.398	24.35	2.76	33.398	24.35	2.76	33.398
1989	24.35	2.76	33.616	24.35	2.76	33.616	24.35	2.76	33.616
1990	20.30	2.78	40.471	20.30	2.78	40.471	20.30	2.78	40.471
1991	20.30	2.78	40.690	20.30	2.78	40.690	20.30	2.78	40.690
1992	20.30	2.78	40.908	20.30	2.78	40.908	20.30	2.78	40.908
1993	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1994	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1995	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1996	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1997	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1998	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1999	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
2000	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2001	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2002	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2003	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2004	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2005	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2005				17.40	3.40	41.127			
2005				17.40	3.40	34.273			
2005				17.40	3.40	27.418			
2005				17.40	3.40	20.563			
2005				17.40	3.40	13.709			
2005				17.40	3.40	6.854			
2006	17.40	3.40	47.982				17.40	3.40	47.982
2007	17.40	3.40	47.982				17.40	3.40	47.982
2008	17.40	3.40	47.982				17.40	3.40	47.982
2009	17.40	3.40	47.982				17.40	3.40	47.982
2010	17.40	3.40	47.982				17.40	3.40	47.982
2010	17.40	3.40	41.127				17.40	3.40	41.127
2010	17.40	3.40	34.273				17.40	3.40	34.273
2010	17.40	3.40	27.418				17.40	3.40	27.418
2010	17.40	3.40	20.563				17.40	3.40	20.563
2010	17.40	3.40	13.709				17.40	3.40	13.709
2010	17.40	3.40	6.854				17.40	3.40	6.854

Table 5. Fuelling data for F2 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1983	24.35	2.10	15.544	24.35	2.10	15.544	24.35	2.10	15.544
1984	24.35	2.10	21.994	24.35	2.10	21.994	24.35	2.10	21.994
1985	24.35	2.40	28.444	24.35	2.40	28.444	24.35	2.40	28.444
1986	24.35	2.76	32.249	24.35	2.76	32.249	24.35	2.76	32.249
1987	24.35	2.76	32.249	24.35	2.76	32.249	24.35	2.76	32.249
1988	24.35	2.78	32.995	24.35	2.78	32.995	24.35	2.78	32.995
1989	24.35	2.78	33.400	24.35	2.78	33.400	24.35	2.78	33.400
1990	20.30	3.00	40.255	20.30	3.00	40.255	20.30	3.00	40.255
1991	20.30	3.00	40.659	20.30	3.00	40.659	20.30	3.00	40.659
1992	20.30	3.20	41.064	20.30	3.20	41.064	20.30	3.20	41.064
1993	20.30	3.20	41.469	20.30	3.20	41.469	20.30	3.20	41.469
1994	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1995	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1996	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1997	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1998	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
1999	20.30	3.20	41.127	20.30	3.20	41.127	20.30	3.20	41.127
2000	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2001	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2002	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2003	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2004	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2005	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2006	17.40	3.40	47.982	17.40	3.40	47.982	17.40	3.40	47.982
2006				17.40	3.40	41.127			
2006				17.40	3.40	34.273			
2006				17.40	3.40	27.418			
2006				17.40	3.40	20.563			
2006				17.40	3.40	13.709			
2006				17.40	3.40	6.854			
2007	17.40	3.40	47.982				17.40	3.40	47.982
2008	17.40	3.40	47.982				17.40	3.40	47.982
2009	17.40	3.40	47.982				17.40	3.40	47.982
2010	17.40	3.40	47.982				17.40	3.40	47.982
2010	17.40	3.40	41.127				17.40	3.40	41.127
2010	17.40	3.40	34.273				17.40	3.40	34.273
2010	17.40	3.40	27.418				17.40	3.40	27.418
2010	17.40	3.40	20.563				17.40	3.40	20.563
2010	17.40	3.40	13.709				17.40	3.40	13.709
2010	17.40	3.40	6.854				17.40	3.40	6.854

Table 6. Fuelling data for F3 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some fuel from shutdown reactors is used. III: Spent recycled uranium based fuel from 2000 to 2010.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1987	31.33	2.28	18.419	31.33	2.28	18.419	31.33	2.28	18.419
1988	31.33	2.40	25.291	31.33	2.40	25.291	31.33	2.40	25.291
1989	25.06	2.76	32.162	25.06	2.76	32.162	25.06	2.76	32.162
1990	25.06	2.90	36.860	25.06	2.90	36.860	25.06	2.90	36.860
1991	25.06	2.90	36.564	25.06	2.90	36.564	25.06	2.90	36.564
1992	25.06	3.00	36.267	25.06	3.00	36.267	25.06	3.00	36.267
1993	25.06	3.00	36.904	25.06	3.00	36.904	25.06	3.00	36.904
1994	25.06	3.20	37.541	25.06	3.20	37.541	25.06	3.20	37.541
1995	25.06	3.20	37.541	25.06	3.20	37.541	25.06	3.20	37.541
1996	20.88	3.40	45.050	20.88	3.40	45.050	20.88	3.40	45.050
1997	20.88	3.40	45.050	20.88	3.40	45.050	20.88	3.40	45.050
1998	20.88	3.40	45.050	20.88	3.40	45.050	20.88	3.40	45.050
1999	20.88	3.40	45.050	20.88	3.40	45.050	20.88	3.40	45.050
2000	17.90	3.60	52.558	20.88	3.40	37.541	17.90	3.60	52.558
2000				20.88	3.40	45.050			
2001	17.90	3.60	52.558	20.88	3.40	37.541	17.90	3.60	52.558
2002	17.90	3.60	52.558	20.88	3.40	37.541	17.90	3.60	52.558
2002				10.70	3.40	42.386			
2003	17.90	3.60	52.558	20.88	3.40	37.541	17.90	3.60	52.558
2003				14.38	3.50	38.478			
2003				17.40	3.40	43.052			
2004	17.90	3.60	52.558	10.70	3.40	43.718	17.90	3.60	52.558
2005	17.90	3.60	52.558	10.70	3.40	36.875	17.90	3.60	52.558
2005				20.88	3.40	45.050			
2005				14.38	3.50	47.301			
2006	17.90	3.60	52.558	14.38	3.50	41.107	17.90	3.60	52.558
2006				9.66	3.40	45.050			
2007	17.90	3.60	52.558	14.38	3.50	42.421	17.90	3.60	52.558
2007				17.40	3.40	42.435			
2007				10.18	3.40	45.050			
2008	17.90	3.60	52.558	2.82	3.40	37.541	17.90	3.60	52.558
2008				17.40	3.40	42.435			
2008				2.82	3.40	45.050			
2009	17.90	3.60	52.558	14.38	3.50	36.142	17.90	3.60	52.558
2009				10.70	3.40	37.541			
2009				17.40	3.40	43.088			
2010	17.90	3.60	52.558	7.68	3.40	7.508	17.90	3.60	52.558
2010	17.90	3.60	45.050	17.40	3.40	14.362	17.90	3.60	45.050
2010	17.90	3.60	37.541	5.64	3.40	15.016	17.90	3.60	37.541
2010	17.90	3.60	30.033	17.40	3.40	21.217	17.90	3.60	30.033
2010	17.90	3.60	22.525	7.16	3.40	22.525	17.90	3.60	22.525
2010	17.90	3.60	15.016	17.40	3.40	29.379	17.90	3.60	15.016
2010	17.90	3.60	7.508	6.64	3.40	30.033	17.90	3.60	7.508
2010				17.40	3.40	35.580			
2010				17.40	3.40	36.234			
2010				11.18	3.40	37.541			

Table 7. Fuelling data for O1 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1974	13.22	2.10	7.658	13.22	2.10	7.658	13.22	2.10	7.658
1975	13.22	2.30	12.057	13.22	2.30	12.057	13.22	2.30	12.057
1976	13.22	2.40	16.109	13.22	2.40	16.109	13.22	2.40	16.109
1977	13.22	2.50	20.478	13.22	2.50	20.478	13.22	2.50	20.478
1978	13.22	2.70	23.251	13.22	2.70	23.251	13.22	2.70	23.251
1979	13.22	2.90	24.911	13.22	2.90	24.911	13.22	2.90	24.911
1980	13.22	2.90	27.678	13.22	2.90	27.678	13.22	2.90	27.678
1981	13.22	2.90	28.164	13.22	2.90	28.164	13.22	2.90	28.164
1982	13.22	2.90	28.997	13.22	2.90	28.997	13.22	2.90	28.997
1983	13.22	2.90	29.513	13.22	2.90	29.513	13.22	2.90	29.513
1984	13.22	2.90	29.310	13.22	2.90	29.310	13.22	2.90	29.310
1985	13.22	2.90	29.310	13.22	2.90	29.310	13.22	2.90	29.310
1986	13.22	2.90	29.310	13.22	2.90	29.310	13.22	2.90	29.310
1987	13.22	2.90	29.310	13.22	2.90	29.310	13.22	2.90	29.310
1988	11.33	3.00	34.250	11.33	3.00	34.250	11.33	3.00	34.250
1989	11.33	3.00	34.306	11.33	3.00	34.306	11.33	3.00	34.306
1990	11.33	3.00	34.361	11.33	3.00	34.361	11.33	3.00	34.361
1991	9.92	3.20	39.302	9.92	3.20	39.302	9.92	3.20	39.302
1992	9.92	3.20	39.357	9.92	3.20	39.357	9.92	3.20	39.357
1993	9.92	3.20	39.413	9.92	3.20	39.413	9.92	3.20	39.413
1994	9.92	3.20	39.468	9.92	3.20	39.468	9.92	3.20	39.468
1995	9.92	3.20	39.524	9.92	3.20	39.524	9.92	3.20	39.524
1996	8.81	3.40	44.464	8.81	3.40	44.464	8.81	3.40	44.464
1997	8.81	3.40	44.464	8.81	3.40	44.464	8.81	3.40	44.464
1997				8.81	3.40	39.524			
1997				8.81	3.40	34.583			
1997				8.81	3.40	29.643			
1997				8.81	3.40	24.702			
1997				8.81	3.40	19.762			
1997				8.81	3.40	14.821			
1997				8.81	3.40	9.881			
1997				8.81	3.40	4.940			
1998	8.81	3.40	44.464				8.81	3.40	44.464
1999	8.81	3.40	44.464				8.81	3.40	44.464
2000	8.81	3.40	44.464				8.81	3.40	44.464
2001	8.81	3.40	44.464				8.81	3.40	44.464
2002	8.81	3.40	44.464				8.81	3.40	44.464
2003	8.81	3.40	44.464				8.81	3.40	44.464
2004	8.81	3.40	44.464				8.81	3.40	44.464
2005	8.81	3.40	44.464				8.81	3.40	44.464
2006	8.81	3.40	44.464				8.81	3.40	44.464
2007	8.81	3.40	44.464				8.81	3.40	44.464
2008	8.81	3.40	44.464				8.81	3.40	44.464
2009	8.81	3.40	44.464				8.81	3.40	44.464

Table 7. Cont.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
2010	8.81	3.40	44.464				8.81	3.40	44.464
2010	8.81	3.40	39.524				8.81	3.40	39.524
2010	8.81	3.40	34.583				8.81	3.40	34.583
2010	8.81	3.40	29.643				8.81	3.40	29.643
2010	8.81	3.40	24.702				8.81	3.40	24.702
2010	8.81	3.40	19.762				8.81	3.40	19.762
2010	8.81	3.40	14.821				8.81	3.40	14.821
2010	8.81	3.40	9.881				8.81	3.40	9.881
2010	8.81	3.40	4.940				8.81	3.40	4.940

Table 8. Fuelling data for O2 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1977	18.73	2.10	15.503	18.73	2.10	15.503	18.73	2.10	15.503
1978	18.73	2.30	20.711	18.73	2.30	20.711	18.73	2.30	20.711
1979	18.73	2.50	22.422	18.73	2.50	22.422	18.73	2.50	22.422
1980	18.73	2.70	24.323	18.73	2.70	24.323	18.73	2.70	24.323
1981	18.73	2.76	25.484	18.73	2.76	25.484	18.73	2.76	25.484
1982	18.73	2.76	26.193	18.73	2.76	26.193	18.73	2.76	26.193
1983	18.73	2.76	26.193	18.73	2.76	26.193	18.73	2.76	26.193
1984	18.73	2.76	26.193	18.73	2.76	26.193	18.73	2.76	26.193
1985	14.98	2.76	32.741	14.98	2.76	32.741	14.98	2.76	32.741
1986	14.98	2.76	32.741	14.98	2.76	32.741	14.98	2.76	32.741
1987	14.98	2.78	32.741	14.98	2.78	32.741	14.98	2.78	32.741
1988	14.98	2.78	33.039	14.98	2.78	33.039	14.98	2.78	33.039
1989	14.98	2.78	33.338	14.98	2.78	33.338	14.98	2.78	33.338
1990	14.98	2.78	33.636	14.98	2.78	33.636	14.98	2.78	33.636
1991	12.48	3.00	40.483	12.48	3.00	40.483	12.48	3.00	40.483
1992	12.48	3.00	40.781	12.48	3.00	40.781	12.48	3.00	40.781
1993	12.48	3.20	41.080	12.48	3.20	41.080	12.48	3.20	41.080
1994	12.48	3.20	41.080	12.48	3.20	41.080	12.48	3.20	41.080
1995	12.48	3.20	41.080	12.48	3.20	41.080	12.48	3.20	41.080
1996	12.48	3.20	41.080	12.48	3.20	41.080	12.48	3.20	41.080
1997	12.48	3.20	41.080	12.48	3.20	41.080	12.48	3.20	41.080
1998	10.70	3.40	47.927	10.70	3.40	47.927	10.70	3.40	47.927
1999	10.70	3.40	47.927	10.70	3.40	47.927	10.70	3.40	47.927
				10.70	3.40	41.080			
				10.70	3.40	34.233			
				10.70	3.40	27.386			
				10.70	3.40	20.540			
				10.70	3.40	13.693			
				10.70	3.40	6.846			
2000	10.70	3.40	47.927				10.70	3.40	47.927
2001	10.70	3.40	47.927				10.70	3.40	47.927
2002	10.70	3.40	47.927				10.70	3.40	47.927
2003	10.70	3.40	47.927				10.70	3.40	47.927
2004	10.70	3.40	47.927				10.70	3.40	47.927
2005	10.70	3.40	47.927				10.70	3.40	47.927
2006	10.70	3.40	47.927				10.70	3.40	47.927
2007	10.70	3.40	47.927				10.70	3.40	47.927
2008	10.70	3.40	47.927				10.70	3.40	47.927
2009	10.70	3.40	47.927				10.70	3.40	47.927
2010	10.70	3.40	47.927				10.70	3.40	47.927
2010	10.70	3.40	41.080				10.70	3.40	41.080
2010	10.70	3.40	34.233				10.70	3.40	34.233
2010	10.70	3.40	27.386				10.70	3.40	27.386
2010	10.70	3.40	20.540				10.70	3.40	20.540
2010	10.70	3.40	13.693				10.70	3.40	13.693
2010	10.70	3.40	6.846				10.70	3.40	6.846

Table 9. Fuelling data for O3 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some fuel from shutdown reactors used. III: Recycled uranium based fuel from 1995 to 2010.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1987	31.33	2.28	18.443	31.33	2.28	18.443	31.33	2.28	18.443
1988	31.33	2.40	25.309	31.33	2.40	25.309	31.33	2.40	25.309
1989	25.06	2.76	32.174	25.06	2.76	32.174	25.06	2.76	32.174
1990	25.06	2.90	36.731	25.06	2.90	36.731	25.06	2.90	36.731
1991	25.06	2.90	36.483	25.06	2.90	36.483	25.06	2.90	36.483
1992	25.06	3.00	36.235	25.06	3.00	36.235	25.06	3.00	36.235
1993	25.06	3.00	36.872	25.06	3.00	36.872	25.06	3.00	36.872
1994	25.06	3.20	37.508	25.06	3.20	37.508	25.06	3.20	37.508
1995	25.06	3.20	37.508	25.06	3.20	37.508	25.06	3.20	37.508
1996	20.88	3.40	45.010	20.88	3.40	37.508	20.88	3.40	45.010
1996				20.88	3.40	45.010			
1997	20.88	3.40	45.010	20.88	3.40	37.508	20.88	3.40	45.010
1998	20.88	3.40	45.010	8.81	3.40	44.646	20.88	3.40	45.010
1999	20.88	3.40	45.010	20.88	3.40	45.010	20.88	3.40	45.010
1999				8.81	3.40	47.207			
2000	17.90	3.60	52.512	8.81	3.40	44.828	17.90	3.60	52.512
2000				20.88	3.40	45.010			
2000				8.81	3.40	49.769			
2001	17.90	3.60	52.512	20.88	3.40	45.010	17.90	3.60	52.512
2002	17.90	3.60	52.512	6.54	3.40	45.010	17.90	3.60	52.512
2002				8.81	3.40	47.389			
2002				10.70	3.40	49.892			
2003	17.90	3.60	52.512	3.36	3.40	45.010	17.90	3.60	52.512
2003				8.81	3.40	49.951			
2003				10.70	3.40	50.547			
2004	17.90	3.60	52.512	10.70	3.40	42.373	17.90	3.60	52.512
2004				10.70	3.40	43.700			
2004				8.81	3.40	45.010			
2005	17.90	3.60	52.512	10.70	3.40	44.355	17.90	3.60	52.512
2005				8.29	3.40	45.010			
2006	17.90	3.60	52.512	17.10	3.40	45.010	17.90	3.60	52.512
2006				10.70	3.40	50.534			
2007	17.90	3.60	52.512	20.88	3.40	45.010	17.90	3.60	52.512
2008	17.90	3.60	52.512	4.65	3.40	45.010	17.90	3.60	52.512
2008				10.70	3.40	51.193			
2009	17.90	3.60	52.512	1.37	3.40	45.010	17.90	3.60	52.512
2009				10.70	3.40	51.853			
2010	17.90	3.60	52.512	30.21	3.40	45.010	17.90	3.60	52.512
2010	17.90	3.60	45.010	18.99	3.40	37.508	17.90	3.60	45.010
2010	17.90	3.60	37.508	27.87	3.40	30.007	17.90	3.60	37.508
2010	17.90	3.60	30.007	20.88	3.40	22.505	17.90	3.60	30.007
2010	17.90	3.60	22.505	15.35	3.40	15.003	17.90	3.60	22.505
2010	17.90	3.60	15.003	12.07	3.40	7.501	17.90	3.60	15.003
2010	17.90	3.60	7.501				17.90	3.60	7.501

Table 10. Fuelling data for R1 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1978	19.17	2.10	10.543	19.17	2.10	10.543	19.17	2.10	10.543
1979	19.17	2.30	15.551	19.17	2.30	15.551	19.17	2.30	15.551
1980	19.17	2.50	20.560	19.17	2.50	20.560	19.17	2.50	20.560
1981	19.17	2.60	25.568	19.17	2.60	25.568	19.17	2.60	25.568
1982	19.17	2.70	28.261	19.17	2.70	28.261	19.17	2.70	28.261
1983	19.17	2.76	29.480	19.17	2.76	29.480	19.17	2.76	29.480
1984	19.17	2.76	30.048	19.17	2.76	30.048	19.17	2.76	30.048
1985	19.17	2.76	30.048	19.17	2.76	30.048	19.17	2.76	30.048
1986	19.17	2.76	30.048	19.17	2.76	30.048	19.17	2.76	30.048
1987	19.17	2.76	30.048	19.17	2.76	30.048	19.17	2.76	30.048
1988	19.17	2.76	30.664	19.17	2.76	30.664	19.17	2.76	30.664
1989	19.17	2.78	31.850	19.17	2.78	31.850	19.17	2.78	31.850
1990	19.17	3.00	33.036	19.17	3.00	33.036	19.17	3.00	33.036
1991	19.17	3.00	34.222	19.17	3.00	34.222	19.17	3.00	34.222
1992	19.17	3.20	35.408	19.17	3.20	35.408	19.17	3.20	35.408
1993	19.17	3.20	36.594	19.17	3.20	36.594	19.17	3.20	36.594
1994	19.17	3.20	37.164	19.17	3.20	37.164	19.17	3.20	37.164
1995	16.43	3.40	43.358	16.43	3.40	43.358	16.43	3.40	43.358
1996	16.43	3.40	43.358	16.43	3.40	43.358	16.43	3.40	43.358
1997	16.43	3.40	43.358	16.43	3.40	43.358	16.43	3.40	43.358
1998	16.43	3.40	43.358	16.43	3.40	43.358	16.43	3.40	43.358
1999	16.43	3.40	43.358	16.43	3.40	43.358	16.43	3.40	43.358
2000	14.38	3.50	49.552	14.38	3.50	49.552	14.38	3.50	49.552
2001	14.38	3.50	49.552	14.38	3.50	49.552	14.38	3.50	49.552
2001				14.38	3.50	43.358			
2001				14.38	3.50	37.164			
2001				14.38	3.50	30.970			
2001				14.38	3.50	24.776			
2001				14.38	3.50	18.582			
2001				14.38	3.50	12.388			
2001				14.38	3.50	6.194			
2002	14.38	3.50	49.552				14.38	3.50	49.552
2003	14.38	3.50	49.552				14.38	3.50	49.552
2004	14.38	3.50	49.552				14.38	3.50	49.552
2005	14.38	3.50	49.552				14.38	3.50	49.552
2006	14.38	3.50	49.552				14.38	3.50	49.552
2007	14.38	3.50	49.552				14.38	3.50	49.552
2008	14.38	3.50	49.552				14.38	3.50	49.552
2009	14.38	3.50	49.552				14.38	3.50	49.552
2010	14.38	3.50	49.552				14.38	3.50	49.552
2010	14.38	3.50	43.358				14.38	3.50	43.358
2010	14.38	3.50	37.164				14.38	3.50	37.164
2010	14.38	3.50	30.970				14.38	3.50	30.970
2010	14.38	3.50	24.776				14.38	3.50	24.776
2010	14.38	3.50	18.582				14.38	3.50	18.582
2010	14.38	3.50	12.388				14.38	3.50	12.388
2010	14.38	3.50	6.194				14.38	3.50	6.194

Table 11. Fuelling data for R2 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1979	17.10	3.20	30.984	17.10	3.20	30.984	17.10	3.20	30.984
1980	17.10	3.20	30.775	17.10	3.20	30.775	17.10	3.20	30.775
1981	17.10	3.20	30.702	17.10	3.20	30.702	17.10	3.20	30.702
1982	17.10	3.30	30.674	17.10	3.30	30.674	17.10	3.30	30.674
1983	17.10	3.40	30.674	17.10	3.40	30.674	17.10	3.40	30.674
1984	17.10	3.40	30.674	17.10	3.40	30.674	17.10	3.40	30.674
1985	17.10	3.40	30.674	17.10	3.40	30.674	17.10	3.40	30.674
1986	17.10	3.40	30.674	17.10	3.40	30.674	17.10	3.40	30.674
1987	17.10	3.40	30.674	17.10	3.40	30.674	17.10	3.40	30.674
1988	17.10	3.40	32.518	17.10	3.40	32.518	17.10	3.40	32.518
1989	13.68	3.40	42.031	13.68	3.40	42.031	13.68	3.40	42.031
1990	13.68	3.40	43.875	13.68	3.40	43.875	13.68	3.40	43.875
1991	13.68	3.40	45.719	13.68	3.40	45.719	13.68	3.40	45.719
1992	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1993	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1994	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1995	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1996	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1997	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1998	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
1999	13.68	3.40	47.563	13.68	3.40	47.563	13.68	3.40	47.563
2000	11.40	3.75	57.076	11.40	3.75	57.076	11.40	3.75	57.076
2000				11.40	3.75	47.563			
2000				11.40	3.75	38.051			
2000				11.40	3.75	28.538			
2000				11.40	3.75	19.025			
2000				11.40	3.75	9.512			
2001	11.40	3.75	57.076				11.40	3.75	57.076
2002	11.40	3.75	57.076				11.40	3.75	57.076
2003	11.40	3.75	57.076				11.40	3.75	57.076
2004	11.40	3.75	57.076				11.40	3.75	57.076
2005	11.40	3.75	57.076				11.40	3.75	57.076
2006	11.40	3.75	57.076				11.40	3.75	57.076
2007	11.40	3.75	57.076				11.40	3.75	57.076
2008	11.40	3.75	57.076				11.40	3.75	57.076
2009	11.40	3.75	57.076				11.40	3.75	57.076
2010	11.40	3.75	57.076				11.40	3.75	57.076
2010	11.40	3.75	47.563				11.40	3.75	47.563
2010	11.40	3.75	38.051				11.40	3.75	38.051
2010	11.40	3.75	28.538				11.40	3.75	28.538
2010	11.40	3.75	19.025				11.40	3.75	19.025
2010	11.40	3.75	9.512				11.40	3.75	9.512

Table 12. Fuelling data for R3 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some unloaded fuel is redistributed to operating reactors. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1983	18.06	3.20	20.061	18.06	3.20	20.061	18.06	3.20	20.061
1984	18.06	3.20	28.745	18.06	3.20	28.745	18.06	3.20	28.745
1985	18.06	3.20	34.738	18.06	3.20	34.738	18.06	3.20	34.738
1986	18.06	3.20	34.738	18.06	3.20	34.738	18.06	3.20	34.738
1987	18.06	3.40	34.738	18.06	3.40	34.738	18.06	3.40	34.738
1988	18.06	3.40	36.333	18.06	3.40	36.333	18.06	3.40	36.333
1989	18.06	3.40	37.928	18.06	3.40	37.928	18.06	3.40	37.928
1990	18.06	3.40	39.523	18.06	3.40	39.523	18.06	3.40	39.523
1991	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1992	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1993	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1994	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1995	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1996	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1997	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1998	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1999	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
2000	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2001	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2002	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2003	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2004	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2005	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2006	12.04	4.20	61.677	12.04	4.20	61.677	12.04	4.20	61.677
2006				12.04	4.20	51.398			
2006				12.04	4.20	41.118			
2006				12.04	4.20	30.838			
2006				12.04	4.20	20.559			
2006				12.04	4.20	10.279			
2007	12.04	4.20	61.677				12.04	4.20	61.677
2008	12.04	4.20	61.677				12.04	4.20	61.677
2009	12.04	4.20	61.677				12.04	4.20	61.677
2010	12.04	4.20	61.677				12.04	4.20	61.677
2010	12.04	4.20	51.398				12.04	4.20	51.398
2010	12.04	4.20	41.118				12.04	4.20	41.118
2010	12.04	4.20	30.838				12.04	4.20	30.838
2010	12.04	4.20	20.559				12.04	4.20	20.559
2010	12.04	4.20	10.279				12.04	4.20	10.279

Table 13. Fuelling data for R4 and the three scenarios considered. Scenarios; I: All reactors operate until mid of the year 2010. II: Reactors shut down after 25 years of operation, but not later than mid 2010. Some fuel from shutdown reactors used. III: Same as alternative I for this reactor.

	Scenario I			Scenario II			Scenario III		
Year	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg	Amount tonnes	Enr. %	Burnup MWd/kg
1984	18.06	3.20	13.807	18.06	3.20	13.807	18.06	3.20	13.807
1985	18.06	3.20	24.922	18.06	3.20	24.922	18.06	3.20	24.922
1986	18.06	3.20	36.037	18.06	3.20	36.037	18.06	3.20	36.037
1987	18.06	3.20	44.460	18.06	3.20	44.460	18.06	3.20	44.460
1988	18.06	3.40	43.624	18.06	3.40	43.624	18.06	3.40	43.624
1989	18.06	3.40	42.789	18.06	3.40	42.789	18.06	3.40	42.789
1990	18.06	3.40	41.953	18.06	3.40	41.953	18.06	3.40	41.953
1991	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1992	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1993	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1994	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1995	18.06	3.40	41.118	18.06	3.40	41.118	18.06	3.40	41.118
1996	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1997	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1998	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
1999	14.44	3.80	51.398	14.44	3.80	51.398	14.44	3.80	51.398
2000	12.04	4.20	61.677	14.44	3.80	51.398	12.04	4.20	61.677
2001	12.04	4.20	61.677	14.44	3.80	51.398	12.04	4.20	61.677
2002	12.04	4.20	61.677	11.04	3.75	49.097	12.04	4.20	61.677
2002				14.44	3.80	51.398			
2003	12.04	4.20	61.677	14.44	3.80	51.398	12.04	4.20	61.677
2004	12.04	4.20	61.677	11.40	3.75	49.864	12.04	4.20	61.677
2004				14.44	3.80	51.398			
2005	12.04	4.20	61.677	3.04	3.80	51.398	12.04	4.20	61.677
2006	12.04	4.20	61.677	11.40	3.75	50.631	12.04	4.20	61.677
2006				3.04	3.80	51.398			
2007	12.04	4.20	61.677	14.44	3.80	51.398	12.04	4.20	61.677
2008	12.04	4.20	61.677	2.40	3.80	10.279	12.04	4.20	61.677
2008				2.40	3.80	20.559			
2008				12.04	4.20	20.559			
2008				3.04	3.80	30.838			
2008				25.84	3.80	41.118			
2008				12.04	4.20	41.118			
2008				14.44	3.80	51.398			
2009	12.04	4.20	61.677				12.04	4.20	61.677
2010	12.04	4.20	61.677				12.04	4.20	61.677
2010	12.04	4.20	51.398				12.04	4.20	51.398
2010	12.04	4.20	41.118				12.04	4.20	41.118
2010	12.04	4.20	30.838				12.04	4.20	30.838
2010	12.04	4.20	20.559				12.04	4.20	20.559
2010	12.04	4.20	10.279				12.04	4.20	10.279

Table 14. Comparison of actinide concentrations in fuel computed by several codes (12) and results for the same case calculated with the BURNUP code.

Nuclide	CASMO	CASMO-EXT	BEGAFIP	ORIGEN	BURNUP
U-232					0.00086
U-233					0.00050
U-234					150.600
U-235	9400.000	9430.000	8770.000	8520.000	6969.000
U-236	4010.000	4010.000	3960.000	4420.000	3832.000
U-237			16.900	13.600	3.824
U-238	940830.000	940730.000	944700.000	942000.000	944600.000
U-239			0.689	0.672	0.174
U-240			0.000031	0.000000	0.000002
Np-237	441.000	456.000	605.000	515.000	585.700
Np-238			2.450	1.990	0.512
Np-239			99.300	96.600	25.050
Np-240m			0.000217	0.000000	0.000013
Np-240			0.001740	0.003890	0.000096
Pu-238	153.000	158.000	201.000	184.000	194.700
Pu-239	6480.000	6500.000	5510.000	5820.000	6338.000
Pu-240	2330.000	2350.000	2340.000	2160.000	1786.000
Pu-241	1580.000	1570.000	1520.000	1110.000	1120.000
Pu-242	444.000	441.000	462.000	337.000	315.200
Pu-243			0.182	0.165	0.030
Pu-244					0.010
Pu-245					0.0000001
Pu-246					0.000000000
Am-241	39.000	40.900	38.900	24.000	103.500
Am-242m			672.000	1.010	1.355
Am-242	1.640	0.684	0.108	0.087	0.082
Am-243	95.100	99.700	102.000	93.600	66.130
Am-244m					0.0009
Am-244			0.0073	0.0051	0.0013
Am-245					0.00000002
Am-246					0.000000000
Cm-242	14.200	13.200	13.500	11.000	14.220
Cm-243		0.633	0.355	0.079	0.329
Cm-244	27.500	29.700	32.300	31.100	21.240
Cm-245		1.120	1.300	2.180	1.138
Cm-246		0.100	0.144	0.229	0.136
Cm-247		0.00081	0.00140	0.00311	0.00157
Cm-248		0.0000476	0.0000881	0.0002170	0.0001427
Cm-249				0.000000003	0.000000001
Cm-250					0.000000000
Bk-249		0.00000071	0.00000138	0.00000264	0.00000176
Bk-250			0.000000002	0.000000002	0.000000000
Bk-251					0.000000000
Cf-249		0.00000009	0.00000016	0.00000029	0.00000071
Cf-250		0.00000019	0.00000040	0.00000039	0.00000030
Cf-251		0.00000008	0.00000014	0.00000021	0.00000013
Cf-252		0.00000003	0.00000007	0.00000011	0.00000007
Cf-253		0.000000000	0.000000000	0.000000000	0.000000000
Cf-254					0.000000000

Table 15. Average composition of fuel and specific activities assumed to be unloaded from F1 in 2000 and decay corrected to mid 2100. All three scenarios as defined in table 8 give the same data.

Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
AC225	6.851E-11	1.471E+05	CS133	1.782E+03	
AC227	8.603E-07	2.303E+06	CS134	2.391E-13	1.145E+01
AC228	3.133E-16	2.601E+01	CS135	4.532E+02	1.480E+10
			CS137	1.811E+02	5.799E+14
AG107	2.356E-03				
AG109	7.109E+01		DY160	4.502E-02	
			DY161	3.124E-01	
AM241	1.199E+03	1.520E+14	DY162	2.175E-01	
AM242	1.747E-05	5.230E+11	DY163	8.011E-02	
AM242M	1.454E+00	5.230E+11	DY164	1.398E-02	
AM243	4.072E+02	3.007E+12			
			ER166	4.327E-05	
AS 75	1.875E-01				
			EU151	3.978E+00	
BA134	9.948E+01		EU152	4.764E-04	3.190E+09
BA135	1.047E-02		EU153	1.310E+02	
BA136	1.324E+01		EU154	9.931E-03	1.003E+11
BA137	1.668E+03		EU155	8.816E-06	1.536E+08
BA137M	2.755E-05	5.484E+14			
BA138	1.925E+03		FR223	2.221E-14	3.179E+04
BI209	1.384E-07		GD152	7.115E-02	5.628E-02
BI210	8.052E-11	3.699E+05	GD154	3.479E+01	
			GD155	1.233E+01	
BR 79	8.638E-03		GD156	1.167E+01	
BR 81	3.066E+01		GD157	4.474E-02	
			GD158	1.213E+01	
CD110	1.589E-01		GD160	8.885E-01	
CD111	1.730E+01				
CD112	8.500E+00		GE 72	5.448E-03	
CD113	1.640E-01	2.133E-03	GE 73	2.101E-02	
CD113M	1.898E-05	1.587E+08	GE 74	6.161E-02	
CD114	1.340E+01		GE 76	5.264E-01	
CD116	5.828E+00				
CE140	1.858E+03		I 127	5.539E+01	
CE142	1.720E+03		I 129	3.110E+02	1.994E+09
CF249	6.948E-04	1.052E+08	IN113	2.660E-03	
CF250	7.661E-07	3.095E+06	IN115	3.143E+00	7.092E-01
CF251	6.695E-05	3.921E+06			
			KR 80	1.110E-03	
CM242	3.537E-03	4.337E+11	KR 81	1.088E-05	8.460E+03
CM243	7.638E-02	1.459E+11	KR 82	4.028E-01	
CM244	6.149E+00	1.841E+13	KR 83	7.195E+01	
CM245	1.586E+01	1.007E+11	KR 84	1.649E+02	
CM246	7.328E+00	8.385E+10	KR 85	6.489E-02	9.443E+11
CM247	1.628E-01	5.447E+05	KR 86	2.980E+02	
CM248	3.733E-02	5.688E+06			
			LA139	1.863E+03	

Table 15. Cont.

Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
MO 95	1.230E+03		RA223	1.216E-09	2.303E+06
MO 96	1.644E+01		RA224	8.328E-08	4.906E+08
MO 97	1.245E+03		RA225	1.014E-10	1.471E+05
MO 98	1.238E+03		RA226	2.028E-05	7.420E+05
MO100	1.407E+03				
			RB 85	2.005E+02	
NB 93	4.276E-02		RB 87	3.973E+02	1.259E+06
NB 93M	9.609E-03	1.003E+11			
			RH103	7.161E+02	
ND142	1.203E+01				
ND143	1.361E+03		RN222	1.942E-08	7.115E+05
ND144	1.864E+03	8.155E+01			
ND145	1.086E+03		RU 99	4.148E-01	
ND146	9.603E+02		RU100	4.113E+01	
ND148	5.369E+02		RU101	1.140E+03	
ND150	2.356E+02		RU102	1.041E+03	
			RU104	6.644E+02	
NP237	6.655E+02	1.735E+10			
NP239	3.491E-04	3.007E+12	SB121	5.516E+00	
NP240	2.943E-16	1.273E+02	SB123	6.891E+00	
NP240M	2.917E-14	1.127E+05	SB125	5.270E-11	2.066E+03
			SB126	7.454E-07	2.305E+09
PA231	1.374E-03	2.399E+06	SB126M	5.664E-09	1.646E+10
PA233	2.267E-05	1.735E+10			
PA234	3.143E-09	2.307E+08	SE 76	1.487E-03	
PA234M	4.579E-10	1.167E+10	SE 77	1.247E+00	
			SE 78	3.503E+00	
PB208	8.902E-04		SE 79	7.989E+00	2.059E+10
			SE 80	1.457E+01	
PD104	1.181E+02		SE 82	3.960E+01	
PD105	4.286E+02				
PD106	3.612E+02		SM147	4.800E+02	4.076E+05
PD107	2.199E+02	4.183E+09	SM148	1.281E+02	1.432E+00
PD108	1.518E+02		SM149	3.243E+00	
PD110	4.406E+01		SM150	4.363E+02	
			SM151	3.424E+00	3.333E+12
PM147	1.054E-09	3.616E+04	SM152	2.290E+02	
			SM154	3.856E+01	
PO210	2.190E-09	3.641E+05			
			SN115	2.198E-01	
PR141	1.796E+03		SN116	1.398E+00	
PR144	1.740E+01	1.020E-22	SN117	4.528E+00	
			SN118	5.051E+00	
PU238	2.030E+02	1.286E+14	SN119	5.141E+00	
PU239	4.536E+03	1.040E+13	SN120	5.245E+00	
PU240	2.311E+03	1.940E+13	SN121M	4.426E-02	8.799E+10
PU241	9.741E+00	3.715E+13	SN122	1.228E+01	
PU242	1.080E+03	1.570E+11	SN124	8.172E+00	
PU243	5.657E-12	5.447E+05	SN126	1.568E+01	1.646E+10
PU244	1.683E-01	1.127E+05			

Table 15. Cont.

Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
SR 86	1.720E-01	
SR 88	5.698E+02	
SR 90	8.230E+01	4.197E+14
TB159	2.075E+00	
TC 99	1.266E+03	7.902E+11
TE122	8.466E-02	
TE124	5.074E+00	
TE125	9.483E+00	
TE125M	7.575E-13	5.048E+02
TE126	1.545E+00	
TE128	1.466E+02	
TE130	6.138E+02	3.122E-05
TH227	1.997E-09	2.272E+06
TH228	1.617E-05	4.906E+08
TH229	1.860E-05	1.472E+05
TH230	5.648E-02	4.060E+07
TH231	1.433E-09	2.820E+07
TH232	6.897E-03	2.791E+01
TH234	1.362E-05	1.167E+10
U 232	6.006E-04	4.775E+08
U 233	1.912E-02	6.816E+06
U 234	2.974E+02	6.862E+10
U 235	3.524E+02	2.820E+07
U 236	1.943E+03	4.652E+09
U 238	9.379E+05	1.167E+10
U 240	3.293E-12	1.127E+05
XE128	5.233E-01	
XE129	1.347E-03	
XE130	4.932E+00	
XE131	1.510E+03	
XE132	1.382E+03	
XE134	2.195E+03	
XE136	3.342E+03	
Y 89	7.661E+02	
Y 90	2.089E-02	4.199E+14
ZR 90	8.592E+02	
ZR 91	9.897E+02	
ZR 92	1.037E+03	
ZR 93	1.142E+03	1.061E+11
ZR 94	1.199E+03	
ZR 96	1.236E+03	

Table 16. Average composition and specific activities of fuel assumed to be unloaded from O3 in 2000 and decay corrected to mid 2100. The three scenarios are defined in table 9.

	Scenario I		Scenario II		Scenario III	
Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
AC225	7.469E-11	1.604E+05	5.917E-11	1.271E+05	2.651E-10	5.693E+05
AC227	7.950E-07	2.127E+06	8.025E-07	2.148E+06	2.935E-06	7.855E+06
AC228	3.021E-16	2.506E+01	3.119E-16	2.588E+01	1.175E-15	9.749E+01
AG109	6.257E+01		7.292E+01		6.257E+01	
AM241	1.210E+03	1.534E+14	1.185E+03	1.503E+14	1.240E+03	1.572E+14
AM242	1.670E-05	5.000E+11	1.619E-05	4.845E+11	1.764E-05	5.281E+11
AM242M	1.391E+00	5.000E+11	1.347E+00	4.845E+11	1.468E+00	5.281E+11
AM243	4.791E+02	3.538E+12	3.755E+02	2.774E+12	4.394E+02	3.246E+12
AS 75	2.085E-01		1.789E-01		2.085E-01	
BA134	7.419E+01		1.151E+02		7.419E+01	
BA135	1.177E-02		9.960E-03		1.177E-02	
BA136	9.899E+00		1.413E+01		9.899E+00	
BA137	1.819E+03		1.604E+03		1.819E+03	
BA137M	3.030E-05	6.034E+14	2.639E-05	5.255E+14	3.030E-05	6.034E+14
BA138	2.116E+03		1.845E+03		2.116E+03	
BI210	8.011E-11	3.678E+05	7.643E-11	3.511E+05	2.418E-10	1.111E+06
BR 81	3.427E+01		2.920E+01		3.427E+01	
CD111	1.406E+01		1.813E+01		1.406E+01	
CD112	4.512E+00		9.658E+00		4.512E+00	
CD113M	1.972E-05	1.650E+08	2.654E-05	2.219E+08	1.972E-05	1.650E+08
CD114	1.192E+01		1.371E+01		1.192E+01	
CD116	5.972E+00		5.724E+00		5.972E+00	
CE140	2.036E+03		1.783E+03		2.036E+03	
CE142	1.902E+03		1.644E+03		1.902E+03	
CF249	1.432E-03	2.168E+08	5.365E-04	8.120E+07	9.257E-04	1.401E+08
CF250	1.632E-06	6.592E+06	5.975E-07	2.413E+06	1.033E-06	4.173E+06
CF251	1.434E-04	8.397E+06	5.142E-05	3.011E+06	8.994E-05	5.269E+06
CM242	3.382E-03	4.148E+11	3.276E-03	4.018E+11	3.572E-03	4.381E+11
CM243	8.117E-02	1.551E+11	7.496E-02	1.432E+11	7.978E-02	1.523E+11
CM244	8.140E+00	2.438E+13	5.486E+00	1.642E+13	6.916E+00	2.070E+13
CM245	2.159E+01	1.372E+11	1.398E+01	8.883E+10	1.803E+01	1.145E+11
CM246	1.156E+01	1.323E+11	6.131E+00	7.013E+10	8.816E+00	1.008E+11
CM247	2.803E-01	9.380E+05	1.320E-01	4.418E+05	2.025E-01	6.782E+05
CM248	7.313E-02	1.115E+07	2.903E-02	4.425E+06	4.879E-02	7.436E+06

Table 16. Cont.

	Scenario I		Scenario II		Scenario III	
Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
CS133	2.021E+03		1.688E+03		2.021E+03	
CS134	1.868E-13	8.944E+00	2.528E-13	1.210E+01	1.868E-13	8.944E+00
CS135	5.091E+02	1.664E+10	4.310E+02	1.408E+10	5.091E+02	1.664E+10
CS137	1.992E+02	6.374E+14	1.735E+02	5.554E+14	1.992E+02	6.374E+14
DY160	1.694E-03		9.410E-02		1.694E-03	
DY161	2.909E-01		3.155E-01		2.909E-01	
DY162	1.731E-01		2.289E-01		1.731E-01	
EU151	4.220E+00		3.879E+00		4.220E+00	
EU152	5.082E-04	3.402E+09	4.611E-04	3.086E+09	5.082E-04	3.402E+09
EU153	1.358E+02		1.281E+02		1.358E+02	
EU154	7.849E-03	7.933E+10	1.046E-02	1.058E+11	7.849E-03	7.933E+10
EU155	6.570E-06	1.145E+08	9.428E-06	1.642E+08	6.570E-06	1.145E+08
FR223	2.051E-14	2.936E+04	2.071E-14	2.964E+04	7.575E-14	1.084E+05
GD154	2.730E+01		3.701E+01		2.730E+01	
GD155	9.201E+00		1.318E+01		9.201E+00	
GD156	7.145E-02		2.708E-01		7.145E-02	
GD157	4.878E-02		4.305E-02		4.878E-02	
GD158	9.486E+00		1.283E+01		9.486E+00	
GD160	5.012E-01		9.999E-01		5.012E-01	
GE 72	5.461E-03		5.383E-03		5.461E-03	
GE 73	2.256E-02		2.030E-02		2.256E-02	
GE 74	6.665E-02		5.934E-02		6.665E-02	
GE 76	5.899E-01		5.011E-01		5.899E-01	
I 127	5.760E+01		5.409E+01		5.760E+01	
I 129	3.375E+02	2.163E+09	2.994E+02	1.919E+09	3.375E+02	2.163E+09
IN113	2.765E-03		3.721E-03		2.765E-03	
IN115	3.624E+00	8.173E-01	2.959E+00	6.675E-01	3.624E+00	8.173E-01
KR 80	1.311E-03		1.036E-03		1.311E-03	
KR 81	6.760E-06	5.256E+03	1.205E-05	9.369E+03	6.760E-06	5.256E+03
KR 82	2.518E-01		4.455E-01		2.518E-01	
KR 83	8.615E+01		6.677E+01		8.615E+01	
KR 84	1.817E+02		1.578E+02		1.817E+02	
KR 85	7.564E-02	1.101E+12	6.087E-02	8.854E+11	7.564E-02	1.101E+12
KR 86	3.393E+02		2.820E+02		3.393E+02	
LA139	2.058E+03		1.782E+03		2.058E+03	
MO 95	1.378E+03		1.171E+03		1.378E+03	
MO 96	1.830E+00		2.084E+01		1.830E+00	
MO 97	1.373E+03		1.191E+03		1.373E+03	
MO 98	1.353E+03		1.189E+03		1.353E+03	
MO100	1.537E+03		1.352E+03		1.537E+03	

Table 16. Cont.

Nuclide	Scenario I		Scenario II		Scenario III	
	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
NB 93	4.798E-02		4.069E-02		4.798E-02	
NB 93M	1.082E-02	1.130E+11	9.125E-03	9.524E+10	1.082E-02	1.130E+11
ND142	2.370E+00		1.492E+00		2.370E+00	
ND143	1.648E+03		1.258E+03		1.648E+03	
ND144	1.937E+03	8.475E+01	1.822E+03	7.970E+01	1.937E+03	8.475E+01
ND145	1.239E+03		1.026E+03		1.239E+03	
ND146	1.019E+03		9.316E+02		1.019E+03	
ND148	5.872E+02		5.155E+02		5.872E+02	
ND150	2.509E+02		2.284E+02		2.509E+02	
NP237	6.771E+02	1.766E+10	6.539E+02	1.705E+10	2.200E+03	5.737E+10
NP239	4.106E-04	3.538E+12	3.218E-04	2.774E+12	3.766E-04	3.246E+12
NP240	4.047E-16	1.750E+02	2.574E-16	1.114E+02	3.359E-16	1.453E+02
NP240M	4.011E-14	1.550E+05	2.551E-14	9.854E+04	3.330E-14	1.286E+05
PA231	1.268E-03	2.213E+06	1.285E-03	2.244E+06	4.665E-03	8.145E+06
PA233	2.306E-05	1.764E+10	2.228E-05	1.705E+10	7.497E-05	5.737E+10
PA234	3.127E-09	2.297E+08	3.150E-09	2.312E+08	3.102E-09	2.277E+08
PA234M	4.556E-10	1.161E+10	4.589E-10	1.170E+10	4.518E-10	1.152E+10
PB208	9.056E-04		7.958E-04		3.213E-03	
PD104	4.631E+01		1.393E+02		4.631E+01	
PD105	4.201E+02		4.265E+02		4.201E+02	
PD106	3.192E+02		3.703E+02		3.192E+02	
PD107	1.906E+02	3.627E+09	2.266E+02	4.310E+09	1.906E+02	3.627E+09
PD108	1.273E+02		1.577E+02		1.273E+02	
PD110	2.994E+01		4.799E+01		2.994E+01	
PM147	1.316E-09	4.515E+04	9.624E-10	3.302E+04	1.316E-09	4.515E+04
PO210	2.178E-09	3.621E+05	2.079E-09	3.457E+05	6.575E-09	1.094E+06
PR141	1.988E+03		1.717E+03		1.988E+03	
PR144	1.790E+01	1.233E-22	1.373E+01	9.459E-23	1.790E+01	1.233E-22
PU238	2.135E+02	1.353E+14	1.891E+02	1.198E+14	5.512E+02	3.492E+14
PU239	4.528E+03	1.039E+13	4.536E+03	1.040E+13	4.727E+03	1.084E+13
PU240	2.410E+03	2.022E+13	2.271E+03	1.905E+13	2.422E+03	2.033E+13
PU241	9.922E+00	3.782E+13	9.722E+00	3.706E+13	1.012E+01	3.858E+13
PU242	1.185E+03	1.722E+11	1.030E+03	1.497E+11	1.140E+03	1.658E+11
PU243	9.743E-12	9.380E+05	4.589E-12	4.418E+05	7.039E-12	6.782E+05
PU244	2.315E-01	1.550E+05	1.472E-01	9.854E+04	1.921E-01	1.286E+05
RA223	1.123E-09	2.127E+06	1.133E-09	2.148E+06	4.145E-09	7.855E+06
RA224	8.469E-08	4.992E+08	7.451E-08	4.392E+08	3.005E-07	1.770E+09
RA225	1.106E-10	1.604E+05	8.759E-11	1.271E+05	3.923E-10	5.693E+05
RA226	2.025E-05	7.408E+05	1.925E-05	7.043E+05	6.050E-05	2.215E+06

Table 16. Cont.

	Scenario I		Scenario II		Scenario III	
Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
RB 85	2.285E+02		1.896E+02		2.285E+02	
RB 87	4.537E+02	1.437E+06	3.755E+02	1.190E+06	4.537E+02	1.437E+06
RH103	8.302E+02		6.726E+02		8.302E+02	
RN222	1.812E-08	7.128E+05	1.886E-08	6.748E+05	6.430E-08	2.115E+06
RU 99	4.631E-01		3.953E-01		4.631E-01	
RU100	1.475E+01		4.893E+01		1.475E+01	
RU101	1.242E+03		1.096E+03		1.242E+03	
RU102	1.106E+03		1.009E+03		1.106E+03	
RU104	6.721E+02		6.548E+02		6.721E+02	
SB121	5.804E+00		5.364E+00		5.804E+00	
SB123	7.145E+00		6.738E+00		7.145E+00	
SB125	5.782E-11	2.267E+03	5.052E-11	1.981E+03	5.782E-11	2.267E+03
SB126	7.313E-07	2.263E+09	7.415E-07	2.293E+09	7.313E-07	2.263E+09
SB126M	5.560E-09	1.616E+10	5.634E-09	1.638E+10	5.560E-09	1.616E+10
SE 77	1.422E+00		1.179E+00		1.422E+00	
SE 78	3.825E+00		3.365E+00		3.825E+00	
SE 79	9.240E+00	2.382E+10	7.512E+00	1.936E+10	9.240E+00	2.382E+10
SE 80	1.639E+01		1.386E+01		1.639E+01	
SE 82	4.460E+01		3.762E+01		4.460E+01	
SM147	5.804E+02	4.926E+05	4.438E+02	3.768E+05	5.804E+02	4.926E+05
SM148	1.098E+02	1.226E+00	1.323E+02	1.479E+00	1.098E+02	1.226E+00
SM149	3.513E+00		3.150E+00		3.513E+00	
SM150	4.766E+02		4.189E+02		4.766E+02	
SM151	3.633E+00	3.537E+12	3.339E+00	3.251E+12	3.633E+00	3.537E+12
SM152	2.617E+02		2.163E+02		2.617E+02	
SM154	3.769E+01		3.841E+01		3.769E+01	
SN115	2.121E-01		2.198E-01		2.121E-01	
SN116	5.978E-01		1.633E+00		5.978E-01	
SN117	4.508E+00		4.485E+00		4.508E+00	
SN118	5.107E+00		4.978E+00		5.107E+00	
SN119	5.202E+00		5.065E+00		5.202E+00	
SN120	5.453E+00		5.123E+00		5.453E+00	
SN121M	5.206E-02	1.035E+11	4.137E-02	8.223E+10	5.206E-02	1.035E+11
SN122	1.272E+01		1.201E+01		1.272E+01	
SN124	8.291E+00		8.043E+00		8.291E+00	
SN126	1.539E+01	1.616E+10	1.560E+01	1.638E+10	1.539E+01	1.616E+10
SR 88	6.503E+02		5.386E+02		6.503E+02	
SR 90	9.486E+01	4.837E+14	7.752E+01	3.954E+14	9.486E+01	4.837E+14
TB159	1.598E+00		2.201E+00		1.598E+00	

Table 16. Cont.

Nuclide	Scenario I Conc. (g/tIHM)	Scenario I Sp. act. (Bq/tIHM)	Scenario II Conc. (g/tIHM)	Scenario II Sp. act. (Bq/tIHM)	Scenario III Conc. (g/tIHM)	Scenario III Sp. act. (Bq/tIHM)
TC 99	1.417E+03	8.849E+11	1.204E+03	7.520E+11	1.417E+03	8.849E+11
TE122	1.202E-03		1.182E-01		1.202E-03	
TE124	4.630E+00		5.155E+00		4.630E+00	
TE125	9.626E+00		9.335E+00		9.626E+00	
TE125M	8.313E-13	5.540E+02	7.263E-13	4.840E+02	8.313E-13	5.540E+02
TE126	1.490E+00		1.544E+00		1.490E+00	
TE128	1.563E+02		1.420E+02		1.563E+02	
TE130	6.670E+02	3.394E-05	5.906E+02	3.005E-05	6.670E+02	3.394E-05
TH227	1.845E-09	2.098E+06	1.863E-09	2.118E+06	6.810E-09	7.749E+06
TH228	1.645E-05	4.991E+08	1.448E-05	4.390E+08	5.838E-05	1.770E+09
TH229	2.028E-05	1.604E+05	1.606E-05	1.271E+05	7.196E-05	5.693E+05
TH230	5.726E-02	4.117E+07	5.343E-02	3.843E+07	1.645E-01	1.183E+08
TH231	9.821E-10	1.932E+07	1.762E-09	3.467E+07	1.628E-09	3.203E+07
TH232	6.642E-03	2.688E+01	6.880E-03	2.782E+01	2.574E-02	1.041E+02
TH234	1.355E-05	1.161E+10	1.365E-05	1.170E+10	1.344E-05	1.152E+10
U 232	6.106E-04	4.857E+08	5.373E-04	4.273E+08	2.167E-03	1.724E+09
U 233	1.946E-02	6.944E+06	1.869E-02	6.664E+06	7.073E-02	2.523E+07
U 234	3.067E+02	7.078E+10	2.799E+02	6.459E+10	8.413E+02	1.941E+11
U 235	2.416E+02	1.932E+07	4.334E+02	3.467E+07	4.005E+02	3.203E+07
U 236	1.847E+03	4.421E+09	1.981E+03	4.743E+09	6.754E+03	1.617E+10
U 238	9.335E+05	1.161E+10	9.401E+05	1.170E+10	9.257E+05	1.152E+10
U 240	4.528E-12	1.550E+05	2.880E-12	9.854E+04	3.758E-12	1.286E+05
XE129	1.462E-03		1.317E-03		1.462E-03	
XE130	8.860E-01		6.147E-01		8.860E-01	
XE131	1.768E+03		1.414E+03		1.768E+03	
XE132	1.434E+03		1.351E+03		1.434E+03	
XE134	2.408E+03		2.106E+03		2.408E+03	
XE136	3.618E+03		3.221E+03		3.618E+03	
Y 89	8.771E+02		7.233E+02		8.771E+02	
Y 90	2.407E-02	4.839E+14	1.968E-02	3.955E+14	2.407E-02	4.839E+14
ZR 90	9.810E+02		8.123E+02		9.810E+02	
ZR 91	1.127E+03		9.366E+02		1.127E+03	
ZR 92	1.172E+03		9.837E+02		1.172E+03	
ZR 93	1.287E+03	1.196E+11	1.085E+03	1.009E+11	1.287E+03	1.196E+11
ZR 94	1.340E+03		1.143E+03		1.340E+03	
ZR 96	1.371E+03		1.180E+03		1.371E+03	

Table 17. Average composition and specific activities of fuel assumed to be unloaded from R2 in 2000 and decay corrected to mid 2100. The three scenarios are defined in table 11.

	Scenario I		Scenario II		Scenario III	
Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
AC225	1.059E-10	2.275E+05	4.217E-11	9.053E+04	1.059E-10	2.275E+05
AC227	1.276E-06	3.416E+06	1.162E-06	3.111E+06	1.276E-06	3.416E+06
AC228	5.074E-16	4.211E+01	4.191E-16	3.477E+01	5.074E-16	4.211E+01
AG109	8.458E+01		5.553E+01		8.458E+01	
AM241	1.585E+03	2.010E+14	9.727E+02	1.233E+14	1.585E+03	2.010E+14
AM242	2.127E-05	6.367E+11	1.148E-05	3.438E+11	2.127E-05	6.367E+11
AM242M	1.770E+00	6.367E+11	9.556E-01	3.438E+11	1.770E+00	6.367E+11
AM243	4.059E+02	2.999E+12	1.455E+02	1.075E+12	4.059E+02	2.999E+12
AS 75	2.204E-01		1.264E-01		2.204E-01	
BA134	1.561E+02		1.250E+02		1.561E+02	
BA135	1.057E-02		3.470E-02		1.057E-02	
BA136	1.644E+01		1.179E+01		1.644E+01	
BA137	1.984E+03		1.151E+03		1.984E+03	
BA137M	3.295E-05	6.560E+14	2.058E-05	4.099E+14	3.295E-05	6.560E+14
BA138	2.289E+03		1.332E+03		2.289E+03	
BI209	2.061E-07		7.510E-08		2.061E-07	
BI210	1.242E-10	5.704E+05	9.737E-11	4.470E+05	1.242E-10	5.704E+05
BR 81	3.610E+01		2.063E+01		3.610E+01	
CD110	1.037E+01		1.729E+01		1.037E+01	
CD111	2.184E+01		1.516E+01		2.184E+01	
CD112	1.208E+01		9.612E+00		1.208E+01	
CD113M	4.138E-05	3.460E+08	6.155E-05	5.145E+08	4.138E-05	3.460E+08
CD114	1.677E+01		1.115E+01		1.677E+01	
CD116	7.032E+00		4.303E+00		7.032E+00	
CE140	2.214E+03		1.292E+03		2.214E+03	
CE142	2.043E+03		1.183E+03		2.043E+03	
CF249	1.260E-03	1.907E+08	2.639E-04	3.997E+07	1.260E-03	1.907E+08
CF250	1.236E-06	4.993E+06	2.566E-07	1.037E+06	1.236E-06	4.993E+06
CF251	1.263E-04	7.400E+06	2.598E-05	1.522E+06	1.263E-04	7.400E+06
CM242	4.305E-03	5.280E+11	2.324E-03	2.851E+11	4.305E-03	5.280E+11
CM243	1.175E-01	2.244E+11	5.105E-02	9.753E+10	1.175E-01	2.244E+11
CM244	6.839E+00	2.047E+13	2.073E+00	6.204E+12	6.839E+00	2.047E+13
CM245	2.461E+01	1.563E+11	6.931E+00	4.405E+10	2.461E+01	1.563E+11
CM246	8.422E+00	9.640E+10	2.072E+00	2.372E+10	8.422E+00	9.640E+10
CM247	2.096E-01	7.018E+05	4.832E-02	1.618E+05	2.096E-01	7.018E+05
CM248	5.144E-02	7.839E+06	1.106E-02	1.685E+06	5.144E-02	7.839E+06

Table 17. Cont.

	Scenario I		Scenario II		Scenario III	
Nuclide	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
CS133	2.075E+03		1.168E+03		2.075E+03	
CS134	3.531E-13	1.690E+01	2.005E-12	9.599E+01	3.531E-13	1.690E+01
CS135	4.575E+02	1.495E+10	2.627E+02	8.579E+09	4.575E+02	1.495E+10
CS137	2.166E+02	6.932E+14	1.353E+02	4.329E+14	2.166E+02	6.932E+14
DY160	1.449E-01		1.719E-01		1.449E-01	
DY161	3.675E-01		2.396E-01		3.675E-01	
DY162	2.639E-01		1.811E-01		2.639E-01	
DY163	1.406E-01		1.299E-01		1.406E-01	
DY164	2.711E-02		2.564E-02		2.711E-02	
ER166	3.860E-03		7.342E-03		3.860E-03	
EU151	5.446E+00		3.882E+00		5.446E+00	
EU152	4.309E-04	2.885E+09	2.961E-04	1.982E+09	4.309E-04	2.885E+09
EU153	1.591E+02		9.408E+01		1.591E+02	
EU154	1.374E-02	1.389E+11	1.269E-02	1.283E+11	1.374E-02	1.389E+11
EU155	1.235E-05	2.151E+08	1.687E-05	2.939E+08	1.235E-05	2.151E+08
FR223	3.295E-14	4.715E+04	3.001E-14	4.296E+04	3.295E-14	4.715E+04
GD154	4.846E+01		3.467E+01		4.846E+01	
GD155	1.725E+01		1.288E+01		1.725E+01	
GD156	3.739E+01		4.938E+01		3.739E+01	
GD157	6.032E-02		3.711E-02		6.032E-02	
GD158	1.561E+01		1.102E+01		1.561E+01	
GD160	1.225E+00		9.599E-01		1.225E+00	
GE 72	6.416E-03		3.931E-03		6.416E-03	
GE 73	2.475E-02		1.454E-02		2.475E-02	
GE 74	7.275E-02		4.257E-02		7.275E-02	
GE 76	6.204E-01		3.546E-01		6.204E-01	
HO165	2.018E-02		4.477E-02		2.018E-02	
I 127	6.539E+01		3.921E+01		6.539E+01	
I 129	3.679E+02	2.358E+09	2.151E+02	1.379E+09	3.679E+02	2.358E+09
IN113	5.800E-03		7.382E-03		5.800E-03	
IN115	3.375E+00	7.615E-01	1.852E+00	4.178E-01	3.375E+00	7.615E-01
KR 80	1.308E-03		7.194E-04		1.308E-03	
KR 81	1.354E-05	1.054E+04	1.046E-05	8.135E+03	1.354E-05	1.054E+04
KR 82	5.956E-01		4.579E-01		5.956E-01	
KR 83	8.400E+01		4.536E+01		8.400E+01	
KR 84	1.960E+02		1.139E+02		1.960E+02	
KR 85	7.804E-02	1.135E+12	5.523E-02	8.030E+11	7.804E-02	1.135E+12
KR 86	3.524E+02		1.996E+02		3.524E+02	
LA139	2.211E+03		1.280E+03		2.211E+03	

Table 17. Cont.

Nuclide	Scenario I		Scenario II		Scenario III	
	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)	Conc. (g/tIHM)	Sp. act. (Bq/tIHM)
MO 95	1.455E+03		8.322E+02		1.455E+03	
MO 96	2.518E+01		2.422E+01		2.518E+01	
MO 97	1.477E+03		8.563E+02		1.477E+03	
MO 98	1.473E+03		8.605E+02		1.473E+03	
MO100	1.673E+03		9.763E+02		1.673E+03	
NB 93	5.043E-02		2.782E-02		5.043E-02	
NB 93M	1.137E-02	1.186E+11	6.470E-03	6.753E+10	1.137E-02	1.186E+11
ND142	1.779E+01		1.621E+01		1.779E+01	
ND143	1.606E+03		8.595E+02		1.606E+03	
ND144	2.225E+03	9.737E+01	1.350E+03	5.908E+01	2.225E+03	9.737E+01
ND145	1.270E+03		7.141E+02		1.270E+03	
ND146	1.162E+03		6.970E+02		1.162E+03	
ND148	6.386E+02		3.727E+02		6.386E+02	
ND150	2.813E+02		1.674E+02		2.813E+02	
NP237	1.198E+03	3.126E+10	6.895E+02	1.799E+10	1.198E+03	3.126E+10
NP239	3.479E-04	2.999E+12	1.247E-04	1.075E+12	3.479E-04	2.999E+12
NP240	3.205E-16	1.387E+02	9.194E-17	3.977E+01	3.205E-16	1.387E+02
NP240M	3.176E-14	1.227E+05	9.112E-15	3.520E+04	3.176E-14	1.227E+05
PA231	2.057E-03	3.591E+06	2.069E-03	3.612E+06	2.057E-03	3.591E+06
PA233	4.084E-05	3.126E+10	2.351E-05	1.799E+10	4.084E-05	3.126E+10
PA234	3.094E-09	2.271E+08	3.165E-09	2.324E+08	3.094E-09	2.271E+08
PA234M	4.507E-10	1.149E+10	4.612E-10	1.176E+10	4.507E-10	1.149E+10
PD104	1.766E+02		1.485E+02		1.766E+02	
PD105	5.032E+02		3.135E+02		5.032E+02	
PD106	4.589E+02		3.054E+02		4.589E+02	
PD107	2.704E+02	5.144E+09	1.811E+02	3.444E+09	2.704E+02	5.144E+09
PD108	1.866E+02		1.264E+02		1.866E+02	
PD110	5.779E+01		4.289E+01		5.779E+01	
PM147	1.315E-09	4.511E+04	3.829E-09	1.313E+05	1.315E-09	4.511E+04
PO210	3.376E-09	5.614E+05	2.648E-09	4.401E+05	3.376E-09	5.614E+05
PR141	2.128E+03		1.230E+03		2.128E+03	
PU238	3.345E+02	2.119E+14	1.428E+02	9.049E+13	3.345E+02	2.119E+14
PU239	6.346E+03	1.455E+13	5.641E+03	1.293E+13	6.346E+03	1.455E+13
PU240	2.368E+03	1.988E+13	1.611E+03	1.351E+13	2.368E+03	1.988E+13
PU241	1.320E+01	5.034E+13	9.490E+00	3.618E+13	1.320E+01	5.034E+13
PU242	1.011E+03	1.470E+11	4.395E+02	6.385E+10	1.011E+03	1.470E+11
PU243	7.287E-12	7.018E+05	1.680E-12	1.618E+05	7.287E-12	7.018E+05
PU244	1.833E-01	1.227E+05	5.260E-02	3.520E+04	1.833E-01	1.227E+05

Table 17. Cont.

Nuclide	Scenario I Conc. (g/tIHM)	Scenario I Sp. act. (Bq/tIHM)	Scenario II Conc. (g/tIHM)	Scenario II Sp. act. (Bq/tIHM)	Scenario III Conc. (g/tIHM)	Scenario III Sp. act. (Bq/tIHM)
RA223	1.803E-09	3.416E+06	1.641E-09	3.110E+06	1.803E-09	3.416E+06
RA224	1.335E-07	7.870E+08	6.316E-08	3.724E+08	1.335E-07	7.870E+08
RA225	1.568E-10	2.275E+05	6.240E-11	9.056E+04	1.568E-10	2.275E+05
RA226	3.155E-05	1.154E+06	2.519E-05	9.217E+05	3.155E-05	1.154E+06
RB 85	2.367E+02		1.338E+02		2.367E+02	
RB 87	4.690E+02	1.486E+06	2.651E+02	8.401E+05	4.690E+02	1.486E+06
RH103	8.204E+02		4.497E+02		8.204E+02	
RN222	2.794E-08	1.110E+06	3.724E-08	8.559E+05	2.794E-08	1.110E+06
RU 99	4.863E-01		2.701E-01		4.863E-01	
RU100	6.727E+01		5.714E+01		6.727E+01	
RU101	1.354E+03		7.914E+02		1.354E+03	
RU102	1.249E+03		7.454E+02		1.249E+03	
RU104	7.986E+02		4.908E+02		7.986E+02	
SB121	6.486E+00		3.849E+00		6.486E+00	
SB123	8.150E+00		4.901E+00		8.150E+00	
SB125	6.618E-11	2.595E+03	1.697E-10	6.655E+03	6.618E-11	2.595E+03
SB126	8.956E-07	2.770E+09	5.599E-07	1.732E+09	8.956E-07	2.770E+09
SB126M	6.808E-09	1.979E+10	4.257E-09	1.237E+10	6.808E-09	1.979E+10
SE 77	1.463E+00		8.237E-01		1.463E+00	
SE 78	4.138E+00		2.413E+00		4.138E+00	
SE 79	9.404E+00	2.425E+10	5.247E+00	1.352E+10	9.404E+00	2.425E+10
SE 80	1.726E+01		9.872E+00		1.726E+01	
SE 82	4.665E+01		2.663E+01		4.665E+01	
SM147	5.304E+02	4.503E+05	2.835E+02	2.407E+05	5.304E+02	4.503E+05
SM148	1.621E+02	1.811E+00	1.069E+02	1.194E+00	1.621E+02	1.811E+00
SM149	5.389E+00		4.158E+00		5.389E+00	
SM150	5.381E+02		3.119E+02		5.381E+02	
SM151	4.689E+00	4.564E+12	3.546E+00	3.451E+12	4.689E+00	4.564E+12
SM152	2.556E+02		1.415E+02		2.556E+02	
SM154	4.679E+01		2.941E+01		4.679E+01	
SN115	2.693E-01		1.714E-01		2.693E-01	
SN116	2.255E+00		1.809E+00		2.255E+00	
SN117	5.467E+00		3.401E+00		5.467E+00	
SN118	6.121E+00		3.766E+00		6.121E+00	
SN119	6.218E+00		3.826E+00		6.218E+00	
SN120	6.247E+00		3.773E+00		6.247E+00	
SN121M	5.237E-02	1.041E+11	3.008E-02	5.980E+10	5.237E-02	1.041E+11
SN122	1.455E+01		8.799E+00		1.455E+01	
SN124	9.746E+00		5.957E+00		9.746E+00	
SN126	1.884E+01	1.979E+10	1.178E+01	1.237E+10	1.884E+01	1.979E+10

Table 17. Cont.

Nuclide	Scenario I Conc. (g/tIHM)	Scenario I Sp. act. (Bq/tIHM)	Scenario II Conc. (g/tIHM)	Scenario II Sp. act. (Bq/tIHM)	Scenario III Conc. (g/tIHM)	Scenario III Sp. act. (Bq/tIHM)
SR 86	2.793E-01		2.318E-01		2.793E-01	
SR 88	6.723E+02		3.799E+02		6.723E+02	
SR 90	9.781E+01	4.988E+14	5.934E+01	3.027E+14	9.781E+01	4.988E+14
TB159	2.639E+00		1.864E+00		2.639E+00	
TC 99	1.488E+03	9.289E+11	8.490E+02	5.303E+11	1.488E+03	9.289E+11
TE122	1.822E-01		1.807E-01		1.822E-01	
TE124	6.046E+00		3.905E+00		6.046E+00	
TE125	1.138E+01		6.984E+00		1.138E+01	
TE125M	9.509E-13	6.340E+02	2.439E-12	1.626E+03	9.509E-13	6.340E+02
TE126	1.829E+00		1.145E+00		1.829E+00	
TE128	1.743E+02		1.033E+02		1.743E+02	
TE130	7.292E+02	3.711E-05	4.270E+02	2.172E-05	7.292E+02	3.711E-05
TH227	2.963E-09	3.370E+06	2.698E-09	3.068E+06	2.963E-09	3.370E+06
TH228	2.594E-05	7.868E+08	1.227E-05	3.720E+08	2.594E-05	7.868E+08
TH229	2.875E-05	2.275E+05	1.145E-05	9.059E+04	2.875E-05	2.275E+05
TH230	8.982E-02	6.460E+07	6.697E-02	4.816E+07	8.982E-02	6.460E+07
TH231	4.903E-09	9.640E+07	3.303E-08	6.493E+08	4.903E-09	9.640E+07
TH232	1.121E-02	4.532E+01	9.339E-03	3.776E+01	1.121E-02	4.532E+01
TH234	1.341E-05	1.149E+10	1.371E-05	1.176E+10	1.341E-05	1.149E+10
U 232	9.632E-04	7.659E+08	4.556E-04	3.625E+08	9.632E-04	7.659E+08
U 233	3.570E-02	1.274E+07	1.983E-02	7.072E+06	3.570E-02	1.274E+07
U 234	4.831E+02	1.115E+11	3.116E+02	7.191E+10	4.831E+02	1.115E+11
U 235	1.205E+03	9.640E+07	8.118E+03	6.493E+08	1.205E+03	9.640E+07
U 236	3.291E+03	7.878E+09	3.056E+03	7.316E+09	3.291E+03	7.878E+09
U 238	9.237E+05	1.149E+10	9.447E+05	1.176E+10	9.237E+05	1.149E+10
U 240	3.586E-12	1.227E+05	1.029E-12	3.520E+04	3.586E-12	1.227E+05
XE128	1.139E+00		1.178E+00		1.139E+00	
XE129	1.639E-03		2.127E-02		1.639E-03	
XE130	7.530E+00		6.770E+00		7.530E+00	
XE131	1.721E+03		9.359E+02		1.721E+03	
XE132	1.680E+03		1.021E+03		1.680E+03	
XE134	2.613E+03		1.523E+03		2.613E+03	
XE136	4.064E+03		2.390E+03		4.064E+03	
Y 89	9.035E+02		5.092E+02		9.035E+02	
Y 90	2.482E-02	4.988E+14	1.506E-02	3.027E+14	2.482E-02	4.988E+14
ZR 90	1.013E+03		5.681E+02		1.013E+03	
ZR 91	1.171E+03		6.625E+02		1.171E+03	
ZR 92	1.229E+03		6.993E+02		1.229E+03	
ZR 93	1.351E+03	1.256E+11	7.704E+02	7.161E+10	1.351E+03	1.256E+11
ZR 94	1.422E+03		8.174E+02		1.422E+03	
ZR 96	1.467E+03		8.467E+02		1.467E+03	

Table 18. Minimum, average and maximum composition and specific activity of all fuel assumed to be unloaded from all reactors in scenario I, decay corrected to mid 2100. Total amount of spent fuel in this scenario is 6821 (tonnes IHM).

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
AC225	5.217E-13	4.780E-11	1.173E-10	1.120E+03	1.027E+05	2.519E+05
AC227	5.225E-07	9.300E-07	1.370E-06	1.398E+06	2.489E+06	3.667E+06
AC228	7.455E-17	3.618E-16	5.951E-16	6.185E+00	3.002E+01	4.937E+01
AG109	2.439E+00	6.291E+01	8.843E+01			
AM241	4.620E+01	1.061E+03	1.664E+03	5.857E+12	1.345E+14	2.109E+14
AM242	1.453E-07	1.421E-05	2.303E-05	4.348E+09	4.255E+11	6.891E+11
AM242M	1.209E-02	1.183E+00	1.916E+00	4.348E+09	4.255E+11	6.891E+11
AM243	1.163E-01	2.308E+02	4.789E+02	8.590E+08	1.705E+12	3.538E+12
AS 75	1.576E-02	1.433E-01	2.407E-01			
BA134	2.426E+00	1.191E+02	2.125E+02			
BA136	4.992E-01	1.291E+01	1.901E+01			
BA137	1.372E+02	1.306E+03	2.132E+03			
BA137M	2.436E-06	2.068E-05	4.479E-05	4.850E+13	4.117E+14	8.919E+14
BA138	1.675E+02	1.493E+03	2.474E+03			
BI209	4.040E-10	9.046E-08	2.322E-07			
BI210	4.689E-11	9.053E-11	1.643E-10	2.153E+05	4.158E+05	7.545E+05
BR 81	2.648E+00	2.336E+01	3.960E+01			
CD110	3.127E-06	1.389E+01	3.545E+01			
CD111	7.962E-01	1.634E+01	2.408E+01			
CD112	4.307E-01	9.688E+00	1.598E+01			
CD113	5.204E-02	1.344E-01	2.302E-01	6.769E-04	1.748E-03	2.995E-03
CD113M	2.000E-06	3.537E-05	1.543E-04	1.673E+07	2.958E+08	1.290E+09
CD114	8.022E-01	1.207E+01	1.736E+01			
CD116	4.380E-01	4.773E+00	7.186E+00			
CE140	1.614E+02	1.446E+03	2.387E+03			
CE142	1.511E+02	1.327E+03	2.220E+03			
CF249	1.959E-13	3.539E-04	2.223E-03	2.965E-02	5.357E+07	3.365E+08
CF250	1.084E-16	4.633E-07	3.704E-06	4.378E-04	1.872E+06	1.496E+07
CF251	1.903E-15	3.446E-05	2.271E-04	1.114E-04	2.018E+06	1.330E+07
CM242	2.940E-05	2.877E-03	4.661E-03	3.607E+09	3.529E+11	5.716E+11
CM243	6.768E-05	5.616E-02	1.696E-01	1.293E+08	1.073E+11	3.239E+11
CM244	1.955E-04	3.358E+00	1.265E+01	5.854E+08	1.005E+13	3.789E+13
CM245	7.707E-05	8.599E+00	3.192E+01	4.896E+05	5.463E+10	2.028E+11
CM246	2.051E-06	3.383E+00	1.219E+01	2.347E+04	3.871E+10	1.395E+11
CM247	4.229E-09	7.514E-02	3.223E-01	1.415E-02	2.515E+05	1.079E+06
CM248	6.471E-11	1.727E-02	8.596E-02	9.864E-03	2.633E+06	1.310E+07

Table 18. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
CS133	1.585E+02	1.337E+03	2.310E+03			
CS134	3.259E-18	1.274E-12	1.196E-11	1.561E-04	6.102E+01	5.726E+02
CS135	4.227E+01	3.331E+02	5.083E+02	1.381E+09	1.088E+10	1.661E+10
CS137	1.601E+01	1.360E+02	2.946E+02	5.127E+13	4.352E+14	9.424E+14
DY160	1.408E-03	1.447E-01	3.278E-01			
DY161	1.234E-02	2.682E-01	3.802E-01			
DY162	5.735E-03	2.036E-01	2.921E-01			
DY163	2.848E-05	1.216E-01	2.308E-01			
DY164	4.391E-04	2.166E-02	4.552E-02			
ER166	4.308E-05	6.071E-03	1.522E-02			
EU151	1.589E+00	3.723E+00	5.792E+00			
EU152	1.245E-05	3.420E-04	8.641E-04	8.336E+07	2.290E+09	5.788E+09
EU153	6.320E+00	1.051E+02	1.635E+02			
EU154	8.843E-05	9.279E-03	3.604E-02	8.942E+08	9.378E+10	3.641E+11
EU155	3.213E-08	1.088E-05	6.074E-05	5.596E+05	1.895E+08	1.058E+09
FR223	1.349E-14	2.400E-14	3.536E-14	1.931E+04	3.435E+04	5.059E+04
GD154	6.641E-01	3.455E+01	5.717E+01			
GD155	8.995E-01	1.259E+01	2.066E+01			
GD156	5.491E-02	4.345E+01	9.543E+01			
GD157	7.739E-03	3.706E-02	6.495E-02			
GD158	6.083E-01	1.174E+01	1.752E+01			
GD160	3.480E-02	9.851E-01	1.600E+00			
GE 72	2.886E-04	4.462E-03	6.420E-03			
GE 73	1.537E-03	1.647E-02	2.621E-02			
GE 74	4.753E-03	4.810E-02	7.761E-02			
GE 76	4.589E-02	4.007E-01	6.812E-01			
I 127	3.687E+00	4.442E+01	6.761E+01			
I 129	2.448E+01	2.425E+02	3.933E+02	1.569E+08	1.554E+09	2.521E+09
IN115	2.655E-01	2.270E+00	3.834E+00	5.988E-02	5.121E-01	8.645E-01
KR 81	2.729E-07	1.139E-05	1.754E-05	2.123E+02	8.859E+03	1.364E+04
KR 82	1.101E-02	4.406E-01	7.641E-01			
KR 83	7.308E+00	5.169E+01	9.763E+01			
KR 84	1.459E+01	1.276E+02	2.123E+02			
KR 85	2.142E-03	4.944E-02	1.689E-01	3.116E+10	7.191E+11	2.457E+12
KR 86	2.809E+01	2.246E+02	3.920E+02			
LA139	1.630E+02	1.438E+03	2.400E+03			
MO 95	1.095E+02	9.382E+02	1.600E+03			
MO 96	2.930E-01	2.318E+01	4.414E+01			
MO 97	1.082E+02	9.615E+02	1.602E+03			
MO 98	1.058E+02	9.640E+02	1.584E+03			
MO100	1.189E+02	1.096E+03	1.800E+03			

Table 18. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
NB 93	3.391E-03	3.343E-02	5.552E-02			
NB 93M	8.732E-04	7.298E-03	1.255E-02	9.113E+09	7.617E+10	1.309E+11
NB 94	0.000E+00	7.172E-08	1.558E-07	0.000E+00	5.047E+02	1.096E+03
ND142	2.567E-01	1.613E+01	2.890E+01			
ND143	1.426E+02	9.716E+02	1.883E+03			
ND144	1.451E+02	1.508E+03	2.300E+03	6.349E+00	6.598E+01	1.006E+02
ND145	9.992E+01	8.127E+02	1.419E+03			
ND146	8.040E+01	7.690E+02	1.220E+03			
ND148	4.594E+01	4.177E+02	6.879E+02			
ND150	1.891E+01	1.872E+02	2.964E+02			
NP237	2.796E+01	6.217E+02	1.223E+03	7.292E+08	1.622E+10	3.191E+10
NP239	9.970E-08	1.978E-04	4.105E-04	8.590E+08	1.705E+12	3.538E+12
NP240	5.641E-21	1.464E-16	4.183E-16	2.441E-03	6.332E+01	1.809E+02
NP240M	5.592E-19	1.451E-14	4.145E-14	2.160E+00	5.604E+04	1.602E+05
PA231	1.027E-03	1.538E-03	2.348E-03	1.793E+06	2.686E+06	4.100E+06
PA233	9.527E-07	2.119E-05	4.167E-05	7.292E+08	1.621E+10	3.188E+10
PA234	3.068E-09	3.168E-09	3.279E-09	2.252E+08	2.326E+08	2.408E+08
PA234M	4.469E-10	4.615E-10	4.777E-10	1.139E+10	1.176E+10	1.218E+10
PB206	5.721E-08	1.254E-07	2.699E-07			
PB207	6.307E-07	2.047E-06	3.346E-06			
PB208	8.743E-06	6.919E-04	1.497E-03			
PD104	2.182E+00	1.451E+02	2.584E+02			
PD105	2.484E+01	3.569E+02	5.018E+02			
PD106	1.847E+01	3.270E+02	4.785E+02			
PD107	9.553E+00	1.990E+02	2.855E+02	1.816E+08	3.785E+09	5.429E+09
PD108	5.548E+00	1.394E+02	2.014E+02			
PD110	1.549E+00	4.526E+01	7.031E+01			
PM147	2.853E-13	2.725E-09	2.261E-08	9.789E+00	9.351E+04	7.754E+05
PO210	1.275E-09	2.465E-09	4.485E-09	2.121E+05	4.099E+05	7.458E+05
PR141	1.559E+02	1.383E+03	2.314E+03			
PU238	7.719E-01	1.500E+02	3.948E+02	4.889E+11	9.506E+13	2.500E+14
PU239	1.726E+03	4.815E+03	6.510E+03	3.959E+12	1.104E+13	1.493E+13
PU240	2.813E+02	1.979E+03	2.512E+03	2.360E+12	1.660E+13	2.107E+13
PU241	2.942E-01	8.279E+00	2.219E+01	1.121E+12	3.156E+13	8.463E+13
PU242	3.116E+00	6.948E+02	1.183E+03	4.533E+08	1.010E+11	1.719E+11
PU243	1.470E-19	2.612E-12	1.120E-11	1.415E-02	2.515E+05	1.079E+06
PU244	3.226E-06	8.372E-02	2.392E-01	2.160E+00	5.604E+04	1.602E+05
RA223	7.369E-10	1.313E-09	1.935E-09	1.397E+06	2.488E+06	3.665E+06
RA224	9.796E-10	6.350E-08	1.548E-07	5.777E+06	3.743E+08	9.117E+08
RA225	7.728E-13	7.076E-11	1.737E-10	1.121E+03	1.027E+05	2.519E+05
RA226	1.234E-05	2.208E-05	3.695E-05	4.519E+05	8.080E+05	1.352E+06

Table 18. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
RB 85	1.886E+01	1.508E+02	2.637E+02			
RB 87	3.775E+01	2.986E+02	5.231E+02	1.196E+05	9.459E+05	1.657E+06
RH103	6.184E+01	5.234E+02	9.324E+02			
RN222	1.491E-08	2.834E-08	7.582E-08	4.123E+05	7.648E+05	1.270E+06
RU 99	3.255E-02	3.231E-01	5.339E-01			
RU100	1.117E+00	5.271E+01	9.893E+01			
RU101	9.581E+01	8.894E+02	1.454E+03			
RU102	8.376E+01	8.296E+02	1.313E+03			
RU104	4.557E+01	5.469E+02	8.078E+02			
SB121	3.784E-01	4.381E+00	6.777E+00			
SB123	4.636E-01	5.543E+00	8.405E+00			
SB125	1.026E-14	1.285E-10	9.208E-10	4.022E-01	5.036E+03	3.611E+04
SB126	4.484E-08	6.246E-07	8.931E-07	1.386E+08	1.932E+09	2.762E+09
SB126M	3.408E-10	4.748E-09	6.790E-09	9.908E+08	1.380E+10	1.973E+10
SE 77	1.110E-01	9.341E-01	1.631E+00			
SE 78	2.857E-01	2.721E+00	4.445E+00			
SE 79	7.611E-01	5.928E+00	1.061E+01	1.962E+09	1.528E+10	2.733E+10
SE 80	1.335E+00	1.110E+01	1.901E+01			
SE 82	3.558E+00	3.004E+01	5.140E+01			
SM147	5.538E+01	3.386E+02	6.314E+02	4.703E+04	2.874E+05	5.362E+05
SM148	3.030E+00	1.164E+02	1.715E+02	3.386E-02	1.301E+00	1.915E+00
SM149	2.054E+00	3.277E+00	5.954E+00			
SM150	3.053E+01	3.411E+02	5.735E+02			
SM151	1.528E+00	3.085E+00	5.385E+00	1.487E+12	3.004E+12	5.243E+12
SM152	1.764E+01	1.682E+02	2.867E+02			
SM154	2.530E+00	3.255E+01	4.666E+01			
SN115	1.487E-02	1.879E-01	2.685E-01			
SN116	3.531E-02	1.714E+00	3.072E+00			
SN117	3.088E-01	3.774E+00	5.460E+00			
SN118	3.664E-01	4.174E+00	6.202E+00			
SN119	3.708E-01	4.244E+00	6.303E+00			
SN120	3.754E-01	4.228E+00	6.448E+00			
SN121M	5.171E-03	3.191E-02	6.793E-02	1.028E+10	6.344E+10	1.351E+11
SN122	8.409E-01	9.897E+00	1.496E+01			
SN124	5.291E-01	6.685E+00	9.879E+00			
SN126	9.431E-01	1.314E+01	1.880E+01	9.908E+08	1.380E+10	1.973E+10
SR 86	4.873E-03	2.124E-01	3.976E-01			
SR 88	5.381E+01	4.282E+02	7.495E+02			
SR 90	7.640E+00	5.985E+01	1.396E+02	3.896E+13	3.052E+14	7.119E+14
TB159	8.707E-02	2.008E+00	2.990E+00			
TC 99	1.112E+02	9.627E+02	1.636E+03	6.948E+10	6.011E+11	1.022E+12

Table 18. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
TE122	1.194E-03	1.520E-01	3.286E-01			
TE124	1.445E-01	4.398E+00	6.239E+00			
TE125	6.502E-01	7.784E+00	1.153E+01			
TE125M	1.474E-16	1.846E-12	1.324E-11	9.827E-02	1.231E+03	8.828E+03
TE126	7.074E-02	1.298E+00	1.824E+00			
TE128	1.125E+01	1.160E+02	1.838E+02			
TE130	5.060E+01	4.794E+02	7.812E+02	2.574E-06	2.439E-05	3.975E-05
TH227	1.212E-09	2.158E-09	3.180E-09	1.378E+06	2.454E+06	3.616E+06
TH228	1.904E-07	1.234E-05	3.007E-05	5.775E+06	3.742E+08	9.117E+08
TH229	1.419E-07	1.298E-05	3.185E-05	1.123E+03	1.027E+05	2.521E+05
TH230	3.169E-02	5.586E-02	9.482E-02	2.279E+07	4.016E+07	6.818E+07
TH231	9.705E-10	9.904E-09	8.174E-08	1.910E+07	1.948E+08	1.608E+09
TH232	1.682E-03	7.985E-03	1.307E-02	6.800E+00	3.229E+01	5.283E+01
TH234	1.330E-05	1.373E-05	1.422E-05	1.139E+10	1.176E+10	1.218E+10
U 232	7.067E-06	4.580E-04	1.116E-03	5.621E+06	3.642E+08	8.877E+08
U 233	7.201E-04	1.827E-02	3.640E-02	2.568E+05	6.516E+06	1.298E+07
U 234	1.257E+02	2.624E+02	5.170E+02	2.900E+10	6.056E+10	1.193E+11
U 235	2.387E+02	2.436E+03	2.010E+04	1.910E+07	1.948E+08	1.608E+09
U 236	6.280E+02	2.319E+03	3.621E+03	1.503E+09	5.551E+09	8.671E+09
U 238	9.159E+05	9.456E+05	9.786E+05	1.139E+10	1.176E+10	1.218E+10
U 240	6.312E-17	1.638E-12	4.680E-12	2.160E+00	5.604E+04	1.602E+05
XE128	4.849E-05	1.003E+00	2.170E+00			
XE129	1.434E-04	1.590E-02	5.066E-02			
XE130	1.582E-01	6.706E+00	1.191E+01			
XE131	1.344E+02	1.095E+03	1.972E+03			
XE132	1.079E+02	1.124E+03	1.732E+03			
XE134	1.896E+02	1.706E+03	2.820E+03			
XE136	2.795E+02	2.636E+03	4.340E+03			
Y 89	7.280E+01	5.742E+02	1.010E+03			
Y 90	1.938E-03	1.519E-02	3.543E-02	3.896E+13	3.053E+14	7.122E+14
ZR 90	7.906E+01	6.472E+02	1.130E+03			
ZR 91	9.321E+01	7.457E+02	1.304E+03			
ZR 92	9.590E+01	7.864E+02	1.360E+03			
ZR 93	1.043E+02	8.675E+02	1.491E+03	9.693E+09	8.063E+10	1.386E+11
ZR 94	1.075E+02	9.182E+02	1.557E+03			
ZR 96	1.089E+02	9.505E+02	1.598E+03			

Table 19. Minimum, average and maximum composition and specific activity of fuel assumed to be unloaded from all reactors in scenario II, decay corrected to mid 2100. Total amount of spent fuel is 5764 (t IHM).

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
AC225	1.051E-12	4.391E-11	1.173E-10	2.257E+03	9.431E+04	2.519E+05
AC227	5.224E-07	9.359E-07	1.370E-06	1.398E+06	2.505E+06	3.667E+06
AC228	1.347E-16	3.772E-16	5.951E-16	1.118E+01	3.130E+01	4.937E+01
AG109	6.560E+00	6.578E+01	8.861E+01			
AM241	1.109E+02	1.073E+03	1.657E+03	1.405E+13	1.361E+14	2.100E+14
AM242	3.960E-07	1.401E-05	2.261E-05	1.185E+10	4.194E+11	6.767E+11
AM242M	3.295E-02	1.166E+00	1.881E+00	1.185E+10	4.194E+11	6.767E+11
AM243	5.700E-01	2.087E+02	4.701E+02	4.211E+09	1.542E+12	3.473E+12
AS 75	2.887E-02	1.388E-01	2.407E-01			
BA134	8.981E+00	1.326E+02	2.125E+02			
BA136	1.355E+00	1.393E+01	1.901E+01			
BA137	2.517E+02	1.283E+03	2.132E+03			
BA137M	2.436E-06	1.896E-05	4.086E-05	4.850E+13	3.774E+14	8.134E+14
BA138	3.044E+02	1.453E+03	2.474E+03			
BI209	8.217E-10	8.248E-08	2.322E-07			
BI210	4.687E-11	9.459E-11	1.643E-10	2.153E+05	4.344E+05	7.545E+05
BR 81	4.810E+00	2.256E+01	3.960E+01			
CD110	4.735E-06	1.767E+01	3.545E+01			
CD111	1.923E+00	1.737E+01	2.408E+01			
CD112	1.051E+00	1.086E+01	1.598E+01			
CD113	6.771E-02	1.287E-01	2.302E-01	8.807E-04	1.674E-03	2.995E-03
CD113M	2.000E-06	3.836E-05	1.397E-04	1.673E+07	3.208E+08	1.169E+09
CD114	1.713E+00	1.258E+01	1.737E+01			
CD116	8.409E-01	4.776E+00	7.186E+00			
CE140	2.937E+02	1.409E+03	2.387E+03			
CE142	2.736E+02	1.288E+03	2.220E+03			
CF249	7.417E-12	1.977E-04	2.206E-03	1.123E+00	2.992E+07	3.340E+08
CF250	5.443E-15	2.211E-07	2.997E-06	2.198E-02	8.932E+05	1.211E+07
CF251	1.217E-13	1.873E-05	2.265E-04	7.130E-03	1.097E+06	1.326E+07
CM242	8.015E-05	2.836E-03	4.577E-03	9.826E+09	3.478E+11	5.613E+11
CM243	2.937E-04	5.176E-02	1.539E-01	5.611E+08	9.888E+10	2.940E+11
CM244	9.169E-04	2.495E+00	1.105E+01	2.744E+09	7.470E+12	3.306E+13
CM245	7.273E-04	6.869E+00	3.191E+01	4.619E+06	4.363E+10	2.027E+11
CM246	2.786E-05	2.400E+00	1.218E+01	3.187E+05	2.746E+10	1.394E+11
CM247	8.122E-08	4.924E-02	3.223E-01	2.718E-01	1.649E+05	1.079E+06
CM248	1.776E-09	1.016E-02	8.596E-02	2.707E-01	1.549E+06	1.310E+07

Table 19. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
CS133	2.847E+02	1.282E+03	2.310E+03			
CS134	3.259E-18	6.377E-13	8.006E-12	1.561E-04	3.054E+01	3.834E+02
CS135	7.538E+01	3.210E+02	5.030E+02	2.462E+09	1.049E+10	1.643E+10
CS137	1.601E+01	1.246E+02	2.686E+02	5.127E+13	3.989E+14	8.596E+14
DY160	5.635E-03	1.789E-01	3.278E-01			
DY161	3.054E-02	2.772E-01	3.802E-01			
DY162	1.867E-02	2.173E-01	2.921E-01			
DY163	9.437E-03	1.446E-01	2.308E-01			
DY164	2.001E-03	2.571E-02	4.552E-02			
ER166	4.308E-05	7.712E-03	1.522E-02			
EU151	2.012E+00	3.727E+00	5.792E+00			
EU152	1.245E-05	2.928E-04	8.119E-04	8.336E+07	1.961E+09	5.435E+09
EU153	1.399E+01	1.048E+02	1.635E+02			
EU154	8.843E-05	8.283E-03	2.977E-02	8.942E+08	8.372E+10	3.010E+11
EU155	3.213E-08	8.286E-06	4.432E-05	5.596E+05	1.443E+08	7.720E+08
FR223	1.349E-14	2.415E-14	3.536E-14	1.929E+04	3.457E+04	5.059E+04
GD154	2.508E+00	3.726E+01	5.717E+01			
GD155	1.737E+00	1.361E+01	2.066E+01			
GD156	3.006E-01	5.416E+01	9.543E+01			
GD157	1.134E-02	3.619E-02	6.495E-02			
GD158	1.434E+00	1.257E+01	1.752E+01			
GD160	9.561E-02	1.099E+00	1.600E+00			
GE 72	6.306E-04	4.500E-03	6.420E-03			
GE 73	2.951E-03	1.619E-02	2.621E-02			
GE 74	8.973E-03	4.714E-02	7.761E-02			
GE 76	8.310E-02	3.867E-01	6.812E-01			
I 127	7.346E+00	4.420E+01	6.761E+01			
I 129	4.588E+01	2.373E+02	3.933E+02	2.941E+08	1.521E+09	2.521E+09
IN115	4.808E-01	2.157E+00	3.834E+00	1.085E-01	4.866E-01	8.645E-01
KR 81	9.536E-07	1.262E-05	1.754E-05	7.418E+02	9.814E+03	1.364E+04
KR 82	3.684E-02	4.878E-01	7.641E-01			
KR 83	1.259E+01	4.822E+01	9.763E+01			
KR 84	2.636E+01	1.241E+02	2.123E+02			
KR 85	2.142E-03	3.865E-02	1.323E-01	3.116E+10	5.622E+11	1.923E+12
KR 86	4.969E+01	2.152E+02	3.920E+02			
LA139	2.954E+02	1.396E+03	2.400E+03			
MO 95	1.970E+02	9.054E+02	1.600E+03			
MO 96	1.512E+00	2.750E+01	4.414E+01			
MO 97	1.965E+02	9.344E+02	1.602E+03			
MO 98	1.935E+02	9.406E+02	1.584E+03			
MO100	2.181E+02	1.070E+03	1.800E+03			

Table 19. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
NB 93	6.085E-03	3.319E-02	5.552E-02			
NB 93M	1.561E-03	7.031E-03	1.255E-02	1.629E+10	7.338E+10	1.309E+11
NB 94	0.000E+00	9.069E-08	1.558E-07	0.000E+00	6.382E+02	1.096E+03
ND142	1.152E+00	1.892E+01	2.890E+01			
ND143	2.438E+02	9.008E+02	1.883E+03			
ND144	2.746E+02	1.501E+03	2.300E+03	1.201E+01	6.568E+01	1.006E+02
ND145	1.777E+02	7.773E+02	1.419E+03			
ND146	1.486E+02	7.596E+02	1.220E+03			
ND148	8.393E+01	4.074E+02	6.879E+02			
ND150	3.534E+01	1.846E+02	2.964E+02			
NP237	5.756E+01	6.274E+02	1.223E+03	1.501E+09	1.637E+10	3.191E+10
NP239	4.887E-07	1.789E-04	4.030E-04	4.211E+09	1.542E+12	3.473E+12
NP240	4.020E-20	1.175E-16	4.183E-16	1.739E-02	5.081E+01	1.809E+02
NP240M	3.984E-18	1.164E-14	4.145E-14	1.539E+01	4.497E+04	1.602E+05
PA231	1.027E-03	1.541E-03	2.348E-03	1.792E+06	2.690E+06	4.100E+06
PA233	1.961E-06	2.138E-05	4.167E-05	1.500E+09	1.636E+10	3.188E+10
PA234	3.068E-09	3.171E-09	3.270E-09	2.252E+08	2.328E+08	2.402E+08
PA234M	4.469E-10	4.620E-10	4.765E-10	1.139E+10	1.178E+10	1.215E+10
PB206	5.694E-08	1.340E-07	2.699E-07			
PB207	6.305E-07	2.112E-06	3.346E-06			
PB208	1.570E-05	6.674E-04	1.497E-03			
PD104	9.992E+00	1.663E+02	2.584E+02			
PD105	5.255E+01	3.623E+02	5.018E+02			
PD106	4.203E+01	3.416E+02	4.793E+02			
PD107	2.336E+01	2.089E+02	2.864E+02	4.442E+08	3.973E+09	5.448E+09
PD108	1.482E+01	1.474E+02	2.015E+02			
PD110	4.394E+00	4.953E+01	7.031E+01			
PM147	2.853E-13	1.189E-09	1.371E-08	9.789E+00	4.080E+04	4.704E+05
PO210	1.275E-09	2.577E-09	4.485E-09	2.120E+05	4.285E+05	7.458E+05
PR141	2.831E+02	1.342E+03	2.314E+03			
PU238	2.195E+00	1.402E+02	3.825E+02	1.390E+12	8.882E+13	2.422E+14
PU239	3.095E+03	4.874E+03	6.509E+03	7.100E+12	1.118E+13	1.493E+13
PU240	4.770E+02	1.984E+03	2.512E+03	4.001E+12	1.665E+13	2.107E+13
PU241	2.942E-01	7.453E+00	1.911E+01	1.121E+12	2.841E+13	7.283E+13
PU242	9.591E+00	6.668E+02	1.168E+03	1.394E+09	9.694E+10	1.698E+11
PU243	2.824E-18	1.712E-12	1.120E-11	2.718E-01	1.649E+05	1.079E+06
PU244	2.299E-05	6.718E-02	2.392E-01	1.539E+01	4.497E+04	1.602E+05
RA223	7.368E-10	1.322E-09	1.935E-09	1.397E+06	2.504E+06	3.665E+06
RA224	1.761E-09	5.892E-08	1.489E-07	1.037E+07	3.473E+08	8.778E+08
RA225	1.557E-12	6.501E-11	1.737E-10	2.259E+03	9.433E+04	2.519E+05
RA226	1.235E-05	2.278E-05	3.695E-05	4.519E+05	8.334E+05	1.352E+06

Table 19. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
RB 85	3.336E+01	1.444E+02	2.637E+02			
RB 87	6.660E+01	2.856E+02	5.231E+02	2.109E+05	9.048E+05	1.657E+06
RH103	1.115E+02	4.963E+02	9.324E+02			
RN222	1.526E-08	2.964E-08	7.582E-08	4.116E+05	7.893E+05	1.270E+06
RU 99	5.895E-02	3.197E-01	5.339E-01			
RU100	4.074E+00	6.062E+01	9.893E+01			
RU101	1.760E+02	8.690E+02	1.454E+03			
RU102	1.566E+02	8.189E+02	1.313E+03			
RU104	9.039E+01	5.496E+02	8.078E+02			
SB121	7.439E-01	4.340E+00	6.777E+00			
SB123	9.205E-01	5.522E+00	8.405E+00			
SB125	1.026E-14	6.311E-11	6.417E-10	4.022E-01	2.474E+03	2.515E+04
SB126	9.362E-08	6.340E-07	8.931E-07	2.895E+08	1.961E+09	2.762E+09
SB126M	7.118E-10	4.819E-09	6.789E-09	2.069E+09	1.401E+10	1.973E+10
SE 77	1.993E-01	8.941E-01	1.631E+00			
SE 78	5.294E-01	2.656E+00	4.445E+00			
SE 79	1.339E+00	5.633E+00	1.061E+01	3.452E+09	1.452E+10	2.733E+10
SE 80	2.384E+00	1.070E+01	1.901E+01			
SE 82	6.382E+00	2.893E+01	5.140E+01			
SM147	9.279E+01	3.133E+02	6.314E+02	7.883E+04	2.660E+05	5.362E+05
SM148	1.016E+01	1.225E+02	1.721E+02	1.135E-01	1.369E+00	1.922E+00
SM149	2.521E+00	3.194E+00	5.954E+00			
SM150	5.939E+01	3.333E+02	5.735E+02			
SM151	1.528E+00	2.979E+00	5.221E+00	1.487E+12	2.900E+12	5.084E+12
SM152	3.348E+01	1.607E+02	2.867E+02			
SM154	5.121E+00	3.308E+01	4.666E+01			
SN115	2.974E-02	1.917E-01	2.685E-01			
SN116	1.311E-01	1.949E+00	3.072E+00			
SN117	6.151E-01	3.813E+00	5.460E+00			
SN118	7.136E-01	4.194E+00	6.202E+00			
SN119	7.235E-01	4.263E+00	6.303E+00			
SN120	7.304E-01	4.209E+00	6.448E+00			
SN121M	5.761E-03	2.905E-02	6.459E-02	1.145E+10	5.775E+10	1.284E+11
SN122	1.660E+00	9.866E+00	1.496E+01			
SN124	1.070E+00	6.711E+00	9.879E+00			
SN126	1.970E+00	1.334E+01	1.879E+01	2.069E+09	1.401E+10	1.973E+10
SR 86	1.689E-02	2.420E-01	3.976E-01			
SR 88	9.503E+01	4.097E+02	7.495E+02			
SR 90	7.640E+00	5.336E+01	1.268E+02	3.896E+13	2.722E+14	6.466E+14
TB159	2.198E-01	2.156E+00	2.990E+00			
TC 99	2.009E+02	9.290E+02	1.636E+03	1.254E+11	5.801E+11	1.022E+12

Table 19. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
TE124	4.361E-01	4.564E+00	6.239E+00			
TE125	1.288E+00	7.814E+00	1.153E+01			
TE125M	1.474E-16	9.071E-13	9.224E-12	9.827E-02	6.045E+02	6.146E+03
TE126	1.661E-01	1.325E+00	1.824E+00			
TE128	2.133E+01	1.144E+02	1.838E+02			
TE130	9.354E+01	4.689E+02	7.812E+02	4.762E-06	2.386E-05	3.975E-05
TH227	1.211E-09	2.172E-09	3.180E-09	1.377E+06	2.470E+06	3.616E+06
TH228	3.420E-07	1.145E-05	2.893E-05	1.037E+07	3.472E+08	8.770E+08
TH229	2.858E-07	1.192E-05	3.185E-05	2.261E+03	9.437E+04	2.521E+05
TH230	3.170E-02	5.615E-02	9.482E-02	2.279E+07	4.037E+07	6.818E+07
TH231	1.027E-09	9.326E-09	8.174E-08	2.021E+07	1.835E+08	1.608E+09
TH232	3.038E-03	8.318E-03	1.307E-02	1.229E+01	3.364E+01	5.283E+01
TH234	1.330E-05	1.375E-05	1.418E-05	1.139E+10	1.178E+10	1.215E+10
U 232	1.269E-05	4.249E-04	1.074E-03	1.010E+07	3.379E+08	8.538E+08
U 233	1.451E-03	1.870E-02	3.640E-02	5.173E+05	6.669E+06	1.298E+07
U 234	1.257E+02	2.560E+02	5.170E+02	2.901E+10	5.907E+10	1.193E+11
U 235	2.526E+02	2.294E+03	2.010E+04	2.021E+07	1.835E+08	1.608E+09
U 236	1.136E+03	2.393E+03	3.621E+03	2.718E+09	5.727E+09	8.671E+09
U 238	9.159E+05	9.467E+05	9.760E+05	1.139E+10	1.178E+10	1.215E+10
U 240	4.497E-16	1.314E-12	4.680E-12	1.539E+01	4.497E+04	1.602E+05
XE128	5.144E-05	1.214E+00	2.170E+00			
XE129	6.250E-04	1.996E-02	5.066E-02			
XE130	5.511E-01	7.858E+00	1.191E+01			
XE131	2.409E+02	1.033E+03	1.972E+03			
XE132	2.042E+02	1.120E+03	1.732E+03			
XE134	3.452E+02	1.662E+03	2.820E+03			
XE136	5.146E+02	2.582E+03	4.340E+03			
Y 89	1.283E+02	5.485E+02	1.010E+03			
Y 90	1.938E-03	1.354E-02	3.218E-02	3.896E+13	2.722E+14	6.468E+14
ZR 90	1.396E+02	6.228E+02	1.130E+03			
ZR 91	1.649E+02	7.142E+02	1.304E+03			
ZR 92	1.707E+02	7.560E+02	1.360E+03			
ZR 93	1.863E+02	8.351E+02	1.491E+03	1.732E+10	7.762E+10	1.386E+11
ZR 94	1.933E+02	8.875E+02	1.557E+03			
ZR 96	1.969E+02	9.215E+02	1.598E+03			

Table 20. Minimum, average and maximum composition and specific activity of fuel assumed to be unloaded from all reactors in scenario III, decay corrected to mid 2100. Total amount of spent fuel is 6821 (t IHM).

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
AC225	5.217E-13	6.531E-11	2.647E-10	1.120E+03	1.403E+05	5.684E+05
AC227	5.373E-07	1.159E-06	2.927E-06	1.438E+06	3.103E+06	7.835E+06
AC228	7.455E-17	4.686E-16	1.325E-15	6.185E+00	3.888E+01	1.099E+02
AG109	2.439E+00	6.291E+01	8.843E+01			
AM241	4.620E+01	1.062E+03	1.664E+03	5.857E+12	1.347E+14	2.109E+14
AM242	1.453E-07	1.428E-05	2.303E-05	4.348E+09	4.273E+11	6.891E+11
AM242M	1.209E-02	1.188E+00	1.916E+00	4.348E+09	4.273E+11	6.891E+11
AM243	1.163E-01	2.267E+02	4.703E+02	8.590E+08	1.675E+12	3.473E+12
AS 75	1.576E-02	1.433E-01	2.407E-01			
BA134	2.426E+00	1.191E+02	2.125E+02			
BA136	4.992E-01	1.291E+01	1.901E+01			
BA137	1.372E+02	1.306E+03	2.132E+03			
BA137M	2.436E-06	2.068E-05	4.479E-05	4.850E+13	4.117E+14	8.919E+14
BA138	1.675E+02	1.493E+03	2.474E+03			
BI209	4.040E-10	1.237E-07	5.363E-07			
BI210	4.744E-11	1.083E-10	2.675E-10	2.178E+05	4.973E+05	1.228E+06
BR 81	2.648E+00	2.336E+01	3.960E+01			
CD110	3.128E-06	1.389E+01	3.545E+01			
CD111	7.962E-01	1.634E+01	2.408E+01			
CD112	4.307E-01	9.688E+00	1.598E+01			
CD113	5.204E-02	1.344E-01	2.302E-01	6.769E-04	1.748E-03	2.995E-03
CD113M	2.000E-06	3.537E-05	1.543E-04	1.673E+07	2.958E+08	1.290E+09
CD114	8.022E-01	1.207E+01	1.736E+01			
CD116	4.380E-01	4.773E+00	7.186E+00			
CE140	1.614E+02	1.446E+03	2.387E+03			
CE142	1.511E+02	1.327E+03	2.220E+03			
CF249	1.959E-13	3.188E-04	2.223E-03	2.965E-02	4.826E+07	3.365E+08
CF250	1.084E-16	4.111E-07	3.704E-06	4.378E-04	1.661E+06	1.496E+07
CF251	1.903E-15	3.081E-05	2.271E-04	1.114E-04	1.804E+06	1.330E+07
CM242	2.940E-05	2.890E-03	4.661E-03	3.607E+09	3.544E+11	5.716E+11
CM243	6.768E-05	5.584E-02	1.696E-01	1.293E+08	1.067E+11	3.239E+11
CM244	1.955E-04	3.234E+00	1.265E+01	5.854E+08	9.683E+12	3.789E+13
CM245	7.707E-05	8.296E+00	3.192E+01	4.896E+05	5.270E+10	2.028E+11
CM246	2.051E-06	3.172E+00	1.219E+01	2.347E+04	3.630E+10	1.395E+11
CM247	4.229E-09	6.945E-02	3.223E-01	1.415E-02	2.325E+05	1.079E+06
CM248	6.471E-11	1.558E-02	8.596E-02	9.864E-03	2.374E+06	1.310E+07

Table 20. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
CS133	1.585E+02	1.337E+03	2.310E+03			
CS134	3.259E-18	1.274E-12	1.196E-11	1.561E-04	6.102E+01	5.726E+02
CS135	4.227E+01	3.331E+02	5.084E+02	1.381E+09	1.088E+10	1.661E+10
CS137	1.601E+01	1.360E+02	2.946E+02	5.127E+13	4.352E+14	9.424E+14
DY160	1.409E-03	1.447E-01	3.278E-01			
DY161	1.234E-02	2.682E-01	3.802E-01			
DY162	5.735E-03	2.036E-01	2.921E-01			
DY163	2.849E-05	1.216E-01	2.308E-01			
DY164	4.391E-04	2.166E-02	4.552E-02			
ER166	4.308E-05	6.071E-03	1.522E-02			
EU151	1.589E+00	3.723E+00	5.792E+00			
EU152	1.245E-05	3.420E-04	8.642E-04	8.336E+07	2.290E+09	5.790E+09
EU153	6.320E+00	1.051E+02	1.635E+02			
EU154	8.843E-05	9.279E-03	3.604E-02	8.942E+08	9.378E+10	3.641E+11
EU155	3.213E-08	1.088E-05	6.074E-05	5.596E+05	1.895E+08	1.058E+09
FR223	1.387E-14	2.991E-14	7.556E-14	1.985E+04	4.282E+04	1.081E+05
GD154	6.641E-01	3.455E+01	5.717E+01			
GD155	8.995E-01	1.259E+01	2.066E+01			
GD156	5.492E-02	4.345E+01	9.543E+01			
GD157	7.739E-03	3.706E-02	6.495E-02			
GD158	6.083E-01	1.174E+01	1.752E+01			
GD160	3.480E-02	9.851E-01	1.600E+00			
GE 72	2.886E-04	4.462E-03	6.420E-03			
GE 73	1.537E-03	1.647E-02	2.621E-02			
GE 74	4.753E-03	4.810E-02	7.761E-02			
GE 76	4.589E-02	4.007E-01	6.812E-01			
I 127	3.687E+00	4.442E+01	6.761E+01			
I 129	2.448E+01	2.425E+02	3.933E+02	1.569E+08	1.554E+09	2.521E+09
IN115	2.655E-01	2.270E+00	3.834E+00	5.988E-02	5.121E-01	8.645E-01
KR 81	2.729E-07	1.139E-05	1.754E-05	2.123E+02	8.859E+03	1.364E+04
KR 82	1.101E-02	4.406E-01	7.641E-01			
KR 83	7.308E+00	5.169E+01	9.763E+01			
KR 84	1.459E+01	1.276E+02	2.123E+02			
KR 85	2.142E-03	4.944E-02	1.689E-01	3.116E+10	7.191E+11	2.457E+12
KR 86	2.809E+01	2.246E+02	3.920E+02			
LA139	1.630E+02	1.438E+03	2.400E+03			
MO 95	1.095E+02	9.382E+02	1.600E+03			
MO 96	2.930E-01	2.318E+01	4.414E+01			
MO 97	1.082E+02	9.615E+02	1.602E+03			
MO 98	1.058E+02	9.640E+02	1.584E+03			
MO100	1.189E+02	1.096E+03	1.800E+03			

Table 20. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
NB 93	3.391E-03	3.343E-02	5.552E-02			
NB 93M	8.732E-04	7.298E-03	1.255E-02	9.113E+09	7.617E+10	1.309E+11
NB 94	0.000E+00	7.172E-08	1.558E-07	0.000E+00	5.047E+02	1.096E+03
ND142	2.567E-01	1.613E+01	2.890E+01			
ND143	1.426E+02	9.716E+02	1.883E+03			
ND144	1.451E+02	1.508E+03	2.300E+03	6.349E+00	6.598E+01	1.006E+02
ND145	9.992E+01	8.127E+02	1.419E+03			
ND146	8.040E+01	7.690E+02	1.220E+03			
ND148	4.594E+01	4.177E+02	6.879E+02			
ND150	1.891E+01	1.872E+02	2.964E+02			
NP237	2.796E+01	7.929E+02	2.194E+03	7.292E+08	2.068E+10	5.723E+10
NP239	9.970E-08	1.943E-04	4.031E-04	8.590E+08	1.675E+12	3.473E+12
NP240	5.641E-21	1.406E-16	4.183E-16	2.441E-03	6.084E+01	1.809E+02
NP240M	5.592E-19	1.394E-14	4.145E-14	2.160E+00	5.384E+04	1.602E+05
PA231	1.059E-03	1.905E-03	4.654E-03	1.848E+06	3.326E+06	8.125E+06
PA233	9.527E-07	2.702E-05	7.478E-05	7.292E+08	2.068E+10	5.723E+10
PA234	3.068E-09	3.165E-09	3.279E-09	2.252E+08	2.323E+08	2.408E+08
PA234M	4.469E-10	4.610E-10	4.777E-10	1.139E+10	1.175E+10	1.218E+10
PB206	5.811E-08	1.479E-07	3.708E-07			
PB207	6.416E-07	2.539E-06	6.811E-06			
PB208	8.743E-06	9.086E-04	3.207E-03			
PD104	2.182E+00	1.451E+02	2.584E+02			
PD105	2.484E+01	3.569E+02	5.018E+02			
PD106	1.847E+01	3.270E+02	4.785E+02			
PD107	9.553E+00	1.990E+02	2.855E+02	1.816E+08	3.786E+09	5.429E+09
PD108	5.548E+00	1.394E+02	2.014E+02			
PD110	1.549E+00	4.526E+01	7.031E+01			
PM147	2.853E-13	2.725E-09	2.261E-08	9.789E+00	9.351E+04	7.754E+05
PO210	1.290E-09	2.948E-09	7.285E-09	2.146E+05	4.902E+05	1.212E+06
PR141	1.559E+02	1.383E+03	2.314E+03			
PU238	7.719E-01	1.853E+02	5.951E+02	4.889E+11	1.174E+14	3.771E+14
PU239	1.726E+03	4.832E+03	6.510E+03	3.959E+12	1.108E+13	1.493E+13
PU240	2.813E+02	1.978E+03	2.512E+03	2.360E+12	1.659E+13	2.107E+13
PU241	2.942E-01	8.280E+00	2.219E+01	1.121E+12	3.156E+13	8.463E+13
PU242	3.116E+00	6.888E+02	1.138E+03	4.533E+08	1.001E+11	1.654E+11
PU243	1.470E-19	2.414E-12	1.120E-11	1.415E-02	2.325E+05	1.079E+06
PU244	3.226E-06	8.044E-02	2.392E-01	2.160E+00	5.384E+04	1.602E+05
RA223	7.577E-10	1.637E-09	4.134E-09	1.436E+06	3.102E+06	7.835E+06
RA224	9.796E-10	8.501E-08	3.304E-07	5.777E+06	5.010E+08	1.947E+09
RA225	7.728E-13	9.668E-11	3.919E-10	1.121E+03	1.403E+05	5.689E+05
RA226	1.248E-05	2.659E-05	6.501E-05	4.568E+05	9.731E+05	2.379E+06

Table 20. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
RB 85	1.886E+01	1.508E+02	2.637E+02			
RB 87	3.775E+01	2.986E+02	5.231E+02	1.196E+05	9.459E+05	1.657E+06
RH103	6.184E+01	5.234E+02	9.324E+02			
RN222	1.575E-08	3.427E-08	9.924E-08	4.155E+05	9.201E+05	2.268E+06
RU 99	3.255E-02	3.231E-01	5.339E-01			
RU100	1.117E+00	5.271E+01	9.893E+01			
RU101	9.581E+01	8.894E+02	1.454E+03			
RU102	8.376E+01	8.296E+02	1.313E+03			
RU104	4.557E+01	5.469E+02	8.078E+02			
SB121	3.784E-01	4.381E+00	6.777E+00			
SB123	4.636E-01	5.543E+00	8.405E+00			
SB125	1.026E-14	1.285E-10	9.208E-10	4.022E-01	5.036E+03	3.611E+04
SB126	4.484E-08	6.246E-07	8.931E-07	1.386E+08	1.932E+09	2.762E+09
SB126M	3.408E-10	4.748E-09	6.790E-09	9.908E+08	1.380E+10	1.973E+10
SE 77	1.110E-01	9.341E-01	1.631E+00			
SE 78	2.857E-01	2.721E+00	4.445E+00			
SE 79	7.611E-01	5.928E+00	1.061E+01	1.962E+09	1.528E+10	2.733E+10
SE 80	1.335E+00	1.110E+01	1.901E+01			
SE 82	3.558E+00	3.004E+01	5.140E+01			
SM147	5.538E+01	3.386E+02	6.314E+02	4.703E+04	2.874E+05	5.362E+05
SM148	3.030E+00	1.164E+02	1.715E+02	3.386E-02	1.301E+00	1.915E+00
SM149	2.054E+00	3.277E+00	5.954E+00			
SM150	3.053E+01	3.411E+02	5.735E+02			
SM151	1.528E+00	3.085E+00	5.385E+00	1.487E+12	3.004E+12	5.243E+12
SM152	1.764E+01	1.682E+02	2.867E+02			
SM154	2.530E+00	3.256E+01	4.666E+01			
SN115	1.487E-02	1.879E-01	2.685E-01			
SN116	3.531E-02	1.714E+00	3.072E+00			
SN117	3.088E-01	3.774E+00	5.460E+00			
SN118	3.664E-01	4.174E+00	6.202E+00			
SN119	3.708E-01	4.244E+00	6.303E+00			
SN120	3.754E-01	4.228E+00	6.448E+00			
SN121M	5.171E-03	3.191E-02	6.793E-02	1.028E+10	6.344E+10	1.351E+11
SN122	8.409E-01	9.897E+00	1.496E+01			
SN124	5.291E-01	6.685E+00	9.879E+00			
SN126	9.431E-01	1.314E+01	1.880E+01	9.908E+08	1.380E+10	1.973E+10
SR 86	4.873E-03	2.124E-01	3.976E-01			
SR 88	5.381E+01	4.282E+02	7.495E+02			
SR 90	7.640E+00	5.985E+01	1.396E+02	3.896E+13	3.053E+14	7.119E+14
TB159	8.707E-02	2.008E+00	2.990E+00			
TC 99	1.112E+02	9.627E+02	1.636E+03	6.948E+10	6.011E+11	1.022E+12

Table 20. Cont.

Nuclide	Concentration (g/t IHM)			Specific activity (Bq/t IHM)		
	Min	Average	Max	Min	Average	Max
TE122	1.195E-03	1.520E-01	3.286E-01			
TE124	1.445E-01	4.398E+00	6.239E+00			
TE125	6.502E-01	7.784E+00	1.153E+01			
TE125M	1.474E-16	1.846E-12	1.324E-11	9.827E-02	1.231E+03	8.828E+03
TE126	7.074E-02	1.298E+00	1.824E+00			
TE128	1.125E+01	1.160E+02	1.838E+02			
TE130	5.060E+01	4.794E+02	7.812E+02	2.574E-06	2.439E-05	3.975E-05
TH227	1.246E-09	2.690E-09	6.793E-09	1.417E+06	3.059E+06	7.729E+06
TH228	1.904E-07	1.652E-05	6.419E-05	5.775E+06	5.009E+08	1.947E+09
TH229	1.419E-07	1.773E-05	7.188E-05	1.123E+03	1.403E+05	5.689E+05
TH230	3.214E-02	6.794E-02	1.674E-01	2.311E+07	4.884E+07	1.204E+08
TH231	1.401E-09	1.011E-08	8.174E-08	2.756E+07	1.989E+08	1.608E+09
TH232	1.682E-03	1.034E-02	2.912E-02	6.800E+00	4.181E+01	1.177E+02
TH234	1.330E-05	1.372E-05	1.422E-05	1.139E+10	1.175E+10	1.218E+10
U 232	7.067E-06	6.131E-04	2.383E-03	5.621E+06	4.876E+08	1.895E+09
U 233	7.201E-04	2.385E-02	7.218E-02	2.568E+05	8.504E+06	2.574E+07
U 234	1.262E+02	3.218E+02	8.392E+02	2.912E+10	7.426E+10	1.936E+11
U 235	3.446E+02	2.486E+03	2.010E+04	2.756E+07	1.989E+08	1.608E+09
U 236	6.280E+02	2.986E+03	9.151E+03	1.503E+09	7.148E+09	2.191E+10
U 238	9.159E+05	9.446E+05	9.786E+05	1.139E+10	1.175E+10	1.218E+10
U 240	6.312E-17	1.573E-12	4.680E-12	2.160E+00	5.384E+04	1.602E+05
XE128	4.850E-05	1.003E+00	2.170E+00			
XE129	1.434E-04	1.590E-02	5.066E-02			
XE130	1.582E-01	6.706E+00	1.191E+01			
XE131	1.344E+02	1.095E+03	1.972E+03			
XE132	1.079E+02	1.124E+03	1.732E+03			
XE134	1.896E+02	1.706E+03	2.820E+03			
XE136	2.795E+02	2.636E+03	4.340E+03			
Y 89	7.280E+01	5.742E+02	1.010E+03			
Y 90	1.938E-03	1.519E-02	3.543E-02	3.896E+13	3.053E+14	7.122E+14
ZR 90	7.906E+01	6.472E+02	1.130E+03			
ZR 91	9.321E+01	7.457E+02	1.304E+03			
ZR 92	9.590E+01	7.864E+02	1.360E+03			
ZR 93	1.043E+02	8.675E+02	1.491E+03	9.693E+09	8.063E+10	1.386E+11
ZR 94	1.075E+02	9.182E+02	1.557E+03			
ZR 96	1.089E+02	9.506E+02	1.598E+03			

Figure 1. BNFL's fuel cycle operations (14)

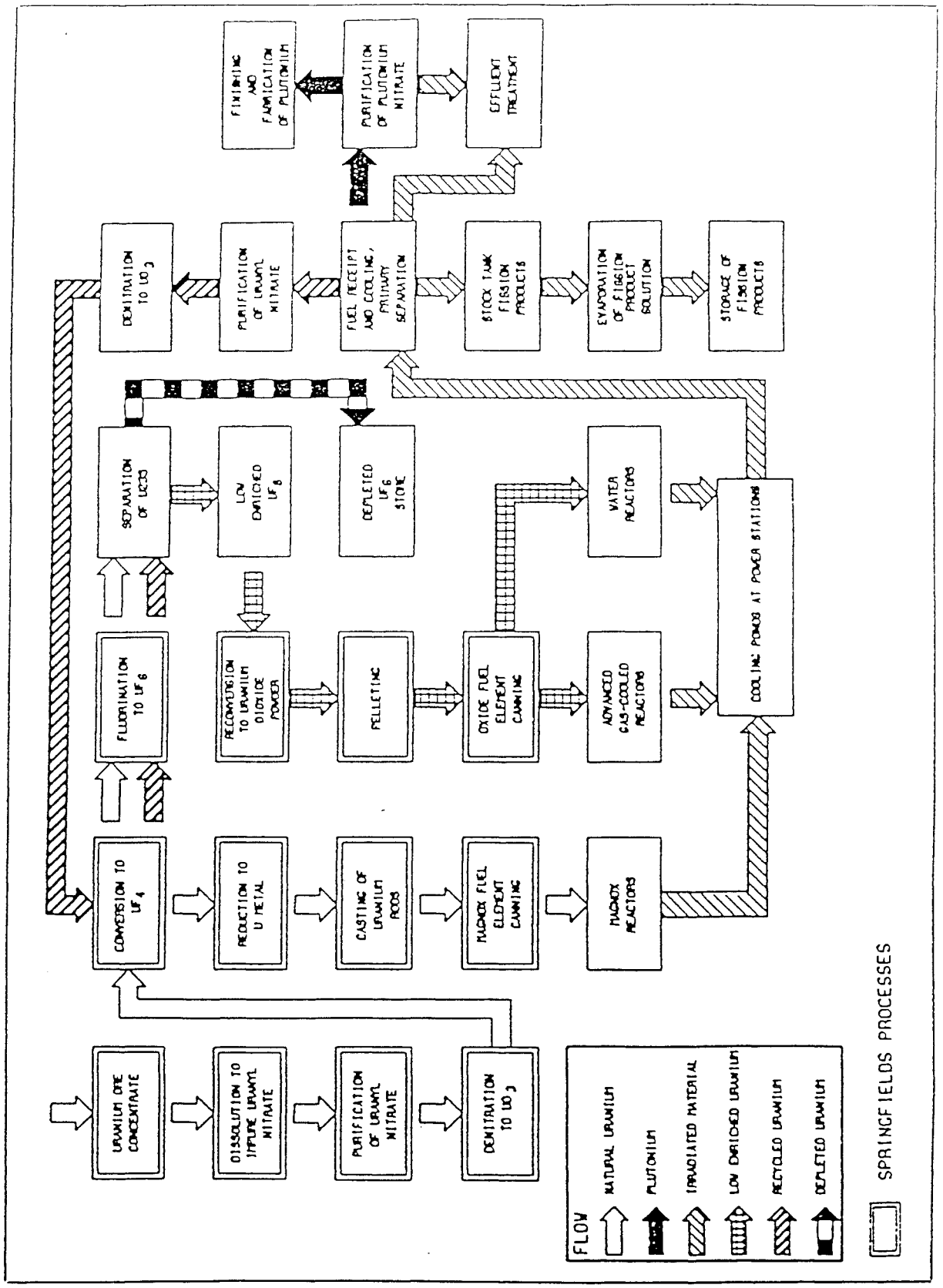
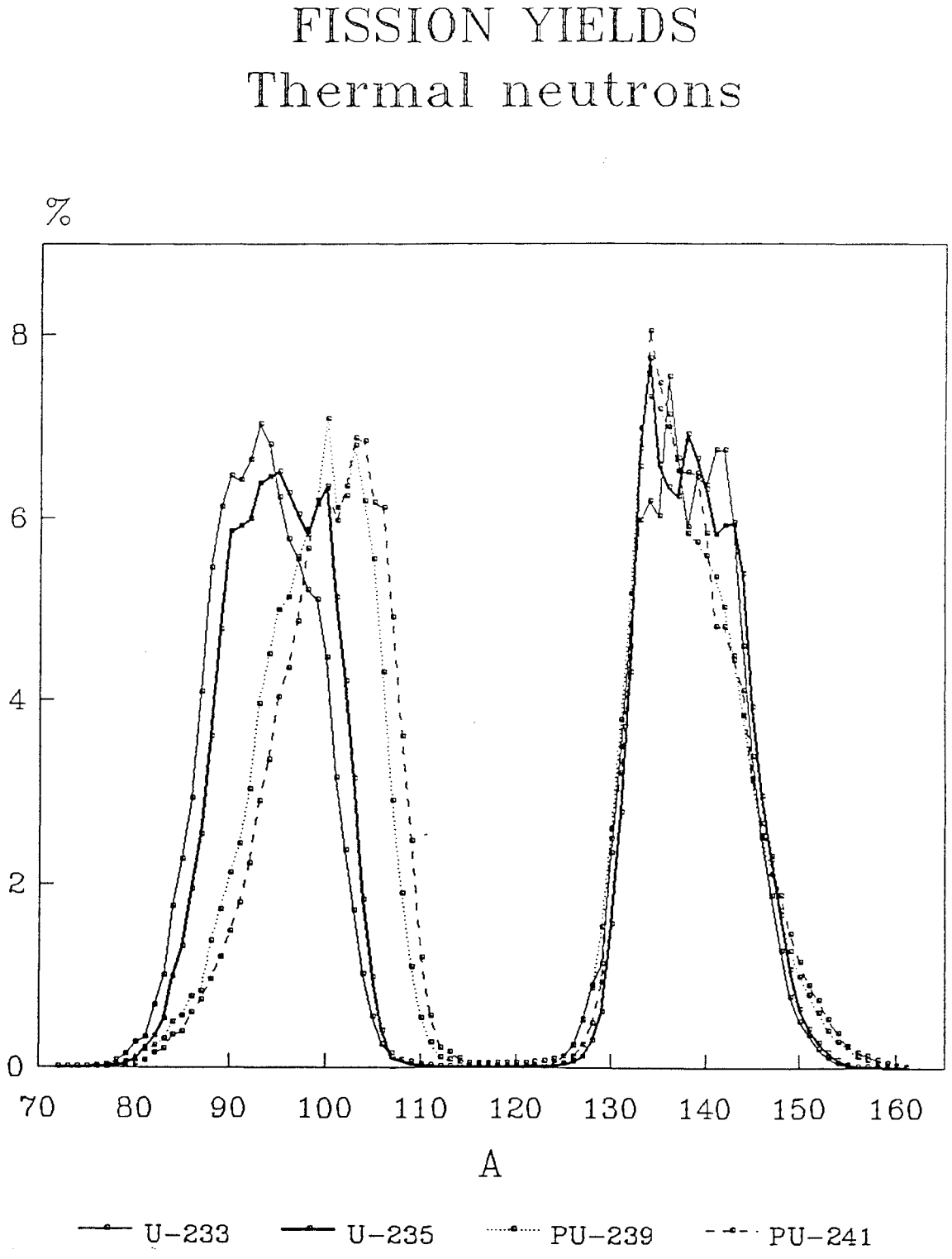


Figure 2. Mass yield curves for thermal fission



Crouch 1977

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