Liquid Discharges from nuclear installations in 2019

Radioactive Substances Series

2021

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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 Michel Chartier (convenor), France, Mr Andrew Pynn, United Kingdom and Ms Inge Krol, Germany with the support of the OSPAR Secretariat.

Contents

Executive summary

This report presents the 2019 data for liquid radioactive discharges from nuclear installations along with temporal trends for the period 1989 - 2019. On this basis, an assessment has been made for the discharges from the nuclear sector which comprises the following sub-sectors;

- nuclear power stations;
- nuclear fuel reprocessing plants;
- nuclear fuel fabrication and enrichment plants;
- research and development facilities;
- decommissioning facilities and management of legacy radioactive wastes activities.

Discharges are reported as total alpha, tritium and total beta (excluding tritium) in terabecquerels per year (TBq/y).

The total discharges of alpha activity from all nuclear installations in 2019 were 0.19 TBq which is similar to the previous year which is 36% lower than in 2016. Annual alpha discharges have fluctuated in the range 0.17 – 0.3 TBq since 2007, and in 2019 were about 6% of the 1989 peak.

Discharges of total beta activity (excluding tritium) from all nuclear installations have decreased markedly and are now only 1.5% of what they were in 1989. In 2019 total beta discharges were about 14 TBq which is 16% lower than the previous year.

The total discharge of tritium in 2019 of about 16,000 TBq is similar to annual discharges made in recent years and about 21% lower than the peak seen in 2004. Discharges of tritium are dominated by those from the reprocessing sector (with 81% of the total from Cap de la Hague) and fluctuate in accordance with spent fuel reprocessing rates.

Récapitulatif

Le présent rapport annuel comporte les données de 2019 sur les rejets radioactifs liquides provenant des installations nucléaires et les tendances temporelles pour la période de 1989 à 2019. Une évaluation a été réalisée, à partir de ces informations, portant sur les rejets du secteur nucléaire, provenant des sous-secteurs suivants :

- centrales nucléaires ;
- usines de retraitement de combustible nucléaire ;
- usines de production de combustible nucléaire et usines d'enrichissement ;
- installations de recherche et de développement ;
- activités de démantèlement et de gestion des déchets radioactifs hérités.

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 térabecquerel par an (TBq/y).

L'activité d'alpha total rejetée par toutes les installations nucléaires en 2019 était de 0,19 TBq, soit similaire à l'année précédente et 36 % de moins qu'en 2016. Les rejets alpha annuels ont fluctué entre 0,17 et 0,3 TBq depuis 2007, et en 2019, ils représentaient environ 6 % du pic enregistré en 1989.

L'activité de bêta total (à l'exclusion du tritium) rejetée par toutes les installations nucléaires a diminué de manière significative et ne représente actuellement que 1,5 % du niveau enregistré en 1989. En 2019, les rejets totaux de bêta étaient d'environ 14 TBq, ce qui représente une baisse de 16 % par rapport à l'année précédente.

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;
- OSPAR Recommendation 2018/01 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 Fourth Periodic Evaluation of the Progress in Implementing the OSPAR Radioactive Substances Strategy, published in 2016 (OSPAR publication 2016/687), has also informed this report.

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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).

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 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 and, 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. The calculation of total-β varies between Contracting Parties, for example, in some cases it is the sum of individual radionuclide measurements and in other cases gross-β measurements are used.

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 sum of 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 2019

Introduction

Tables 1 to 3 summarise liquid radioactive discharges from nuclear installations for the period 1989 – 2019 (i.e. 31 years of discharge data); data are taken from the OSPAR Annual Reports on Liquid Discharges from Nuclear Installations[5]. These annual reports have been required from the Contracting Parties after the signature of the OSPAR Convention in 1992 in order to quantify the "land-based sources" of radioactive substances which may reach the OSPAR maritime area and to identify their trends. Reported discharges include data on operational discharges from nuclear power stations, nuclear fuel reprocessing plants, nuclear fuel fabrication and enrichment plants, and research and development facilities. Since 2005, exceptional discharges associated with the recovery of historical or legacy waste and decommissioning are reported separately for some sites. In 2014 the Contracting Parties agreed to apply the definitions for 'operational' and 'exceptional' discharges adopted at RSC 2013 and these definitions were included in the guidance to the revised reporting formats for discharges made since 2013. Such differentiation is becoming particularly important where the magnitude of discharges associated with the recovery of historical and legacy wastes and decommissioning is clearly evident. In recent years, the contribution of 'exceptional' discharges has increased to become one of the main contributor of discharges from nuclear installations.

Table 1 gives discharges of total alpha activity, Table 2 gives tritium discharges and Table 3 gives discharges of total beta activity (excluding tritium) in terabecquerels per year (TBq/y) for each sub-sector. The tables also give the percentage contributions from each sub-sector. Figures 1 to 3 show the trends in annual discharges of total alpha, tritium and total beta (excluding tritium) for the period 1989 to 2019 (more than three decades trends). Table 1 to 3 therefore shows the achievements of the OSPAR Convention since it has been signed in 1992.

Tables 4 to 6 gives the same discharges data but for the period 1995 to 2019 only. Table 4 to 6 therefore shows the achievements of the OSPAR Strategy adopted in 1998.

Trends in total alpha discharges

Table 1 and Figure 1 show the total alpha activity discharged from 1989 to 2019. The total discharges of alpha activity from all nuclear installations in 2019 were 0.19 TBq which is similar to the previous year. Annual alpha discharges have fluctuated in the range 0.17 – 0.3 TBq since 2007, and in 2019 were about 6.0% of the 1989 peak.

Discharges from the fuel reprocessing sub-sector contributed about 58% of the overall total alpha discharges in 2019 at 0.11 TBq. Operational discharges from Sellafield contributed about 36% (0.0685 TBq). The variations mainly reflect spent fuel throughput and fuel burn up.

Total alpha discharges arising from decommissioning have been recorded separately since 2006. In 2016 the 'exceptional' discharges[2] from this sub-sector were 0.068 TBq (18% lower than in the previous year), about 36% of the total from all nuclear installations. 'Exceptional' discharges is the second contributor to the total from all nuclear installations since several years, nearly at the same level as the first contributor (the fuel reprocessing sub-sector). However, the 'exceptional' discharges vary significantly from one year to another as they follow the decommissioning operations.

[5] Discharge data have been rounded to two significant figures in this assessment report. Data from 1995 have been submitted to Contracting Parties for verification and correction.

The discharges from the fuel fabrication and enrichment sub-sector contributed about 5% to the total alpha discharges in 2019 at 0.0098 TBq, which is 26% higher than the previous year. Most of the discharges of total alpha from this sub-sector are from the Springfields fuel fabrication plant in the UK.

Discharges of alpha activity from nuclear power plants and research and development facilities in 2019 were a very small fraction of the total discharge (≈1 $^{0}/_{00}$).

Trends in tritium discharges

Table 2 and Figure 2 present the discharges of tritium, a weak beta emitter with a low radiological impact. The total discharge of tritium in 2019 of about 16,000 TBq is similar to annual discharges made in recent years and about 21% lower than the peak seen in 2004. Discharges of tritium are dominated by those from the reprocessing sector (with 81% of the total from Cap de la Hague) and fluctuate in accordance with spent fuel reprocessing rates.

During 2019 the discharge of tritium by nuclear power stations decreased by about 16% over the previous year and contributed a fraction of about 16% of the total tritium discharges from the nuclear sector; this fraction remains of the same order of magnitude from 1995. The UK's reactors (mainly Advanced Gas-cooled Reactors) contributed about 59% (1,590 TBq) of the total from power stations. The Pressurised Water Reactors in France contributed about 30% (806 TBq) of the total from power stations in 2019.

Tritium discharges arising from exceptional discharges have been recorded separately since 2006, and continue to be a relatively small and variable contribution depending upon decommissioning and legacy waste management operations. Discharges in 2019 were 14 TBq (84% lower than the previous year) which was about 0.1% of the total across all sub-sectors.

Discharges from other sub-sectors were very small.

Trends in total beta discharges

Table 3 and Figure 3 show that the discharges of total beta activity (excluding tritium) from all nuclear installations has decreased markedly since 1989 and are now only 1.5% of what they were in 1989. In 2019 total beta discharges were about 14 TBq, which is 16% lower than the previous year.

Historically, total beta discharges have been dominated by discharges from the reprocessing plants at Sellafield and the nuclear fuel fabrication plant at Springfields to a lesser extent. In 2019, the contribution of the reprocessing sub-sector (47%) is lower than the peak contribution of this sub-sector (78% in 2007); the reprocessing plants at Cap de la Hague and Sellafield contributed 26% and 21% respectively in 2019 to operational discharges of total beta activity; it is the first year that the total beta (exc. Tritium) routine discharges are higher for La Hague than for Sellafield. Between the mid-1990s and 2002 total beta discharges from Sellafield were mainly attributable to the radionuclide technetium-99. The contribution from technetium-99 to the total beta discharge at Sellafield has reduced very substantially since 2001. In 2019 the discharge of technetium-99 from Sellafield was 0.386 TBq, which is nearly half the value of the previous year.

Discharges from decommissioning, and the management of historical or legacy waste, had steadily increased until 2016 primarily due to more nuclear installations entering the decommissioning phase, but decreased in 2019 (24% lower than the previous year). The contribution of exceptional discharges reached 30% of all installations in 2018; it is the second largest contributor for the second year.

Discharges from power stations over recent years have fluctuated but are typically one half of the reprocessing sub-sector. In 2019 power stations were the third largest contributor (22%) to total discharges after reprocessing and decommissioning.

Discharges from the R&D sub-sector remained as the smallest contributor to total discharge

Table 1. Total alpha discharges 1989-2019 (in TBq)

Discharges in TBq	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
All Nuclear Installations	3,1E+00	2,4E+00	2,4E+00	1,8E+00	2,9E+00	1,4E+00	6,9E-01	5,3E-01	3,8E-01	4,4E-01	4,2E-01	3,4E-01	4,1E-01	6,2E-01	6,2E-01	4,9E-01	5,2E-01	3,1E-01	1,7E-01	1,8E-01	1,9E-01	1,9E-01	1,7E-01	1,9E-01	2,0E-01	2,1E-01	2,3E-01	2,9E-01	2,2E-01	1,9E-01	1,9E-01
Reprocessing Plants	2,7E+00	2,2E+00	2,3E+00	1,7E+00	2,7E+00	1,1E+00	4,7E-01	3,2E-01	2,3E-01	2,2E-01	1,7E-01	1,6E-01	2,5E-01	3,9E-01	4,3E-01	3,1E-01	2,7E-01	2,3E-01	1,4E-01	1,5E-01	1,7E-01	1,6E-01	1,4E-01	1,6E-01	1,5E-01	1,8E-01	1,9E-01	2,5E-01	1,3E-01	9,5E-02	1,1E-01
% of all installations	86	91	93	93	94	81	68	59	60	51	41	47	60	63	70	63	52	74	84	84	89	86	85	86	75	86	82	85	59	51	58
Nuclear Power Plants	-	-	-	-	-	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,00	0,00	0,00	3,4E-04	4,2E-05	3,9E-05	4,2E-05	3,4E-05	3,114E-05	3,3E-05	2,5E-05
% of all installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,18	0,02	0,02	0,02	0,01	0,01	0,02	0,01
Nuclear Fuel Fabrication	4,1E-01	2,1E-01	1,5E-01	1,0E-01	8,0E-02	1,6E-01	1,3E-01	1,2E-01	1,2E-01	2,0E-01	2,4E-01	1,8E-01	1,6E-01	2,2E-01	1,8E-01	1,8E-01	2,5E-01	8,0E-02	2,6E-02	2,2E-02	1,7E-02	2,1E-02	2,2E-02	2,4E-02	1,6E-02	1,4E-02	2,3E-02	1,5E-02	1,8E-02	7,8E-03	9,8E-03
% of all installations	13	9	6	5	3	12	19	23	33	46	58	53	40	36	29	36	48	26	16	13	9	11	13	13	8	7	10	5	8	4	5
Research and Development Facilities	3,0E-02	2,0E-02	3,0E-02	3,0E-02	1,0E-01	1,0E-01	9,5E-02	9,1E-02	2,8E-02	1,4E-02	3,1E-03	2,0E-03	1,8E-03	2,5E-03	4,4E-03	1,2E-03	1,4E-04	1,3E-04	1,4E-04	9,2E-05	6,4E-05	6,5E-05	8,0E-05	9,3E-05	5,9E-05	7,6E-05	1,4E-04	1,2E-04	8,4E-05	1,1E-04	1,3E-04
% of all installations	0,96	0,82	1,23	1,63	3,47	7,35	13,62	17,04	7,27	3,25	0,74	0,60	0,45	0,41	0,72	0,24	0,03	0,04	0,08	0,05	0,03	0,04	0,05	0,05	0,03	0,04	0,06	0,04	0,04	0,06	0,07
Decommissioning																	1,2E-03	6,6E-04	5,9E-04	6,3E-03	3,6E-03	4,5E-03	3,3E-03	2,3E-03	3,4E-02	1,6E-02	1,8E-02	3,0E-02	7,2E-02	8,4E-02	6,8E-02
% of all installations																	0,2	0,2	0,3	3,6	1,9	2,4	1,9	1,2	17,2	7,5	7,9	10,3	32,4	44,9	36,4

Table 2. Tritium discharges 1989-2019 (in TBq)

Discharges in TBq	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
All Nuclear Installations	8,0E+03	7,2E+03	8,8E+03	7,7E+03	1,1E+04	1,3E+04	1,5E+04	1,7E+04	1,8E+04	1,6E+04	1,9E+04	1,6E+04	1,6E+04	1,9E+04	2,0E+04	2,1E+04	1,9E+04	1,6E+04	1,6E+04	1,1E+04	1,4E+04	1,4E+04	1,4E+04	1,6E+04	1,8E+04	1,7E+04	1,8E+04	1,8E+04	1,6E+04	1,6E+04	1,6E+04
Reprocessing Plants	5,8E+03	5,0E+03	6,5E+03	5,0E+03	7,5E+03	9,8E+03	1,2E+04	1,4E+04	1,5E+04	1,3E+04	1,5E+04	1,3E+04	1,2E+04	1,5E+04	1,6E+04	1,7E+04	1,5E+04	1,2E+04	1,3E+04	9,0E+03	1,1E+04	1,1E+04	1,1E+04	1,3E+04	1,5E+04	1,4E+04	1,5E+04	1,4E+04	1,3E+04	1,3E+04	1,4E+04
% of all installations	72	69	74	65	68	76	82	80	80	79	82	79	76	80	80	83	81	78	81	80	78	80	78	80	81	82	84	81	80	80	83
Nuclear Power Plants	2,2E+03	2,2E+03	2,3E+03	2,7E+03	3,4E+03	3,0E+03	2,7E+03	3,3E+03	3,5E+03	3,4E+03	3,4E+03	3,3E+03	3,8E+03	3,7E+03	3,9E+03	3,6E+03	3,4E+03	3,4E+03	2,9E+03	2,2E+03	2,9E+03	2,8E+03	3,0E+03	3,1E+03	3,4E+03	3,0E+03	2,8E+03	3,3E+03	3,2E+03	3,2E+03	2,7E+03
% of all installations	27	30	26	35	31	24	18	20	20	21	18	21	24	20	20	17	18	22	19	19	22	20	22	20	19	18	16	19	19	20	16
Nuclear Fuel Fabrication		-	-	-	-	-	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,03	0,00	0	0	0	0	0	0	0	0	0	0	0
% of all installations		-	-	-	-	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Research and Development Facilities	6,1E+01	1,0E+02	3,2E+01	2,4E+01	8,8E+01	1,2E+02	2,6E+01	1,8E+01	1,8E+01	1,5E+01	5,0E+01	1,1E+01	8,3E+00	1,4E+01	2,0E+01	4,2E+01	1,1E+01	7,9E+00	1,7E+01	8,9E+00	4,7E+00	1,4E+01	5,0E+00	2,7E+00	5,9E+00	6,1E+00	4,0E+00	3,0E+00	3,4E+00	1,9E+00	3,5E+00
% of all installations	0,76	1,40	0,37	0,31	0,81	0,91	0,17	0,11	0,10	0,09	0,26	0,07	0,05	0,07	0,10	0,20	0,06	0,05	0,11	0,08	0,03	0,10	0,04	0,02	0,03	0,04	0,02	0,02	0,02	0,01	0,02
Decommissioning																	9,4E+00	1,7E+01	2,5E+01	1,1E+01	1,8E+00	2,9E+00	6,0E+00	2,8E+01	2,8E+01	1,7E+01	5,2E+01	3,4E+01	2,3E+01	2,3E+01	1,4E+01
% of all installations																	0,1	0,1	0,2	0,1	0,0	0,0	0,0	0,2	0,2	0,1	0,3	0,2	0,1	0,1	0,1

Table 3. Total beta (excl. tritium) discharges 1989-2019 (in TBq)

Discharges in TBq	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
All Nuclear Installations	9,3E+02	4,9E+02	2,3E+02	2,7E+02	2,5E+02	3,2E+02	3,7E+02	3,3E+02	3,2E+02	2,7E+02	2,6E+02	1,7E+02	2,3E+02	2,4E+02	2,0E+02	1,6E+02	1,6E+02	6,1E+01	3,6E+01	2,8E+01	2,8E+01	2,4E+01	2,7E+01	2,2E+01	2,2E+01	2,0E+01	2,0E+01	2,3E+01	2,3E+01	1,7E+01	1,4E+01
Reprocessing Plants	6,9E+02	3,8E+02	1,8E+02	1,3E+02	1,7E+02	2,0E+02	2,4E+02	1,7E+02	1,7E+02	1,1E+02	1,3E+02	9,8E+01	1,4E+02	1,2E+02	9,7E+01	8,6E+01	5,4E+01	3,7E+01	3,0E+01	2,1E+01	2,1E+01	1,5E+01	1,8E+01	1,3E+01	1,1E+01	1,1E+01	1,2E+01	1,1E+01	1,2E+01	7,4E+00	6,6E+00
% of all installations	74	78	78	50	67	61	66	51	53	42	49	56	61	53	49	54	34	60	82	75	77	64	67	57	50	53	62	47	54	44	47
Nuclear Power Plants	7,6E+00	1,0E+01	3,8E+00	8,9E+00	1,1E+01	2,8E+00	5,6E+00	6,9E+00	7,5E+00	4,7E+00	4,8E+00	3,5E+00	4,6E+00	4,1E+00	5,2E+00	2,8E+00	3,5E+00	3,1E+00	2,9E+00	1,3E+00	2,1E+00	3,2E+00	3,3E+00	4,2E+00	4,6E+00	3,7E+00	3,4E+00	5,5E+00	5,5E+00	3,6E+00	3,2E+00
% of all installations	1	2	2	3	4	1	2	2	2	2	2	2	2	2	3	2	2	5	8	5	7	13	12	19	21	18	17	24	24	21	22
Nuclear Fuel Fabrication	1,1E+02	9,2E+01	3,9E+01	1,2E+02	6,3E+01	1,1E+02	1,1E+02	1,5E+02	1,4E+02	1,5E+02	1,3E+02	7,1E+01	8,5E+01	1,1E+02	9,7E+01	7,1E+01	1,0E+02	2,1E+01	3,0E+00	4,6E+00	3,3E+00	4,5E+00	5,0E+00	4,5E+00	2,7E+00	2,9E+00	1,8E+00	1,7E+00	8,4E-01	2,8E-01	1,1E-01
% of all installations	12	19	17	45	25	36	30	45	44	56	49	41	37	45	49	44	63	34	8	16	12	18	18	21	12	14	9	7	4	2	1
Research and Development Facilities	1,2E+02	4,5E+00	6,3E+00	6,6E+00	8,2E+00	9,1E+00	7,2E+00	6,5E+00	1,0E+00	6,8E-01	4,2E-01	5,0E-01	4,6E-01	4,5E-01	5,3E-01	6,0E-01	8,8E-02	6,4E-02	1,3E-01	6,7E-02	2,1E-02	3,0E-02	2,1E-02	3,0E-02	2,1E-02	1,4E-02	1,1E-02	9,1E-03	1,2E-02	8,6E-03	1,1E-02
% of all installations	12,79	0,91	2,78	2,47	3,24	2,84	1,96	1,96	0,33	0,25	0,16	0,29	0,20	0,19	0,27	0,37	0,05	0,10	0,37	0,24	0,07	0,12	0,08	0,14	0,10	0,07	0,05	0,04	0,05	0,05	0,08
Decommissioning																	1,3E+00	9,0E-01	6,2E-01	1,2E+00	9,6E-01	1,1E+00	7,0E-01	6,2E-01	3,5E+00	2,9E+00	2,1E+00	5,1E+00	4,0E+00	5,6E+00	4,3E+00
% of all installations																	0,8	1,5	1,7	4,2	3,5	4,5	2,6	2,8	16,3	14,2	10,9	22,0	17,8	33,4	30,3

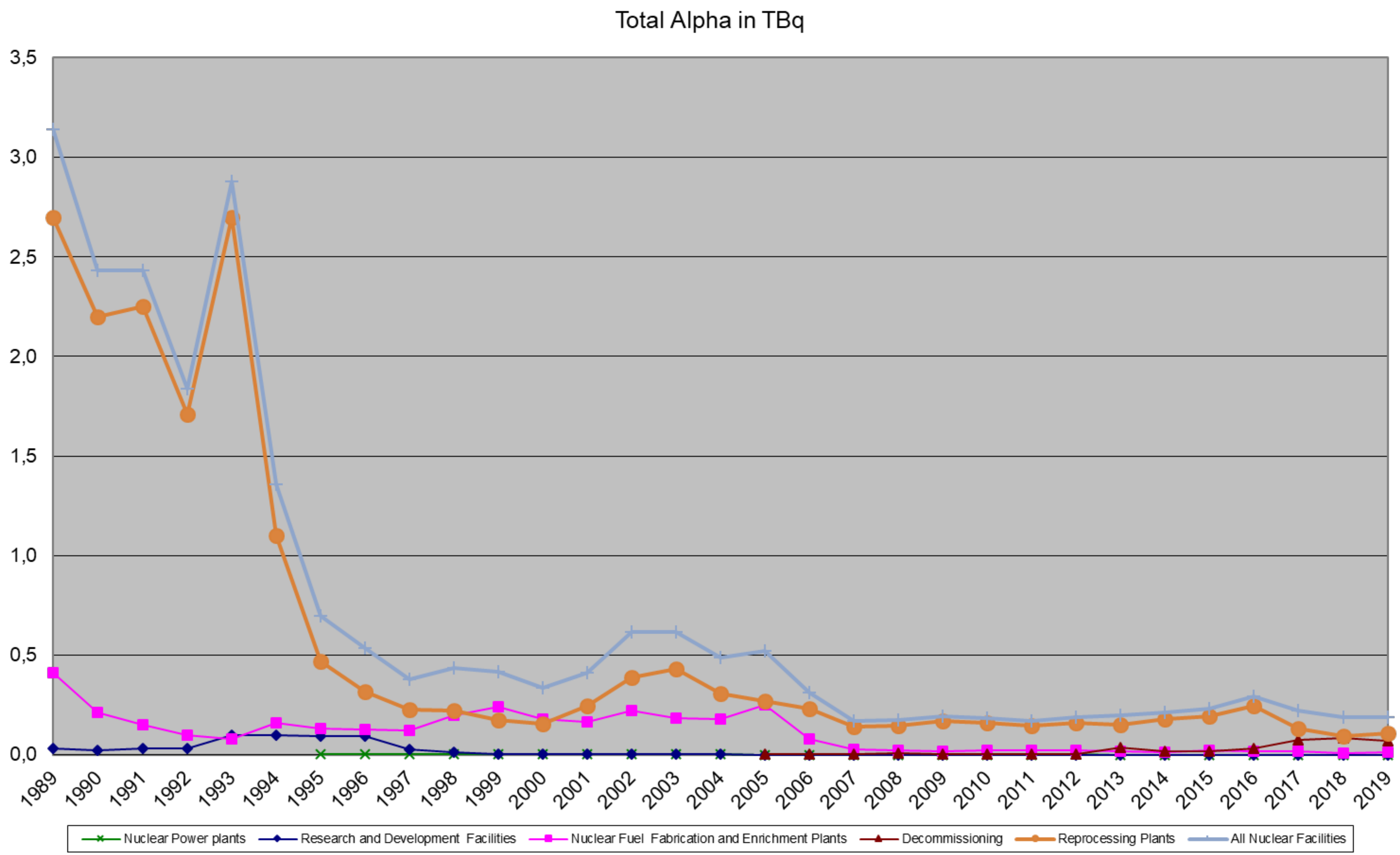

Figure 1. Total alpha activity discharges 1989 – 2019 (in TBq) – Achievements of the OSPAR Convention signed in 1992

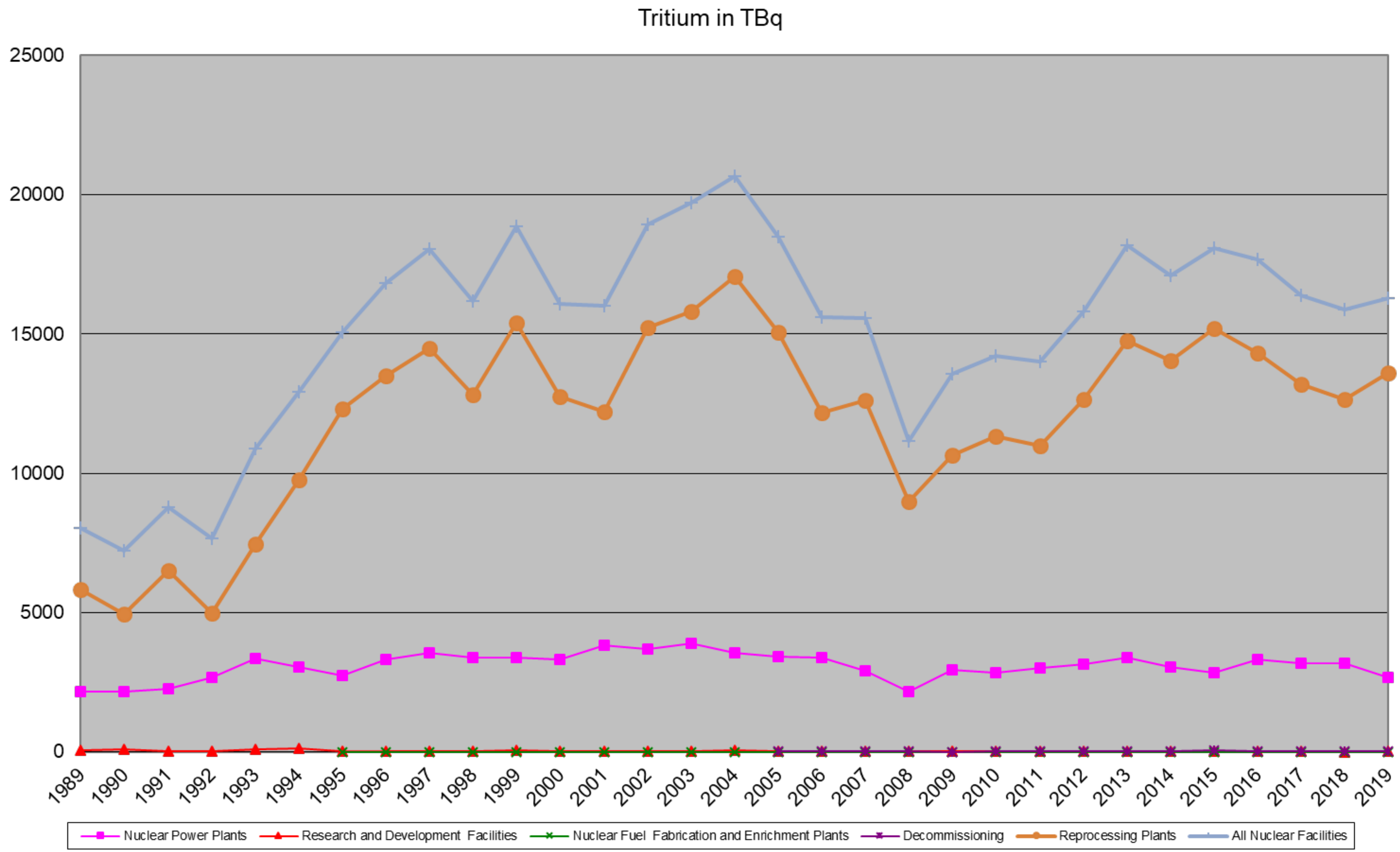

Figure 2. Discharges of tritium 1989 – 2019 (in TBq) – Achievements of the OSPAR Convention signed in 1992

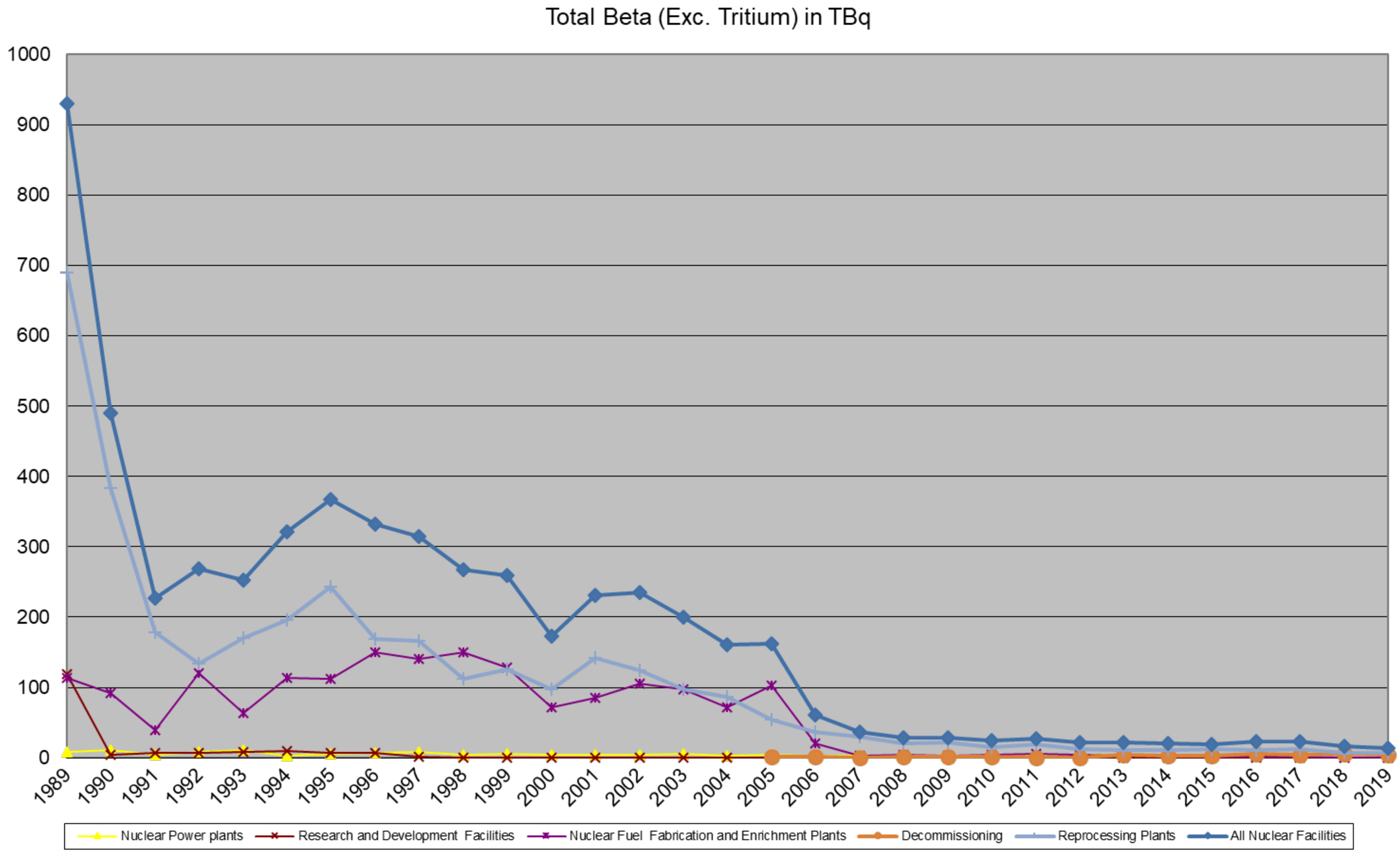

Figure 3. Total beta discharges 1989 – 2019 (in TBq) – Achievements of the OSPAR Convention signed in 1992

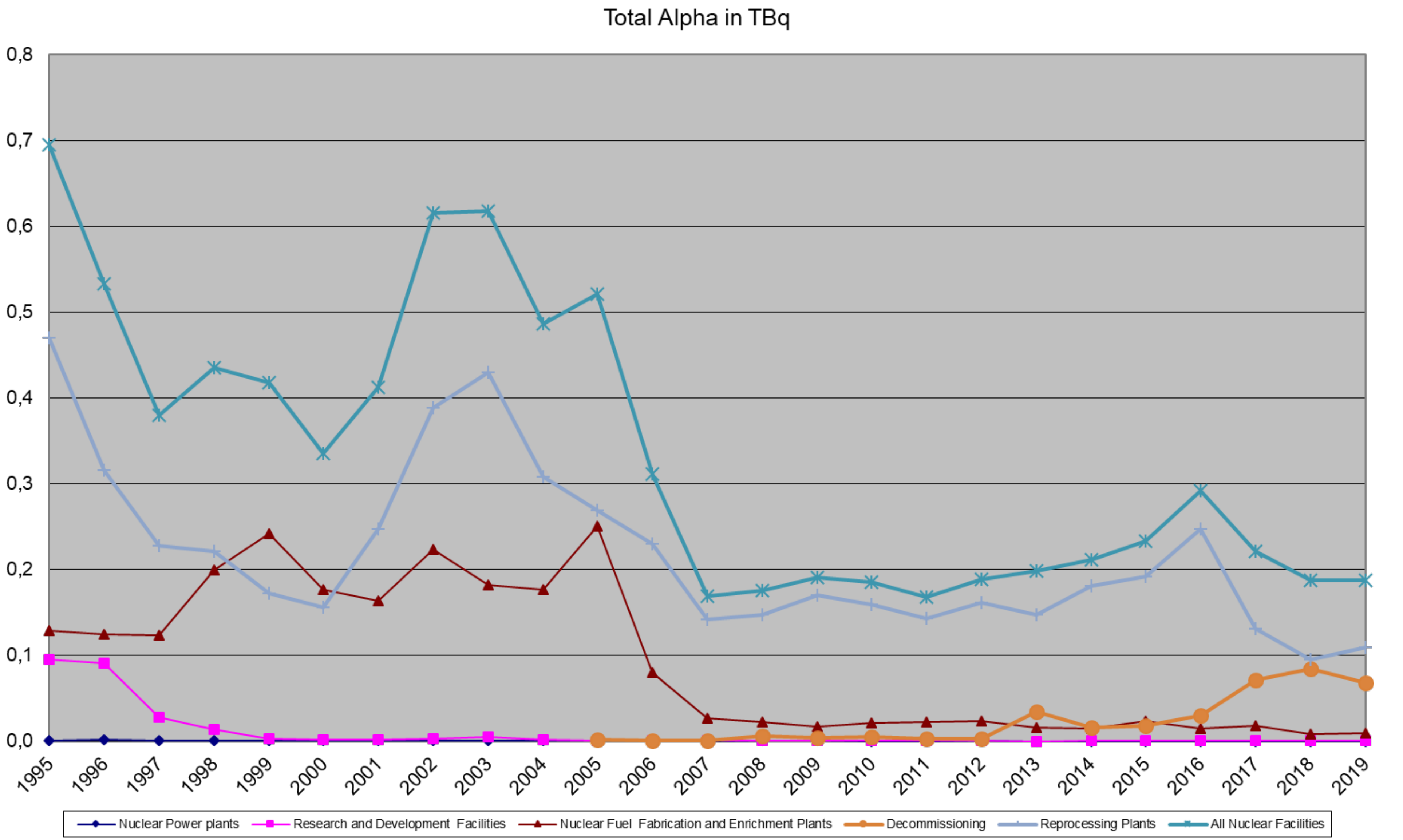

Figure 4. Total alpha activity discharges 1995 – 2019 (in TBq) – Achievements of the OSPAR Strategy adopted in Sintra in 1998

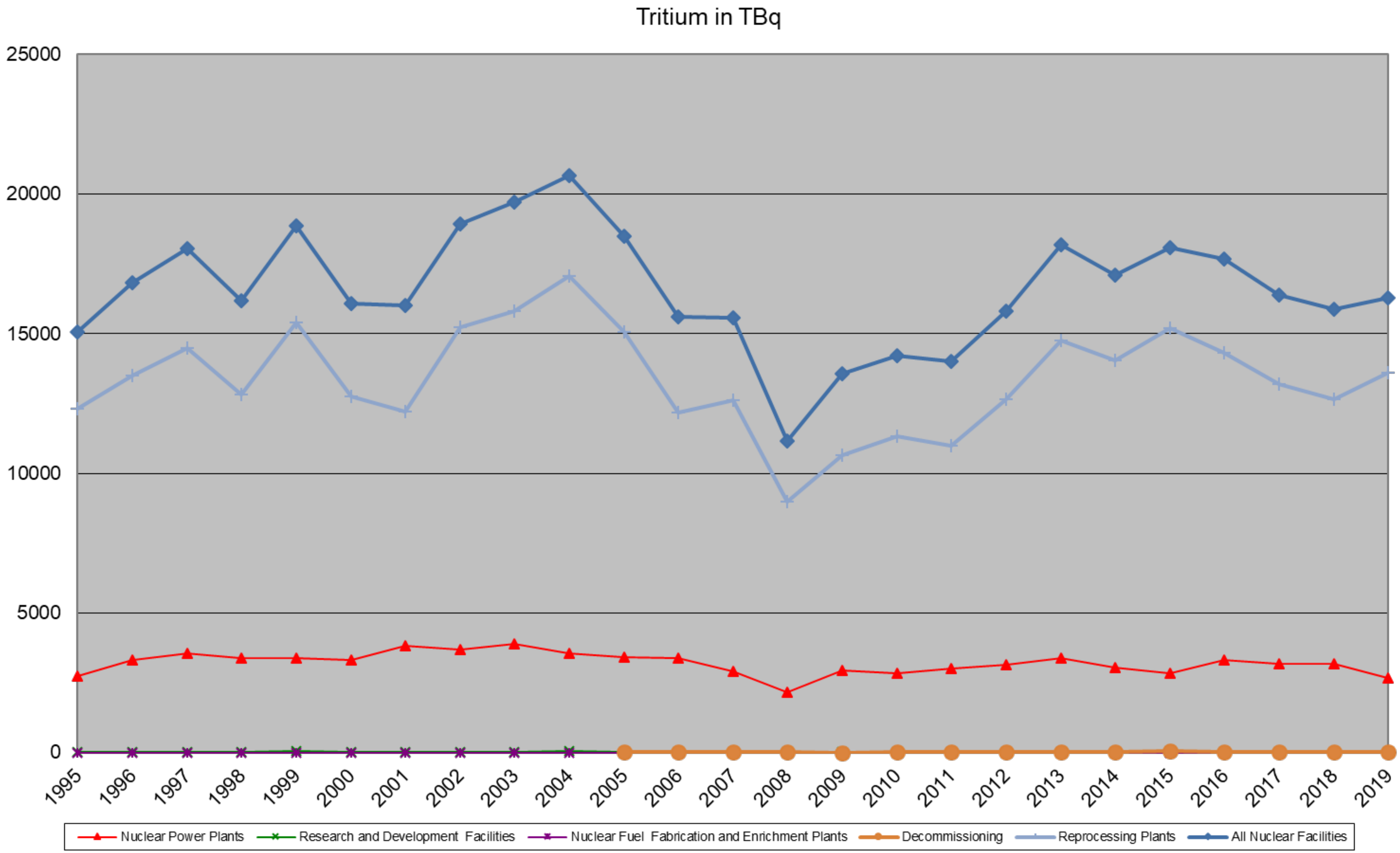

Figure 5. Discharges of tritium 1995 – 2019 (in TBq) – Achievements of the OSPAR Strategy adopted in Sintra in 1998

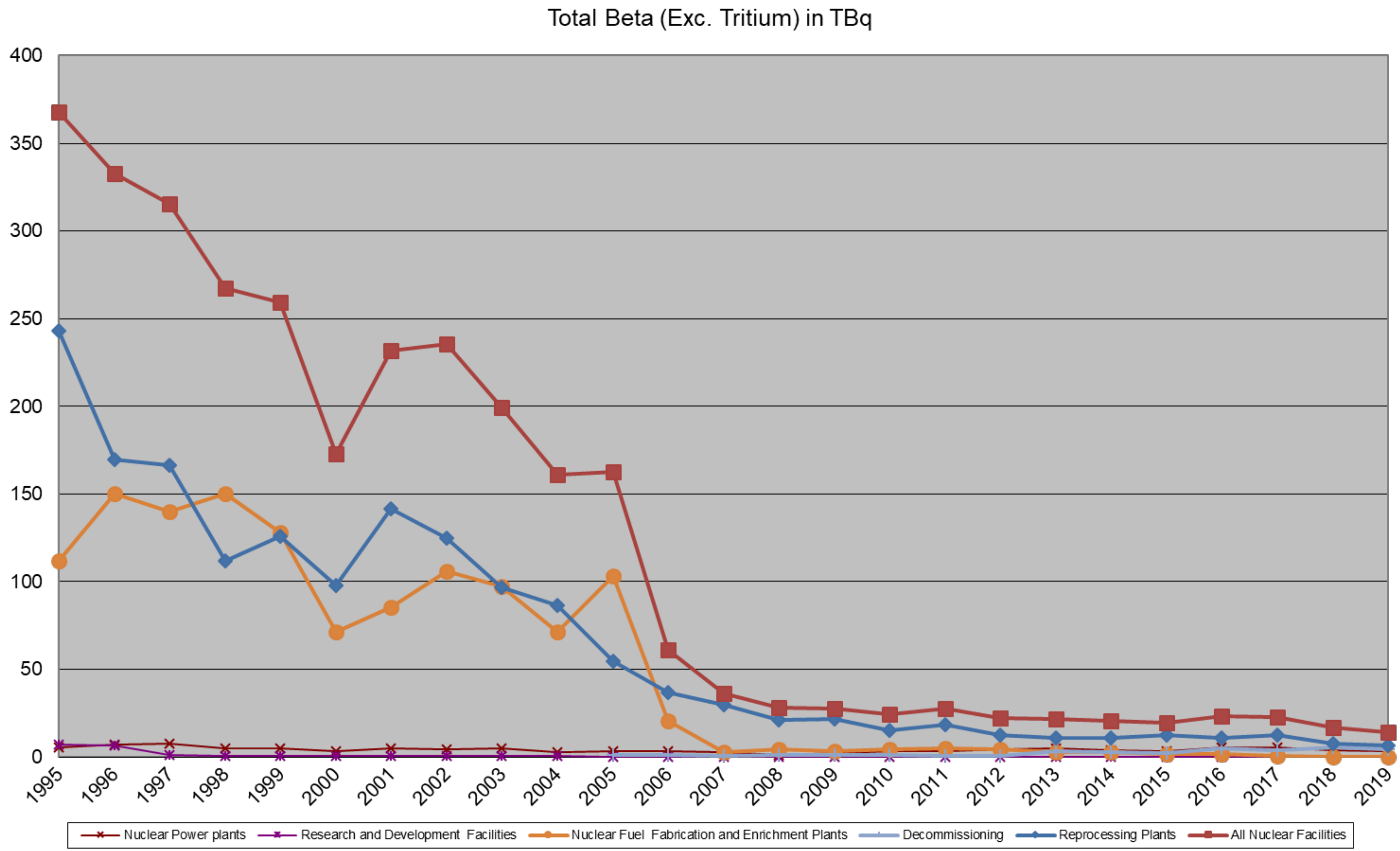

Figure 6. Total beta discharges 1995 – 2019 (in TBq) – Achievements of the OSPAR Strategy adopted in Sintra in 1998

3. 2019 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 1:	Nuclear Power Stations;
Table 2:	Nuclear Fuel Reprocessing Plants;
Table 3:	Nuclear Fuel Fabrication and Enrichment Plants;
Table 4:	Research and Development Facilities;
Table 5:	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.

The data can be viewed and downloaded here
https://odims.ospar.org/en/submissions/ospar_discharges_nuclear_2019_01/

3.1 Map of nuclear installations

The map showing the location of nuclear facilities in OSPAR countries discharging directly or indirectly to the OSPAR Maritime Area can be found in our assessment portal https://oap.ospar.org/en/ospar-assessments/committee-assessments/radioactive-substances/discharges-nuclear-installations/

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
DE1b	Biblis B	DMLRW	Rhine
DE2	Brokdorf	NPS	Elbe
DE3	Brunsbüttel	DMLRW	Elbe
DE4	Grafenrheinfeld	NPS	Main
DE5	Grohnde/Emmerthal	NPS	Weser
DE8a	Krümmel/Geesthacht	DMLRW	Elbe
DE8b	Geesthacht	RDF	Elbe
DE9a	Lingen/Emsland	NPS	Ems
DE9b	Lingen	DMLRW	Ems - via municipal sewer system
DE10	Mülheim-Kärlich	DMLRW	Rhine
DE11a	Neckar-westheim 1	DMLRW	Neckar
DE11b	Neckar-wesheim 2	NPS	Neckar

Country / Code	Name of installation	Type	Discharging into
DE12	Obrigheim	DMLRW	Neckar
DE13a	Philippsburg KKP1	DMLRW	Rhine
DE13b	Philippsburg KKP2	NPS	Rhine
DE14	Rheinsberg	DMLRW	Havel
DE15	Stade	DMLRW	Elbe
DE16	Rodenkirchen-Unterweser	DMLRW	Weser
DE17	Würgassen/Beverungen	DMLRW	Weser
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	DMLRW	Severn Estuary
UK11a	Sizewell A	DMLRW	North Sea

Country / Code	Name of installation	Type	Discharging into
UK11b	Sizewell B	NPS	North Sea
UK12	Torness	NPS	North Sea
UK13	Trawsfynydd	DMLRW	Trawsfynydd lake
UK14	Wylfa	NPS	Irish Sea
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
RDF: Research and Development Facilities
NFRP: Nuclear Fuel Reprocessing Plants
NFFEP: Nuclear Fuel Fabrication and Enrichment Plants
DMLRW: Decommissioning and Management of Legacy Radioactive Wastes

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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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