OSPAR COMMISSION

Annual report and assessment of discharges of radionuclides from the non-nuclear sectors in 2019

Radioactive Substances Series

2021

Annual report and assessment of discharges of radionuclides from the non-nuclear sectors in 2019

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 Mette Nilsen Norway, Michel Chartier (Convenor) France, Andy Pynn, United Kingdom, Inge Krol, Germany; and with the support of Lucy Ritchie and Chris Moulton of the OSPAR Secretariat.

Contents

Executive summary

Annual data collection by OSPAR on discharges from the non-nuclear sector has only been taking place since 2006 (collecting data from 2005). Due to the incompleteness of datasets, no data were published until 2009.

RSC 2004 agreed that Contracting Parties should report the discharges from their non-nuclear sub-sectors annually using the agreed reporting template. The data for 2019 have been reported in accordance with the Revised Reporting Procedures for Discharges of Radioactive Substances from Non-Nuclear Sectors. Data have been collected since 2005. A number of Contracting Parties (CPs) have provided non-nuclear discharge data for 2019: 7 out of 7 CPs reported for oil/gas; 7 CPs reported on their university and research; and 7 CPs reported on their medical sector.

There are sufficient data to make an assessment for 2019. The reports for produced water discharges from the oil/gas sub-sector cover the major contributions and, although incomplete, it is possible to judge the relative contribution from the medical sub-sector. Other sub-sectors are either well reported or make relatively insignificant contributions.

It has been necessary to estimate certain discharges from incomplete data – consequently care needs to be taken in using this assessment report for purposes other than those envisaged by OSPAR RSC. In this assessment report the term “total beta” means total beta (excluding tritium) – the full definition is used in headings, but the abbreviation is used in the text.

Récapitulatif

Le recueil annuel, par OSPAR, des données sur les rejets provenant du secteur non-nucléaire n’a lieu que depuis 2006 (recueil des données de 2005). Aucune donnée n’a été publiée avant 2009, les séries de données étant jusque-là incomplètes.

Le Comité substances radioactives (RSC) est convenu en 2004 que des Parties contractantes devraient notifier les rejets provenant des sous-secteurs non-nucléaires tous les ans en se servant du formulaire de notification agréé. Les données pour 2019 ont été notifiées conformément aux Procédures révisées pour la notification des rejets de substances radioactives provenant des secteurs non-nucléaires. Les données ont été recueillies à partir de 2005. Plusieurs Parties contractantes ont notifié leurs données sur les rejets non nucléaires pour 2019 : 7 Parties contractantes sur 7 ayant une industrie pétrolière et gazière ont soumis les données pour ce secteur, 7 Parties contractantes ont soumis les données pour les rejets provenant des universités/de la recherché; et 7 Parties contractantes ont soumis les données pour le secteur médical.

Il y avait suffisamment de données pour faire une évaluation pour 2019. Les rapports sur les rejets de l’eau de production provenant du sous-secteur pétrolier et gazier couvrent les principales contributions, et bien qu'ils soient incomplets, il est possible de juger de la contribution relative du sous-secteur médical. Les autres sous-secteurs sont soit bien rapportés, soit apportent des contributions relativement insignifiantes.

Il a été nécessaire d'estimer certains rejets à partir de données incomplètes - par conséquent, il convient de faire preuve de prudence dans l'utilisation de ce rapport d'évaluation à des fins autres que celles envisagées par le RSC d’OSPAR. Dans ce rapport d'évaluation, le terme " bêta total " signifie bêta total (à l'exclusion du tritium) - la définition complète est utilisée dans les titres, mais l'abréviation est utilisée dans le texte.

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 1992, 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 Atlantic Environment 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 considered: (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 from the non-nuclear sector. Regular reporting is therefore required in order to review progress towards the targets of the Radioactive Substances Strategy.

The OSPAR Commission adopted in 2005 a set of reporting procedures to be used for annual reporting of data on discharges from the non-nuclear sector which were updated in 2013 (OSPAR Agreement number 2013-11). Trial runs of reporting made in accordance with the procedures were conducted in 2006 and 2007 with data from 2004 and 2005. Both these datasets and the 2006 data reported in 2008 were incomplete and could not be published. This report presents and assesses the 2019 data, and for the offshore oil and gas sector, also presents the total discharges from 2005 to 2019.

This report includes an estimate on uncertainty (given as +/- numerical values after the value of discharged water) for Ra-226, Ra-228 and Pb-210 for the oil and gas sectors. The estimate was requested by the Expert Assessment Panel so that they can report on discharge data measurement uncertainty.

An overview of potential non-nuclear sources of radioactive discharges is given in Table 1 below.

Table 1: Non-nuclear sectors with the potential to discharge radioactive substances to the OSPAR Maritime Area

Contracting Party	Oil/gas extraction (inc. on-shore)	Phosphate Industry	Titanium-Dioxide Pigment	Steel	Rare Earth	Medical	Universities and Research Centres	Radio chemical production
Belgium	Not present	Present	Present	Present	Not present	Present	Present	?
Denmark	Present	Present	Not present	Not present	Not present	Present	Present	?
Finland	Not present	Present	Present	Present	Not present	Present	Present	?
France	Present	Present	Present	Present	Present	Present	Present	?
Germany	Present	Not present	Present	Present	Not present	Present	Present	?
Iceland	Not present	Not present	Not present	Not present	Not present	Present	Present	?
Ireland	Present	Not present	Not present	Not present	Not present	Present	Present	Not present[1]
Luxembourg	Not present	Not present	Not present	Present	Not present	Present	Present	Not present[2]
Netherlands	Present	Present	Present	Present	Not present	Present	Present	?
Norway	Present	Not present	Present	Present	Not present	Present	Present	?
Portugal	Not present	Present	Not present	Present	Not present	Present	Present	?
Spain	Present	Present	Present	Present	Not present	Present	Present	Not present
Sweden	Not present	Not Present	Not present	Not Present	Not present	Present	Present	Not present
Switzerland	Not	Not	Not	Not	Not	Present	Present	Not

[1] Fluorine (F-18) is produced in Ireland for Positron Emission Tomography (PET). However, F-18 has a half life of 109,8 minutes and so is not reported.

[2] There is only chemical labeling of pharmaceutical molecules (tracers) with isotopes (mainly from Mo-99 - Tc-99m generator) in hospitals' nuclear medicine departments for diagnosis (+ extremely low-activity labeling in research labs on mice/rats or blood samples). But there is no production of isotopes in Luxembourg.

	present	present	present	Present	present			present
United Kingdom	Present	Not present	Present	Present	Present	Present	Present	Present

2 Assessment of the radioactive discharges from non-nuclear sources in 2019

Assessment of the Discharges of Radionuclides from the Non-nuclear Sub-sectors in 2019

1. Introduction

1. RSC 2004 agreed that Contracting Parties should report the discharges from their non-nuclear sub-sectors annually using the agreed reporting template. The data for 2019 have been reported in accordance with the Revised Reporting Procedures for Discharges of Radioactive Substances from Non-Nuclear Sectors. Data have been collected since 2005. A number of Contracting Parties (CPs) have provided non-nuclear discharge data for 2019: 7 out of 7 CPs reported for oil/gas; 7 CPs reported on their university and research; and 7 CPs reported on their medical sector.

2. There are sufficient data to make an assessment for 2019. The reports for produced water discharges from the oil/gas sub-sector cover the major contributions and, although incomplete, it is possible to judge the relative contribution from the medical sub-sector. Other sub-sectors are either well reported or make relatively insignificant contributions.

3. It has been necessary to estimate certain discharges from incomplete data – consequently care needs to be taken in using this assessment report for purposes other than those envisaged by OSPAR RSC. In this assessment report the term “total beta” means total beta (excluding tritium) – the full definition is used in headings, but the abbreviation is used in the text.

2. Discharges from the oil/gas sub-sector

4. Data were provided by Denmark, Germany, Ireland, the Netherlands, Norway, Spain and United Kingdom. The total discharges in 2019 of the three main radionuclides were radium-226 (Ra-226) 0.85TBq, radium-228 (Ra-228) 0.66 TBq and lead-210 (Pb-210) 0,05 TBq. The levels are comparable to discharges for recent years. The discharges of Ra-226 in 2012 was the highest since the reporting of discharges started in 2005.

5. Figure 1 gives the discharges to sea of Ra-226, Ra-228 and Pb-210 for the years 2005–2019.

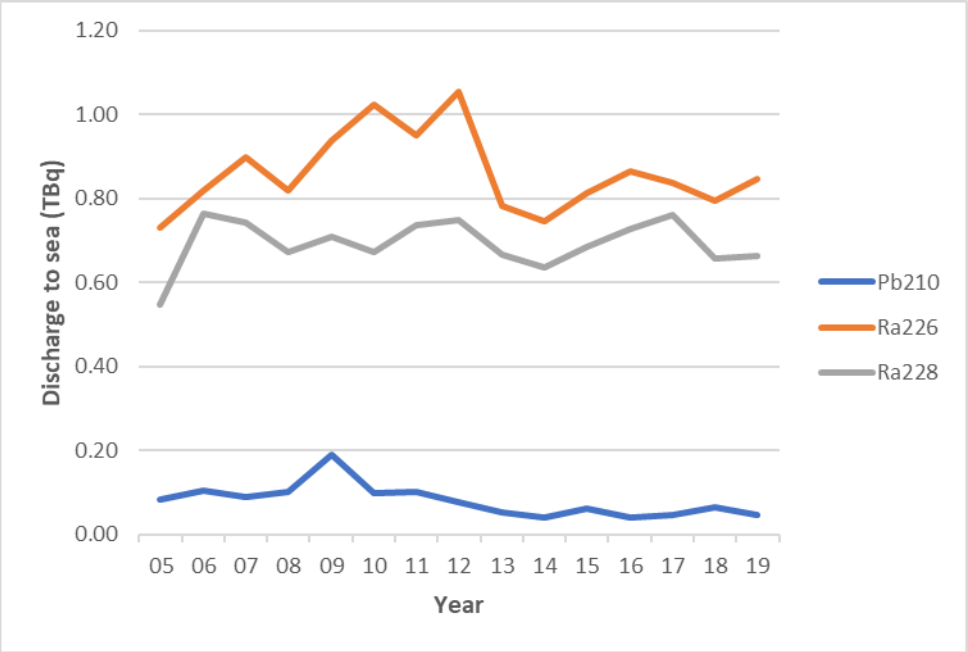

Figure 1: Discharges of Ra-226, Ra-228 and Pb-210 to sea in produced water from the oil/gas sub-sector 2005-2019

Figure 1 shows that there has been little variation since 2005 in discharges of the key radionuclides. The highest discharge of Ra-226 of 1.05 TBq occurred in 2012 and the highest discharge of Ra-228 was 0.76 TBq in 2006.

6. Norway, the UK and the Netherlands are normally the principal contributors. In 2019 the relative contributions of discharges in produced water (using Ra-226 as an indicator), were Norway 50 %, UK 38 %, the Netherlands 9 % and Denmark 3%.

8. Total alpha and total beta discharges from produced water have been estimated based on reported measured values for Pb-210, Ra-226 and Ra-228 and using the formulae agreed at RSC to include contributions from key radioactive daughter products assumed to be in equilibrium in the respective decay chains. The results of the calculations are presented in Table 1 and Table 2 for total alpha and total beta respectively. The assessments are based on produced water discharge data only, while the quality of the data for discharges from descaling (during normal operations and decommissioning) is improving, the magnitude of discharge from these sources is very small compared to the produced water contribution.

9. The calculation of the total alpha and total beta discharges from the oil/gas sub-sector allows for the comparison of discharges with those from the nuclear sector. The total alpha and beta discharges given for the oil/gas sector are based on measurements of Ra-226, Ra-228 and Pb-210 and assuming, conservatively, that these are all in secular equilibrium with their decay products (see paragraphs 10-14).

a) Total alpha from produced water discharges

10. The agreed formula for the calculation of total alpha discharges from produced water is:

Total alpha (TBq) = (5xRa-228) + (4xRa-226) + (1xPb-210).

The formula assumes equilibrium in these decay chains at the time of discharge.

11. The total alpha discharges are given below in Table 1; for comparison the reported Ra-226 and the total measured alpha discharge from the nuclear sector are also illustrated.

Table 1: Total calculated alpha and Ra-226 discharges 2005-2019 in produced water from the oil and gas subsector. Total alpha from nuclear sector is presented for comparison (TBq)

Year	Oil/gas		Nuclear
	Total alpha	Ra-226	Total alpha
2005	6.4	0.81	0.52
2006	6.9	0.78	0.34
2007	7.4	0.90	0.19
2008	6.8	0.82	0.17
2009	7.4	0.94	0.18
2010	7.6	1.0	0.18
2011	7.6	0.95	0.17
2012	7.9	1.1	0.19
2013	6.5	0.78	0.20
2014	6.1	0.73	0.22
2015	6.7	0.80	0.23
2016	7.1	0.85	0.29
2017	7.2	0.84	0.22
2018	6.5	0.80	0.19
2019	6.8	0.66	0.19

12. While a large number (>100) of offshore installations contribute to the total alpha discharge, approximately 19.9 % arises from just two installations in the Troll Oilfield in the Norwegian sector of the North Sea.

b) Total beta (excluding tritium) from produced water discharges

13. The agreed formula for the calculation of total beta discharges from produced water is:

Total beta (TBq) = (4xRa-228) + (2xRa-226) + (2xPb-210)

The formula assumes equilibrium in these decay chains at the time of discharge.

14. The total beta discharges are given below in Table 2; for comparison the equivalent nuclear contributions are also illustrated.

Table 2: Total beta (excluding tritium) discharges 2005-2019 in produced water from the oil and gas subsector. Total beta from nuclear sector is presented for comparison (TBq)

Year	**Oil/gas**	**Nuclear**
2005	4.3	160
2006	4.7	58
2007	4.9	33
2008	4.5	27
2009	5.0	30
2010	4.9	23
2011	5.0	26
2012	5.2	20
2013	4.3	21
2014	4.1	21[3]
2015	4.4	20
2016	4.7	22
2017	4.8	23[4]
2018	4.8	17
2019	5.0	14

c) Tritium and other radionuclides

15. Tritium is used as a tracer in the oil industry, and 0.0004 TBq was discharged by the Norwegian sector during 2019 in connection with data collection from exploration wells. The discharges are insignificant compared to the discharges from the nuclear industry.

[3] The data for 2013 and 2014 for nuclear industry are updated due to erratum in the nuclear report

[4] The data for 2017 for nuclear industry is updated based on data from the nuclear assessment report for RSC20

3. Medical sub-sector

16. RSC originally agreed that iodine-131 and technetium-99 (arising from the decay of the medical product technetium-99m) should be reported from the medical sub-sector. At RSC 2009 it was decided that so little technetium-99 was generated from the medical use of technetium-99m that data collection for technetium-99 could cease.

Reporting of iodine-131 discharges is not required where delay tanks are used to deal with liquid effluents.

a) Total alpha discharges

17. No alpha emitting radionuclides are reported from this sub-sector.

b) Total beta (excluding tritium) discharges (principally iodine-131)

18. The total reported discharge of iodine-131 for 2019 was. 13.8 TBq, which is comparable to previous years. Not all CPs reported discharges of iodine-131. Given that iodine-131 is widely used in medicine, it is assumed that the discharges from those CPs that did not report, and do not have delay tanks to allow for decay, is approximately proportional to population. The total discharge of iodine-131, including an estimate for non-reported discharges, in 2019 is 18 TBq. This discharge is of a similar order to the discharge of total beta from the nuclear sector, however iodine-131 is relatively short-lived (half-life = 8 days) compared to many beta-gamma emitting radionuclides discharged by the nuclear sector.

4. University and research sub-sector

19. It is difficult to make an assessment of the discharges from this sector as reporting is very variable. From the data that have been provided it is reasonable to conclude that this sector is not a significant contributor to total beta (<1TBq) or tritium (<1TBq) discharges and there are no reported alpha emitting radionuclide discharges. Discharge of tritium was 0.06 TBq.

5. Radiochemical manufacturing sub-sector

20. Radiochemical manufacturing is carried out in several of the CP, however only the UK have reported separately on this sub-sector in 2019. The discharge is of the same order as the previous year. The discharges from this sub-sector in France are included with those from the Research and Development sub-sector due to co-location of sites.

a) Total alpha

21. There was no total alpha discharge reported for 2019.

b) Total beta (excluding tritium)

22. The total reported discharge of beta emitters during 2019 from this sub-sector was 0.093 GBq which is similar to 2018, however both are lower than the reported discharge for 2017 (0,14 GBq). The discharge is a minor contribution of the total beta discharges to the marine environment. Of these discharges, all are reported as discharges of carbon-14.

c) Tritium

23. In 2019 the tritium discharge from this sub-sector amounted to 0.05 TBq, which was at a similar level as 2015 to 2018, whereas less tritium were reported in 2014. These discharges represent a minor contribution to tritium discharges in the OSPAR maritime area. These discharges of tritium are often in the form of tritium labelled organic

compounds, which have different environmental pathways to that of tritiated water, which is the most common form of tritium discharged by the nuclear industry.6. Other non-nuclear sub-sectors.

24. Discharges were also reported for titanium dioxide pigment manufacture and rare earth mineral production, neither of these sub-sectors made a significant contribution to the overall discharges of total alpha, total beta or tritium.

7. Summary and conclusions.

25. For 2019 the overall summary including **comparison** with the nuclear sector is shown in Table 3 below.

Table 3: Summary of discharges in 2019 from the non-nuclear sector and a comparison with the nuclear sector (TBq)[5]

	Non-nuclear					**Nuclear**
	Oil/gas	Medical	Univ/R&D	Radiochem	**Total**	
Total alpha	6.8	-	-	-	**6.8**	0.19
Total beta	5.0	18	0.06	0.09	**23,2**	14
Tritium	0.0004	-	0.06	0.05	**0.11**	16000

26. The oil/gas sub-sector is the main source of total alpha discharges to the OSPAR area, accounting for about 97 % of the total from all sectors (non-nuclear and nuclear). This sub-sector also makes a 13 % contribution to the overall total beta from all sectors (nuclear and non-nuclear). In total, the non-nuclear sector contributed an estimated 62% of the total beta discharges from all sectors, with the largest single contribution 48% coming from the iodine-131 discharges from the medical sub-sector. Tritium discharges from the non-nuclear sector are insignificant in comparison with those from the nuclear sector.

3 2019 data and information

In this section of the report, data and information on discharges from the non-nuclear sectors are presented for each Contracting Party.

The columns, headings and abbreviations used in the tables correspond to the reporting requirements set out in the reporting format (OSPAR Agreement number 2013-11). The following abbreviations for radionuclides (elements) are used in the tables:

C:	Carbon	Po:	Polonium
Cr:	Chromium	Ra:	Radium
H-3:	Tritium	S:	Sulphur
I:	Iodine	Th:	Thorium
P:	Phosphorus	Pu:	Plutonium
Pb:	Lead		

[5] Note that total alpha and total beta activities do not provide an accurate indication of radiological impact which depends on radionuclide specific properties.

3.1 Data reported on discharges from the offshore oil and gas industry

Contracting Parties have been invited to report the estimated discharges from offshore installations of radioactive substances:

a. in produced water (Pb-210, Ra-226, Ra-228);

b. from descaling and decommissioning operations (Pb-210, Ra-226, Ra-228, Th-228);

c. from tracer experiments (H-3, other beta and gamma emitters).

The data can be viewed and downloaded here
https://odims.ospar.org/en/submissions/ospar_rnuclides_non_nuclear_2019_01/

OSPAR Secretariat
The Aspect
12 Finsbury Square
London
EC2A 1AS
United Kingdom

t: +44 (0)20 7430 5200
f: +44 (0)20 7242 3737
e: secretariat@ospar.org
www.ospar.org

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.

Publication Number: 806/2021