OSPAR COMMISSION

Liquid discharges from nuclear installations, 2012

Radioactive Substances Series

2014

OSPAR Convention

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. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

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. Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l’Espagne, 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, la Suisse et l’Union européenne.

Acknowledgement

This report has been prepared by the Expert Assessment Panel of the OSPAR Radioactive Substances Committee, comprising of Mr Henning Natvig (convenor), Norway, Mr Michel Chartier, France, Ms Inge Krol, Germany and Mr Andy Mayall (United Kingdom) with the support of Ms Luisa Rodriguez Lucas and Ms Corinne Michel of the OSPAR Secretariat.

Contents

Executive summary

Discharges of radioactive substances measured as total alpha and total beta activity and excluding tritium from nuclear installations have decreased over the period 1990 – 2012. The discharges of tritium peaked in 2004.

This annual report includes the data of 2012 on liquid radioactive discharges from nuclear installations and temporal trends for the period 1990 - 2012. 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, research and development facilities, and decommissioning and management of legacy radioactive wastes activities. Discharges are reported as total alpha, tritium and total beta activity (excluding tritium) in terabecquerel per year (TBq/y) for each type of nuclear installation.

There is a decrease in the total alpha activity discharged from all nuclear installations over the 21-year period. Discharges are at its lowest reported level since 1990, accounting for less than 6% of the peak value in 1993. In 2012, there was a 17% increase compared to 2011 in alpha discharges from the fuel reprocessing sub-sector at Sellafield. Discharges at La Hague plant were at their lowest since 2009. Total alpha discharges arising from decommissioning are insignificant.

Downward trends for discharges of tritium since 2004 were re-established. The total discharges of tritium were the highest since 2006. However, such trends were related to reprocessing throughput and could rise or fall in the future. La Hague contributed 73% of the total tritium discharges and Sellafield saw a decrease of 48% compared to the previous year. Discharges of tritium from nuclear power stations contributed around 20% of the total tritium discharge. Tritium discharges arising from decommissioning are a very minor contributor although quite variable.

Total beta discharges (excluding tritium) from all nuclear installations are dominated by discharges from the reprocessing plant which contributed approximately 61% of the overall discharges. Discharges of Tc-99 discharges from Sellafield went down by 42% in 2012 compared with 2011 figures. Total beta discharges from the fuel fabrication sub-sector at Springfields dropped by 9% in 2012. Total beta discharges (excluding tritium) arising from decommissioning were insignificant.

Récapitulatif

La mesure des activités d’alpha total et de bêta total, à l’exclusion du tritium, révèle que les rejets de substances radioactives, provenant des installations nucléaires, ont diminué entre 1990 et 2012. Les rejets de tritium ont atteint leur maximum en 2004.

Le présent rapport annuel comporte les données de 2012 sur les rejets radioactifs liquides provenant des installations nucléaires et les tendances temporelles pour la période de 1990 à 2012. Une évaluation a été réalisée, à partir de ces informations, portant sur les rejets provenant des centrales nucléaires, des usines de retraitement de combustible nucléaire, des usines de production de combustible nucléaire et des usines d’enrichissement, des installations de recherche et de développement ainsi que le démantèlement et la gestion des déchets radioactifs du passé. Les rejets sont notifiés au titre des activités d’alpha total, de tritium et de bêta total (à l’exclusion du tritium) et exprimés en terabecquerel par an (TBq/y) pour chaque type d’installation nucléaire.

L’activité d’alpha total rejetée par toutes les installations nucléaires a diminué au cours des vingt dernières années. Les rejets sont redescendus au même niveau qu’en 1990, réprésentant moins qu’un sixième du maximum enregistré en 1993. Par rapport à 2011, on note en 2012 une augmentation de 17% des rejets d’activité alpha des usines de retraitement de combustible nucléaire à Sellafield. Les rejets de la Hague sont les plus bas depuis 2009. Les rejets de total alpha provenant du déclassement sont négligeables.

Les tendances à la baisse des rejets de tritium que l'on observe depuis 2004 se sont confirmées. En 2012, on enregistre les rejets les plus hauts depuis 2006. Toutefois, ces tendances sont liées au débit des usines de retraitement, et pourraient augmenter ou diminuer à l'avenir. La Hague a contribué 73% de l'ensemble des rejets du tritium tandis qu'à Sellafield une réduction de 48% s'est avérée. Les rejets du tritium des centrales nucléaires ont contribué environ 20% des rejets totaux de tritium alors que les rejets provenant du déclassement sont négligeables mais variables.

Les rejets totaux de total bêta (à l'exclusion du tritium) émanant de toutes les installations nucléaires représentent pour la plupart les rejets des usines de retraitement, contribuant environ 61% de l'ensemble des rejets. En 2012, on relève une diminution de 42% des rejets de Tc-99 de Sellafield par rapport à 2011. Pour cette même période on note également une réduction de 9% de l'usine de production de combustible nucléaire à Springfield. Les rejets de total bêta (à l'exclusion du tritium) provenant du déclassement sont négligeables.

1. Introduction

Work to prevent and reduce pollution from ionising radiation in the North-East Atlantic was first undertaken within the framework of the former 1974 Convention for the Prevention of Marine Pollution from Land-based Sources (the "Paris Convention") and then under the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention"), which replaces the Paris Convention and establishes the OSPAR Commission.

At the first Ministerial Meeting of the OSPAR Commission (20-24 July 1998, Sintra, Portugal), an OSPAR Strategy for Radioactive Substances was adopted to guide the future work of the OSPAR Commission on protecting the marine environment of the North-East Atlantic against radioactive substances arising from human activities. This strategy was revised at the third Ministerial Meeting of the OSPAR Commission (23-24 September 2010, Bergen, Norway), where the Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010-2020 (the "North-East Strategy") was adopted.

The North-East Atlantic Environment Strategy sets out OSPAR's vision, objectives, strategic directions and action for the period up to 2020. In Part I, the new Strategy gives prominence to the overarching implementation of the ecosystem approach and the need for integration and coordination of OSPAR's work across themes and groups. In Part II, the Strategy provides its thematic strategies for Biodiversity and Ecosystems, Eutrophication, Hazardous Substances, Offshore Oil and Gas Industry and Radioactive Substances.

The Radioactive Substances thematic Strategy (Radioactive Substances Strategy) sets the objective of preventing pollution of the OSPAR maritime area from ionising radiation through progressive and substantial reductions of discharges, emissions and losses of radioactive substances, with the ultimate aim of concentrations in the environment near background values for naturally occurring radioactive substances and close to zero for artificial radioactive substances. In achieving this objective the following issues should, *inter alia*, be taken into account: (1) radiological impacts on man and biota, (2) legitimate uses of the sea, and (3) technical feasibility.

As its timeframe, the Radioactive Substances Strategy further declares that the OSPAR Commission will implement this Strategy progressively by making every endeavour, through appropriate actions and measures to ensure that 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.

The Radioactive Substances Strategy provides that in accordance with the provisions of the OSPAR Convention and the findings of the Quality Status Report 2010, the OSPAR Commission will, where appropriate, develop and maintain programmes and measures to identify, prioritise, monitor and control the emissions, discharges and losses of the radioactive substances caused by human activities which reach or could reach the marine environment.

To this end, the Radioactive Substances Strategy requires the OSPAR Commission to continue the annual collection of data on discharges of radionuclides from the nuclear sector. Regular reporting is therefore required in order to review progress towards the targets of the Radioactive Substances Strategy.

1.1 Programmes and measures

Since the mid 1980s, liquid discharges of radioactive substances from nuclear installations have been addressed first under the former Paris Convention and then under the OSPAR Convention. The following relevant measures [1] are applicable [2] under the OSPAR Convention:

- PARCOM Recommendation 88/4 on Nuclear Reprocessing Plants;
- PARCOM Recommendation 91/4 on Radioactive Discharges [3];
- PARCOM Recommendation 94/8 Concerning Environmental Impact Resulting from Discharges of Radioactive Discharges [4];
- OSPAR Decision 2000/1 on Substantial Reductions and Elimination of Discharges, Emissions and Losses of Radioactive Discharges, with Special Emphasis on Nuclear Reprocessing.

The OSPAR First and Third Periodic Evaluation of the Progress in Implementing the OSPAR Radioactive Substances Strategy, published in 2006 and 2009, have also informed this report. (OSPAR, 2006 and OSPAR, 2009).

1.2 Annual reporting

In 1985, Contracting Parties to the former Paris Convention initiated reporting on liquid discharges from nuclear installations. These data have subsequently been submitted annually by Contracting Parties, collated by the Secretariat and, following examination by the Expert Assessment Panel (EAP) of the OSPAR Radioactive Substances Committee, published by the OSPAR Commission in the form of annual reports. At first annual reports were published as part of the OSPAR Commission's general Annual Report, and from 1991 onwards they are published in the form of Annual OSPAR Reports on Liquid Discharges from Nuclear Installations in the OSPAR maritime area. From 1998 onwards, the annual reports also contain an assessment of liquid discharges which include a description of the trends from 1989 until the date of the latest report. Over time, reporting requirements and formats for data collection as regards nuclear installations have been regularly reviewed and updated in the light of experience and ongoing work under the OSPAR Commission. With a view to harmonising the way in which data and information are being established and reported, the OSPAR Commission adopted in 1996 a set of reporting formats for the annual Collection of Data on Liquid Discharges from Nuclear Installations, which were updated in 2010 to

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

2 OSPAR Decision 2000/1: France and the United Kingdom abstained from voting.

3 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: 2004-03).

4 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 (EC, 2003).

include a guide to generate "total-α" and "total-β" discharge data. There was a further update of the set of reporting formats in 2013 (OSPAR Agreement number: 2013-10).

RSC decided at the meeting in 2006, that for data from 2005 onwards, discharges arising from decommissioning and the recovery and conditioning of legacy wastes should be reported separately from operational nuclear discharges. The discharges from such activities were reported as "Exceptional Discharges" and appear in this report in a separate table.

1.3 Parameters monitored and reported

Tables 1-8 of this report contain data on total-α (Table 1), tritium (Table 2), total-β (Table 3), and individual radionuclides (Tables 4-8). Figures 1-3 of this report show trends in discharges of total-α activity, tritium and total-β activity respectively.

Total-α and total-β 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-α and total-β values provide limited information about the potential harm as such information should be based on the characteristics of individual radionuclides. Tritium is reported separately.

There is currently little consistency in the approach adopted by Contracting Parties in the assessment of total-α and total-β quantities. Consequently, for the purposes of this report total-α quantities include measurements that are strictly gross-α. Similarly for total-β, quantities as gross-β measurements are included.

Total-α represents the measured radioactivity of α-particle emitting radionuclides. These particles are emitted as a result of the decay of certain radionuclides, the so-called α-emitters. Typically, the total liquid discharges of α-emitters from all nuclear sites represent mainly Pu-239, Pu-240 and Am-241 and, to a lesser extent, Th-230, Pu-238 and some other nuclides. Total-β represents the measured radioactivity of β-particle emitting radionuclides. These particles are emitted as a result of the decay of certain 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, a range of other radionuclides. Total-β in this report excludes tritium, which is reported separately.

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

2. Assessment of the liquid radioactive discharges from nuclear installations in 2012

2.1 Introduction

Tables 1 to 3 summarise liquid radioactive discharges from nuclear installations for the period 1990 – 2012; data for 1990–2012 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, research and development facilities. Since 2006, discharges from decommissioning and legacy waste retrievals are reported separately.

For each type of nuclear installation, Table 1 gives total alpha activity, Table 2 gives tritium and Table 3 gives 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 trends for total alpha, tritium and total beta (excluding tritium) for the time period 1990 to 2012.

2.2 Trends in total alpha discharges[5]

Figure 1 shows the total alpha activity discharged from 1990 to 2012. The total discharges from all nuclear installations in 2012 were 0.19 TBq. This is an increase of about 12 % relative to 2011, where the total alpha activity discharges were 0.17 TBq. The discharges of alpha activity in 2012 are about 6.5 % of the peak value in 1993.

Fuel reprocessing sub-sector - in 2012 the total alpha discharge from this sub-sector was 0.16 TBq, an increase from 0.14 TBq in 2011.The discharges from Sellafield were 0.14 TBq which is about 17 % higher than in 2011 (0.12 TBq). In 2012 the La Hague plant contributed nearly 0.02TBq to the overall total alpha discharge, which is a slight decrease relative to 2011. The total alpha discharges from La Hague plant have been fairly constant since 2005 except in 2009 which appeared an unusual year of low discharges. The discharges in 2012 are the lowest since 2009. The variations reflect mainly fuel throughput, burn up and decay.

The discharges from the fuel fabrication sub-sector were slightly higher than in 2012. Nearly all the discharges of total alpha from this sub-sector are due to the discharges at the Springfields site which during 2012 was 0.024 TBq, about 7 % higher than in 2011. This sub-sector accounts for 13 % of the overall total alpha discharges in 2012.

Discharges from research and development facilities further increased in 2012 relative to the previous years. The discharges for 2011 were 89 MBq in total, a 17 % growth, but they do not contribute significantly to the overall total (less than 0.05%). Total alpha discharges arising from decommissioning have been recorded separately since 2006, but do not contribute significantly to the overall total.

2.3 Trends in tritium discharges

Figure 2 presents the discharges of tritium. The total discharges of tritium increased to almost 16,000 TBq in 2012, an increase of about 18 % relative to 2011. The discharge of 2012 was the highest since 2006. The sum of the tritium discharges from all installations increased from around 8000 TBq/y during the period 1990 - 1992 to a peak of almost 21,000 TBq in 2004. This increase was mainly due to the discharges from La Hague which grew to 14,000 TBq in 2004. Since 2004 the discharges from La Hague have been lower and have fluctuated as tritium discharges tend to follow trends in reprocessing throughput. The reprocessing plant at La Hague contributed 73 % of the total tritium discharge from all sectors in 2012.

The tritium discharges from Sellafield declined over the four-year period 2004-2007 to a low point of 630TBq in 2007. Since 2007 the discharges have fluctuated and rose to 2100 TBq by 2011. In 2012 the discharge from Sellafield was 1100 TBq, a decrease of about 1000 TBq (48 %) relative to the previous year.

During 2012 nuclear power stations contributed about 20% of the total tritium discharges from the nuclear sector. The discharges of tritium from this sub-sector increased by 34% in 2009 to 2900 TBq, ending a 6-year downward trend. In 2010, however, the discharges from the nuclear power sub-sector decreased again and further to 2500 TBq in 2011. In 2012, however the discharges increased again to 3200 TBq, an increase of about 28%. Of the total discharges from the nuclear power stations the UK AGRs contributed about 49 % (about 1600 TBq). This is the same relative amount of the total discharges from this sub-sector but the discharge increased by around 340 TBq relative to the previous year. The PWRs in France contributed 27 % (870 TBq), this is a decrease of 7 % in the relative amount, but the discharges are 26 TBq higher than in 2011. For the other contributing countries there are only small changes for the discharges of tritium from the nuclear power stations. The contribution to discharges from the research and

[5] The numbers for alpha discharges have been rounded to two significant figures in the assessment report

development facilities in 2012 was 3.9 TBq. This is about 0.9 TBq or 30 % higher than in 2011 but still a minor contribution to the total discharges of tritium from the nuclear sector.

Tritium discharges arising from decommissioning have been recorded separately since 2006, and though they are a relative small contributor they are quite variable. Discharges in 2012 were 30 TBq which is a significant increase of 24 TBq from 2011 and are the highest value recorded since the recording started in 2006.

2.4 Trends in total beta discharges

Figure 3 shows that the sum of total beta activity (excluding tritium) from all nuclear installations has decreased markedly since monitoring started in 1990. In 2012 the discharges of the total beta was 20 TBq, which is a decrease of nearly 6 TBq (22%) from the previous year. Historically, total beta discharges have been dominated by discharges from the reprocessing plant at Sellafield and the nuclear fuel fabrication plant at Springfields. The top three 2012 contributions were: Sellafield, 47%; Springfields 22% and La Hague 14 %. The contribution in TBq decreased from all the three facilities relative to the previous year. Reprocessing contributed approximately 61% of the overall discharges in 2012, a decrease of 9 %.

Prior to 2002 the high total beta discharges from Sellafield (2001, 120 TBq) were mainly attributable to the radionuclide Technetium-99 (2001, 79TBq). The contribution from Technetium-99 to the total beta discharge at Sellafield has been reducing markedly since 2001 and since 2007 the yearly discharges have been below 5 TBq. In 2012 the discharge of Technetium-99 from Sellafield was 0.92 TBq, a decrease of about 0.7 TBq (42%) relative to the previous year. The 7-year downward trend (to 2008) in total beta discharges from Sellafield ended in 2009 with a 24% rise relative to 2008, mostly due to radionuclides other than Technetium-99. In 2010 the total beta discharges from Sellafield dropped by 40% relative to 2009 while in 2011 the discharge increased again by 33%. In 2012 the discharges of total beta from Sellafield were 9.5 TBq, a decrease of 5.7 TBq (38 %) relative to 2011.

In the 3 years prior to 2008, the most significant change noted in total beta discharges was the decline in beta discharges from the fuel fabrication sub-sector, in particular from the Springfields site (2005, 100 TBq; 2006, 21 TBq; 2007, 3 TBq). However, in 2008 the total beta discharges from Springfields rose by 53% to 4.6 TBq, in 2009 there was a 29% reduction on the 2008 figure to 3.3 TBq, in 2010 there was a 33% increase to 4.5 TBq, in 2011 there was a further 12% increase in the discharge to 5 TBq. In 2012 the discharges decreased to 4.5 TBq, a reduction of 9%. These numbers clearly highlight the variability of these much reduced discharges.

Table 1. Total alpha discharges 1990-2012

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
All Nuclear Installations (TBq)	2.43	2.43	1.84	2.88	1.36	0.68	0.57	0.38	0.43	0.41	0.33	0.41	0.61	0.62	0.54	0.52	0.34	0.19	0.17	0.18	0.18	0.17	0.19
Reprocessing Plants (TBq)	2.20	2.25	1.71	2.70	1.10	0.47	0.32	0.23	0.22	0.17	0.16	0.25	0.39	0.43	0.31	0.27	0.23	0.15	0.14	0.15	0.16	0.14	0.16
% of all installations	90.5	92.6	92.9	93.8	80.9	69.1	56.1	61.0	50.9	41.2	47.7	59.9	63.3	69.8	57.3	51.7	68.2	76.54	83.46	88.12	85.89	84.90	85.82
Nuclear Power Plants (TBq)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
% 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	0.25	0.11	0.04	0.02	0.02	0.02	0.02	0.02
% of all installations	8.6	6.2	5.4	2.8	11.8	17.6	21.1	31.8	46.1	58.1	51.7	39.7	36.3	29.5	42.5	48.1	31.6	23.09	12.84	9.78	11.59	13.34	14.82
Research and Development Facilities (TBq)	0.02	0.03	0.03	0.10	0.10	0.09	0.13	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% of all installations	0.8	1.2	1.6	3.5	7.4	13.2	22.8	7.2	3.0	0.7	0.5	0.4	0.3	0.7	0.2	0.2	0.0	0.06	0.05	0.04	0.03	0.05	0.06
Decommissioning (TBq)																	0.00	0.00	0.01	0.00	0.00	0.00	0.00
% of all installations																	0.2	0.31	3.65	2.07	2.48	1.71	1.44

Table 2. Tritium discharges 1990-2012

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
All Nuclear Installations (TBq)	7224	8798	7658	10902	12931	15040	16779	17956	16244	18771	16548	15759	18880	19637	20637	18517	15607	15594	11178	13593	14185	13485	15856
Reprocessing Plants (TBq)	4959	6513	4969	7460	9770	12310	13500	14500	12800	15420	13300	12210	15220	15800	17070	15070	12190	12628	8968	10640	11340	10990	12650
% of all installations	68,6	74,0	64,9	68,4	75,6	81,8	80,5	80,8	78,8	82,1	80,4	77,5	80,6	80,5	82,7	81,4	78,6	81,0	80,2	78,3	79,9	81,5	79,8
Nuclear Power Plants (TBq)	2164	2252	2666	3354	3044	2713	3264	3440	3430	3335	3241	3543	3648	3819	3560	3429	3394	2936	2193	2948	2830	2486	3174
% of all installations	30,0	25,6	34,8	30,8	23,5	18,0	19,5	19,2	21,1	17,8	19,6	22,5	19,3	19,4	17,3	18,5	21,7	18,8	19,6	21,7	19,9	18,4	20,0
Nuclear Fuel Fabrication (TBq)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% of all installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Research and Development Facilities (TBq)	101	32	24	88	118	17	15	16	14	16	7	6	12	18	7	18	5	6	6	2,40	14,22	3,01	3,89
% of all installations	1,4	0,4	0,3	0,8	0,9	0,1	0,1	0,1	0,1	0,1	0,0	0,0	0,1	0,1	0,0	0,1	0,0	0,0	0,1	0,0	0,1	0,0	0,0
Decommissioning (TBq)																	16,90	25,07	11,18	1,90	0,81	6,03	27,57
% of all installations																	0,1	0,16	0,10	0,0	0,0	0,0	0,2

Table 3. Total beta (excl tritium) discharges 1990-2012

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
All Nuclear Installations (TBq)	491	227	269	252	321	365	332	315	265	256	172	231	235	198	204	105	58	33,42	27,23	26,38	23,05	25,88	20,12
Reprocessing Plants (TBq)	384	178	134	170	195	243	169	167	112	126	98	141	125	97	86	54	37	29,61	20,67	17,91	14,75	18,05	12,30
% of all installations	78,2	78,4	49,7	67,4	60,8	66,5	50,9	53,0	42,3	49,1	56,9	61,2	53,1	49,0	42,3	51,8	62,5	88,6	75,9	67,9	64,0	69,8	61,1
Nuclear Power Plants (TBq)	10,3	3,8	8,9	11,1	2,8	3,4	5,2	7,4	2,0	2,0	3,0	4,2	3,6	3,2	1,3	2,0	0,75	0,46	1,53	2,1	3,2	2,23	2,74
% of all installations	2,1	1,7	3,3	4,4	0,9	0,9	1,6	2,3	0,8	0,8	1,7	1,8	1,5	1,6	0,6	1,9	1,3	1,4	5,6	7,9	14,0	8,6	13,6
Nuclear Fuel Fabrication (TBq)	92	39	120	63	114	112	150	140	150	128	71	85	106	97	116	103	21	3	5	3	4	5	5
% of all installations	18,7	17,1	44,6	25,0	35,5	30,7	45,1	44,4	56,7	49,9	41,2	36,8	45,1	49,1	56,8	98,0	35,4	8,9	16,8	12,4	19,3	19,3	22,6
Reserch and Development Facilities (TBq)	4,5	6,3	6,6	8,2	9,1	7,0	8,1	1,0	0,66	0,36	0,30	0,46	0,46	0,44	0,47	0,09	0,06	0,13	0,07	2,31	0,02	0,02	0,00
% of all installations	0,9	2,8	2,5	3,2	2,8	1,9	2,4	0,3	0,2	0,1	0,2	0,2	0,2	0,2	0,2	0,1	0,1	0,4	0,2	8,7	0,1	0,1	0,0
Decommissioning (TBq)																	0,40	0,04	0,38	0,80	0,59	0,59	0,54
% of all installations																	0,0	0,1	1,4	3,0	2,6	2,3	2,7

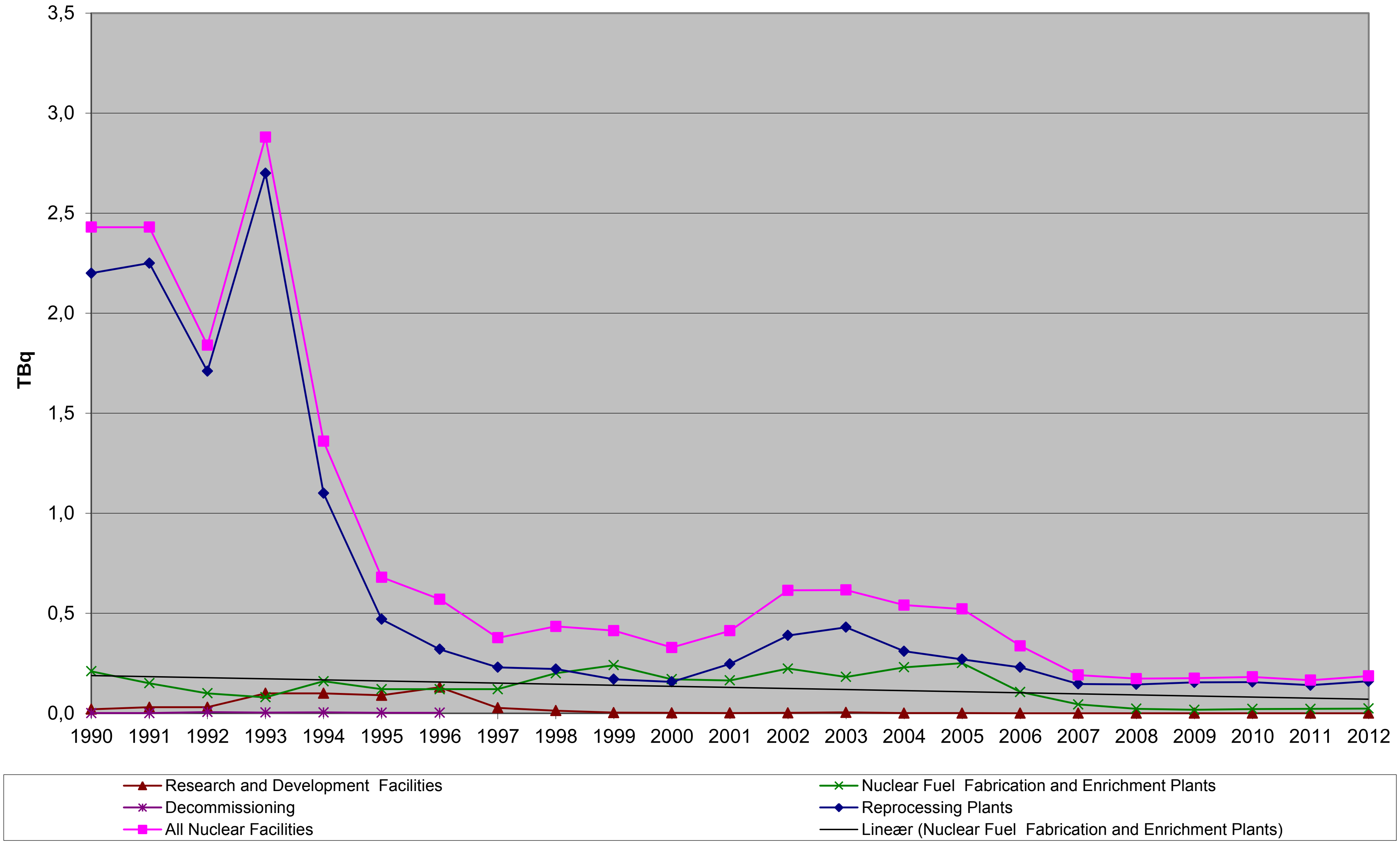


Figure 1. Total alpha activity discharge 1990 - 2012

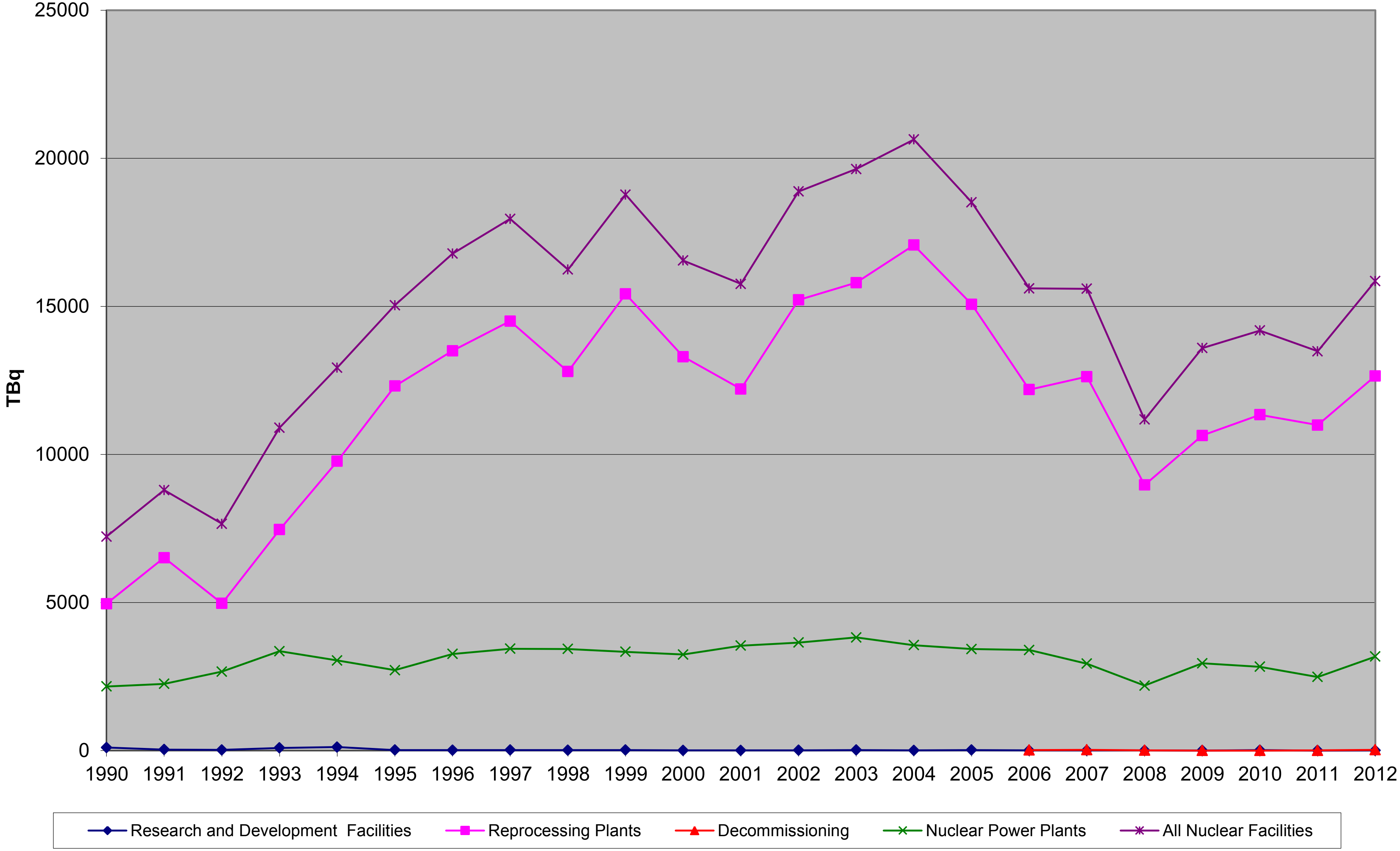


Figure 2. Discharge of tritium 1990 – 2012

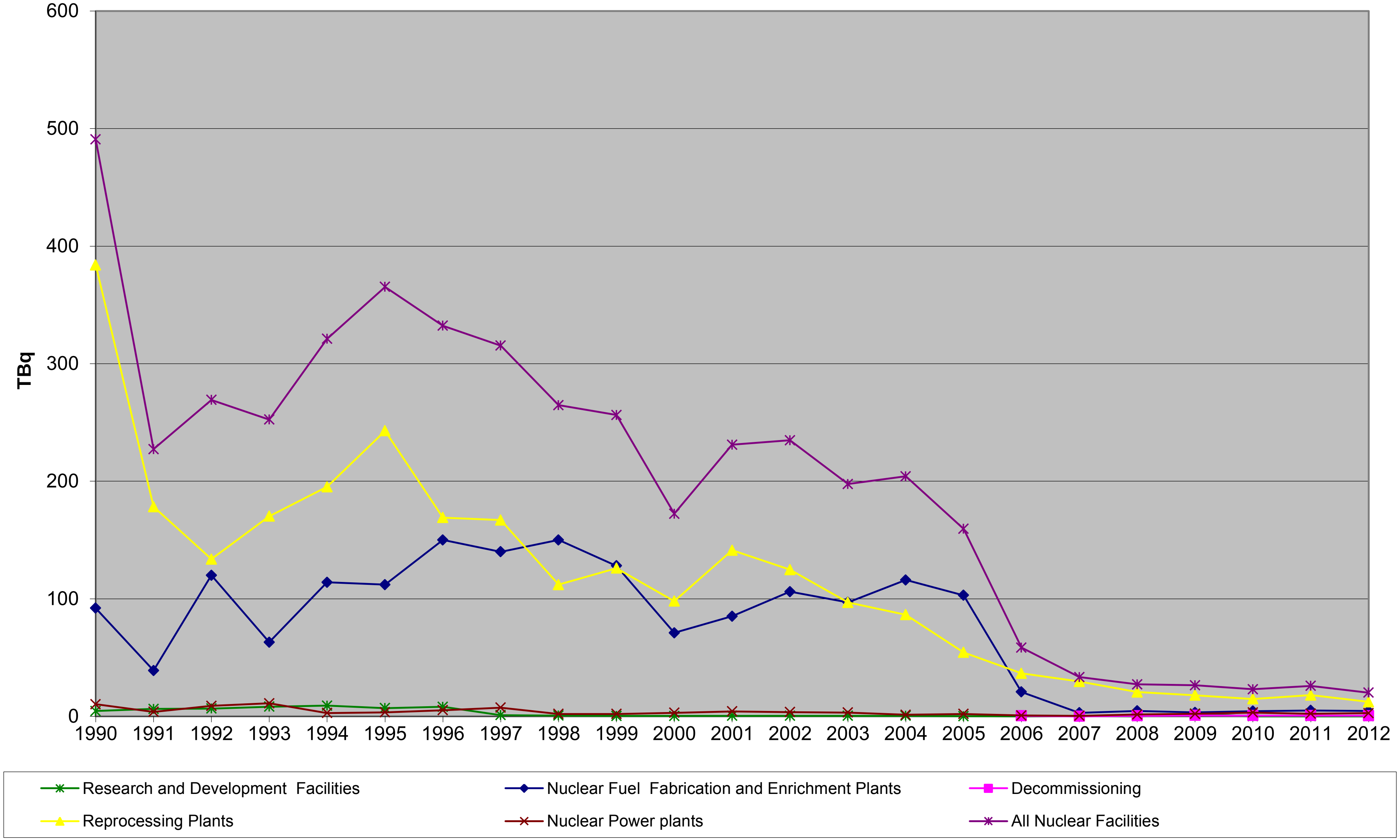


Figure 3. Total beta discharge 1990 - 2012

3. 2012 data and information

This section presents information on the location of the nuclear installations and data and information on liquid discharges for each OSPAR Contracting Party under the following categories of nuclear installations draining into the OSPAR maritime area:

Table 4:	Nuclear Power Stations;
Table 5:	Nuclear Fuel Reprocessing Plants;
Table 6:	Nuclear Fuel Fabrication and Enrichment Plants;
Table 7:	Research and Development Facilities;
Table 8:	Discharges from decommissioning and treatment/recovery of old radioactive waste.

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 (OSPAR Agreement No. 2013/10). 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.

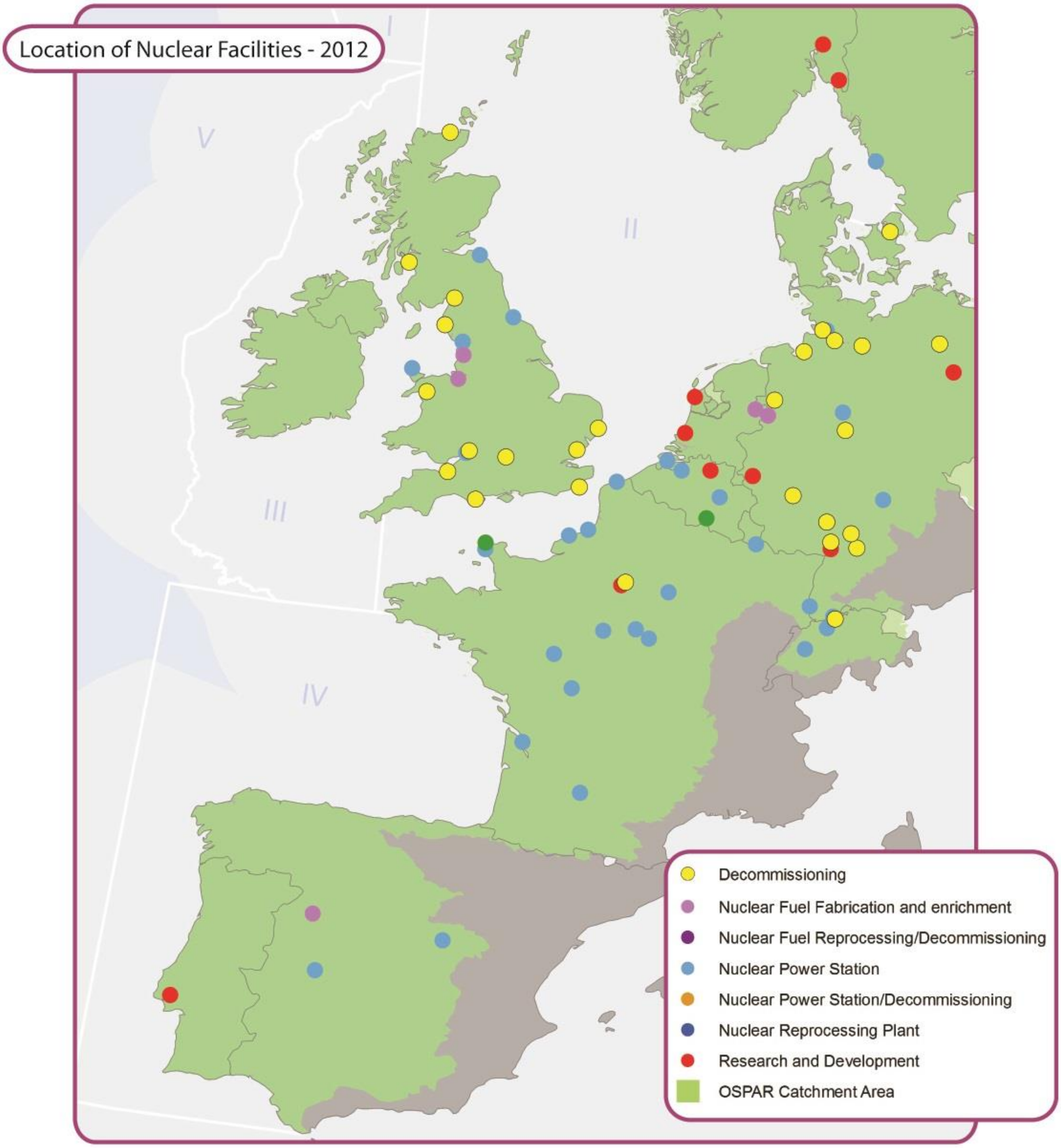
For radionuclides:

Ag:	Silver	Gd:	Gadolinium	Rh:	Rhodium
Am:	Americium	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 Map of nuclear installations

The map shows the location of nuclear facilities in OSPAR countries discharging directly or indirectly to the OSPAR maritime area.



3.2 Location of nuclear installations

The location and type of each installation is listed in the table below.

Country / Code	Name of installation	Type	Discharging into
Belgium			
BE1	Doel	NPS	Schelde
BE2	Tihange	NPS	Meuse
BE3	Mol	RDF	River Mol-Neet
Denmark			
DK1	Risø	DMLRW	Kattegat through Roskilde Fjord
France			
FR1	Belleville	NPS	Loire
FR3	Cattenom	NPS	Mosel
FR4	Chinon	NPS	Loire
FR5	Chooz	NPS/ DMLRW	Meuse
FR6	Dampierre en-Burly	NPS	Loire
FR7	Fessenheim	NPS	Rhine
FR8	Flamanville	NPS	Channel
FR9	Golfech	NPS	Garonne
FR10	Gravelines	NPS	North Sea
FR11	Nogent-sur-Seine	NPS	Seine
FR12	Paluel	NPS	Channel
FR13	Penly	NPS	Channel
FR14	Saint Laurent	NPS	Loire
FR15	La Hague	NFRP/ DMLRW	English Channel
FR16	Civaux	NPS	Vienne
FR17	Fontenay-aux-Roses	DMLRW	Seine
FR18	Le Blayais	NPS	Gironde Estuary
FR19	Saclay	RDF	Etang de Saclay
Germany			
DE1a	Biblis A	DMLRW	Rhine – Shut down
DE1b	Biblis B	DMLRW	Rhine – Shut down
DE2	Brokdorf	NPS	Elbe
DE3	Brunsbüttel	DMLRW	Elbe – Shut down
DE4	Grafenrheinfeld	NPS	Main
DE5	Grohnde/Emmerthal	NPS	Weser
DE8a	Krümmel/Geesthacht	DMLRW	Elbe – Shut down
DE8b	Geesthacht	RDF	Elbe
DE9a	Lingen/Emsland	NPS	Ems
DE9b	Lingen	DMLRW	Ems - via municipal sewer system – Shut down
DE10	Mülheim-Kärlich	DMLRW	Rhine – Shut down
DE11a	Neckar-westheim 1	DMLRW	Neckar – Shut down
DE11b	Neckar-wesheim 2	NPS	Neckar
DE12	Obrigheim	DMLRW	Neckar – Shut down
DE13a	Philippsburg KKP1	DMLRW	Rhine – Shut down
DE13b	Philippsburg KKP2	NPS	Rhine
DE14	Rheinsberg	DMLRW	Havel – Shut down
DE15	Stade	DMLRW	Elbe – Shut down
DE16	Rodenkirchen-	DMLRW	Weser – Shut down

Country / Code	Name of installation	Type	Discharging into
	Unterweser		
DE17	Würgassen/Beverungen	DMLRW	Weser – Shut down
DE18	Karlsruhe	RDF	Rhine
DE19	Gronau	NFFEP	Vechte, IJsselmeer
DE24	HMI Berlin	RDF	Havel
DE25	Jülich	RDF	Rur
The Netherlands			
NL1	Borssele	NPS	Scheldt Estuary
NL3	Almelo	NFFEP	Municipal sewer system
NL4	Delft	RDF	Sewage system
NL5	Petten	RDF	North Sea
Norway			
NO1	Halden	RDF	River Tista (Skagerrak)
NO2	Kjeller	RDF	River Nitelva (Skagerrak)
Portugal			
PT1	Campus de Sacavém	RDF	Tagus River
Spain			
ES1	Almaraz	NPS	Tagus
ES2	José Cabrera	DMLRW	Tagus
ES3	Trillo	NPS	Tagus
ES4	Juzbado	NFFEP	River Tormes - Duero
Sweden			
SE2	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
CH6	ZWILAG Würenlingen	DMLRW	Aare
United Kingdom			
UK1	Berkeley	DMLRW	Severn Estuary
UK2	Bradwell	DMLRW	North Sea
UK4	Chapelcross	DMLRW	Solway Firth
UK5a	Dungeness A	DMLRW	English Channel
UK5b	Dungeness B	NPS	English Channel
UK6	Hartlepool	NPS	North Sea
UK7a	Heysham 1	NPS	Morecambe Bay
UK7b	Heysham 2	NPS	Morecambe Bay
UK8a	Hinkley Point A	DMLRW	Severn Estuary
UK8b	Hinkley Point B	NPS	Severn Estuary
UK9a	Hunterston A	DMLRW	Firth of Clyde
UK9b	Hunterston B	NPS	Firth of Clyde
UK10	Oldbury	NPS	Severn Estuary
UK11a	Sizewell A	DMLRW	North Sea
UK11b	Sizewell B	NPS	North Sea
UK12	Torness	NPS	North Sea
UK13	Trawsfynydd	DMLRW	Trawsfynydd lake
UK14	Wylfa	NPS	Irish Sea

Country / Code	Name of installation	Type	Discharging into
UK15	Sellafield	NFRP and DMLRW	Irish Sea
UK16	Capenhurst	NFFEP	Irish Sea via Rivacre Brook and Mersey Estuary
UK17	Springfields	NFFEP	Irish Sea via River Ribble
UK18	Dounreay	DMLRW	Pentland Firth
UK19	Harwell	DMLRW	River Thames
UK20	Winfrith	DMLRW	Weymouth Bay (English Channel)

NPS: Nuclear Power Stations
NFRP: Nuclear Fuel Reprocessing Plants
RDF: Research and Development Facilities
NFFEP: Nuclear Fuel Fabrication and Enrichment Plants
DMLRW: Decommissioning and Management of Legacy Radioactive Wastes

Table 4 Nuclear Power Stations (in TBq/y)

Loca-tion Ref	Country Site	Discharges to	Reactors Number and Type	Installed Capacity MW	Net Electrical Output MW e.h. (2012)	Calculated Total-a	Calculated Total-b	Operational discharges of radioactive substances in 2012: Tritium	other radio nuclides (1)	Specific radionuclides: total a-activity	total b-activity (ex.Tritium)	Co58	Co60	Zn65	Sr90	Zr/Nb95	Ru106	Ag110m	Sb125	Cs134	Cs137	Ce144	S35	Notes
BE01	Doel	Schelde	4 PWR	2911	18220317	1.41E-05	5.76E-03	4.76E+01	1.32E-03	1.41E-05	6.34E-04	4.65E-04	7.56E-04	4.11E-05	3.50E-06	1.50E-04	2.10E-04	4.11E-04	6.70E-04	9.47E-05	8.83E-04	1.19E-04		(2)
BE02	Tihange	Meuse	3 PWR	962	6763298	8.53E-08	1.79E-04	3.33E-01	4.93E-05	8.53E-08	0.00E+00	1.95E-06	1.30E-05	4.82E-06	1.03E-06	5.62E-06	1.76E-05	4.70E-06	5.62E-06	8.64E-06	5.17E-05	1.53E-05		(2)
BE02	Tihange	Meuse		1008	5506107	6.22E-07	8.23E-02	2.87E+01	3.96E-04	6.22E-07	0.00E+00	3.08E-04	1.71E-03	4.09E-05	6.01E-06	7.91E-02	1.29E-04	1.63E-04	4.49E-05	8.53E-05	3.42E-04	6.75E-05		(2)
BE02	Tihange	Meuse		1045.8	7974735	1.95E-06	6.06E-03	2.36E+01	8.93E-04	1.95E-06	0.00E+00	7.78E-04	2.90E-03	3.93E-05	9.51E-06	2.54E-04	2.01E-04	2.05E-04	1.32E-04	1.34E-04	4.76E-04	4.04E-05		(2)
FR01	Belleville	Loire	2 PWR	2600			2.70E-04	5.98E+01	2.70E-04			1.10E-04	2.20E-05					1.00E-05	3.10E-05	2.80E-05	3.20E-05			(3)(4)
FR03	Cattenom	Mosel	4 PWR	5200			1.10E-03	1.23E+02	1.10E-03			2.07E-04	5.18E-04					7.80E-05	7.00E-05	2.60E-05	4.70E-05			(3)(4)
FR04	Chinon	Loire	4 PWR	3600			4.18E-04	5.70E+01	4.18E-04			6.30E-05	1.14E-04					1.14E-04	5.50E-05	1.10E-05	1.30E-05			(3)(4)
FR05	Chooz	Meuse	2 PWR	2900			5.60E-04	5.55E+01	5.60E-04			1.20E-04	1.23E-04					2.20E-05	2.20E-05	9.00E-06	1.60E-05			(3)(4)
FR06	Dampierre-en-Burly	Loire	4 PWR	3600			7.44E-04	4.27E+01	7.44E-04			2.87E-04	2.32E-04					6.70E-05	4.10E-05	1.60E-05	2.40E-05			(3)(4)
FR07	Fessenheim	Rhine	2 PWR	1800			2.37E-04	3.13E+01	2.37E-04			3.20E-05	3.80E-05					9.30E-05	2.50E-05	4.00E-06	5.00E-06			(3)(4)
FR08	Flamanville	North Sea (Channel)	2 PWR	2600			4.10E-04	5.87E+01	4.10E-04			1.11E-04	9.30E-05					1.80E-05	7.30E-05	1.80E-05	2.10E-05			(3)(4)
FR09	Golfech	Garonne	2 PWR	2600			2.40E-04	4.88E+01	2.40E-04			1.02E-04	4.50E-05					8.00E-06	2.40E-05	7.00E-06	1.00E-05			(3)(4)
FR10	Gravelines	North Sea	6 PWR	5400			2.39E-03	5.74E+01	2.39E-03			3.06E-04	1.09E-03					6.07E-04	8.70E-05	3.70E-05	6.50E-05			(3)(4)
FR11	Nogent-sur-Seine	Seine	2 PWR	3600			5.80E-04	3.79E+01	5.80E-04			1.78E-04	1.50E-04					4.30E-05	4.40E-05	1.50E-05	1.90E-05			(3)(4)
FR12	Paluel	North Sea (Channel)	4 PWR	5200			7.30E-04	9.56E+01	7.30E-04			2.34E-04	2.46E-04					4.30E-05	4.20E-05	1.70E-05	3.10E-05			(3)(4)
FR13	Penly	North Sea (Channel)	2 PWR	2600			5.20E-04	6.97E+01	5.20E-04			1.85E-04	2.20E-04					1.10E-05	1.90E-05	7.00E-06	8.00E-06			(3)(4)
FR14	Saint Laurent	Loire	2 PWR	1800			1.34E-04	2.28E+01	1.34E-04			1.10E-05	3.70E-05					3.00E-05	1.70E-05	6.00E-06	8.00E-06			(3)(4)
FR16	Civaux	Vienne	2 PWR	2900			3.10E-04	6.73E+01	3.10E-04			1.70E-05	1.00E-04					6.00E-05	1.40E-05	5.00E-06	6.00E-06			(3)(4)
FR18	Le Blayais	Gironde Estuary	4 PWR	3600			9.12E-04	3.95E+01	9.12E-04			2.62E-04	2.19E-04					2.22E-04	6.80E-05	1.60E-05	3.90E-05			(3)(4)
DE1a	Biblis A	Rhine	1 PWR	1225		1.4E-07	1.2E-05	8.6E-01	1.2E-05	1.4E-07			1.0E-06						3.8E-06	1.6E-07	2.1E-06			(5)
DE1b	Biblis B	Rhine	1 PWR	1300		6.1E-08	1.2E-05	6.0E+00	1.2E-05	6.1E-08			9.0E-08						1.1E-05		8.1E-08			(5)
DE2	Brokdorf	Elbe	1 PWR	1480	10768134			2.3E+01																
DE3	Brunsbüttel	Elbe	1 BWR	806			1.3E-05	7.3E-03	1.3E-05				5.0E-06		4.0E-09						2.3E-06			(5)
DE4	Grafenrheinfeld	Main	1 PWR	1345	10601671		2.0E-05	2.1E+01	2.0E-05				1.2E-05			1.1E-06								
DE5	Grohnde/Emmertl	Weser	1 PWR	1430	11692258		2.7E-06	1.8E+01	2.7E-06				1.6E-06											
DE8a	Krümmel/Geestha	Elbe	1 BWR	1402				1.3E-03																(5)
DE9a	Lingen/Emsland	Ems	1 PWR	1400	11430762			1.6E+01																
DE11a	Neckar-Westheim	Neckar	1 PWR	840				2.0E+00																(5)
DE11b	Neckar-Westheim	Neckar	1 PWR	1400	11126700		3.2E-06	2.0E+01	3.2E-06				3.2E-06											
DE13a	Philippsburg 1	Rhine	1 BWR	926			3.3E-05	8.6E-02	3.3E-05			3.3E-07	9.4E-06	7.8E-06	1.1E-07	2.1E-07		1.6E-06		4.0E-07	2.3E-06			(5)
DE13b	Philippsburg 2	Rhine	1 PWR	1468	10778670		4.0E-05	1.1E+01	4.0E-05			1.1E-06	6.9E-06	2.5E-07		5.7E-07		2.1E-07		4.4E-06	9.7E-06			
DE16	Rodenkirchen/Unt	Weser	1 PWR	1410			1.4E-04	1.9E+01	1.4E-04				9.7E-05					8.3E-06	9.4E-07	1.2E-06	6.8E-06			(5)
NL01	Borssele	Scheldt Estuary	1 PWR	520	3706680		6.98E-05	7.79E+00		ND	6.98E-05	1.75E-07	3.09E-05	ND	ND	5.78E-07	ND	6.29E-07	ND	ND	8.54E-06	NI		(6)
ES01	Almaraz	Tagus	2 PWR	2 094	15 044 849		7.57E-03	5.83E+01	7.57E-03	ND	NI	1.77E-03	1.38E-03	4.08E-05	1.38E-05	8.03E-04	1.24E-04	2.18E-04	1.61E-04	4.97E-04	4.71E-04	ND		(7)(8)(9)
ES03	Trillo	Tagus	1 PWR	1 066	7 948 775		2.46E-04	1.53E+01	2.46E-04	ND	NI	4.28E-06	6.35E-05	ND	ND	2.67E-06	ND	3.31E-06	4.93E-06	5.88E-06	2.19E-05	ND		(7)(8)(9)
SE02	Ringhals 1-4	Kattegat	1 BWR	878	5,734,000	1.05E-06	9.49E-04	4.20E-01	2.92E-04	1.05E-06	9.49E-04	1.50E-04	3.90E-04	1.90E-06	1.90E-06	1.41E-05		4.10E-05	1.20E-06		5.80E-05			(10a)(10b)(10c)(
SE02	Ringhals 1-4	Kattegat	1 PWR	865	3,804,800	1.55E-06	9.15E-05	3.40E+00	2.31E-05	1.55E-06	9.15E-05	2.60E-06	2.20E-05		7.10E-07	1.25E-06		3.80E-05	2.20E-06		3.20E-06			(10a)(10b)(10c)(
SE02	Ringhals 1-4	Kattegat	1 PWR	1063	8,758,900	7.46E-07	1.29E-04	6.70E+00	6.24E-05	7.46E-07	1.29E-04	1.80E-05	1.60E-05			2.91E-06		1.60E-05	1.40E-05		6.40E-07			(10a)(10b)(10c)(
SE02	Ringhals 1-4	Kattegat	1 PWR	940	7,325,800	4.93E-07	3.35E-04	1.30E+01	3.02E-05	4.93E-07	3.35E-04	2.70E-04	2.10E-05			5.40E-06		7.90E-07	8.30E-06					(10a)(10b)(10c)(
CH01	Beznau	Aare	2 PWR	365/365	5,518,700	2.50E-07	4.30E-04	1.20E+01	1.10E-04	2.50E-07		1.20E-05	3.40E-05		4.70E-07	2.00E-08		7.40E-06	1.70E-05	9.20E-06	2.40E-04			(15)
CH02	Gösgen	Aare	1 PWR	985	8,073,900	1.30E-07	1.11E-05	1.40E+01	5.70E-06	1.30E-07			1.00E-06							1.20E-06	3.20E-06			(15)
CH03	Leibstadt	Rhine	1 BWR	1165	7,881,300	3.20E-07	1.28E-04	1.40E+00	1.60E-05	3.20E-07		2.70E-06	8.20E-05	2.70E-05										(15)
CH04	Mühleberg	Aare	1 BWR	373	3,002,700	5.30E-08	3.02E-03	2.40E-01	1.30E-03	5.30E-08		3.50E-04	1.30E-03	5.70E-05	6.10E-07	1.50E-06		4.50E-07		1.10E-05				(15)
UK05b	Dungeness B	English Channel	2 AGR	1210			9.45E-02	1.62E+02	1.56E-03				3.42E-04								7.75E-04		9.18E-02	
UK06	Hartlepool	North Sea	2 AGR	1150			1.55E+00	3.78E+02	3.27E-09				3.92E-04								2.24E-03		1.55E+00	
UK07a	Heysham 1	Morecambe Bay	2 AGR	1250			4.55E-01	3.30E+02	5.86E-03				2.28E-04								3.66E-03		4.45E-01	
UK07b	Heysham 2	Morecambe Bay	2 AGR	1220			6.41E-02	3.50E+02	1.22E-02				8.25E-05								1.53E-03		5.03E-02	
UK08b	Hinkley Point B	Severn Estuary	2 AGR	1150			3.07E-01	1.53E+02	2.52E-03				1.02E-04								2.18E-03		3.04E-01	
UK09b	Hunterston B	Firth of Clyde	2 AGR	434		2.79E-05	1.00E-02	1.85E+02	1.00E-02	2.79E-05			3.90E-04										8.50E-01	
UK10	Oldbury	Severn Estuary	2 GCR	1175			2.04E-01	1.32E-01	7.65E-02												1.27E-01			
UK11b	Sizewell B	North Sea	1 PWR	1264			1.30E-02	4.15E+01	1.30E-02												5.00E-03			
UK12	Torness	North Sea	2 AGR	950		2.87E-04	3.74E-03	3.36E+02	3.74E-03	2.87E-04			2.58E-04										5.93E-01	
UK14	Wylfa	Irish Sea	2 GCR					2.87E+00	5.08E-03															

Table 5 Nuclear Fuel Reprocessing Plants

	TBq released per annum	Normed Releases in TBq per Gwye	TBq released per annum
Location Ref	FR15	FR15	UK15
Year	2012	2012	2012
Site	La Hague	La Hague	Sellafield
Discharges to	English Channel	English Channel	Irish Sea
Type of fuel reprocessed	PWR, BWR		Magnox, AGR, LWR
Capacity (t/y)			
Tritium	1.16E+4		1.05E+3
Total-a	1.80E-2	4.59E-4	1.42E-1
Total-b	2.81	7.15E-2	9.49E+0
C14	7.08		4.09E+0
S35			
Mn54	3.06E-3		
Fe55			
Co57	9.48E-5		
Co58	4.13E-4		
Co60	8.33E-2		5.35E-2
Ni63	1.77E-2		
Zn65	ND		
Sr89	ND		
Sr90	8.14E-2		1.19E+0
(Sr90 + Cs137)			
(Zr + Nb95)	ND		1.03E-1
Tc99	2.69E-2		9.24E-1
Ru103	ND		
Ru106	1.22		6.45E-1
(Ru + Rh) 106	2.43		
Ag110m	ND		
Sb124	ND		
Sb125	5.41E-1		
I129	1.29		2.14E-1
Cs134	3.05E-2		5.55E-2
Cs137	4.75E-1		3.58E+0
Ce144	5.10E-5		2.46E-1
(Ce + Pr) 144	1.02E-4		
Pm147			
Eu152			
Eu154	2.15E-4		
Eu155	4.76E-5		
Np237	6.37E-5		3.53E-2
Pu239+240	1.74E-3		1.40E-1
Pu241	1.36E-1		3.01E+0
Am241	1.67E-3		1.78E-2
Cm242	9.20E-6		
Cm 243+244	7.50E-4		1.84E-3
Uranium (kg)	19.8		3.39E+2
Notes	**(1)**	**(2)(3)**	

Table 6 Nuclear Fuel Fabrication and Enrichment Plants (in TBq/y)

Location Ref	Site	Discharges to	Type of Fuel	Capacity (t/y)	Production	Calculated Total-a	Calculated Total-b	Activity	TBq released	Notes
DE19	Gronau	Vechte, IJsselmeer	Uranium enrichment			3.10E-09		Total-a	3.10E-09	
NL03	Urenco, Almelo	Municipal sewer system	Uranium enrichment	6200	5268	1.40E-06		Total-a	1.40E-06	
NL03	Urenco, Almelo	Municipal sewer system	Uranium enrichment	6200	5268		3.00E-06	Total-b (b- & g- emitting rn)	3.00E-06	
ES04	Juzbado	River Tormes - Duero	PWR, BWR	400	389.7	1.73E-05		Total-a	1.73E-05	
UK16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment			1.90E-05		Uranium-a	3.80E-06	
UK16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment					Uranium daughters	4.19E-06	
UK16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment					Other-a	1.10E-05	
UK16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment				1.27E-06	Tc99	1.27E-06	
UK16	Capenhurst	Irish Sea via Rivacre Brook and Mersey Estuary	Uranium enrichment					Tritium		
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication			2.37E-02		Total-a	2.37E-02	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication				4.54E+00	Total-b	4.54E+00	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication					Tc99	1.60E-01	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication					Th230	2.09E-03	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication					Th232	2.05E-04	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication					Uranium-a	1.78E-02	
UK17	Springfields	Irish Sea via River Ribble	GCR, AGR, PWR fuel fabrication					Np237	4.95E-04	

Table 7 Research and Development Facilities (in TBq)

Location Ref	Site	Discharges to	Reactors Number and Type	Installed Capacity	Calculated Total-a	Calculated Total-b	Radionuclides	TBq released per annum	Notes
BE03	Mol	River Mol-Neet	2		4.52E-05		Total-a	4.52E-05	**(1)**
BE03	Mol	River Mol-Neet	2			4.54E-04	Total-b	1.87E-04	
BE03	Mol	River Mol-Neet	2				Tritium	1.34E+00	
BE03	Mol	River Mol-Neet	2				Sr90/Y90	1.69E-05	
BE03	Mol	River Mol-Neet	2				Co60	1.26E-05	
BE03	Mol	River Mol-Neet	2				Cs134	7.14E-06	
BE03	Mol	River Mol-Neet	2				Cs137	2.30E-04	
BE03	Mol	River Mol-Neet	2				Total activitiy	1.34E+00	
FR19	Saclay	Etang de Saclay			4.00E-05		Total-a	4.00E-05	
FR19	Saclay	Etang de Saclay				5.00E-05	Other radionuclides	5.00E-05	
FR19	Saclay	Etang de Saclay					Tritium	9.70E-03	
DE8b	Geesthacht	Elbe	1		4.50E-09		Total a-activity	4.50E-09	
DE8b	Geesthacht	Elbe	1				Tritium	1.50E-04	
DE8b	Geesthacht	Elbe	1			3.70E-06	Other radionuclides	3.7E-06	
DE18	Karlsruhe	Rhine	No reactors		3.90E-06		Total a-activity	3.90E-06	
DE18	Karlsruhe	Rhine	No reactors				Tritium	5.70E-02	
DE18	Karlsruhe	Rhine	No reactors			3.00E-05	Other radionuclides	3.00E-05	
DE24	HMI Berlin	Havel	1		1.50E-08		Total a-activity	1.50E-08	
DE24	HMI Berlin	Havel	1				Tritium	6.90E-04	
DE24	HMI Berlin	Havel	1			4.60E-08	Other radionuclides	4.60E-08	
DE25	Jülich	Rur	1				Tritium	3.00E-01	
DE25	Jülich	Rur	1			9.50E-05	Other radionuclides	9.50E-05	
NL04	Delft	Sewage system	1 Research reactor	2 MWth	<0.00E+00		a-emitting radionuclides	ND	**(2)(3)**
NL04	Delft	Sewage system	1 Research reactor	2 MWth		6.16E-05	Total-b	6.16E-05	**(2)(3)(4)**
NL04	Delft	Sewage system	1 Research reactor	2 MWth			g-emitting radionuclides	3.97E-05	**(2)(3)**
NL04	Delft	Sewage system	1 Research reactor	2 MWth			Total	1.01E-04	**(2)(3)(4)**
NL05	Petten	North Sea	1 high flux and 1 low flux research reactor	50 MWth			Tritium		**(5)(6)**
NL05	Petten	North Sea	1 high flux and 1 low flux research reactor		0.00E+00		a-emitting radionuclides		**(5)(6)**
NL05	Petten	North Sea	1 high flux and 1 low flux research reactor	30kWth		0.00E+00	b/g-emitting radionuclides		**(5)(6)(7)**
NL05	Petten	North Sea	1 high flux and 1 low flux research reactor				Total		**(5)(6)(7)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Tritium	8.50E-01	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator		0.00E+00		Total-a	ND	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator			1.29E-04	Total-b	1.29E-04	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Ag110m	ND	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Cr51	1.20E-05	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Mn54	2.00E-07	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Mn56	ND	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Co58	1.20E-06	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Co60	3.30E-05	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Sr90	5.70E-06	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Zr95	2.10E-06	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Nb95	5.20E-06	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Sb125	ND	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Cd109	ND	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				I131	4.50E-08	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Cs134	8.40E-06	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Cs137	5.50E-05	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Ce141	2.50E-07	**(8)(9)(10)**
NO01	Halden	River Tista (Skagerrak)	1 BWR D2O as moderator				Ce144	5.20E-06	**(8)(9)(10)**

NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Tritium	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor		0.00E+00		Total-a	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor			0.00E+00	Total-b	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Co58	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Co60	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Zn65	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Sr90	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Zr/Nb95	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Ru103	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Ru106	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Ru/Rh106	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Ag110m	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Sb125	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				I125	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				I131	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Cs134	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Cs137	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Ce144	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Pu238	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Pu239/240	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Am241	0.00E+00	**(8)(9)(10)**
NO02	Kjeller	River Nitelva (Skagerrak)	1 JEEP II, heavy water and cooled research reactor				Pu241	0.00E+00	**(8)(9)(10)**
PT01	Campus de Sacavém	Residual water treatment municipal plant	1 Research swimming pool reactor			0.00E+00	Total-b		
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Tritium	1.20E-05	
CH05	Paul Scherrer Institute	Aare	1 Research reactor			3.09E-05	b-and g-emitting radionuclides		
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Be7	4.20E-06	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Na22	1.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Sc44	1.70E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Ti44	1.70E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Mn54	2.10E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Co57	1.50E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Co60	5.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Zn65	2.60E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Ga67	2.80E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Zr88	2.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Y88	6.30E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Sr90	3.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Y90	3.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Ag110m	1.10E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				I111	2.60E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				I125	3.30E-06	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				I131	5.90E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Cs134	2.50E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Cs137	6.30E-06	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Tb161	6.10E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Lu172	1.80E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Lu177	1.30E-05	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Os185	8.80E-09	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Au195	3.10E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Bi207	6.40E-09	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Po208	1.30E-08	
CH05	Paul Scherrer Institute	Aare	1 Research reactor		1.42E-07		a-emitting radionuclides		
CH05	Paul Scherrer Institute	Aare	1 Research reactor				U234/238	1.30E-07	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Pu238/Am241	4.80E-09	
CH05	Paul Scherrer Institute	Aare	1 Research reactor				Pu239/240	7.40E-09	

Table 8 Discharges from decommissioning and treatment/recovery of old radioactive waste (in TBq)

Location Ref	Site	Discharges to	Reactors number and type	Calculated total-a	Calculated total-b	gross a-activity	gross b-activity (ex.Tritium)	Tritium	other radionuclides (1)	Co58	Co60	Zn65	Sr90	Na22	Zr/Nb95	Ru106	Ag110m	Sb125	Cs134	Cs137	Ce144	S35	Pu241	Notes
DK01	Risø	Kattegat through Roskilde Fjord	No reactors		2.59E-04		2.59E-04	2.65E-01																(2)(3)
FR05	Chooz	Meuse	1 PWR		2.79E-04			1.74E-03	2.79E-04		4.29E-06		8.57E-06							2.53E-04				(4)
FR15	La Hague	English Channel	PWR + BWR	1.66E-03	2.33E-01	1.66E-03	2.33E-01				5.65E-05		5.46E-02		5.50E-02					5.64E-02				
FR17	Fontenay-aux-Roses	Seine	No reactors	1.00E-06	4.00E-06	1.00E-06	4.00E-06	8.00E-06																
DE09b	Lingen	Ems	1 BWR	3.64E-09	3.10E-07	3.64E-09		4.40E-07	3.10E-07											2.95E-07				(5)
DE10	Mülheim-K	Rhine	1 PWR		2.90E-06			1.60E-05	2.90E-06		6.42E-07													(6)
DE12	Obrigheim	Neckar	1 PWR	7.20E-08	2.70E-04	7.20E-08		6.40E-04	2.70E-04		3.50E-05		2.30E-08							4.50E-06				(7)
DE14	Rheinsberg	Havel	1 PWR	1.37E-07	3.80E-06	1.37E-07		4.90E-06	3.80E-06	2.43E-07	2.14E-07								6.18E-07					(8)
DE15	Stade	Elbe	1 PWR	1.56E-08	1.10E-05	1.56E-08		1.20E-03	1.10E-05		1.15E-06		3.44E-09							1.71E-06				(9)
DE17	Würgassen	Weser	1 BWR		5.40E-07			9.40E-05	5.40E-07		2.90E-07									1.00E-07				(10)
ES02	José Cabre	Tagus	1PWR	1.32E-07	2.91E-05	1.32E-07	NI	2.35E-02	2.91E-05	ND	1.14E-05	ND	ND	ND	ND	ND	ND	ND	ND	4.03E-06	ND	ND	ND	(11)
CH06	ZWILAG W	Aare		2.20E-09	1.88E-04	2.20E-09		3.10E-02	1.30E-06		1.50E-06							1.60E-07	5.10E-06	1.80E-04				(12)
UK01	Berkeley	Severn	2 GCR		3.00E-04			1.01E-03	3.00E-04											4.24E-04				
UK02	Bradwell	North Sea	2 GCR		2.70E-03			1.45E-02	2.70E-03											2.40E-03				
UK04	Chapelcross	Solway Firth	4 GCR	7.71E-06	5.99E-03	7.71E-06	5.99E-03	3.17E-03																
UK05a	Dungeness A	English Channel	2 GCR		4.90E-03			8.01E-02	4.90E-03											5.07E-03				
UK08a	Hinkley Point A	Severn	2 GCR		1.73E-01			1.18E-01	1.73E-01											3.53E-02				
UK09a	Hunterston A	Firth of Clyde	2 GCR	2.54E-04	4.84E-02	2.54E-04	4.84E-02	6.98E-03															1.98E-04	
UK11a	Sizewell A	North Sea	2 GCR		5.13E-02			1.19E-01	5.13E-02											1.20E-01				
UK13	Trawsfynydd	Trawsfynydd	2 GCR		2.29E-03			1.93E-03	2.29E-03											1.92E-03				(13)
UK18	Dounreay	Penland Firth	No reactors	2.74E-04	3.48E-04	2.74E-04	3.48E-04	2.74E-04					4.41E-03	5.24E-06						3.32E-02				
UK19	Harwell	River Thames	No reactors	9.80E-06	1.53E-04	9.80E-06	1.53E-04	3.41E-03			9.56E-07									3.50E-05				
UK20	Winfrith	Weymouth Bay	No reactors	9.27E-05	1.71E-02	9.27E-05		2.69E+01	1.67E-02											3.51E-04				

3.3 Endnotes to data tables 4 to 8

Table 4

(1) The value indicated corresponds to the sum of individually assessed nuclides except tritium.

(2) ß-Activity for Tihange/Doel: Sr-89, Sr-90, Fe-55. Other radionuclides for Tihange/Doel: Cr-51, Mn54, Co-57, Fe-59, Ru-103, Te-123m, Sb-124, I-131, Ba-140, La-140, Ce-141.

(3) 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 2012, their net electrical output was 315 millions of MWh.

(4) Data from the producers EDF.

(5) No power operation since 2011

(6) "Total-β" values represent an assimilation of β-emitting and γ-emitting radionuclides.

(7) Regarding the nuclear power plants, the discharge data have been estimated taking into account the 2004/2/Euratom recommendation criteria.

(8) Other radionuclides for Almaraz: Cr-51, Mn-54, Fe-55, Fe-59, Co-58, Co-60, Ni-63, Zn-65, Sr-89, Sr-90, Nb-95, Zr-95, Ru-103, Ru-106, Ag-110m, Sb-122, Sb-124, Sb-125, Te-123m, I-131, Cs-134, Cs-137, Ce-141, Ce-144. Other radionuclides for Trillo: Mn-54, Fe-55, Co-58, Co-60, Ni-63, Nb-95, Ag-110m, Sb-122, Sb-124, Sb-125, Te-123m, Cs-134, Cs-137. In both cases activities for Fe-55 and Ni-63 have been estimated from Co-60 using factors that have been obtained as a result of the analysis of annual compound samples.

(9) Total-α activity reported for Spanish NPP is actually a "Total-α" measurement.

(10a) The value reported corresponds to the sum of individually assessed α-emitting radionuclides

(10b) The value reported corresponds to the sum of individually assessed β-emitting radionuclides, excludning H-3 but including the other beta emitting nuclides in the table

(10c) The value reported corresponds to the sum of the detected radionuclides not mentioned in the table

(11) For Ringhals unit 1 the following radionuclides were detected: Cr-51, Mn-54, Fe-59, Co-57, Co-58, Co-60, Ni-63, Zn-65, As-76, Zr-95, Nb-95, Ag-110m, Sb-124, Sb-125, Sr-90, Te-123m, Cs-137, I-131, H-3, Pu-238, Pu-239/Pu-240, Am-241, Cm-242, Cm-244

(12) For Ringhals unit 2 the following radionuclides were detected: Cr-51, Mn-54, Co-58, Co-60, Ni-63, Zr-95, Nb-95, Ag-110m, Sb-122, Sb-124, Sb-125, Sr-89, Sr-90, Te-123m, Cs-137, H-3, Pu-238, Pu-239/Pu-240, Am-241, Cm-242, Cm-244

(13) For Ringhals unit 3 the following radionuclides were detected: Cr-51, Mn-54, Co-58, Co-60, Ni-63, Zr-95, Nb-95, Ag-108m, Ag-110m, Sb-124, Sb-125, Te-123m, Cs-137, H-3, Pu-238, Pu-239/Pu-240, Am-241, Cm-242, Cm-244

(14) For Ringhals unit 4 the following radionuclides were detected: Cr-51, Mn-54, Fe-59, Co-57, Co-58, Co-60, Ni-63, Zr-95, Nb-95, Ag-110m, Sb-124, Sb-125, Te-123m, H-3, Pu-238, Pu-239/Pu-240, Am-241, Cm-242, Cm-244

(15) Total-B value is the sum of the radioactivity of individual radionuclides that do not belong to tritium and alpha emitters.

Table 5

(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 230 te for 2012/2013.

Table 7

(1) The installed capacity is the maximum value. The reactors function in a discontinuous way, often at a fraction of their maximum.

(2) Delft site refers to Research reactor of Technical University Delft and different laboratories.

(3) The data represent the total emissions/discharges from the Reactor Institute Delft (RID) complex, including the Research Reactor (HOR) and different laboratories (it is not possible to make a distinction between the various sources). The discharges from the RID-HOR are substantially lower than the total values reported.

(4) "Total-β" value represents all β-emitting nuclides, including tritium.

(5) The data represent the total emissions/discharges from the Petten complex. This will lead to an overestimate of the discharges of the reactor (it is not possible to distinguish the discharges from the reactor). The LFR ("Low Flux Reactor") is no longer in use since December 2010.

(6) Petten site refers to Research reactor of EU-JRC, the low-flux research reactor (no longer in use since December 2010), Hot Cell Laboratories, Mo Production Facilities and Decontamination and Waste Treatment of NRG.

(7) "Total-β" value represents an assimilation of β-emitting and γ-emitting radionuclides.

(8) Some radionuclides reported to be discharged in small amounts by IFE are not included as specific nuclides in the spreadsheet.

From IFE Halden, these radionuclides are: Ru-103, Fe-59, Hf-175, Hf-181, Ir-192 and Zn-65

All these have been included in the Total-β.

No liquid discharges from IFE Kjeller in 2012.

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

(10) Figure for Total-β does not include tritium.

Table 8

(1) The value indicated corresponds to the sum of individually assessed nuclides.

(2) Additionally reporting required at discharges of H-3 above 2 TBq in one month.

Additionally reporting required at discharges of Gross-β above 0,3E-03 TBq in one month.

(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) France informs that the column entitled "other radionuclides" corresponds to the sum of monthly liquid discharges 2011 (PF+PA+Ni63, Fe55, Sr90, Tc99).

(5) Shut down in 1977.

(6) Shut down in 1986.

(7) Shut down in 2005.

(8) Shut down in 1990.

(9) Shut down in 2003.

(10) Shut down in 1994.

(11) Other radionuclides for José Cabrera: Fe-55, Co-60, Ni-63, Cs-137.

(12) A central interim storage facility including a waste treatment plant (ZWILAG) was put in operation in Switzerland. First year of reporting of discharges from this facility is 2005. Since 2010 only operational waste from the nuclear power stations and the research and development facility Paul Scherrer Institute is treated.

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

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