

OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

Meeting of the Radioactive Substances Committee (RSC)

Stockholm (Sweden): 20-23 April 2010

Position paper on the implications of deep sea disposal of radioactive waste

Prepared by the Secretariat in cooperation with IAEA

This document seeks to establish the context for further discussions as to the potential impact of former deep sea radioactive waste disposals in the North-East Atlantic

Background

1 RSC 2009 agreed to include a product in the draft Programme of Work for 2009/2010 to consider the potential impact of radioactive waste disposed in the deep sea in the past (RSC 09/12/1 §11.3). Consequently, Product 4: Development of a position paper on the implications of deep sea disposal of waste in the North-East Atlantic was included in the Programme of Work for RSC 2009/2010 (OSPAR 09/22/1 Annex 16). After a request from OSPAR Secretariat, the IAEA Secretariat submitted a report summarizing its involvement in the assessment and control of radioactive waste dumping activities since 1957. Part of that report¹ was used to prepare the present position paper.

Radioactive waste

Classes

2 Following the International Atomic Energy Agency (IAEA) criteria², radioactive waste can be classified into the following six categories:

- (1) Exempt waste (EW): Waste that meets the criteria for clearance, exemption or exclusion from regulatory control for radiation protection purposes;
- (2) Very short lived waste (VSLW): Waste that can be stored for decay over a limited period of up to a few years and subsequently cleared from regulatory control;
- (3) Very low level waste (VLLW): Waste that does not necessarily meet the criteria of EW, but that does not need a high level of containment and isolation and, therefore, is suitable for disposal in near surface landfill type facilities with limited regulatory control;
- (4) Low level waste (LLW): Waste that is above clearance levels, but with limited amounts of long lived radionuclides. Such waste requires robust isolation and containment for periods up to a few hundred years and is suitable for disposal in engineered near surface facilities;

¹ The report *Dumping of Radioactive Wastes at Sea*, March 2010, prepared by the International Atomic Energy Agency at the request of OSPAR Radioactive Substances Committee Secretariat can be downloaded from OSPAR web site (RSC 10/4/3 Info.2).

² INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), 2009, *Classification of Radioactive Waste*, General Safety Guide No. GSC-1, Vienna, pp.5-6.

- (5) Intermediate level waste (ILW): Waste that, because of its content, particularly of long lived radionuclides, requires greater degree of containment and isolation than LLW. Waste of this category requires disposal at depths of the order of tens of metres to a few hundreds metres;
- (6) High level waste (HLW): Waste with sufficiently high levels of activity concentration that a high degree of containment and isolation, normally in stable geological formations several hundred metres or more below the surface, is required.

Sources

3 Radioactive waste can be generated by a wide range of activities such as those involving the production of nuclear energy, including all the steps in the nuclear fuel cycle, those regarding the institutional use of radioactive materials in the fields of research, industry and medicine; those related to the development of defence and weapons programmes; or those involving the processing of mineral ores or other materials containing naturally occurring radionuclides. Examples of the last include the processing of phosphate ore and oil and gas exploration.

4 The radioactive waste that is generated is as varied in form and activity concentration as it is in type of generating activity. It may be solid, liquid or gaseous and levels of activity concentration range from high and intermediate levels associated with spent fuel and residues from fuel reprocessing to very low levels associated with radioisotope applications in laboratories or hospitals.

Sources of radioactive waste in the marine environment

5 Four sources of anthropogenic radionuclides that could enter in the marine environment have been identified. These are:

- (1) Dumping at sea of radioactive waste, arising from sources such as nuclear power plants, reprocessing plants, nuclear powered vessels, industries, hospitals, scientific research centres and nuclear weapons facilities;
- (2) Controlled releases of low level radioactive liquid effluent from nuclear and non-nuclear industries, hospitals, scientific research centres and nuclear weapons facilities;
- (3) Fallout from testing of nuclear weapons either in the atmosphere or underwater; and
- (4) Accidents and losses involving radioactive materials, for example the sinking of a nuclear powered submarine, or a loss of vessel carrying nuclear fuel or nuclear weapons, or the re-entry of a satellite containing nuclear materials, or the loss of sealed radioactive sources.

6 In order to respond to the concern expressed at RSC 2009, this document will focus on the first source of radioactive waste in the marine environment, i.e. deep sea disposal, which has been defined by the IAEA as "disposal of waste packaged in containers on the deep ocean floor"³.

International legal framework

The London Convention 1972 and the 1996 Protocol

7 In the 1970s, the practice of sea dumping became subject to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention 1972) in force since 1975.

8 For the regulation of materials to be disposed of in the marine environment, 'black' and 'grey' lists were established. The disposal of substances on the 'black' list (Annex I to the Convention) was prohibited except in trace quantities. Substances on the 'grey' list (Annex II to the Convention) were subject to 'special care' measures to ensure that their disposal, which had to be carried out under the provision of a 'special permit', would not have adverse effects on the marine environment. High level radioactive wastes and other

³ INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), 2007, *IAEA Safety Glossary. Terminology Used in Nuclear Safety and Radiation Protection*, Vienna, p.55.

high level radioactive matter, as defined by the IAEA, were included in the “black” list. Low and intermediate level radioactive wastes were included in the “grey” list, and the IAEA developed a number of recommendations to be taken fully into account by Contracting Parties when issuing the special permit required for the disposal of these wastes.

9 Since 1983 a moratorium on the dumping of low-level radioactive wastes has been in place pending the completion of scientific and technical studies as well as studies on the wider political, legal, economic and social aspects of radioactive waste dumping. Following completion of these studies, the Parties agreed in 1993 to amend the Annexes I and II to the London Convention to ban the dumping of all types of radioactive wastes and radioactive matter. This legally binding prohibition entered into force on 20 February 1994. Russia accepted the ban of dumping in 2005.

10 In 1996, a Protocol was adopted to the London Convention 1972. The 1996 Protocol entered into force in 2006 and prohibits all dumping, except for those wastes listed on an approved list (“reverse list”). Radioactive wastes and other radioactive matter are not included on such a list.

Regional Conventions other than the OSPAR Convention

11 Many of the Conventions established, either under the umbrella of the United Nations Environment Programme (UNEP) or independently, have also adopted a restrictive approach to the regulation of dumping. The sea disposal of radioactive waste was totally prohibited in the Baltic Sea (1974), Mediterranean Sea (1976), Black Sea (1992), and in certain areas of the South Pacific (1985) and Southeast Pacific (1989).

Deep sea disposal of radioactive waste worldwide

12 In 1946, the first sea disposal operation took place at a site in the Northeast Pacific Ocean, some 80 km off the coast of California. Over the next thirty-five years, most sea disposal operations were performed under national authority approval and, in many cases, under an international consultative mechanism: Organization for Economic Cooperation and Development/Nuclear energy Agency (OECD/NEA) Consultation Mechanism for Northeast Atlantic Dump Sites. Some disposal operations continued until 1993.

13 The OECD/NEA has kept records of the disposal operations of packaged low level radioactive waste carried out by its Member States⁴. In addition, the OECD/NEA has developed specific guidelines for waste package design⁵ and site operational procedure⁶.

The IAEA’s Database on Disposals at Sea

14 In response to requests from the London Convention 1972, the IAEA has developed a global inventory of radioactive materials entering the marine environment due to the disposal at sea of radioactive waste. The first report on the global inventory of radioactive waste disposal at sea was issued in 1991⁷. Subsequently the report was revised mainly to take account of the information received on sea disposal operations carried out by the Former Soviet Union and the Russian Federation and reissued in 1999⁸.

15 The information in the IAEA inventory database is heterogeneous due to the various ways in which records on disposal operations have been kept in different countries. Usually an indication of the date of the disposal operations as well as the location of the disposal site, in geographical coordinates, is given. The type, number and weight or volume of the disposed containers is reported. The weight or volume is

⁴ NUCLEAR ENERGY AGENCY OF THE OECD (NEA/OECD), 1983, *Interim Oceanographic Description of the North-East Atlantic Site for the Disposal of Low-Level Radioactive Waste*, Paris.

⁵ NUCLEAR ENERGY AGENCY OF THE OECD (NEA/OECD), 1974, *Guidelines for Seas Disposal Packages of Radioactive Waste*, Paris.

⁶ NUCLEAR ENERGY AGENCY OF THE OECD (NEA/OECD), 1979, *Recommended Operational Procedure for Sea Dumping of Radioactive Waste*, Paris.

⁷ INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), 1991, *Inventory of radioactive material entering the marine environment, Sea disposal of radioactive waste*, IAEA-TECDOC-588, Vienna.

⁸ INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), 1999, *Inventory of radioactive waste disposal at sea*, IAEA-TECDOC-1105, Vienna.

representative of the disposed containers but not of the radioactive waste itself. Total alpha and total beta gamma activities of disposed wastes are reported. In addition, some countries have provided more detailed information on radioactive composition of the waste.

16 After a request from the Contracting Parties to the London convention in 2007, the IAEA is currently in the process of updating and completing the databases with any 'new' or 'historical' information through consultation with all of its Members States via the official established mechanism and in cooperation with the IMO. A report, which includes the updated inventory of the dumped radioactive waste and other sources of artificial radioactive materials into the oceans, is currently under preparation by the IAEA.

Summary of wastes disposed in the North Atlantic Sites

17 In the North Atlantic dumping sites, tritium alone represents one third of the total activities (see Table 1). Tritium, together with other beta-gamma emitters such as ^{90}Sr , ^{134}Cs , ^{137}Cs , ^{55}Fe , ^{58}Co , ^{60}Co , ^{125}I and $^{14}\text{C}^9$, constitutes more than 98% of the total activity of the waste. The waste also contains low quantities (less than 2%) of alpha-emitting radionuclides, with plutonium and americium isotopes representing 96% of the alpha-emitters present.

18 The temporal distribution of the dumping operations at the North-East Atlantic site (Figure 2) started at a very low level in 1954 (0.02 PBq), increased gradually and was at its highest level of almost 7 PBq in 1980, which was shortly before the moratorium on low level radioactive waste disposal was introduced.

19 Close to 53.4% of the activity in the disposed radioactive waste is associated with the disposal of low level packaged solid waste, of which some 93.5% was disposed of at the North-East Atlantic dumping sites by eight countries, predominantly by the United Kingdom. Some 43.3% of the activity in the disposed radioactive waste is associated with the dumping of reactors with spent nuclear fuel by the former Soviet Union in the Kara Sea (Arctic Ocean). The dumping of low level liquid and solid waste in the Arctic Ocean makes up less than 1.6% of the total activity dumped. The inventory of waste dumped into the Pacific Ocean amounts to close to 1.7% of the total activity dumped.

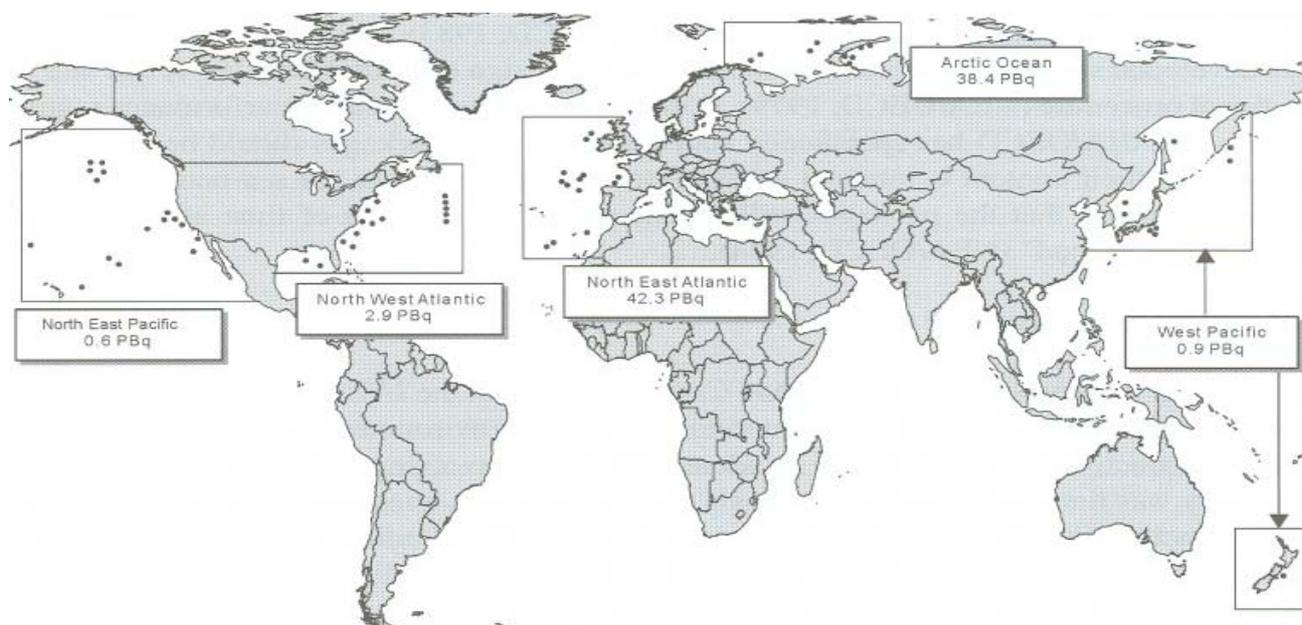


Figure 1. Worldwide disposal at sea of radioactive waste.

⁹ In view of the radioactive half-life of some of these radionuclides, most of the activities of those have already significantly decayed.

Table 1. Activities of alpha and beta gamma emitters and tritium disposed of in the Atlantic (shaded in grey), Pacific and Arctic Oceans between 1946 and 1993.

| Country | Activity (TBq) | | | | Percentage of total activity |
|-----------------------|----------------|-------------------------|---------|---------------------|------------------------------|
| | Alpha | Beta-gamma ^a | Tritium | Total | |
| Atlantic sites | | | | | |
| Belgium | 29 | 2091 | 787 | 2120 | 2.49 |
| France | 8.5 | 345 | | 353 | 0.42 |
| Germany | 0.02 | 0.18 | | 0.2 | – |
| Italy | 0.07 | 0.11 | | 0.2 | – |
| Netherlands | 1.1 | 335 | 99 | 336 | 0.40 |
| Sweden | 0.94 | 2.3 | | 3.2 | – |
| Switzerland | 4.3 | 4415 | 3902 | 4419 | 5.19 |
| United Kingdom | 631 | 34 456 | 10781 | 35 087 | 41.2 |
| United States | | 2942 | | 2942 | 3.4 |
| Subtotals | 675 | 44 586 | 15569 | 45 262 | 53.2 |
| Arctic sites | | | | | |
| Former Soviet Union | | 38 369 | | 38369. ^b | 45.1 |
| Russian Federation | | 0.7 | | 0.7 | |
| Subtotals | | 38369 | | 38369 | 45.1 |
| Pacific sites | | | | | |
| Japan | 0.01 | 15.0 | | 15.0 | 0.02 |
| Korea, Rep. Of | | | | NI ^c | |
| New Zealand | 0.01 | 1.03 | | 1.04 | |
| Russian Federation | | 2.05 | | 2.05 | |
| Former Soviet Union | | 873 | | 873 ^b | 1.01 |
| USA | | 554 | | 554 | 0.66 |
| Subtotals | 0.02 | 1446 | | 1446 | 1.70 |
| Totals (All Sites) | | | | ~85 078 | 100.00 |

^a Tritium activities are included in the beta-gamma values, if tritium is not explicitly specified.

^b For solid packaged low level waste, activity is expressed as ⁹⁰Sr equivalents.

^c No information available in terms of activity disposed of by the Republic of Korea.

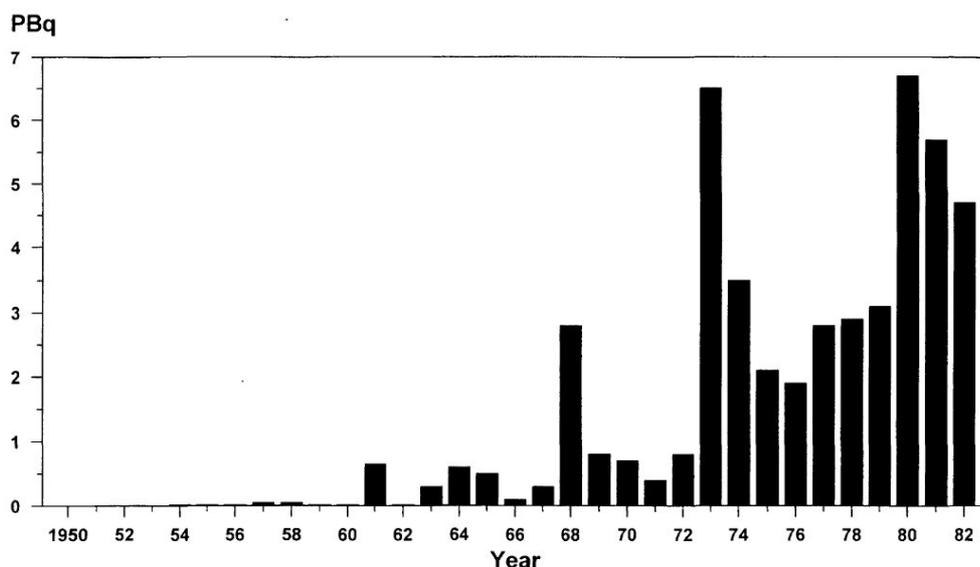


Figure 2. Temporal distribution of radioactive waste disposals in the Northeast Atlantic Ocean.

Table 2. Distribution of activity (TBq) for different types of waste dumped in the Atlantic (shaded in grey) and other oceans.

| Waste type | Atlantic | Pacific | Arctic | Totals | Percent of total activity |
|-------------------------------------|----------|---------|--------|--------|---------------------------|
| Reactors with spent nuclear fuel | Nil | Nil | 36876 | 36876 | 43.3 |
| Reactors without spent nuclear fuel | 1221 | 166 | 143 | 1530 | 1.80 |
| Low level solid waste | 44 042 | 820 | 585.4 | 45 448 | 53.4 |
| Low level liquid waste | <0.001 | 458.5 | 764 | 1223 | 1.44 |
| Total | 45 263 | 1445 | 38369 | 85 078 | |
| Percent of total activity | 53.2 | 1.70 | 45.1 | | 100.00 |

Environmental impact of deep sea disposal

20 NEA's surveillance of the North-East Atlantic dump site used by OECD/NEA member countries started in 1977 and ended in 1995. In 1985, the OECD/NEA Co-ordinated Research and Environmental Surveillance Programme (CRESP) delivered a report on the dump site. The report concluded that the North-East Atlantic dump site posed negligible human radiological risk. On the other hand, the report noted that in the absence of baseline data on the benthic biology, it was difficult to draw firm conclusions about the environmental impacts. A new report on the dump site conducted by CRESP in 1996 reached the same conclusions¹⁰.

21 In its overall assessment, OSPAR QSR 2000 reasserted CRESP's conclusions. It also identified as priorities for action the development of investigations of the significance of possible leakage from old dumpsites and if appropriate the development and implementation of an adequate policy to prevent pollution from such a source.

22 In 1992, the IAEA Marine Environment Laboratory conducted specific measurements at the North-East Atlantic dump site by analysing samples collected above the sea-bed of the site for anthropogenic radionuclides such as ¹⁴C, ¹³⁷Cs, ²³⁸Pu, ²⁹³⁺²⁴⁰Pu and ²⁴¹Am. The analysis showed elevated concentrations of ²³⁸Pu in water samples collected at the dumpsites indicating leakages from the packages. At some locations also the concentrations of ²⁹³⁺²⁴⁰Pu, ²⁴¹Am and ¹⁴C in the water were enhanced. It should be noted that the design of packages for the dumped waste was not intended to confine the radionuclides for tens of years but rather to secure that the wastes are transported intact to the sea bottom¹¹.

23 The dumpsites used by the United States in Northeast Pacific and Northwest Atlantic have been surveyed from time to time. Some samples taken in the immediate vicinity of waste containers have shown slightly elevated levels of caesium and plutonium isotopes¹².

24 In studies carried out in 1992–1994 at the Arctic dump sites, in the fjords of Novaya Zemlya, ⁶⁰Co, ¹³⁷Cs and ²³⁹⁺²⁴⁰Pu were detected in sediment samples indicating slight, non-radiologically significant leakages from the waste disposed in metal containers. No clear indication of leakages from the major objects containing nuclear fuel was found¹³.

¹⁰ OSPAR Commission, *Quality Status Report (QSR) 2000*, London, pp 28-29.

¹¹ BAXTER, M., et al., 1995, *Marine radioactivity studies in the vicinity of sites with potential radionuclide releases*, Proc. Int. Symp. On Environmental Impact of Radioactive Releases, IAEA, Vienna.

¹² UNITED STATES NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION (NOAA), 1995, *Communication from United States National Oceanic and Atmospheric Administration*, USNOAA.

¹³ JOINT NORWEGIAN–RUSSIAN EXPERT GROUP FOR INVESTIGATION OF RADIOACTIVE CONTAMINATION IN THE NORTHERN AREAS, 1996, *Dumping of radioactive waste and investigation of radioactive contamination in the Kara Sea, Results from 3 years of investigations (1992–1994) in the Kara Seas*, Norwegian Radiation Protection Authority (NRPA), Østerås.

25 Studies carried out at the dumpsites of the Sea of Japan have so far not revealed any indication of leakages from the dumped waste¹⁴.

26 It should be noted that the leakages from the dumped waste packages are insignificant, although in some cases measurable. The localized increase in radionuclide concentrations in seawater and sediment represent less than 0.1% of the natural radioactivity in those media (in particular, ⁴⁰K, ²¹⁰Po, ²²⁶Ra, ²³²Th, ²³⁴U ²³⁸U).

27 In conclusion, in the cases where dumping of radioactive wastes were carried out in accordance with the existing conventions and with international safety recommendations (e.g., low level radioactive wastes properly packaged), leakages from the dumped waste packages are insignificant, although in some cases were, in the past, measurable.

OSPAR measures

28 Under the 1992 OSPAR Convention, the dumping of low and intermediate level radioactive substances, including wastes, is prohibited (Annex II, Article 3). After the entry into force of OSPAR Decision 98/2 on Dumping of Radioactive Waste on 9 February 1999, this legally binding prohibition applies to all OSPAR Contracting Parties.

29 In 1994, it was agreed, via PARCOM Recommendation 94/8, that in future assessments more emphasis should be put on assessing biological and ecological effects on the marine environment (including the vulnerability of marine organisms and communities) arising from existing and foreseen future discharges of radioactive substances. This Recommendation reflects the current approach to controlling radioactive discharges to the environment by taking explicit account of the protection of species other than humans. IAEA policies on the radiological protection of the environment are also dictated by this approach.

30 OSPAR works under the 2003 Radioactive Substances Strategy to reduce inputs and levels of radionuclides to protect the marine environment and its users. The objective of the Strategy 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.

31 Progress made in reducing discharges of radioactive substances to the North-East Atlantic, in order to meet the objective of the OSPAR Radioactive Substance Strategy have been analysed in the Third Periodic Evaluation (3PE). According to 3PE, there is evidence to suggest that progress is being made towards this objective. This includes: (1) a reduction in total beta discharges from the nuclear sector, (2) reductions in marine concentrations of radioactive substances in most cases, (3) estimated doses to humans well within international and EU limits and (4) an indication that the calculated doses rates to marine biota from selected radionuclides from the nuclear sector are low and are below the lowest levels at which any effects are likely to occur.

32 At present, there are no OSPAR assessments or monitoring programmes that provide specific data as to the environmental impact of former deep sea radioactive waste disposals.

Action requested

33 RSC is invited:

- a. to take this information into account when discussing the implications of deep sea disposal of radioactive waste in the North-East Atlantic and,
- b. as appropriate, to make arrangements for next steps.

¹⁴ PETERSON, H.B.L., et al., 1996, *Radionuclide analysis from the 1995 Japanese–Korean–Russian Expedition to the far Eastern Seas*, IAEA-MEL, Monaco.