Radioactive Substances Series

Liquid Discharges from Nuclear Installations in 2004

OSPAR Commission

2006

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

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contents

Executive summary/*Récapitulatif*

This annual report includes the data of 2004 on liquid radioactive discharges from nuclear installations and covers the period 1989-2004. On this basis, an assessment has been made for the discharges from nuclear power stations, nuclear fuel reprocessing plants, nuclear fuel fabrication and enrichment plants, and research and development facilities. It covers total alpha, tritium and total beta activity (excluding tritium) in TBq/y for each type of nuclear installation. To facilitate comparison of the discharges year by year temporal trends are shown for total alpha, tritium and total beta (excluding tritium) for the period 1989-2004.

Le présent rapport annuel comprend les données de 2004 sur les rejets radioactifs liquides des installations nucléaires, et couvre la période de 1989 à 2004. Sur cette base, les rejets des centrales nucléaires, des usines de retraitement du combustible nucléaire, des installations de fabrication et d'enrichissement du combustible nucléaire, ainsi que des équipements de recherche et développement ont été évalués. Cette évaluation porte sur l'activité alpha totale, le tritium et l'activité bêta totale (à l'exclusion du tritium) exprimés en TBq/an pour chacun des secteurs des installations nucléaires. Pour faciliter la comparaison des rejets d'une année à l'autre, les tendances chronologiques d'alpha total, du tritium et de bêta total (à l'exclusion du tritium) sont mises en évidence pendant la période de 1989 à 2004.

There is a downward trend in the amount of total-alpha activity discharged from all nuclear installations over the 15-year period. However, discharges of alpha activity between 2002 and 2004 were higher than over the period 1997 – 2000, largely as a result of higher total-alpha releases from the reprocessing plant at Sellafield. In 2004, the discharges from Sellafield were lower than those in 2003. It is expected that this downturn will continue. Further significant contributors to the summed discharges are from the fuel fabrication plant at Springfields and the reprocessing plant at La Hague. Discharges from research and development facilities were very low in 2002, with an increase in 2003 and a further reduction in 2004.

On constate une tendance à la baisse de l'activité alpha totale rejetée par toutes les installations nucléaires sur la période de 15 ans en cause. Toutefois, les rejets d'activité alpha de 2002 à 2004 se sont avérés plus importants que sur la période 1997-2000, en grande partie en raison de l'augmentation des émissions d'alpha total de l'usine de retraitement de Sellafield. En 2004, les rejets de Sellafield étaient inférieurs à ceux de 2003. On s'attend à ce que ce début de tendance à la baisse se poursuive. Les autres contributeurs importants à la somme des rejets sont l'installation de fabrication de combustible de Springfields et l'usine de retraitement de La Hague. Les rejets des équipements de recherche et de développement étaient très faibles en 2002. Cependant, ils se sont avérés plus importants en 2003, suivis d'une reduction en 2004.

The tritium releases from all installations increased in the period from 1996 – 2004, which is mainly due to the discharges from La Hague. The reprocessing plants in La Hague and Sellafield contribute, in aggregate, to approximately 83 % of the overall discharges. Discharges of tritium from nuclear power stations and research and development facilities show slowly increasing values over the period 2000 – 2004. The contribution of the research and development facilities had decreased in 2004.

Les rejets de tritium de toutes les installations ont augmenté sur la période de 1996 à 2004, augmentation essentiellement due aux rejets de l'usine de La Hague. Regroupées, les usines de retraitement de La Hague et de Sellafield représentent environ 83 % de l'ensemble des rejets. On constate une fluctuation légère à la hausse des rejets de tritium des centrales nucléaires et des équipements de recherche et développement sur la période de 2000 à 2004. La contribution des installations de recherche et développement a diminué en 2004.

The sum of total-beta activity (excluding tritium) from all nuclear installations has fallen significantly over the past 15 years. Total emissions are dominated by discharges from the reprocessing plant at Sellafield and the fuel-fabrication plant at Springfields. The two installations together contribute approximately 93 % of the overall discharges. The high, but decreasing total-beta discharges from Sellafield are mainly attributable to the radionuclide Technetium-99. The reduction of Sellafield's total-beta discharges from 2001 to 2004 is a result of the significant reduction in Technetium-99 discharges, due to the vitrification process, since 1994 for oxide fuels and 2003, for magnox fuels. Discharge of Tc-99 to sea (primarily from treatment of stored Magnox wastes) has been reduced by a factor of 13 between 1994 and 2004.

A l'exclusion du tritium, la somme d'activité beta totale de toutes les installations nucléaires a significativement baissé ces quinze dernières années. Les émissions de l'usine de retraitement du combustible nucléaire à Sellafield et l'installation de fabrication et d'enrichissement du combustible nucléaire de Springfields constituent les rejets totaux pour l'essentiel. Conjointement, ces deux équipements représentent environ 93% de l'ensemble des rejets. Les rejets élevés, mais décroissants, de bêta total de Sellafield sont surtout imputables au radionucléide technétium 99. La baisse des rejets de bêta total de l'usine de Sellafield, telle que survenue pendant la période de 2001 à 2004, résulte d'une réduction significative des rejets de Technétium 99, due à la procédure de vitrication en vigueur depuis 1994 pour le combustible oxyde, et 2003, pour le combustible Magnox. Les rejets de technétium 99 dans le milieu marin (plus particulièrement du traitement des rejets de Magnox stocké) ont baissé d'un coefficient de 13 entre 1994 et 2004.

1. Introduction

1.1 Programmes and measures

Since the mid 1980s, liquid discharges of radioactive substances from nuclear installations have been addressed under the former Paris Convention (PARCOM) and under the OSPAR Convention. The following relevant measures[1] are applicable under the OSPAR Convention:

- PARCOM Recommendation 88/4 on Nuclear Reprocessing Plants;
- PARCOM Recommendation 91/4 on Radioactive Discharges[2];
- PARCOM Recommendation 93/5 Concerning Increases in Radioactive Discharges from Nuclear Reprocessing Plants;
- PARCOM Recommendation 94/8 Concerning Environmental Impact Resulting from Discharges of Radioactive Discharges[3];
- PARCOM Recommendation 94/9 Concerning the Management of Spent Nuclear Fuel[4];
- OSPAR Decision 2000/1 on Substantial Reductions and Elimination of Discharges, Emissions and Losses of Radioactive Discharges, with Special Emphasis on Nuclear Reprocessing;
- OSPAR Decision 2001/1 on the Review of Authorisations for Discharges or Releases of Radioactive Substances from Nuclear Reprocessing Activities.

In 1998, the Ministerial meeting of the OSPAR Commission adopted the OSPAR Strategy with regard to Radioactive Substances which was updated and revised at the 2nd OSPAR Ministerial meeting in 2003 (reference number: 2003-21). In 2000, the OSPAR Commission adopted, and in 2001 revised, the Programme for the More Detailed Implementation of the OSPAR with regard to Radioactive Substances (reference number: 2001-13). The national reports submitted in 2002 and 2003 in accordance with this more detailed programme contain information on liquid discharges from nuclear installations which include, where available, forecasts on how these discharges would develop in future in order to move towards a situation whereby by the year 2020, discharges, emissions and losses of radioactive substances are reduced to levels where the additional concentrations in the marine environment above historic levels, resulting from such discharges, emissions and losses, are close to zero. Regular reporting from Contracting Parties is therefore required in order to review progress towards this target. The 2003 Progress Report on the More Detailed Implementation of the OSPAR Strategy with regard to Radioactive Substances, approved by the Ministerial meeting of the OSPAR Commission in 2003, provides an overview of the situation.

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1 All measures referred to in this chapter can be downloaded from the OSPAR website www.ospar.org (under "measures").

2 The implementation of this Recommendation requires an assessment to be carried out as to whether BAT is being applied in nuclear installations. Contracting Parties submit national reports that also contain discharge data on a regular basis thereby using the Guidelines for the submission of information about, and the assessment of, the application of BAT in nuclear facilities (reference number: 1999-11). A summary report of the second round of implementation reporting on PARCOM Recommendation was published for the first time by the OSPAR Commission in 1999. A summary report of the third round is being published by the Commission in 2003.

3 Assessments of the effect and relative contributions of remobilised historical discharges and current discharges of radioactive substances, including wastes, on the marine environment have been published in the Quality Status Report 2000 published by the OSPAR Commission in 2000 (ISBN 0 946956 52 9) and in the MARINA II Report published by the European Commission; see website: http://europa.eu.int/comm/environment/radprot/.

4 At the request of the OSPAR Commission in this Recommendation, the OECD Nuclear Energy Agency published in 2000 a comparative study on Radiological Impacts of Spent Nuclear Fuel Management Options (ISBN 92 64 17657 8).

1.2 Annual reporting

In 1985, Contracting Parties to the former Paris Convention initiated reporting on liquid discharges from nuclear installations. These data were submitted annually by Contracting Parties and compiled by the Secretariat and, following examination by the relevant subsidiary bodies, published by the Commission in the form of annual reports; at first as part of the Commission's general annual report, and from 1991 onwards in annual reports on discharges from nuclear sectors. From 1998 onwards, the annual reports (starting with 1996 data) also contain an assessment of liquid discharges which include a description of the trends from 1989 until the date of the latest report. The Commission also published in 1998 a summary of the report on sources, inputs and temporal trends of radioactive discharges from nuclear installations for the years 1989 to 1995 (ISBN 0 946955 85 9).

Over time, reporting requirements and formats for data collection as regards nuclear installations were regularly reviewed and updated in the light of experience and ongoing work under the Commission. With a view to harmonising the way in which data and information are being established and reported, the Programmes and Measures Committee (PRAM) of the OSPAR Commission adopted in 1996 the reporting format and procedures currently used (reference number: 1996-2), which sets out the data and information to be provided by Contracting Parties.

1.3 Parameters monitored and reported

The tables in this annual report contain data on total alpha, total beta, tritium and individual radionuclides. The assessment in Chapter 2 and the Figures 1, 2 and 3 show trends in discharges of total alpha activity, total beta activity and tritium.

Total alpha and total beta values are useful as they will encompass the contribution to the overall activity from a wide range of radionuclides which, individually, would be difficult to measure or could be below detection limits. However, total alpha and total beta values provide limited information about the potential harm as such information should be based on the characteristics of individual radionuclides. Tritium is reported separately.

Total alpha represents the measured radioactivity of alpha particles that are composed of two protons and two neutrons. These particles are emitted as a result of the decay of certain radionuclides, the so-called α-emitters. On average, the total liquid discharges of α-emitters from all nuclear sites represent mainly Pu-239 and Am-241 and, to a lesser extent, Th-230, Pu-238 and some other nuclides[5].

Total beta represents the measured radioactivity of beta particles that are similar to electrons, except they originate from (processes within) the atomic nucleus. These particles are emitted as a result of the decay of other radionuclides, the so-called β-emitters. On average, the total liquid discharges of β-emitters from all nuclear sites represent mainly Ru-106, Sr-90, Pu-241, Cs-137, Tc-99 and, to a lesser extent, some other nuclides. The breakdown for β-emitters in liquid discharges from nuclear power plants comprises Cs-137 (39%), S-35 (20%), Sr-90 (11%), Co-60 (5%) and (for about 20%) other radionuclides. Total beta in this report excludes tritium.

Tritium (^{3}H) is an isotope of hydrogen that emits low-energy radiation in the form of beta particles. Tritium is discharged from most nuclear power plants, reprocessing plants and some research and development facilities.

5 For abbreviations of radionuclides see Chapter 3.

2. Assessment of the liquid radioactive discharges from nuclear installations in 2004/*Evaluation des rejets radioactifs liquides des installations nucléaires en l'an 2004*

Table 1 summarises liquid radioactive discharges from nuclear installations for the time period 1990 – 2004; data for 1990 – 2003 are taken from the OSPAR Annual Reports on Liquid Discharges from Nuclear Installations. Reported discharges include data from nuclear power stations, nuclear fuel reprocessing plants, nuclear fuel fabrication and enrichment plants and research and development facilities. For each type of nuclear installation, Table 1 gives total alpha activity, tritium and total beta activity excluding tritium in TBq/y as well as the ratio as a percentage of the total discharges from all installations. To facilitate comparison of the discharges year by year, Figures 1 to 3 show temporal trends of total alpha, tritium and total beta excluding tritium for the time period 1990 to 2004.

Les rejets radioactifs liquides des installations nucléaires pour la période allant de 1999 à 2004 sont résumés au tableau 1. Les rapports annuels OSPAR concernant la période de 1990 à l'an 2003, sur les rejets liquides des installations nucléaires, constituent la base de cette évaluation. Les rejets notifiés des centrales nucléaires, des usines de retraitement du combustible nucléaire, des équipements de fabrication du combustible nucléaire et des équipements d'enrichissement ainsi que des installations de recherche et de développement ont été pris en compte. Le tableau 1 indique, pour chaque type d'installation nucléaire, l'activité alpha totale, le tritium et l'activité bêta totale sans le tritium, exprimés en TBq/an, ainsi que le ratio, en pourcentage, de l'ensemble des rejets de la totalité des installations. Pour faciliter la comparaison des rejets d'une année à l'autre, les figures 1 à 3 illustrent les tendances chronologiques d'alpha total, du tritium et de bêta total sans le tritium pendant la période de 1990 à 2003.

Both Table 1 and Figure 1 show a decrease of the total alpha activity discharged from all nuclear installations over the 15-year period. However, discharges of alpha activity in 2002, 2003 and 2004 were higher than over the period 1997 - 2000. The reason for this rise to 0,61, 0,62 and 0,54 TBq/y is largely a result of higher total alpha releases from the reprocessing plant at Sellafield, United Kingdom (2000: 0,12 TBq, 2001: 0,2 TBq, 2002: 0,35 TBq, 2003: 0,41 TBq, 2004: 0,29 TBq). The discharge in 2004 from Sellafield was lower than 2003. It is expected that this downturn will continue and that 2003 will clearly be seen as a peak that has now passed. Further significant contributors to the total discharges are from the fuel fabrication plant at Springfields (0,23 TBq) and, to a lesser extent, the reprocessing plant at La Hague (0,017 TBq). Discharges from research and development facilities have been very low and in the range 0,0016 - 0,0047 TBq in the period up to 2003 and have decreased further in 2004 to 0,0005 TBq.

Le tableau 1 et la figure 1 mettent en évidence une tendance à la baisse de l'activité alpha totale rejetée par toutes les installations nucléaires sur la période de 15 ans. Cependant les rejets d'activité alpha de 2002 à 2004 se sont avérés plus importants par rapport à la période de 1997 à 2000. Cette augmentation, de 0,61, de 0,62 et de 0,54 TBq/an est due en grande partie à l'augmentation des émissions d'activité alpha totale de l'usine de retraitement de combustible nucléaire de Sellafield au Royaume-Uni (2000 : 0,12 TBq, 2001 : 0,2 TBq, 2002: 0,35 TBq, 2003 : 0,41 TBq, 2004 : 0,29 TBq). Les rejets en 2004 de l'usine Sellafield sont inférieurs à ceux de 2003. On s'attend que cette tendance à la baisse se poursuive et que l'année 2003 sera clairement considérée comme un pic, désormais terminé. Les autres contributeurs les plus importants à la somme des rejets sont l'usine de fabrication de combustible de Springfields (0,23 TBq) et, dans une moindre mesure, l'usine de retraitement de La Hague (0,017 TBq). Les rejets des équipements de recherche et de développement étaient très faibles, entre de 0,0016 à 0,0047 TB jusqu'en 2003. En 2004, les rejets ont diminué davantage et sont passés à 0,0005 TBq.

Figure 2 presents the discharges of tritium, in terms of activity. The tritium releases from all installations increased from around 8000 TBq/y during the period 1990 - 1992 to discharges between 16779 and 20634 TBq in the period 1996 - 2004. This increase is mainly due to the discharges from La Hague (2001: 9650 TBq, 2002: 12000 TBq, 2003: 11900 TBq, 2004: 13900 TBq). The reprocessing plants in La Hague and Sellafield contribute in total approximately 83 % (2004) of the overall discharges. Discharges of tritium from nuclear power stations show slowly increasing values over the time period 2000 – 2004. The contribution of the research and development facilities has decreased to 3,6 TBq (0,02 %) in 2004.

La figure 2 illustre les rejets de tritium en termes d'activité. Les émissions de tritium de toutes les installations ont augmenté de 8 000 TBq/an approximativement, pour la période de 1990 à 1992, elles se situent entre 16 779 et 20 634 TBq pour la période de 1996 et 2004. Cette augmentation est pour l'essentiel due aux rejets de La Hague (2001 : 9 650 TBq, 2002 : 12 000 TBq, 2003 : 11 900 TB, 2004 : 13 900 TBq). Après regroupement, la contribution des usines de retraitement de La Hague et de Sellafield représente environ 83 % (en 2004) de l'ensemble des rejets. Les rejets de tritium des centrales nucléaires présentent une légère tendance à la hausse sur la période allant de l'an 2000 à l'an 2004. La contribution des installations de recherche et de développement présente une tendance à la baisse de 3,6 TBq (0,02 %) en 2004.

Figure 3 shows that the sum of total beta activity excluding tritium from all nuclear installations has significantly decreased over the past 15 years, from 491 TBq (1990), down to 204 TBq (2004). Total beta discharges are dominated by discharges from the reprocessing plant at Sellafield and the nuclear fuel plant at Springfields. Both installations together contribute approximately 93 % (2003) of the overall discharges. The high, but decreasing, total beta discharges from Sellafield (2001: 123 TBq, 2002: 112 TBq, 2003: 83 TBq, 2004: 73 TBq) are mainly attributable to the radionuclide Technetium-99 (2001: 79 TBq, 2002: 85 TBq, 2003: 37 TBq, 2004: 14 TBq). The reduction of Sellafield's total beta discharges over the period 2001 to 2004 are due to the reduction of Technetium 99 discharges from the Sellafield site. Technetium 99 has been the focus of discharge reduction efforts at Sellafield and has been directed to the vitrification process, rather than discharge, since 1994 for oxide fuels and since 2003 for Magnox fuels. Discharge of Tc-99 to sea (primarily from treatment of stored Magnox wastes) has been reduced by a factor of 13 between 1994 and 2004.

La figure 3 montre que la somme de l'activité bêta totale, à l'exclusion du tritium, rejetée par l'ensemble des installations nucléaires, a baissé significativement les 15 dernières années, puisqu'elle est passée de 491 TBq (1990), à 204 TBq (2004). Les émissions de l'usine de retraitement du combustible nucléaire de Sellafield et de l'usine de fabrication du combustible nucléaire de Springfields constituent pour l'essentiel les rejets totaux de bêta. Conjointement, les deux installations contribuent approximativement 93 % (en 2003) de l'ensemble des rejets. Les rejets élevés, mais en décroît, de bêta total de Sellafield (2001 : 123 TBq, 2002 : 112 TBq, 2003 : 83 TBq, 2004 : 73 TBq) sont surtout imputables au radionucléide technétium 99 (2001 : 79 Tbq, 2002 : 85 TBq, 2003 : 37 TBq, 2004 : 14 TBq). La baisse des rejets de bêta total de l'usine de Sellafield, pour la période de 2001 à 2004, résulte d'une réduction des rejets de Technétium 99 de l'usine de Sellafield. On a axé les efforts de réduire les rejets de technétium 99 de l'usine de Sellafield, en orientant le technétium 99 vers la procédure de vitrification, plutôt que de rejets, et ce, depuis l'année 1994 pour le combustible oxyde et l'année 2003 pour le combustible Magnox. Les rejets de technétium 99 dans le milieu marin (plus particulièrement du traitement des rejets de Magnox stocké) ont baissé d'un coefficient de 13 entre 1994 et 2004.

Table 1 - Summary of Liquid Radioactive Discharges of Nuclear Installations, 1990 - 2004

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TOTAL ALPHA															
All Nuclear Installations (TBq)	2,43	2,43	1,83	2,88	1,36	0,68	0,57	0,38	0,43	0,42	0,33	0,41	0,61	0,62	0,54
Reprocessing Plants (TBq)	2,2	2,2	1,7	2,7	1,1	0,47	0,32	0,23	0,22	0,17	0,16	0,25	0,39	0,43	0,31
% of all installations	90,6	90,6	93,0	93,7	80,9	69,1	56,1	60,5	51,2	41,6	47,7	59,9	63,3	69,9	57,4
Nuclear Power Plants (TBq)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% of all installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear Fuel Fabrication (TBq)	0,21	0,15	0,10	0,08	0,16	0,12	0,12	0,12	0,20	0,24	0,17	0,16	0,22	0,18	0,23
% of all installations	8,6	6,2	5,4	2,8	11,8	17,6	21,1	31,6	46,5	57,7	51,7	39,7	36,3	29,9	42,5
Research & Development Facilities (TBq)	0,02	0,03	0,03	0,1	0,1	0,09	0,13	0,03	0,01	0,003	0,0019	0,0016	0,0021	0,0047	0,0005
% of all installations	0,8	1,2	1,6	3,5	7,3	13,3	22,8	7,9	2,3	0,7	0,6	0,4	0,3	0,7	0,1
TRITIUM															
All Nuclear Installations (TBq)	7224	8797	7658	10902	12931	15040	16779	17991	16240	18871	16548	15759	18880	19636	20634
Reprocessing Plants (TBq)	4959	6513	4969	7460	9770	12310	13500	14500	12800	15420	13300	12221	15220	15800	17070
% of all installations	68,6	74,0	64,9	68,4	75,6	81,9	80,5	80,6	78,8	82,1	80,4	77,5	80,6	80,5	82,7
Nuclear Power Plants (TBq)	2164	2252	2665	3354	3044	2713	3264	3440	3430	3335	3241	3543	3648	3819	3560
% of all installations	30,0	25,6	34,8	30,8	23,3	18	19,5	19,1	21,1	17,8	19,6	22,5	19,3	19,4	17,3
Nuclear Fuel Fabrication (TBq)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% of all installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Research & Development Facilities (TBq)	101	32	23,7	87,9	117,5	16,7	15	16	14	16	7	5,8	11,6	18	3,6
% of all installations	1,4	0,4	0,3	0,8	0,9	0,1	0,09	0,1	0,1	0,1	0,04	0,04	0,06	0,09	0,02
TOTAL BETA (OTHER RADIO-NUCLIDES EXCLUDING TRITIUM)															
All Nuclear Installations (TBq)	491	227	269	252	321	365	332	315	265	256	173	231	235	198	204
Reprocessing Plants (TBq)	384	178	134	170	195	243	169	167	112	126	98	141	125	97,3	86,4
% of all installations	78,3	78,4	49,8	67,4	60,8	66,5	50,9	53,0	42,4	49,1	57,5	61,2	53,1	49,0	42,4
Nuclear Power Plants (TBq)	10,3	3,8	8,8	11,1	2,8	3,4	5,2	7,4	2,0	2,0	3,0	4,2	3,6	3,2	1,3
% of all installations	2,1	1,7	3,3	4,4	0,9	0,9	1,6	2,3	0,8	0,7	1,7	1,8	1,5	1,6	0,6
Nuclear Fuel Fabrication (TBq)	92	38,9	120	63	114	112	150	140	150	128	71	85	106	97	116
% of all installations	18,7	17,1	44,6	25	35,5	30,7	45,1	44,4	56,6	50,0	41,6	36,8	45,1	49,1	56,8
Research & Development Facilities (TBq)	4,5	6,3	6,6	8,2	9,1	7,0	8,1	1	0,66	0,36	0,30	0,46	0,46	0,44	0,47
% of all installations	0,9	2,8	2,4	3,2	2,8	1,9	2,4	0,3	0,2	0,1	0,2	0,2	0,2	0,3	0,2

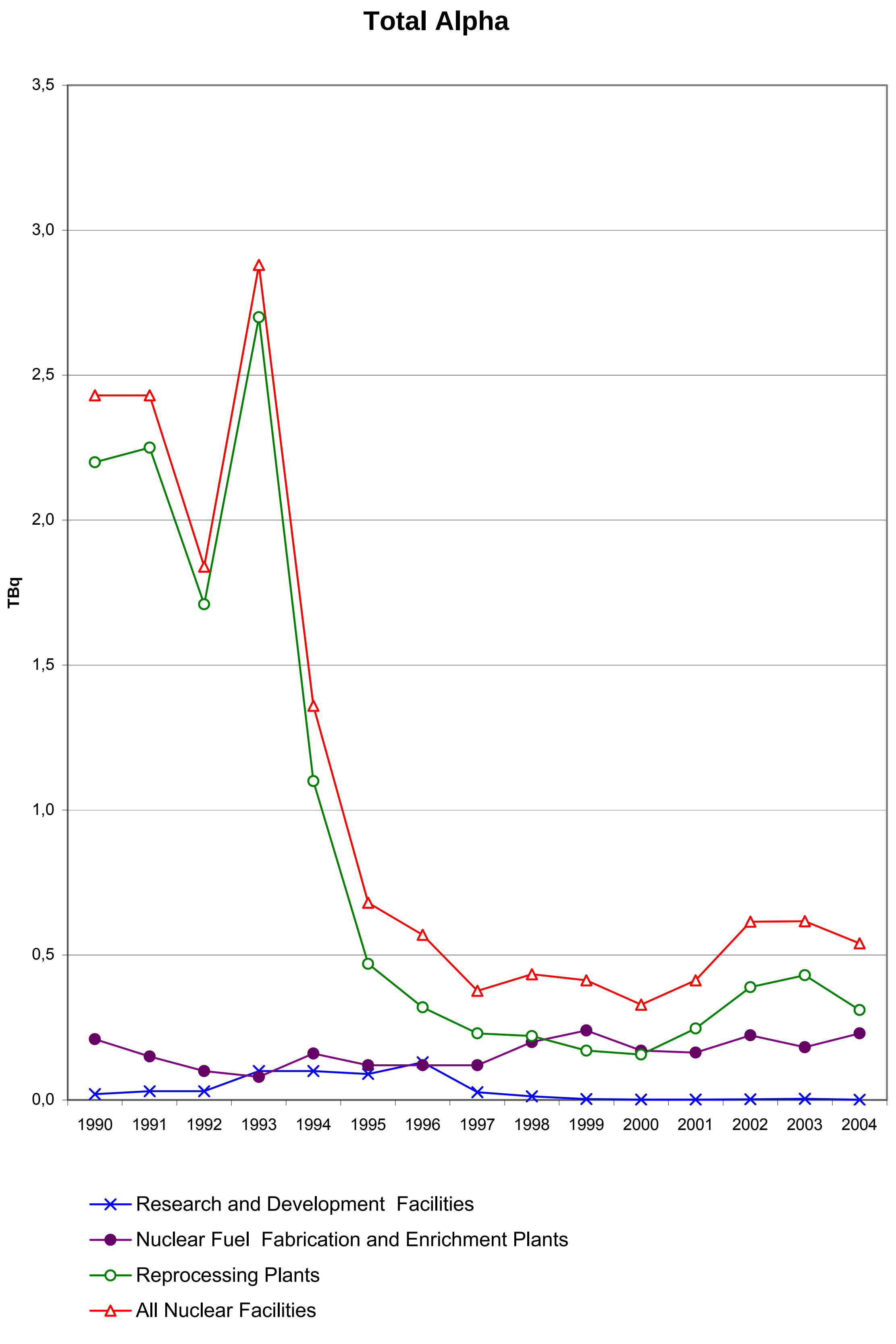

Figure 1 Annual releases of Total Alpha in liquid discharges from all nuclear installations in member states of Oslo and Paris Conventions, 1990 – 2004

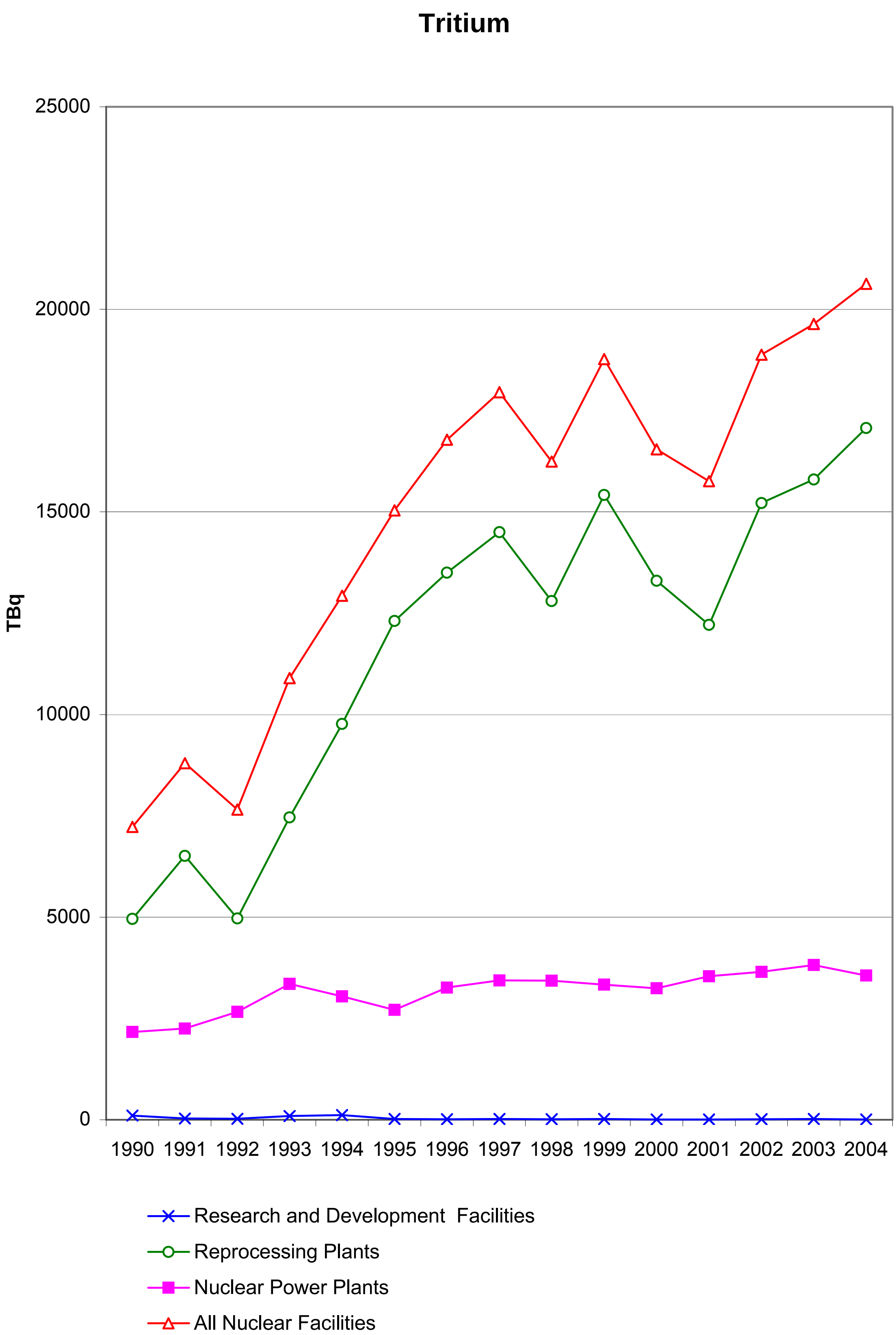

Figure 2 Annual releases of Tritium in liquid discharges from all nuclear installations in member states of Oslo and Paris Conventions, 1990 – 2004

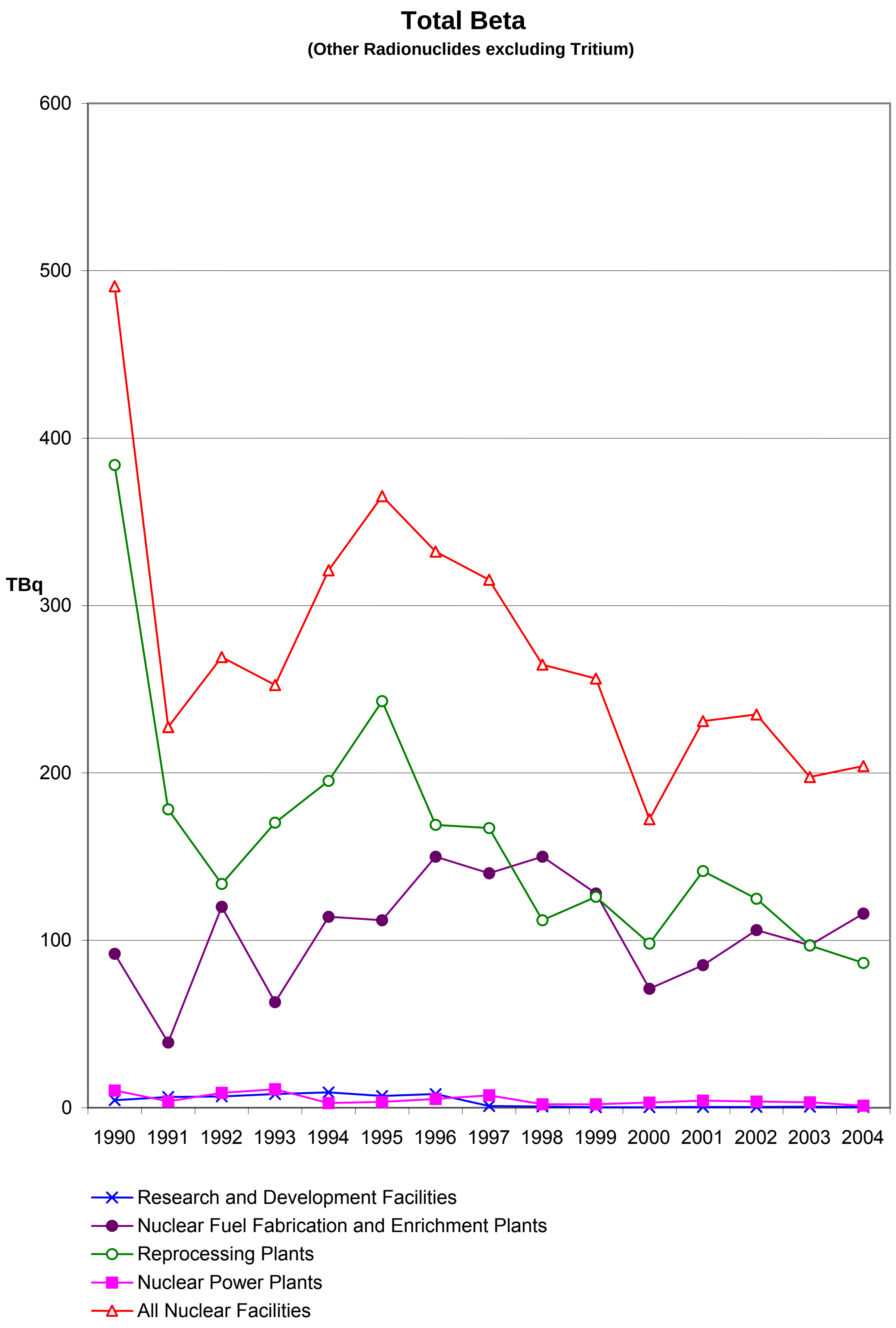

Figure 3 Annual releases of Total Beta in liquid discharges from all nuclear installations in member states of Oslo and Paris Conventions, 1990 - 2004

3. 2004 Data and Information

In this chapter of the report, data and information on liquid discharges is presented for each Contracting Party under the following categories of nuclear installations draining into the OSPAR maritime area:

Table 2: Nuclear Power Stations;

Table 3: Nuclear Fuel reprocessing Plants;

Table 4: Nuclear Fuel Fabrication and Enrichment Plants;

Table 5: Research and Development Facilities.

Further detailed information with respect to individual plants is presented in endnotes after the entire set of tables.

The columns, headings and abbreviations used in the tables correspond to the reporting requirements set out in the current reporting format. The following abbreviations are used in the tables:

AGR: Advanced Gas Cooled Reactor;

GCR: Gas Cooled Reactor;

UNGG: Natural Uranium Gas Graphite (French equivalent for GCR);

PWR: Pressurised Water Reactor;

THTR: Thorium High Temperature Reactor;

BWR: Boiling Water Reactor;

NA: Not applicable;

NI: No information;

ND: Not detectable.

For radionuclides:

Ag:	Silver	Gd:	Gadolinium	Rh:	Rhodium
Am:	Americum	I:	Iodine	Ru:	Ruthenium
Ba:	Barium	Mn:	Manganese	S:	Sulphur
Be:	Beryllium	Na:	Sodium	Sb:	Antimony
C:	Carbon	Nb:	Niobium	Se:	Selenium
Ce:	Cerium	Ni:	Nickel	Sr:	Strontium
Cm:	Curium	Np:	Neptunium	Tc:	Technetium
Co:	Cobalt	Pm:	Promethium	Th:	Thorium
Cr:	Chromium	Pr:	Praseodymium	U:	Uranium
Cs:	Caesium	Pu:	Plutonium	Y:	Yttrium
Eu:	Europium	Ra:	Radium	Zn:	Zinc
Fe:	Iron	Rb:	Rubidium	Zr:	Zirconium

All data on discharge limits and releases of radionuclides have been entered in the tables using continental decimal system. The data values are expressed in scientific number format, e.g. 0,0009 as 9,0E-04.

3.1 Locations of nuclear installations

The location and type of each installation listed in the table below is identified in the map that follows the table.

Country / Code	Name installation	Type	Discharging into
Belgium			
B1	Doel	NPS	Schelde
B2	Tihange	NPS	Meuse
B3	Mol	RDF	River Mol-Neet
Denmark			
DK1	Risø	RDF	Kattegat through Roskilde Fjord
France			
F1	Belleville	NPS	Loire
F2	Cattenom	NPS	Mosel
F3	Chinon	NPS	Loire
F4	Chooz	NPS	Meuse
F5	Civaux	NPS	Vienne
F6	Dampierre en-Burly	NPS	Loire
F7	Fessenheim	NPS	Rhine
F8	Flamanville	NPS	Channel
F9	Fontenay-aux- Roses	RDF	Seine
F10	Golfech	NPS	Garonne
F11	Gravelines	NPS	North Sea
F12	Le Blayais	NPS	Gironde Estuary
F13	La Hague	NFRP	English Channel
F14	Nogent-sur-Seine	NPS	Seine
F15	Paluel	NPS	Channel
F16	Penly	NPS	Channel
F17	Saclay	RDF	Etang de Saclay
F18	Saint Laurent		Loire
Germany			
D1	Biblis A/Biblis B	NPS	Rhine
D2	Brokdorf	NPS	Elbe
D3	Brunsbüttel	NPS	Elbe
D4	Grafenrheinfeld	NPS	Main
D5	Grohnde/Emmerthal	NPS	Weser
D6	Hamm-Uentrop	NPS	Lippe
D7	Kahl	NPS	Main
D8	Krümmel/Geesthacht	NPS	Elbe
D8	Geesthacht	RDF	Elbe
D9	Lingen/Emsland	NPS	Ems
D9	Lingen	NFFEP	Ems - via municipal sewer system
D10	Mülheim-Kärlich	NPS	Rhine
D11	Neckar- westheim 1/Neckar-wesheim 2	NPS	Neckar
D12	Obrigheim	NPS	Neckar
D13	Philippsburg KKP1/ Philippsburg KKP2	NPS	Rhine
D14	Rheinsberg	NPS	Havel
D15	Stade	NPS	Elbe
D16	Rodenkirchen-Unterweser	NPS	Weser
D17	Würgassen/Beverungen	NPS	Weser
D18	Karlsruhe	RDF	Rhine
D19	Gronau	NFFEP	Vechte, IJsselmeer

Country / Code	**Name installation**	**Type**	**Discharging into**
D20	Hanau	NFFEP	Main - via municipal sewer system
D21[6]	Karlstein	NFFEP	Main - via municipal sewer system
D22	HMI Berlin	RDF	Havel
D23	Jülich	RDF	Rur
D24	Rossendorf	RDF	Elbe
The Netherlands			
NL1	Borssele	NPS	Scheldt Estuary
NL2	Doodewaard	NPS	Waal
NL3	Almelo	NFFEP	Municipal sewer system
NL4	Delft	RDF	Sewage system
NL5	Petten	RDF	North Sea
Norway			
N1	Halden	RDF	River Tista (Skagerrak)
N2	Kjeller	RDF	River Nitelva (Skagerrak)
Portugal			
P1	Campus de Sacavém	RDF	Tagus River
Spain			
E1	Almaraz	NPS	Tagus
E2	José Cabrera	NPS	Tagus
E3	Trillo	NPS	Tagus
E4	Juzbado	NFFEP	River Tormes - Duero
Sweden			
S1	Barsebäck	NPS	Öresund
S2	Ringhals 1-4	NPS	Kattegat
Switzerland			
CH1	Beznau	NPS	Aare
CH2	Gösgen	NPS	Aare
CH3	Leibstadt	NPS	Rhine
CH4	Mühleberg	NPS	Aare
CH5	Paul Scherrer Institute	RDF	Aare
United Kingdom			
GB1	Berkeley	NPS	Severn Estuary
GB2	Bradwell	NPS	North Sea
GB3	Calder Hall	NPS	Irish Sea
GB4	Chapelcross	NPS	Solway Firth
GB5	Dungeness A/Dungeness B	NPS	English Channel
GB6	Hartlepool	NPS	North Sea
GB7	Heysham 1 / Heysham 2	NPS	Morecambe Bay
GB8	Hinkley Point A/Hinkley Point B	NPS	Severn Estuary
GB9	Hunterston A/Hunterston B	NPS	Firth of Clyde
GB10	Oldbury	NPS	Severn Estuary
GB11	Sizewell A/Sizewell B	NPS	North Sea
GB12	Torness	NPS	North Sea
GB13	Trawsfynydd	NPS	Trawsfynydd lake

6 D21, the installation in Karlstein, was shut down in 1994. There is no radioactive waste water and therefore no discharges since 1995.

Country / Code	Name installation	Type	Discharging into
GB14	Wylfa	NPS	Irish Sea
GB15	Sellafield	NFRP	Irish Sea
GB16	Capenhurst	NFFEP	Irish Sea via Rivacre Brook and Mersey Estuary
GB17	Springfields	NFFEP	Irish Sea via River Ribble
GB18	Dounreay	RDF	Pentland Firth
GB19	Harwell	RDF	River Thames
GB20	Winfrith	RDF	Weymouth Bay (English Channel)

NPS: Nuclear Power Stations
RDF: Research and Development Facilities
NFRP: Nuclear Fuel Reprocessing Plants
NFFEP: Nuclear Fuel Fabrication and Enrichment Plants

3.2 Map of nuclear installations

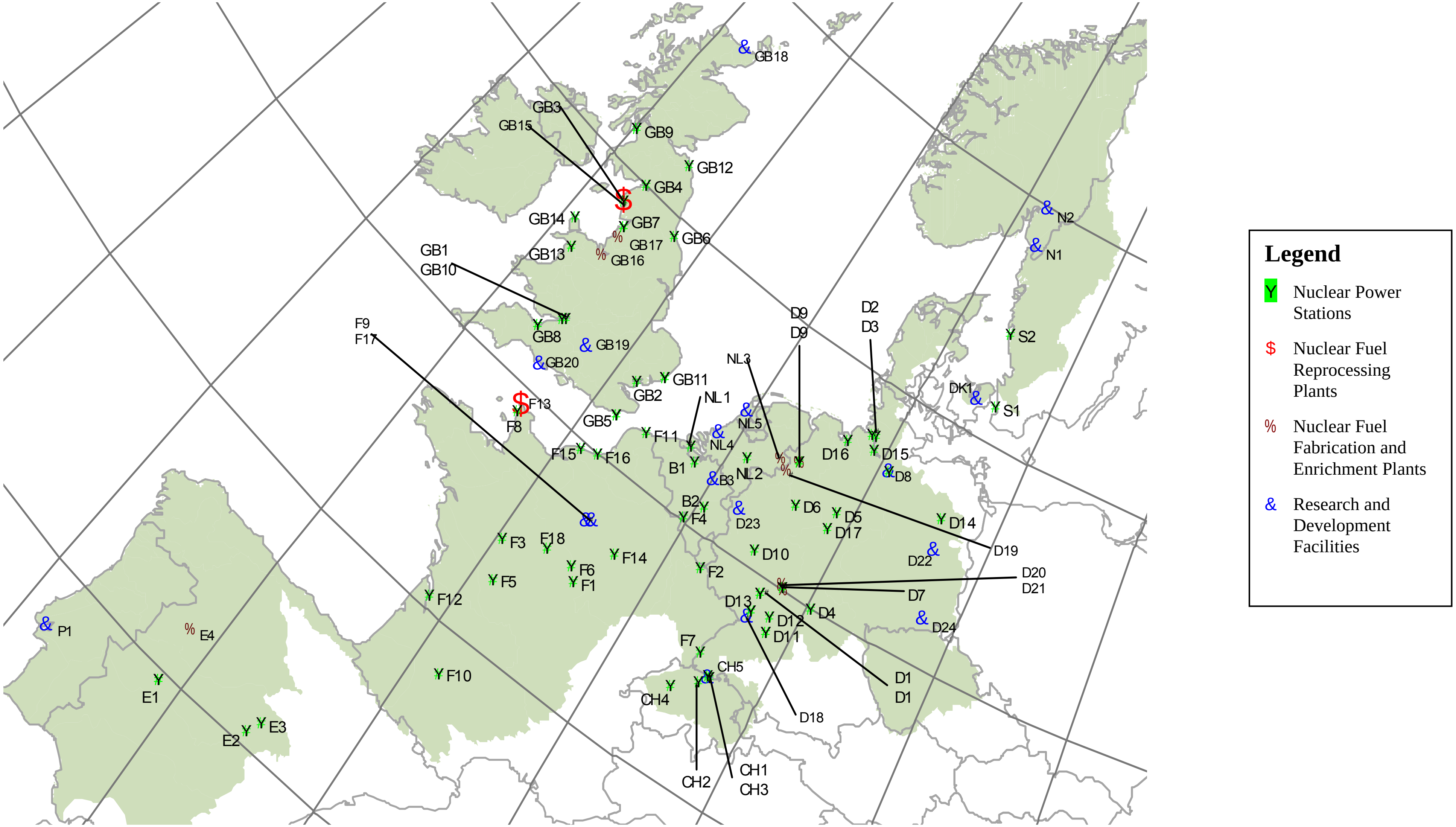

Table 2 Nuclear Power Stations

Map Ref.	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW (e) 2004	Net Electrical Out-put MW (e) a 2004	Discharge limits (upper row value) and releases (lower row value) of radioactive substances (1) in 2004 (TBq)														
								Specific radionuclides												
						Tritium	other (2) (3) radio-	gross (2) a-activity	gross (2) b-activity	Co 58	Co 60	Zn 65	Sr 90	Zr/Nb 95	Ru 106	Ag 110m	Sb 125	Cs 134	Cs 137	Ce 144
	Belgium																			
B1	Doel	Schelde	4 PWR	393 / 433	341,0	4,21E+1	5,22E-3	0,00E+0	0,00E+0	3,85E-4	2,17E-4	0,00E+0	0,00E+0	0,00E+0	0,00E+0	1,31E-3	1,14E-3	5,80E-5	1,40E-3	0,00E+0
				1006 / 985	336									0,00E+0						
					910															
					856															
B2	Tihange	Meuse	3 PWR	962 / 1008	806	4,55E+1	3,13E-2	5,13E-9	0,00E+0	1,07E-2	8,33E-3	0,00E+0	0,00E+0	1,57E-4	0,00E+0	1,44E-3	1,95E-3	2,08E-3	2,10E-3	1,50E-6
				1015	971									3,71E-4						
					904															
	France (4)				**38 093 Mwe.an**															
F1	Belleville-	Loire	2 PWR	2600		6,00E+1	2,51E-2													
	sur-Loire					5,58E+1	3,92E-4				1,08E-4	1,02E-4					1,90E-5	5,10E-5	2,00E-5	2,40E-5
F2	Cattenom	Mosel	4 PWR	5200		1,40E+2	5,02E-2													
						1,00E+2	1,13E-3				1,56E-4	4,31E-4					3,64E-5	9,53E-5	9,40E-5	1,19E-4
F3	Chinon	Loire	4 PWR	3600		8,00E+1	6,06E-2													
						3,86E+1	9,06E-4				1,39E-4	2,59E-4					9,28E-5	1,37E-4	2,65E-5	6,86E-5
F4	Chooz (5)	Meuse	2 PWR	2900		8,00E+1	2,22E-1													
						4,83E+1	6,39E-4				3,87E-5	1,49E-4					2,60E-4	6,31E-5	2,06E-5	2,42E-5
F5	Civaux	Vienne	2 PWR	2900		8,00E+1	2,22E-1													
						3,20E+1	8,52E-4				1,68E-4	1,87E-4					3,03E-4	4,82E-5	1,30E-5	1,84E-5
F6	Dampierre-	Loire	4 PWR	3600		1,10E+2	1,48E+0													
	en-Burly					4,53E+1	6,97E-4				2,32E-4	1,03E-4					1,06E-4	5,88E-5	3,55E-5	5,96E-5
F7	Fessenheim	Rhine	2 PWR	1800		7,50E+1	9,25E-1													
						2,29E+1	1,03E-3				4,81E-4	4,48E-5					3,43E-4	7,24E-5	9,18E-6	2,41E-5
F8	Flamanville	North Sea	2 PWR	2600		6,00E+1	2,51E-2													
		(Channel)				5,79E+1	5,97E-4				1,01E-4	2,36E-4					7,66E-5	7,40E-5	1,49E-5	2,33E-5
F10	Golfech (6)	Garonne	2 PWR	2600		8,00E+1	1,10E+0													
						5,91E+1	7,28E-4				1,24E-4	2,06E-4					3,29E-5	1,24E-4	3,74E-5	7,86E-5
F11	Gravelines	North Sea	6 PWR	5400		1,20E+2	9,09E-2													
						4,66E+1	1,98E-3				2,53E-4	7,27E-4					2,26E-4	1,90E-4	8,70E-5	1,09E-4
F12	Le Blayais	Gironde	4 PWR	3600		8,00E+1	6,06E-2													
		Estuary				4,47E+1	1,41E-3				4,04E-4	2,28E-4					4,16E-4	6,96E-5	1,97E-5	9,11E-5

Map Ref.	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW (e) 2004	Net Electrical Out-put MW (e) a 2004	Discharge limits (upper row value) and releases (lower row value) of radioactive substances (1) in 2004 (TBq)														
								Specific radionuclides												
						Tritium	other (2) (3) radio-	gross (2) a-activity	gross (2) b-activity	Co 58	Co 60	Zn 65	Sr 90	Zr/Nb 95	Ru 106	Ag 110m	Sb 125	Cs 134	Cs 137	Ce 144
F14	Nogent-	Seine	2 PWR	2600		8,00E+1	1,10E+0													
	sur-Seine					5,56E+1	8,61E-4				5,13E-4	9,01E-5					1,47E-5	5,07E-5	2,77E-5	3,35E-5
F15	Paluel	North Sea	4 PWR	5200		1,20E+2	5,02E-2													
		(Channel)				9,72E+1	3,24E-3				9,99E-4	1,05E-3					4,32E-4	1,88E-4	8,12E-5	1,16E-4
F16	Penly	North Sea	2 PWR	2600		8,00E+1	1,10E+0													
		(Channel)				2,90E+1	1,31E-3				1,98E-4	6,05E-4					8,74E-5	5,60E-5	6,00E-5	1,23E-4
F18	Saint Laurent	Loire	2 PWR	1800		4,50E+1	3,03E-2													
	des Eaux (7)					2,59E+1	3,32E-4				4,00E-5	7,80E-5					7,50E-5	3,75E-5	1,49E-5	2,42E-5
	Federal Republic of Germany																			
D1	Biblis A	Rhine	1 PWR	1225		3,00E+1	1,10E-1													
						1,72E+1	5,09E-5			3,68E-7	2,19E-5					3,71E-7	5,91E-6		2,69E-6	
D1	Biblis B	Rhine	1 PWR	1300		3,00E+1	1,10E-1													
						1,06E+1	8,46E-5			5,41E-6	1,72E-5					2,15E-6	1,24E-5		2,25E-6	
D2	Brokdorf	Elbe	1 PWR	1440		3,50E+1	5,50E-2													
						1,55E+1	1,99E-7				1,36E-7								6,30E-8	
D3	Brunsbüttel	Elbe	1 BWR	806		3,70E+1	1,90E-1													
						4,39E-1	2,12E-4			1,84E-6	4,23E-5	1,88E-5	1,20E-7					2,95E-8	1,22E-5	
D4	Grafenrheinfeld	Main	1 PWR	1345		4,10E+1	5,50E-2													
						1,70E+1	4,86E-5			6,08E-6	2,88E-5			2,56E-6		6,65E-7		2,85E-7	1,46E-6	
D5	Grohnde/	Weser	1 PWR	1430		4,80E+1	5,50E-2													
	Emmerthal					2,24E+1	6,84E-6				4,40E-6					2,60E-7			3,25E-8	
D6	Hamm-	Lippe	1 THTR	296	(8)	3,70E+1	1,90E-2													
	Uentrop																			
D7	Kahl	Main	1 BWR	16	(9)	1,50E-1	4,40E-2													
						7,64E-6	3,15E-6	4,53E-8			4,87E-7								1,74E-7	
D8	Krümmel/	Elbe	1 BWR	1316		1,90E+1	5,00E-2													
	Geesthacht					5,60E-1	5,27E-7				5,27E-7									
D9	Lingen/	Ems	1 PWR	1363		3,50E+1	3,70E-2													
	Emsland					1,80E+1	6,00E-9													
D9	Lingen	Ems	1 BWR	268	(10)	2,50E-2	2,50E-5													
						3,68E-6	5,11E-7	9,26E-9			1,94E-7								2,28E-7	
D10	Mülheim-	Rhine	1 PWR	1302	(9)	5,00E+1	6,00E-2													
	Kärlich					7,29E-3	1,89E-5				1,10E-5									

Map Ref.	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW (e) 2004	Net Electrical Out-put MW (e) a 2004	Discharge limits (upper row value) and releases (lower row value) of radioactive substances (1) in 2004 (TBq)														
								Specific radionuclides												
						Tritium	other (2) (3) radio-	gross (2) a-activity	gross (2) b-activity	Co 58	Co 60	Zn 65	Sr 90	Zr/Nb 95	Ru 106	Ag 110m	Sb 125	Cs 134	Cs 137	Ce 144
D11	Neckar-	Neckar	1 PWR	840		1,90E+1	1,90E-2													
	westheim 1					7,44E+0														
D11	Neckar-	Neckar	1 PWR	1365		7,00E+1	6,00E-2													
	westheim 2					1,77E+1	8,17E-8				8,17E-8									
D12	Obrigheim	Neckar	1 PWR	357		1,90E+1	1,90E-1													
						6,27E+0	9,24E-5			4,53E-5	1,03E-5	1,92E-7				5,65E-6		4,84E-7	2,83E-6	
D13	Philippsburg	Rhine	1 BWR	926		1,90E+1	1,50E-1													
	KKP1					4,56E-1	1,44E-4			6,30E-8	3,51E-5	2,60E-5				9,50E-7	1,80E-7	7,50E-7	3,13E-6	
D13	Philippsburg	Rhine	1 PWR	1424		4,80E+1	1,50E-1													
	KKP2					1,46E+1	4,88E-5			2,84E-7	7,86E-6	2,70E-7		3,90E-8		5,37E-7	7,00E-7	2,64E-6	1,86E-5	
D14	Rheinsberg	Havel	1 PWR	70	(11)	2,00E+0	2,00E-3													
						4,20E-3	7,77E-6	2,25E-7			9,42E-7		2,35E-7						1,58E-6	
D15	Stade	Elbe	1 PWR	672		4,80E+1	1,90E-1													
						1,38E+1	4,85E-5	1,88E-8		5,35E-8	2,42E-5					4,80E-6			1,19E-6	
D16	Rodenkirchen-	Weser	1 PWR	1350		3,50E+1	7,40E-2													
	Unterweser					1,45E+1	2,27E-4			1,37E-5	1,29E-4			4,23E-7			1,56E-6		2,05E-6	
D17	Würgassen	Weser	1 BWR	640	(12)	1,00E+1	6,00E-2													
	/Beverungen					2,83E-2	3,53E-5	3,33E-7			1,50E-5		7,83E-7						1,95E-5	
	The Netherlands																			
NL1	Borssele	Scheldt	1 PWR	485	402	3,00E+1	0,2(13)	2,00E-4												
		Estuary				7,34E+0	2,91E-4	1,60E-7	NI	1,50E-5	9,20E-5	NI	2,50E-6	1,20E-5	6,30E-7	7,20E-6	4,40E-7	9,30E-6	1,90E-5	2,50E-6
NL2	Doodewaard	Waal	1 BWR	58	(14)	2,00E+0	0,1(15)	5,00E-5												
						1,00E-2	5,00E-3	9,00E-8	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
	Spain																			
E1	Almaraz	Tagus	2 PWR			(16)	(16,17)													
				1957 (18)	1 797,8	4,42E+1	2,17E-3	ND	NI	3,05E-4	8,50E-4	ND	5,26E-7	1,03E-4	ND	1,11E-4	2,31E-4	2,65E-5	3,15E-4	ND
E2	José	Tagus	1 PWR			(16)	(16,17)													
	Cabrera			150.05 (19)	133,89	2,96E+0	3,61E-5	ND	NI	2,42E-5	1,14E-5	ND	ND	ND	ND	ND	ND	ND	5,73E-7	ND
E3	Trillo	Tagus	1 PWR			(16)	(16,17)													
				1 066	910,97	2,85E+1	3,56E-4	ND	NI	2,65E-5	1,30E-4	ND	ND	5,27E-5	ND	4,55E-5	5,25E-6	8,80E-8	3,90E-5	ND

Map Ref.	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW (e) 2004	Net Electrical Out-put MW (e) a 2004	Discharge limits (upper row value) and releases (lower row value) of radioactive substances (1) in 2004 (TBq)														
								Specific radionuclides												
						Tritium	other (2) (3) radio-	gross (2) a-activity	gross (2) b-activity	Co 58	Co 60	Zn 65	Sr 90	Zr/Nb 95	Ru 106	Ag 110m	Sb 125	Cs 134	Cs 137	Ce 144
	Sweden																			
S1	Barsebäck	Öresund	1 BWR	600	217	(21)	(22, 23)													
	(20)					3,22E-1	1,05E-2			1,50E-3	5,00E-3	1,50E-4	1,10E-6	1,40E-4		9,70E-6	9,40E-5	8,10E-6	1,00E-4	
S2	Ringhals 1-4	Kattegat	BWR	830	692	(21)	(22, 24)													
						7,10E-1	1,33E-2	4,60E-6		1,60E-3	3,50E-3	1,50E-5	2,90E-6	1,60E-4		4,10E-4	1,30E-4	1,50E-5	6,20E-4	
			PWR	875	660	(21)	(22, 25)													
						1,20E+1	3,23E-3	3,10E-6		2,60E-4	1,40E-4		9,10E-7	7,40E-5		6,60E-4	4,50E-4		1,60E-5	1,40E-6
			PWR	915	820	(21)	(22, 26)													
						1,40E+1	1,29E-3	2,00E-7		4,90E-4	1,50E-4	2,10E-6	2,10E-7	8,50E-5		9,50E-5	4,00E-5	2,10E-6	7,60E-6	
			PWR	915	814		(22, 27)													
						1,40E+1	4,52E-3	3,60E-8		3,80E-3	1,20E-4		3,60E-7	1,40E-4		6,80E-6	4,30E-6	2,40E-5	5,50E-5	
	Switzerland																			
CH1	Beznau	Aare	2 PWR	380/380	320/354	7,00E+1	4,00E-1													
						1,10E+1	1,20E-2			1,00E-2	6,30E-4		7,20E-6	1,40E-5		4,40E-5	1,90E-4	1,90E-6	1,40E-4	1,20E-6
CH2	Gösgen	Aare	1 PWR	1015	920	7,00E+1	2,00E-1													
						1,40E+1	4,80E-6	3,10E-8			2,70E-6			2,40E-7						
CH3	Leibstadt	Rhine	1 BWR	1200	990	2,00E+1	4,00E-1													
						1,90E+0	1,90E-4	4,60E-7		8,30E-6	1,00E-4							1,20E-5	1,50E-5	
CH4	Mühleberg	Aare	1 BWR	372	330	2,00E+1	4,00E-1													
						1,50E-1	5,40E-3	1,90E-7		5,50E-4	2,20E-3	2,10E-4	2,00E-5	7,30E-6				2,30E-6	3,80E-4	
	United Kingdom																			
GB1	Berkeley (28)	Severn	2 GCR	0	(29)	2,00E+0	4,00E-1												2,00E-1	
		Estuary				3,00E-4	1,10E-4												1,35E-4	
GB2	Bradwell (28)	North Sea	2 GCR	0	(30)	7,00E+0	7,00E-1												7,00E-1	
						1,82E-1	2,73E-1												3,78E-1	
GB3	Calder Hall (31)	Irish Sea	4 GCR	198	(32)															
GB4	Chapelcross	Solway Firth	4 GCR	192	(33)	5,50E+0	(34)	1,00E-1	2,50E+1											
						7,97E-2		3,20E-5	3,89E-2											
GB5	Dungeness A	English	2 GCR	440	328	8,00E+0	8,00E-1												1,10E+0	
	(28)	Channel				2,78E-1	1,01E-1												1,75E-1	
GB5	Dungeness B	English	2 AGR	1110	751	6,50E+2	2,50E-1				3,00E-2									
	(35)	Channel				4,07E+2	2,76E-2				1,50E-3									

Map Ref.	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW (e) 2004	Net Electrical Out-put MW (e) a 2004	Discharge limits (upper row value) and releases (lower row value) of radioactive substances (1) in 2004 (TBq)		Specific radionuclides												
						Tritium	other (2) (3) radio-	gross (2) a-activity	gross (2) b-activity	Co 58	Co 60	Zn 65	Sr 90	Zr/Nb 95	Ru 106	Ag 110m	Sb 125	Cs 134	Cs 137	Ce 144
GB6	Hartlepool (36)	North Sea	2 AGR	1210	603	1,20E+3	3,00E-1				3,00E-2									
						2,29E+2	1,48E-2				1,40E-3									
GB7	Heysham 1	Morecambe	2 AGR	1150	520	1,20E+3	3,00E-1				3,00E-2									
	(37)	Bay				2,24E+2	1,99E-2				2,96E-4									
GB7	Heysham 2 (38)	Morecambe	2 AGR	1250	954	1,20E+3	3,00E-1				3,00E-2									
		Bay				3,03E+2	2,53E-2				4,63E-4									
GB8	Hinkley Point A	Severn	2 GCR	0	(39)	1,80E+0	7,00E-1												1,00E+0	
	(28)	Estuary				4,17E-1	8,01E-2												2,74E-1	
GB8	Hinkley Point B	Severn	2 AGR	1220	996	6,20E+2	2,35E-1				3,30E-2									
	(40)	Estuary				4,16E+2	1,55E-2				2,38E-4									
GB9	Hunterston A	Firth of	2 CGR	0	(41)	7,00E-1	(42)	4,00E-2	6,00E-1											
		Clyde				6,73E-4		1,52E-4	6,34E-2											
GB9	Hunterston B	Firth of	2 AGR	1150	1007	8,00E+2	(43)	1,00E-3	4,50E-1		3,00E-2									
		Clyde				4,66E+2		1,61E-4	1,55E-2		7,30E-4									
GB10	Oldbury (28)	Severn	2 GCR	434	276	1,00E+0	7,00E-1												7,00E-1	
		Estuary				2,48E-1	2,14E-1												3,92E-1	
GB11	Sizewell A (28)	North Sea	2 GCR	420	259	1,10E+1	7,00E-1												1,00E+0	
						7,79E-1	3,51E-1												6,07E-1	
GB11	Sizewell B	North Sea	1 PWR	1175	1065	8,00E+1	2,00E-1													
						1,76E+1	2,03E-2													
GB12	Torness	North Sea	2 AGR	1264	913	8,00E+2	(43)	1,00E-3	4,50E-1		3,00E-2									
						3,31E+2		2,10E-5	2,89E-3		2,51E-4									
GB13	Trawsfynydd	Trawsfynydd	2 GCR	0	(44)	5,00E-1	1,70E-1						5,00E-2						3,00E-2	
	(28)	lake				2,49E-2	1,06E-2						3,37E-3						1,95E-3	
GB14	Wylfa (28)	Irish Sea	2 GCR	950	843	1,50E+1	1,10E-1													
						6,10E+0	3,90E-2													

Table 3 Nuclear Fuel Reprocessing Plants

Location (Map Ref.)	La Hague (F 13)			Sellafield (GB 15)	
Discharges to	English Channel			Irish Sea	
Type of Fuel Reprocessed Capacity (t/y)	PWR + BWR 1700 t/y			Magnox, AGR, LWR 1750 te/yr Magnox 1200 te/yr U oxide	
Radionuclide	Discharge Limit in TBq per annum (1)	TBq released per annum	Normed releases in TBq per GWye (39,2 GWye in 2004)	Discharge Limit in TBq per annum (2, 3)	TBq released in 2004 (3)
Tritium	1,85E+4	1,39E+4		2,50E+4	3,17E+3
Total-a	1,70E-1	1,74E-2	4,43E-4	1,00E+0	2,91E-1
Total-b		1,31E+1	3,34E-1	4,00E+2	7,33E+1
C 14	4,20E+1	8,90E+0		2,08E+1	1,63E+1
S 35					
Mn 54		1,22E-2			
Fe 55					
Co 57		3,94E-4			
Co 58		9,85E-4			
Co 60	1,50E+0	2,56E-1		1,30E+1	7,75E-1
Ni 63		3,92E-2			
Zn 65		3,50E-5			
Sr 89		ND			
Sr 90	1,20E+1	1,38E-1		4,80E+1	1,80E+1
(Sr 90 + Cs 137)					
(Zr + Nb 95)		ND		9,00E+0	2,31E-1
Tc 99		7,93E-2		9,00E+1	1,43E+1
Ru 103		ND			
Ru 106	1,50E+1	6,45E+0		6,30E+1	4,42E+0
(Ru + Rh) 106		1,29E+1			
Ag 110m		ND			
Sb 124		ND			
Sb 125		1,57E-1			
I 129		1,37E+0		1,60E+0	6,50E-1
Cs 134	2,00E+0	6,41E-2		6,60E+0	4,01E-1
Cs 137	8,00E+0	7,87E-1		7,50E+1	9,67E+0
Ce 144				8,00E+0	8,19E-1
(Ce + Pr) 144		1,56E-3			
Pm 147		ND			
Eu 152		ND			
Eu 154		7,13E-4			
Eu 155		2,62E-4			
Np 237		ND			
Plutonium-a		6,21E-3		7,00E-1	2,92E-1
Pu 241		1,27E-1		2,70E+1	8,10E+0
Am 241		2,50E-3		3,00E-1	3,72E-2
Cm 242		1,58E-5			
Cm 243+244		1,07E-3			
Uranium (in kg for UK data only)		1,74E-3		2,04E+3	4,36E+2

ND: not detectable

Table 4 Nuclear Fuel Fabrication and Enrichment Plants

Map Ref.	Country/ site	Discharges to	Type of Fuel	Capacity (t/y)	Production	Activity	Discharge limit in TBq per annum	TBq released in 2004
	Federal Republic of Germany							
D9	Lingen	Ems - via municipal sewer system	LWR	400		Uranium	350g uranium	not detectable
D19	Gronau	Vechte, IJsselmeer	Uranium enrichment	760		total - α	7,40E-7	1,40E-9
D20	Hanau	Main - via municipal sewer system	PWR, MOX	1350		total - α	1,50E-2	8,40E-6
	Netherlands							
NL3	Almelo	Municipal sewer system	Uranium enrichment	2800	2352	total - α	2,00E-5	2,10E-6
						β- & γ- emitting radionuc.	2,00E-4	7,10E-6
	Spain							
E4	Juzbado	River Tormes - Duero	PWR, BWR	500	313,8	total - α	1,20E-2	1,75E-5
	United Kingdom							
GB16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment	NI		Uranium - α	2,00E-2	4,00E-4
						Uranium daughters	2,00E-2	5,55E-4
						other - α	3,00E-3	1,20E-5
						Tc 99	1,00E-1	3,80E-4
GB17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication	10000 te/yr as UOC		total - α	4,00E+0	2,27E-1
						total - β	2,40E+2	1,16E+2
						Tc 99	6,00E-1	1,22E-1
						Th 230	2,00E+0	1,06E-1
						Th 232	2,00E-1	<1,06E-3
						Uranium α	1,50E-1	4,61E-2
						Np 237	4,00E-2	1,70E-3

Table 5 Research and Development Facilities

Map Ref.	Country/ site	Discharges to	Reactors Number & Type	Installed Capacity	Radionuclides	Discharge limit in TBq per annum	TBq released per annum in 2004
	Belgium						
B3	Mol	River Mol-Neet	1	40MW (th)	weighted activity	1,99E+0	5,59E-2
	Denmark						
DK1	Risø	Kattegat through Roskilde Fjord	No reactors		Tritium	(1)(2)(3)	2,90E-1
					Gross beta	(1)(2)(3)	1,10E-4
	France						
F9	Fontenay-aux-Roses	Seine	Centre de recherches du Commissariat à l'énergie atomique		α	1,00E-3	4,34E-6
					β (other than tritium)	4,00E-2	5,00E-6
					Tritium	2,00E-1	6,20E-6
F17	Saclay	Etang de Saclay	Centre de recherches du Commissariat à l'énergie atomique		α	7,40E-4	<1,03E-4
					β (other than tritium)	3,70E-2	8,53E-4
					Tritium	7,40E+0	4,09E-2
	Germany						
D8	Geesthacht	Elbe	1	5 MW	Tritium	5,60E-2	1,60E-4
					other radionuclides	1,90E-2	2,20E-4
D18	Karlsruhe	Rhine	No reactors	None	Tritium	1,50E+2	9,30E-1
					other radionuclides	3,20E-1	1,90E-5
D22	HMI Berlin	Havel	1	10 MW	Tritium	-	6,60E-4
					other radionuclides	-	1,20E-6
D23	Jülich	Rur	1	23 MW	Tritium	1,10E+1	4,20E-1
					other radionuclides	7,60E-3	1,20E-4
D24	Rossendorf	Elbe	No reactors	None	Tritium	4,00E-1	1,50E-1
					other radionuclides	2,30E-4	9,30E-6
	Netherlands						
NL4	Delft (4)	Sewage system	1	6 MW (th)	α - emitting radionuclides		< 1,70E-7
					β - emitting radionuclides		5,98E-6
					γ - emitting radionuclides		< 3,00E-6
					total	20 gew Re,ing (4+5)	
NL5	Petten (6)	North Sea	1 HFR for material testing	60 MW (th)	Tritium		2,52E-1
			1 LFR		α - emitting radionuclides		5,24E-5
				30 MW (th)	β/γ - emitting radionuclides		8,28E-2
					total	2000 gew Re,ing (5+6)	
	Norway						
N1	Halden (7)	River Tista (Skagerrak)	1 BWR D2O as moderator		H-3	4,90E+3	5,40E-1
					Cr-51	2,50E+0	2,10E-4
					Mn-54	2,35E-2	7,30E-7
					Mn-56	1,55E-1	2,80E-6
					Fe-59	1,38E-2	7,50E-7
					Co-58	1,97E-2	8,70E-6
					Co-60	5,66E-3	6,80E-5
					Zr-95	5,90E-3	4,90E-6
					Nb-95	1,29E-2	1,10E-5

Map Ref.	Country/ site	Discharges to	Reactors Number & Type	Installed Capacity	Radionuclides	Discharge limit in TBq per annum	TBq released per annum in 2004
					Sr-90	1,40E+0	2,10E-6
					Ru-103	1,00E+1	4,50E-7
					Ag-110m	5,50E-2	1,00E-9
					Sb-125	1,58E-1	1,90E-9
					I-131	6,80E-1	6,80E-7
					Cs-134	5,30E-2	8,00E-6
					Cs-137	8,33E-2	7,00E-5
					Ce-141	3,09E-2	6,80E-7
					Ce-144	3,55E-2	1,60E-5
N2	Kjeller (7)	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled Research Reactor		H-3	4,68E+2	2,95E-1
					Sr-90	4,81E-3	2,60E-6
					Cs-134	1,30E-4	3,00E-7
					Cs-137	2,72E-4	7,90E-6
					I-131	1,29E-2	2,70E-5
					I-125	2,52E-2	3,27E-4
					Co-60	1,09E-3	2,40E-5
					Mn-54	2,60E-4	< 2,00E-7
					Zn-65	1,75E-3	1,00E-7
					Pu-238	1,96E-2	1,00E-8
					Pu-239+240	2,05E-2	1,50E-7
					Am-241	2,45E-3	2,70E-9
					Cr-51	1,28E-2	< 2,00E-6
					Fe-59	6,00E-4	< 3,00E-7
					Co-58	3,00E-3	< 1,00E-7
					Ru-103	2,04E-3	1,00E-7
					Ru-106	2,00E-3	< 4,00E-6
					Sb-124	5,90E-3	< 1,00E-7
					Sb-125	3,00E-2	7,50E-8
					Ce-144	5,24E-3	1,10E-6
					Ag-110m	1,14E-2	8,90E-8
					Zr-95	2,70E-4	< 2,00E-7
					Nb-95	4,50E-4	< 6,00E-8
	Portugal						
P1	Campus de Sacavém	Residual Water Treatment Municipal Plant	1 Research Swimming Pool Reactor	1 MW		3,05E-4	
	Switzerland						
CH5	Paul Scherrer Institute	Aare	1 research reactor	zero power	Tritium	(8)	6,60E-1
					other radionuclides	(8)	7,60E-5
					β- and γ- emitting radionuclides		
					Be-7		3,00E-7
					Na-22		3,40E-6
					S-35		4,60E-6
					Mn-54		6,30E-7
					Co-56		1,30E-7
					Co-57		7,30E-7
					Co-58		2,50E-6
					Co-60		8,50E-6
					Sr-85		2,40E-7

Map Ref.	Country/ site	Discharges to	Reactors Number & Type	Installed Capacity	Radionuclides	Discharge limit in TBq per annum	TBq released per annum in 2004
					Sr/Y-90		3,30E-7
					I-125		1,10E-5
					I-131		3,10E-6
					Ba-133		9,20E-8
					Cs-134		1,10E-6
					Cs-137		2,10E-5
					Eu-152		2,80E-6
					Lu-177		8,60E-7
					α - emitting radionuclides		
					Po-210		5,40E-6
					Pu-238/Am-241		3,50E-6
					Pu-239/240		5,30E-6
	United Kingdom						
GB18	Dounreay (9)	Pentland Firth	No reactors	(9)	α - emitting radionuclides (excluding Cm 242)	2,70E-1	5,81E-4
					β - emitting radionuclides (excluding Tritium)	4,90E+1	4,74E-1
					Tritium	3,08E+1	1,44E-1
					Co 60	4,60E-1	2,31E-4
					Sr 90	7,70E+0	1,12E-1
					Zr 95 + Nb 95	4,00E-1	5,73E-4
					Ru 106	4,10E+0	1,19E-3
					Ag 110m	1,30E-1	2,29E-4
					Cs 137	2,30E+1	2,09E-2
					Ce 144	4,20E-1	1,06E-3
					Pu 241	2,30E+0	1,18E-4
					Cm 242	4,00E-2	5,01E-7
GB19	Harwell	River Thames	No reactors		total - α	5,00E-5	9,91E-6
					total - β	3,30E-3	2,10E-4
					Tritium	3,00E-1	3,38E-2
					Co 60	1,20E-4	9,62E-6
					Cs 137	5,40E-4	4,51E-5
GB20	Winfrith	Weymouth Bay (English Channel)	No reactors		total - α	3,00E-1	3,69E-4
					Tritium	6,50E+2	3,59E+1
					Co 60	1,00E+1	1,36E-3
					Zn 65	6,00E+0	1,75E-4
					others	8,00E+1	3,75E-2

4. Footnotes to tables 2 to 5

Table 2

(1) Discharge limits are given in row above the actual releases.

(2) The value indicated corresponds to the sum of individually assessed nuclides. For Belgium, the nuclides included are:

ß-Activity for Tihange: Sr-89, Sr-90, ß-Activity for Doel: Sr-89, Sr-90, Other radionuclides for Tihange: Na-24, Cr-51, Mn54, Co-57, Co-58, Co-60, Fe-59, Zn-65, Zr-95, Nb-95, Mo-99, Tc99m, Ru-103, Ru-106, Ag-110m, Sb-122, Te-123m, Sb-124, Sb-125, I-131, Cs-134, Cs-136, Cs-137, Ba-140, La-140, Ce-141, Ce-144, Other radionuclides for Doel: Cr-51, Mn-54, Co-57, Co-58, Co-60, Fe-59, Zn-65, Zr-95, Nb-95, Ru-103, Ru-106, Ag-110m, Te-123m, Sb-124, Sb-125, I-131, Cs-134, Cs-137, Ba-140, La-140, Ce-141, Ce-144.

(3) France informs that the column entitled "**other radionuclides**" corresponds to the sum of individual radionuclides measured by gamma spectrometry. It includes mainly: 54Mn, 58Co, 60Co, 110mAg, 123mTe, 124Sb, 125Sb, 131I, 134Cs, 137Cs. It does not take into account pure beta emitters (14C, 63Ni) owing to the fact that their measurement was initiated in 2002 and has not been implemented yet in all French nuclear power plants.

(4) France explains that there is no simple relationship between the production of electricity and discharges of radioactive effluent other than tritium. This is because the amounts of effluent discharged depend on many factors: the condition of fuel cladding (first barrier), the processing carried out in the various existing plants, the operational mode of the reactor (load-following or providing basic power) and, above all, the volume of work carried out during shutdowns for refuelling.
Moreover, electricity is produced according to a programme fixed station by station at national level, and deliberate shutdowns, either during stand-by periods or for work to be carried out, are fixed by national criteria: the end of a natural cycle, arrangements for maintenance depending on the availability of teams of workers, constraints of the national grid and the demand for electricity.
It is easy to understand that a unit can operate over a calendar year and can produce a lot of power if it has been refuelled at the end of the previous year and if it is made to extend its cycle. In this case, the production of effluent will be minimised (no work is carried out). On the other hand, a unit shutdown for a long time (decennial shut-down, typically) will show an increase in the production of effluent and a decrease in the power supplied. During the next year, these two scenarios may be reversed. There is therefore good reason not to attempt a comparison of one site with another over short periods (= 10 years) as regards the quantity of radioactive effluent (other than tritium) discharged for a given amount of electrical energy produced.
In order to eliminate the variability associated with specific operating conditions of each reactor, it is more appropriate for a given year to consider the total amount of electricity generated by the French facilities in the OSPAR area. In 2002, their net electrical output was 37 400 MWa.

(5) Chooz A ceased to operate on 30.10.1992. Chooz B1 was connected to the grid on 30.8.1996.

(6) Second reactor was connected to the grid on 28.5.1993.

(7) Ceased to operate on 27.5.1992.

(8) Shut down in 1988.

(9) Shut down in 1986.

(10) Shut down in 1977.

(11) Shut down in 1990.

(12) Shut down in 1994.

(13) Total β- and γ-activity excluding Tritium. In 2004 for Borssele NPP the detected radionuclides were Cr-51; Mn-54; Fe-55; Co-58; Co-60; Ni-63; Sr-90; Zr-95/Nb-95; Nb-97; Ru-103; Ru-106; Ag-110m; Te-123m; I-124; Sb-124; Sb-125; I-131; I-133; Xe-133; Cs-134; Xe-135; Cs-137; Ce-141; Ce-144.

(14) Dodewaard shut down 26 March 1997.

(15) Total β- and γ-activity excluding Tritium. For the year 2004 no specific nuclides were indicated for Dodewaard.

(16) During normal operation, each facility has to comply with a discharge limit of 0,1 mSv/year effective dose to individuals of the critical group, which is distributed between liquid and gaseous effluents in accordance with the criteria established in the Offsite Dose Calculation Manual.

(17) Total β- and γ-activity excluding Tritium. In 2004 the detected radionuclides for Almaraz were: Ag-110-m, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Fe-59, I-131, I-132, Mn-54, Na-24, Nb-95, Sb-122, Sb-124, Sb-125, Sr-89, Sr-90, Te-123m, Zr-95. The detected radionuclides for José Cabrera were: Co-58, Co-60, Cs-137. The detected radionuclides for Trillo were: Ag-110m, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Mn-54, Nb-95, Sb-122, Sb-124, Sb-125, Te-123m, Zr-95.

(18) New value authorised since January 2004.

(19) New value authorised since 1 March 2004.

(20) Discharges into the Øresund (HELCOM area adjacent to the OSPAR Maritime Area). Data provided for information only.

(21) Discharges from Swedish nuclear facilities are regulated on the basis of dose to critical group. The annual effective dose to individuals of the critical group shall during normal operation not exceed 0,1 mSv. The 2004 discharges to the marine environment from the Ringhals and Barsebäck Nuclear Power Plants correspond to annual effective doses of 0,53 μSv and 0,11 μSv, respectively.

(22) Total α-, β-, and γ-activity excluding Tritium.

(23) In 2004 the detected radionuclides for Barsebäck were: Cr-51, Mn-54, Fe-59, Co-58, Co-60, Zn-65, Sr-90, Nb-95, Zr-95, Ag-110m, Sb-124, Sb-125, I-131, Cs-134, Cs-137.

(24) For Ringhals unit 1 the detected radionuclides were: Cr-51, Mn-54, Co-57, Co-58, Co-60, Fe-59, Zn-65, As-76, Sr-89, Sr-90, Nb-95, Zr-95, Ag-108m, Ag-110m, Sn-113, Sb-122, Sb-124, Sb-125, Cs-134, Cs-137, Pu-238, Pu-239, Am-241, Cm-242, Cm-244, I-131.

(25) For Ringhals unit 2 the detected radionuclides were: Be-7, Cr-51, Mn-54, Co-57, Co-58, Co-60, Fe-59, As-76, Sr-90, Nb-95, Zr-95, Ag-108m, Ag-110m, Sn-113, Sb-122, Sb-124, Sb-125, I-131, Cs-137, Ce-144, Pu-238, Pu-239, Am-241, Cm-242, Cm-244.

(26) For Ringhals unit 3 the detected radionuclides were: Cr-51, Mn-54, Co-57, Co-58, Co-60, Fe-59, Zn-65, As-76, Sr-89, Sr-90, Nb-95, Zr-95, Ag-108m, Ag-110m, Sn-113, Sb-122, Sb-124, Sb-125, Cs-134, Cs-137, Pu-238, Pu-239, Am-241, Cm-242, Cm-244, I-131.

(27) For Ringhals unit 4 the detected radionuclides were: Cr-51, Mn-54, Co-57, Co-58, Co-60, Fe-59, As-76, Sr-89, Sr-90, Nb-95, Zr-95, Ag-108m, Ag-110m, Sn-113, Sb-122, Sb-124, Sb-125, Cs-134, Cs-137, Pu-238, Pu-239, Am-241, Cm-242, Cm-244, I-131.

(28) Discharge limits were revised on 18th December 2002.

(29) Berkeley power station was shut down in 1989, reactors decommissioned. Combined discharge data for Berkeley Power Station and Technology Centre.

(30) Bradwell ceased generating electricity in March 2002.

(31) Calder Hall permanently shut down in March 2003.

(32) Discharges from Calder Hall power station are included in the data for Sellafield (cf. Table 3).

(33) Chapelcross ceased generating electricity in June 2004

(34) Gross alpha and beta activity excluding tritium.

(35) Dungeness B also discharges sulphur-35 in a liquid form. The discharge limits and values for sulphur-35 have not been included in the ‘other radionuclides’ category in the table and in 2004 were as follows: limit 2 TBq; discharge 0,305TBq.

(36) Hartlepool also discharges sulphur-35 in a liquid form. The discharge limits and values for sulphur-35 have not been included in the ‘other radionuclides’ category in the table and in 2004 were as follows: limit 3 TBq; discharge 0,623 TBq.

(37) Heysham 1 also discharges sulphur-35 in a liquid form. The discharge limits and values for sulphur-35 have not been included in the ‘other radionuclides’ category in the table and in 2004 were as follows: limit 2,8 TBq; discharge 0,162 TBq.

(38) Heysham 2 also discharges sulphur-35 in a liquid form. The discharge limits and values for sulphur-35 have not been included in the ‘other radionuclides’ category in the table and in 2004 were as follows: limit 2,3 TBq; discharge 0,0849 TBq.

(39) Hinkley A permanently shut down in 2000.

(40) Hinkley B also discharges sulphur-35 in a liquid form. The discharge limits and values for sulphur-35 have not been included in the 'other radionuclides' category in the table and are as follows: limit 5 TBq; discharge 0,475 TBq.

(41) Hunterston A shut down in 1990, reactors decommissioned.

(42) Hunterston A gross alpha and beta activity excluding tritium. This value includes Pu-241 discharge limit 1 TBq, discharged 0,000206 TBq.

(43) Gross alpha, total beta and Co-60, excluding tritium. This value includes S-35, for Hunterston B the S-35 limit is 10 TBq, discharged 0,98 TBq. For Torness S-35 limit is 10 TBq discharged 0,0193 TBq.

(44) Trawsfynydd shut down in 1993, reactors decommissioned.

Table 3

(1) Discharges of the Centre de Stockage de la Manche (low and intermediate level waste disposal site) are included in the La Hague discharges.

(2) The values of the liquid discharge limits for tritium and iodine-129 vary depending on the annual mass throughput of uranium in THORP (Thermal Oxide Reprocessing Plant), at Sellafield which was 613 tonnes in 2002.

(3) Discharges from Calder Hall Nuclear Power Station are included in the discharges from Sellafield.

Table 5

(1) Additionally reporting required at discharges of H-3 above 2 TBq in one month.
Additionally reporting required at discharges of Gross beta above 0,3E-03 TBq in one month.

(2) Discharge limit for H-3: 1,000 TB per year.
Discharge limit for Gross beta: 0,2 TBq per year.

(3) All three Danish research reactors have been taken out of operation and the process of decommissioning has started. As a consequence the discharge limits and the reporting obligations set in the Operational limits and Conditions have been revised. The annual discharges reported are now exclusively from the Waste Management Plant.

(4) The data represent the total emissions/discharges from the Interfaculty Research Institute (IRI) complex, including the IRI-Higher Research Reactor (HOR) and different laboratories (it is not possible to make a distinction between the various sources). The discharges from the IRI-HOR are substantially lower than the values reported. At the end of 1996 the permit regarding discharges to sewage were changed into a maximum value of 20 weighted Re,ing per year.

(5) Depending on the half life of the individual radionuclides. 1 weighted Re,ing corresponds with the following amounts of radioactivity expressed in ICRP-61 Annual Limit Intake (ALI) -units:

0,5	ALI	for	t ½	>	250 year		
5	ALI	for	250 year	>	t ½	>	25 year
50	ALI	for	25 year	>	t ½	>	15 days
500	ALI	for	15 days	>	t ½	>	7,5 days
5 000	ALI	for	7,5 days	>	t ½	>	5 days
50 000	ALI	for	5 days	>	t ½		

(6) The data represent the total emissions/discharges from the Petten complex. This will lead to a substantial overestimate of the discharges of the two reactors (it is not possible to distinct the discharges from each separate reactor). In all cases concentrations of α-emitters were lower than the detection limit, which is used for load calculations. The discharge limits for Petten have been changed into 2000 weighted Re,ing per year.

(7) Annual discharge data of gaseous effluents are also available.

(8) For the Paul Scherrer Institute, the release of radioactivity through the exhaust air and the wastewater systems are directly limited to 0,15 mSv/year via the source-related dose guideline.

(9) The prototype fast reactor was shut down on 31 March 1994 and there is to be no further fuel reprocessing at Dounreay.