OSPAR COMMISSION

Discharges of radioactive substances from the non-nuclear sectors in 2007

Radioactive Substances Series

2009

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. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

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. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

Acknowledgement

This report has been prepared by the expert assessment panel, comprising of Mr Bob Russ (leader), UK; Mr Michel Chartier, France; Mr Justin Gwynn, Norway and Mrs Ann-Christin Hägg, Sweden with the support of Ms Hanne-Grete Nilsen and Ms Corinne Michel 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 have been published so far. This is the first annual report and assessment of discharges from the non-nuclear sector published by OSPAR.

The 2007 data reported by Contracting Parties were sufficient to make and assessment of discharges from the offshore oil and gas sub-sector, which is the major non-nuclear source. It is also possible to judge the relative contribution from the medical sub-sector. Only sparse data are available for the other non-nuclear sub-sectors (universities and research, radiochemical manufacturing and various others), but they are considered to be of minor importance.

The radionuclides reported from the offshore oil and gas industry are: Ra-226, Ra-228, Pb-210, discharged via produced water. The data are converted into total alpha and total beta (excluding tritium) activity in order to be able to compare the magnitude with discharges from other sectors.

It is not possible to say whether there is a trend in the discharges from the offshore oil and gas sector during 2005-2007.

The offshore oil and gas sub-sector is the principal source of total alpha discharges, accounting for 97.6% of the total. This sub-sector also makes a 7% contribution to the total beta discharges from all sectors (nuclear and non-nuclear). In total, the non-nuclear sector contributed an estimated 52% of the total beta discharges from all sectors, with the largest single contribution (43%) 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.

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 à ce jour car les séries de données sont incomplètes. Il s’agit du premier rapport annuel, et évaluation, des données sur les rejets provenant du secteur non nucléaire publié par OSPAR.

Les données de 2007, notifiées par les Parties contractantes, sont suffisantes pour permettre une évaluation des rejets provenant du sous-secteur pétrolier et gazier offshore, qui représente la source principale non nucléaire. Il est également possible d’évaluer la contribution relative du sous-secteur médical. On ne dispose que de données clairsemées pour les autres sous-secteurs non nucléaires (universités et recherche, industrie radiochimique et divers autres), mais on les considère de peu d’importance.

Les radionucléides notifiés, provenant de l’industrie pétrolière et gazière d’offshore, sont les Ra-226, Ra-228, et Pb-210, rejetés avec l’eau de production. Les données sont converties en activité alpha global et activité bêta global (à l’exception du tritium) afin de pouvoir en comparer la magnitude avec les rejets provenant d’autres secteurs.

Il n’est pas possible de déterminer si les rejets provenant du secteur pétrolier et gazier d’offshore de 2005 à 2007 présentent des tendances.

Le sous-secteur de l’industrie pétrolière et gazière d’offshore est la source principale de rejets d’alpha total représentant 97,6% du total. La contribution de ce sous-secteur aux rejets de bêta global provenant de tous les secteurs (nucléaires et non nucléaires) s’élève à 7%. Au total, le secteur non-nucléaire contribue à une quantité estimée représentant 52% des rejets de bêta total provenant de tous les secteurs, la contribution unique la plus importante (43%) provenant des rejets d’iodine-131 par le sous-secteur médical. Les rejets de tritium provenant du secteur non-nucléaire sont négligeables par rapport à ceux du secteur non nucléaire.

1. Introduction

The possibility of harm to the marine environment and its users (including the consumers of food produced from the marine environment) from inputs of radionuclides caused by human activities is a subject of concern for the 1992 OSPAR Convention.

When the Paris Convention was adopted in 1974, in order to provide for international action against land-based sources of marine pollution, the Contracting Parties undertook "to adopt measures to forestall and, as appropriate, eliminate pollution of the maritime area from land-based sources by radioactive substances".

When the first Ministerial Meeting under the 1992 Convention of the OSPAR Commission was held in 1998 at Sintra, Portugal, agreement was reach on a strategy 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 and confirmed by the second Ministerial Meeting of the OSPAR Commission at Bremen in 2003. The OSPAR Radioactive Substances Strategy thus now provides that:

> "In accordance with the general objective [of the OSPAR Convention], the objective of the Commission with regard to radioactive substances, including waste, is to prevent pollution of the 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:
>
> a. legitimate uses of the sea;
>
> b. technical feasibility;
>
> c. radiological impacts on man and biota."
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> The Strategy further provides that:
>
> > "This strategy will be implemented in accordance with the Programme for More Detailed Implementation of the Strategy with regard to Radioactive Substances in order to achieve by the year 2020 that the Commission will ensure that 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, emission and losses, are close to zero."

The Programme for More Detailed Implementation of the Strategy with regard to Radioactive Substances and the agreements made at the second OSPAR Ministerial Meeting, in effect, provide that:

a. the Contracting Parties will each prepare a national plan for achieving the objective of the Strategy;

b. they will monitor and report on progress in implementing those plans, and

c. the OSPAR Commission will periodically evaluate progress against an agreed baseline.

Regular reporting from Contracting Parties is therefore required in order to review progress towards this target.

The OSPAR Commission adopted in 2004 a reporting format to be used for annual reporting of data on discharges from the non-nuclear sector. 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 2007 data, and for the offshore oil and gas sector, presents also the total discharges in 2005 and 2006.

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

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	GTLDs & ICSD[1]	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	Not present	?
Ireland	Present	Not present	Not present	Not present	Not present	Present	Present	Not present	Not present[2]
Luxembourg	Not present	Not present	Not present	Present	Not present	Present	Present	?	?
Netherlands	Present	Present	Present	Present	Not present	Present	Present	Not present	Not present
Norway	Present	Not present	Present	Present	Not present	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	Not present
Sweden	Not present	Not Present	Not present	Not Present	Not present	Present	Present	Not present	?
Switzerland	Not present	Not present	Not present	Not Present	Not present	Present	Present	Present	Not present
United Kingdom	Present	Not present	Present	Present	Present	Present	Present	Not present	Not Present

1 This column refers to "manufacture of americium sources for Gaseous Tritium Light Devices (GTLD) and Ionising-Chamber Smoke Detectors (ICSD).

2 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. Assessment of the radioactive discharges from non-nuclear sources in 2007

2.1 Introduction

Not all Contracting Parties have provided data for 2007: Five out of eight Contracting Parties reported for the offshore oil and gas sub-sector; five Contracting Parties reported on their university and research, and; nine Contracting Parties reported on their medical sub-sector. The number of Contracting Parties reporting is increasing each year and the completeness of the reports is also improving.

There is sufficient data to make an assessment for 2007. The reports for produced water discharges from the offshore oil and 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. 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.

2.2 Discharges from the offshore oil and gas sub-sector

Data were provided by Norway, the Netherlands, the United Kingdom, Ireland and Denmark. The United Kingdom and Norway are the principal contributors. In 2007 the relative contributions, based on produced water activities, were: Norway 56%, United Kingdom 27%, Netherlands 14%, and other Contracting Parties that reported ~3%. There is an unknown, but probably minor, contribution from the other three Contracting Parties with an offshore oil and gas industry. The assessments below are based on produced water discharge data, the data on scale discharges are incomplete, but are very small compared to the produced water contribution.

Total alpha and total beta discharges from produced water have been calculated using the formulae agreed by the OSPAR Radioactive Substances Committee to include contributions from the radioactive daughter products in the respective decay chains. The formulae assume equilibrium in these decay chains, and consequently the calculated total alpha and total beta values are the maximum activities that can be produced from the decay of the measured/assessed parent radionuclides (*i.e*. Ra-226, Ra-228, Pb-210).

Although the formulae for calculating the total alpha and total beta discharges from the offshore oil and gas sub-sector were derived in order that comparison could be made with the equivalent discharges from the nuclear sector, it should be remembered that for the offshore oil and gas sub-sector the values are good estimates of activities discharged, rather than a measured total alpha or total beta discharge. To that extent they differ from the values reported for the nuclear sector.

2.2.1 Total alpha from produced water discharges

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

$$\text{Total alpha (TBq)} = (5\text{xRa-228})+(4\text{xRa-226})+(1\text{xPb-210}).$$

The total alpha discharges, not including scale, are given in Table 2; for comparison the reported radium-226 and the equivalent nuclear contributions are also illustrated.

Table 2. *Total alpha discharges in 2005 - 2007*

	Oil/gas		**Nuclear**
	Total alpha	Ra-226	Total alpha
2005	6.4 TBq	0.81 TBq	0.52 TBq
2006	6.9 TBq	0.78 TBq	0.34 TBq
2007	7.4 TBq	0.90 TBq	0.19 TBq

There are a large number (>100) of offshore installations contributing to this total, but approximately 20% arises from just two installations in the Troll oilfield in the Norwegian sector of the North Sea due to the geological characteristics of that field. It is too early to establish if there is any trend in the level of total alpha discharges from this sub-sector.

2.2.2 Total beta (excluding tritium) from produced water discharges

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

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

The total beta discharges, not including scale, are given in Table 3; for comparison the equivalent nuclear contributions are also illustrated.

Table 3. *Total beta discharges 2005-2007*

	Oil/gas	Nuclear
2005	4.25 TBq	160 TBq
2006	4.67 TBq	58 TBq
2007	4.94 TBq	33.4 TBq

2.2.3 Tritium

Tritium is used as a tracer in the oil industry, and 1.68 TBq was used in the Norwegian sector during 2007. The nuclear industry discharges of tritium are 10 000 times higher than this.

2.3 Discharges from the medical sub-sector

OSPAR's Radioactive Substances Committee 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. Reporting is not required where delay tanks are used to deal with liquid effluents.

2.3.1 Total alpha discharges

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

2.3.2 Total beta (excluding tritium) discharges

From those limited data available it is possible to estimate the contribution of the medical sub-sector to the discharges of technetium-99. Although technetium-99m is widely used, its decay product technetium-99, discharged by this sub-sector, is only of the order of 1 MBq/y. The discharges of technetium-99 from the nuclear sector are more than a million times higher than this and consequently it is possible to conclude that the medical sub-sector does not make a significant contribution to technetium-99 discharges. The total beta value below does not include technetium-99m, as its short half-life (6 hours) means that it has virtually completely decayed to technetium-99 by the time it reaches the marine environment.

The reported discharges of iodine-131 over the period have been in the range 17 to 23 TBq/y. This is an under-estimate of the total, as not all Contracting Parties reported. Iodine-131 is widely used in medicine and in Europe its use is assumed to be approximately proportional to population. In the absence of data from Contracting Parties on their populations living on the NE Atlantic watershed/catchment area, a very rough estimate has been made to allow for those Contracting Parties that did not report their medical discharges; the actual discharge of iodine-131 is likely to be closer to 30 TBq/y. This is a similar level of discharges to those of total beta from the nuclear industry, which in 2007 amounted to 33.4 TBq.

2.4 University and research sub-sector

It is difficult to make an assessment of the discharges from this sector as reporting is very variable. From the data that has been provided it is possible to conclude that this sector is not a significant contributor to total beta (<1 TBq/y) or tritium (<2 TBq/y), and there are no reported alpha emitting radionuclide discharges.

2.5 Radiochemical manufacturing sub-sector

Radiochemical manufacturing is carried out in at least four of the Contracting Parties, however only the United Kingdom reports separately on this sub-sector; the discharges are usually included in those for the nuclear site on which the processes are carried out. The data below only reflects United Kingdom discharges.

2.5.1 Total alpha

The reported total alpha discharge for 2007 was 12.5 MBq. This is a minor contribution to the overall total alpha discharge to the maritime area.

2.5.2Total beta (excluding tritium)

The sum of the reported beta emitters plus the reported total beta during 2007 amounts to 0.67 TBq. This principally due to discharges of carbon-14.

2.5.3Tritium

In 2007 tritium discharges were 28.1 TBq, this is a minor contribution to tritium discharges; nuclear sector discharges of tritium are nearly a thousand times higher than this. However, a proportion of this 28.1 TBq is in the form of tritium labelled organic compounds, which have significantly different environmental pathways/fates to that of tritiated water, as discharged by the nuclear industry, and cannot be compared directly.

2.6 Other non-nuclear sub-sectors

Discharges were reported for the phosphate industry, titanium dioxide pigment manufacture, primary steel manufacture and the manufacture of GTLDs and smoke detector sub-sectors. None of these sub-sectors made a significant contribution to the overall discharges of total alpha, total beta or tritium.

2.7 Summary and conclusions

For 2007 the overall summary including comparison with the nuclear sector is shown in Table 4.

Table 4. *Comparison of discharges in 2007 from the non-nuclear and nuclear sectors.*

Non-nuclear sector (TBq)						Nuclear sector (TBq)
	Oil/gas	Medical	Univ/R&D	Radiochem	Total	
Total alpha	7.4	-	-	-	7.4	0.19
Total beta	4.9	~30*	<1	0.67	~ 36	33.4
Tritium	1.68	-	<2	28.1	~ 32	15594

* estimate based on 20 TBq reported by 9 Contracting Parties

The offshore oil and gas sub-sector is the principal source of total alpha discharges, accounting for 97.6% of the total. This sub-sector also makes a 7% contribution to the overall total beta discharges from all sectors (nuclear + non-nuclear). In total, the non-nuclear sector contributed an estimated 52% of the total beta discharges from all sectors, with the largest single contribution (43%) 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. 2007 data and information

In this chapter 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 2005/7). The following abbreviations for radionuclides (elements) are used in the tables:

Am: Americium

C: Carbon

Cr: Chromium

H-3: Tritium

I: Iodine

P: Phosphorus

Pb: Lead

Po: Polonium

Ra: Radium

S: Sulphur

Tc: Technetium

Th: Thorium

Pu: Plutonium

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).

Table 5 shows the data from the offshore oil and gas industry.

Table 5: *Discharges from the offshore oil and gas industry in 2007, in terabecquerel (TBq). Shaded boxes are not applicable.*

		CP	OSPAR Region [1]	Pb-210	Ra-226	Ra-228	Th-228	H-3	Other β/γ emitters
Produced water, TBq (ES1) (IE1) (NO1) (UK1) (UK2) (UK3)		DK	II	5.97E-04	3.28E-02	1.52E-02			
		IE	III	< 2.2E-06	< 3.11E-06	< 5.9E-07			
		NL	II	9.90E-03	1.00E-01	1.30E-01			
		NO	I	5.00E-03	4.60E-02	3.80E-02			
		NO	II	4.70E-02	4.82E-01	3.59E-01			
		UK [9]	II	2.70E-02	2.32E-01	1.94E-01			
		UK	III	1.59E-04	6.10E-03	5.97E-03			
Descaling operations, both offshore and onshore, from normal production that leads to discharges (UK4) (UK10)	Radioactivity in suspended solids arising from water-jet descaling (TBq)	UK	II	Offshore: 19.25 GBq discharge of scale from undefined processes [UK6] Onshore: 4.22 GBq Total alpha and 2.95 GBq Total beta/gamma (excluding tritium) discharge [UK6]					
	Radioactivity in solution as a result of descaling using acids or scale dissolvers (TBq) (UK5)	DK	II	2.95E-05	1.20E-04	1.02E-04	1.99E-05		
Descaling operations, both offshore and onshore, from decommissioning of oil and gas installations that leads to discharges (UK7) (UK10)	Radioactivity in suspended solids arising from water-jet descaling (TBq)								
	Radioactivity in solution as a result of descaling using acids or scale dissolvers (TBq)								
Radioactivity discharged as a result of tracer experiments, TBq (UK 8) (UK11)		NO	I					1.34E+00	
		NO	II					3.36E-01	5.00E-02

Further details on the data reported in Table 5 are given below.

1. The five OSPAR sub-regions are:

   (I) The Arctic,
   (II) The Greater North Sea (including the English Channel),
   (III) the Celtic seas,
   (IV) the Bay of Biscay/Golfe de Gascogne and Iberian coastal waters, and
   (V) the wider Atlantic.
   The definitions of these and a map are given in the Strategy for the Joint Assessment and Monitoring Programme.

Ireland

IE1 The radioanalysis of the produced water returned MDA values. For calculations, Ireland have assumed that these MDA values represent the maximum possible activity in the sample.

Norway

NO1 Pb-210 values are actually based on samples with concentrations under the detection limit. Figures reported are estimates only, not real values.

Spain

ES1 Gas production in the OSPAR area comes from the North and South Poseidon Concessions. These concessions do not discharge any water production into the sea; the water is treated onshore. Water injection is carried out by the Gaviota field, an offshore underground gas storage. Therefore, all produced water is re-injected or treated onshore and so Spain did not have any discharges into the sea in 2007 and has not had any since 2000.

United Kingdom

UK1 The total activity of each radionuclide analysed per installation was calculated using the activity concentrations provided in EEMS and multiplying by the mass of particulate and solution for the produced water discharged over the period. The total activity provided in the report is based on the sum of the average activity for each of the specified radionuclides per installation where an installation has more than one set of sample data. This method was chosen in the absence of detailed information on the amount of produced water discharged at the time that samples were taken.

UK2 There is no information currently collected on the amount of Pb-210 in produced water. The figure for Pb-210 in produced water is derived from the analysis of Po-210 by assuming that the Pb-210 and Po-210 are in secular equilibrium.

UK3 This applies to Region II. There is no information in EEMS for the total activity of Ra-228 in produced water. The figure for Ra-228 is determined from the reported Ac-228 in EEMS on the assumption that Ac-228 and Ra-228 are in secular equilibrium.

UK4 Individual radionuclide data are currently not reported for discharges from off-shore de-scaling operations.

UK5 This applies to Region II. The information reported does not contain any details of the radionuclides released or the descaling operation adopted (e.g. from jet washing or use of acid dissolvers). It is understood, however, that because the use of acids and scale dissolvers is less widespread such that the activity discharged is primarily due to jet washing.

UK6 This applies to Region II. The information for off-shore descaling operations has been derived from information in the EEMS database and provided by the Department Energy and Climate Change (DECC). Information for on-shore descaling operations has been derived from the information included in the Scottish Pollutant Release Inventory held by SEPA. Total reported activity does not include discharges that are exempt under the Radioactive Substances (Phosphatic Substances, Rare Earths, etc) Exemption Order 1962. This states that solid materials containing mixed nuclides of natural origin are exempt from the requirements of the Radioactive Substances Act 1993 if the activity concentration of the material is below 14.8 Bq/g.

UK7 No information on decommissioning wastes has been reported. All data referring to scale is assumed to relate to normal operations.

UK8 The data generally provided under this heading is the amount of the particular tracer analysed in any discharge water rather than the amount of tracer administered. The estimated amount of tracer reported is approximately 25% of the amount administered. Therefore, the reported activity of tracer is generally modified by a factor of 4 to give an estimate of the activity administered (in compliance with the OSPAR reporting requirements).

UK9 Notes apply to Region II for Ra-226 and Ra-228 and to Regions II and III for Pb-210. The total figures given in the reports are for the contribution due to produced water only. There is no radionuclide-specific activity information available for activity in discharges from scale.

UK10 No specific information is provided on the activity of Th-228 in the discharge of scale; a zero value is reported as a consequence.

UK11 All discharges of tracers are from installations in sub-region II. In 2007, no discharges were reported greater than the reporting threshold levels to water of: tritium: 1,000,000 MBq/year and carbon-14: 100 MBq/year.

3.2 Data reported on discharges from other non-nuclear sectors

Contracting Parties have been invited to report the estimated discharges from the following other non-nuclear sources of radioactive substances:

a. the medical sector (I-131, Tc-99);

b. universities and research centres (H-3, C-14, P-32, S-35, Cr-51, I-125);

c. phosphate industry (Pb-210, Po-210, Ra-226);

d. titanium dioxide pigment manufactures (Pb-210, Po-210, Ra-226, Ra-228);

e. primary steel manufacture (Pb-210, Po-210);

f. rare earth production (Ra-228, Th-228);

g. manufacture of Am sources of Gaseous Tritium Light Devices (GTLDs) and Ionising Chamber Smoke Detectors (ICSD) (Am-241);

h. radiochemical production (H-3, C-14, S-35, Cr-51, I-125, Pb-210, Po 210).

Table 6 shows the data reported from non-nuclear sector other than offshore oil and gas.

Table 6. *Discharges from non-nuclear sector than offshore oil and gas in 2007, in terabecquerel (TBq). Shaded boxes are not applicable.*

			Discharges of specified radionuclides (TBq) (BE1)															
Sector	**CP**	**OSPAR Region [1]**	**I-131**	**Tc-99**	**H-3**	**C-14**	**P-32**	**S-35**	**Cr-51**	**I-125**	**Pb-210**	**Po-210**	**Ra-226**	**Ra-228**	**Th-228**	**Am-241**	**Total Alpha**	**Total Beta/ Gamma**
Medical Sector (CH1) (ES1) (IE1) (NL1) (UK1)	BE	II	4.89E+00	2.58E-05														
	CH	II	1.50E-02	(CH2)														
	DK	II	1.49E+00	1.06E-07														
	ES	IV		2.99E-10														
	IE	III	4.75E-01	4.50E-08														
	NL	II	3.10E+00	4.70E-07														
	N	I	2.83E-01	1.00E-08														
	N	II	8.33E-01	5.00E-08														
	SE	II	4.90E-01	2.60E-08														
	UK	II	8.00E+00	4.20E-07														
	UK	III	2.45E+00	1.40E-07														
Universities & Research centres (B2) (ES1) (IE2) (NL2) (UK2)	BE	II			5.11E+00	1.23E-03				1.05E+01								
	CH	II			2.64E-02	5.90E-03												
	ES	IV			2.16E-03	1.01E-03	5.10E-03	3.11E-02	1.25E-03	7.30E-04								
	IE	III			8.52E-04	6.70E-05	5.43E-05	4.60E-06	2.00E-08	2.39E-04								
	UK	II			5.75E-01	1.36E-01	6.08E-02	4.69E-02	1.45E-02	2.84E-02								
	UK	III			1.76E-01	4.22E-02	7.90E-03	2.49E-02	1.15E-03	3.67E-04								
Phosphate industry (ES2) (UK3)	NL	II									4.60E-04	2.40E-04						
Titanium dioxide pigment manufactures (ES3) (UK4)	ES	IV									3.00E-05	3.00E-05	2.50E-05	5.00E-05				
	NL	II									2.70E-04	2.70E-04	4.50E-03	2.40E-03				
Primary steel manufacture (ES4) (NL3) (UK5)	NL	II									1.90E-04	1.80E-04						
Rare earth production (ES5) (UK6)																		
Manufacture of Am sources of GTLDs & Ionising Chamber Smoke Detectors (CH3) (ES5) (IE3) (UK7)	CH	II			2.20E-02													
Radiochemical production	UK	II				5.20E-01			3.96E-05								1.25E-05	4.32E-03
	UK	III			2.81E+01	1.43E-01				1.26E-06								

Further details on the data reported in Table 6 are given below.

1. The five OSPAR sub-regions are:

(I) The Arctic,

(II) The Greater North Sea (including the English Channel),

(III) the Celtic seas,

(IV) the Bay of Biscay/Golfe de Gascogne and Iberian coastal waters, and

(V) the wider Atlantic.

The definitions of these and a map are given in the Strategy for the Joint Assessment and Monitoring Programme.

Belgium

BE1 I-131: the value given represent all I-131 delivered to the hospitals. Most hospitals have deep freeze toilets which are used for hospitalised patients treated in isolation rooms. A few hospitals do use holding tanks to reduce the concentration in the liquid discharges. However, the limit in Belgium is set at 45 Bq/l. In practice, the isotope will always be kept at least 10 half times to decay and is only released after verification and when all storage tanks are full.

Values reported for H-3, C-14 and I-125 represent the amounts delivered to the laboratories (private institutions or companies, universities, research centres and hospitals laboratories performing “In Vitro or Clinical Biology” practices).

The reported estimations were made by help of the “transported radionuclides” in Belgium to hospitals, universities and research centres in our country (authorisation needed). For 2007 all ordered and delivered radionuclides or activities were added. Since no data is available about the real discharges, we calculated a maximum upper level; all delivered radionuclides and their activity are completely discharged with their original amount of activity.

a) Nuclide properties (decay scheme)

^{99}Mo	^{99m}Tc	^{99}Tc with
$T_{1/2}$ = 2.75 days = 2.38 E+05 s	$T_{1/2}$ = 6 hours = 2.16 E+04 s	$T_{1/2}$ = 2.14 E+05 years = 6.75 E+12 s

b) Explication calculation:

From following equation $Activity = \lambda N = \frac{0.693}{T_{1/2}} \times 6.02 \times 10^{23} \times \frac{mass}{A_{mass}}$ and presuming that all ^{99}Mo is transferred into ^{99}Tc leads to:

$$\frac{mass_{^{99}Mo}}{A_{mass,^{99}Mo}} = \frac{mass_{^{99}Tc}}{A_{mass,^{99}Tc}} \quad \text{or} \quad Activity_{^{99}Mo} \times T_{1/2,^{99}Mo} = Activity_{^{99}TC} \times T_{1/2,^{99}Tc} \quad \text{or}$$

$$Activity_{^{99}Tc} = \frac{Activity_{^{99}Mo} \times T_{1/2,^{99}Mo}}{T_{1/2,^{99}Tc}}$$

$$Activity_{TC-99} = \frac{\left(7.31 \times 10^{14} \, Bq\right) \times \left(2.38 \times 10^{5} \, s\right)}{\left(6.75 \times 10^{12} \, s\right)} = 2.58 \times 10^{7} \, Bq = 2.58 \times 10^{-5} \, TBq$$

BE2 Research centres & Universities use holding tanks to reduce the concentration of P-32, S-35 and Cr-51.

France

France has indicated that French research data are not included in this report as they are already notified and taken into account in Report on Liquid discharges from nuclear installations under other radionuclides.

Ireland

IE1 Medical Sector: Hospitals were requested to record the amount of I-131 discharged to the sewers for the period Jan – Dec 2007. The I-131 figure includes the (ICRP 53) 30% discharge correction for out-patients.

Hospitals were requested to record the amount of Tc-99m administered to patients. It is assumed that 100% of the amount of Tc-99m administered has decayed to Tc-99 and that it is all discharged.

IE2 Universities & Research Sector: The figures are based on results reported by 9 educational establishments and 4 commercial research laboratories that use the specified radionuclides. Two of the 13 establishments reported no discharges for the period in question.

The nature of the discharges was principally biological and pharmacological science research based and take place via a dedicated sink to a foul sewer. In general, the discharges were estimated / calculated by sampling an aliquot of the relevant waste and undertaking liquid scintillation analysis. The discharges have decreased since last year reflecting the decreased usage of the radionuclides, particularly S-35. However, the discharge value for I-125 has increased due to an additional University contributing to the data. The contribution for chromium is from one site.

IE3 Manufacturing of GTLD's and ICSD's: No gaseous tritium light devices or ionisation chamber smoke detectors are manufactured in Ireland. While ICSD's are assembled in Ireland with imported Americium-241 sources, a requirement exists whereby any disused sources are returned to the original supplier at the end of their useful life and exported to the source manufacturer.

The Netherlands

NL1 Medical sector: The estimate of discharges from the medical sector is based on the number of therapeutic and diagnostic procedures, reported to the RIVM institute by the hospitals in the context of a yearly survey, and the recommended activity per procedure.

NL2 The discharges of the Delft (NL4) and Petten (NL5) research centres are already reported as total (reactors + different laboratories) discharges in Table 5 of RSC 09/3/1 and are therefore not reported here.

NL3 The discharges from primary steel manufacture are below the level requiring a permit.

Spain

ES1 There are holding tanks to reduce the concentration of I-131 in the liquid discharges to below 10 Bq/l.

ES2 Two plants process phosphates and produce both phosphoric acid and phosphate fertiliser; the residual phosphogypsum is piled and no radioactive liquid effluents are released into the river because the system works as a closed circuit.

ES3 There is only one Titanium dioxide plant that is located on the South West coast. According to the current Spanish legislation, norm industries are not obliged to report on radioactive discharges. The provided activity values have been estimated as part of a study that is being carried out by the Seville and Huelva Universities, which foresees to perform analyses throughout the next 6 months. Therefore they are generic values.

ES4 According to the available information, in Spain there are not integrated steel plants. The Spanish steel making plants (conversion of pig iron to steel) operate a dry gas cleaning process and, for this reason, no discharges of Pb-210 and Po-210 take place.

ES5 Not present.

Switzerland

CH1 Discharges from holding tanks in hospitals.

CH2 The amount of Tc-99 discharged is not known; 60 TBq of Mo-99 Generators were bought in Switzerland in 2007.

N.B: The medical institutes and hospitals have to report each year to the legal authorities the amount of radioactive isotopes, such as Tc-99m, bought for diagnostic applications. In effect, the institutes report the type and activity of the generators they buy. For Tc-99m, that means that they report the total activity of Mo-99 they bought in a year. But they don't report on activity of Tc-99m extracted from the generators nor do they report on activities of Tc-99m which were really applied to patients.

CH3 From luminous paint production and from tritium gas light source production.

United Kingdom

UK1 Medical Sector: This sector has been interpreted as being hospitals and clinics and medically related laboratories. Tc-99m discharges are generally estimated to be 30% of administered dose. For the purposes of this report, these reported figures have been scaled up to 100% and converted to the Tc-99 equivalent by using a conversion factor, based on the ratio of the half-lives of Tc-99m and Tc-99, of 3.24×10-9.

UK2 Universities and Research Centres: This has been interpreted to include all universities, educational establishments, medical research facilities and research institutes. In addition, it also includes the pharmaceutical industry, which is taken to comprise all operators involved in pharmaceutical research and in the manufacture of pharmaceuticals. An additional category, of non-medical commercial laboratories has been included in this category for the purposes of this report (laboratories associated with medical activities are included in the Medical Sector). The percentage of the discharge due to the pharmaceutical, commercial laboratories and non-commercial (other) sectors are as follows:

Nuclides	% Universities/ Research discharge due to:					
	Pharmaceuticals		Commercial Laboratories		Others[a]	
	Region II	Region III	Region II	Region III	Region II	Region III
H-3	93.4	96.2	1.5	0.0	5.1	3.8
C-14	60.6	94.5	34.1	0.1	5.3	5.4
P-32	0.8	0.2	0.3	1.4	98.9	98.4
S-35	2.1	0.1	0.0	0.0	97.9	99.9
Cr-51	1.0	0.0	0.0	0.0	99.0	100.0
I-125	64.5	5.1	0.7	0.0	34.8	94.9

[a] includes universities, educational establishments and medical research facilities

Due to the range of facilities, the method of estimation and origin is not uniform. Information from previous reviews suggests the majority of organisations estimate discharges based upon direct measurement of discharges.

UK3 Phosphate Industry: No longer present in the United Kingdom.

UK4 Titanium Dioxide Industry: There are three titanium dioxide plants in the United Kingdom, all located on the east coast of England (sub-region II). There are no reported radioactive discharges from these plants and they do not hold authorisations to discharge radioactivity.

UK5 Primary Steel Manufacturing: There are three primary steel manufacturing plants in the United Kingdom, two on the east coast of England (sub-region II) and one in Wales (sub-region III). However, the plants operate a dry gas cleaning process and any dust removed from the stack is either recycled or sent to landfill. There are no liquid discharges arising from this process.

UK6 Rare Earth production: There is no rare earth production in the United Kingdom.

UK7 There are no manufacturers of Americium-241 sources for ICSD operating in the United Kingdom. One GTLD manufacturer was identified in England in 2005; this facility did not report discharges for 2007. No further facilities of this kind are known to operate.

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