

The 2010 UK Radioactive Waste Inventory:

A Summary of Information for International Reporting



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Report prepared for the Department of
Energy & Climate Change (DECC) and the
Nuclear Decommissioning Authority (NDA)
by Pöyry Energy Limited

PREFACE

The Department of Energy & Climate Change (DECC)¹ and the Nuclear Decommissioning Authority (NDA) have commissioned the 2010 UK Radioactive Waste Inventory (2010 Inventory) to provide information on the status of radioactive waste at 1 April 2010 and forecasts of future arisings in the UK. Its aim is to provide comprehensive and up-to-date data in an open and transparent manner for those interested in radioactive waste issues. It is part of an ongoing programme of research jointly conducted by DECC and NDA.

This report provides a summary of information from the 2010 UK Radioactive Waste Inventory to support the UK's international reporting obligations on radioactive waste.

This report has been prepared on the basis of information supplied by UK waste producers to Pöyry Energy, the principal contractor for the production of the 2010 Inventory. This information was verified in accordance with arrangements established by Pöyry Energy.

The information given in this report represents the best available knowledge at the time of compilation of the 2010 Inventory based upon the processes, strategies and assumptions that were applicable at that time. Revision of the predictions, particularly of the long-term forecasts, may be necessary as plans change and estimates are refined.

2010 Inventory documents

Information collected for producing the 2010 Inventory is presented in a series of reports, as listed below.

- A summary of the 2010 Inventory;
- The main report for the 2010 Inventory;
- A summary of Information for International Reporting (this document);
- A review of the processes contributing to radioactive wastes in the UK (the report published in 2008 has not been updated);
- Information on other radioactive substances that may require long-term management as radioactive waste in the UK is presented in a separate report.

These reports are available in both printed and electronic format.

The 2010 Inventory documents can be obtained from the NDA (see contact details opposite) or via the UK Radioactive Waste Inventory website www.nda.gov.uk/ukinventory.

Conditions of Publication

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¹ The results of this work will be used in the formulation of Government policy, but views expressed in this report do not necessarily represent Government policy.

Feedback & Queries

You are invited to provide feedback to the NDA on the content, clarity and presentation of this report and the UK Radioactive Waste Inventory (i.e. the Inventory). Please do not hesitate to contact the NDA if you have any queries on the Inventory and radioactive waste issues. Such feedback and queries should be addressed to:

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An inventory of radioactive waste in the UK is compiled periodically by the Department of Energy & Climate Change (DECC) and the Nuclear Decommissioning Authority (NDA) to provide up-to-date information essential for waste management policy development, and for regulation and planning of waste treatment, storage and long-term management.

This report provides a summary of information from the 2010 UK Radioactive Waste Inventory (2010 Inventory) to meet the UK's international reporting obligations in the field of radioactive waste. The 2010 Inventory is the latest public record of information on the sources, quantities and properties of radioactive waste in the UK at 1 April 2010 and predicted to arise after that date. This is one of a number of reports on the 2010 Inventory; the other reports are listed in References 1-3. These reports update those of the 2007 Inventory.

Preparation of the 2010 Inventory has involved the compilation and assessment of detailed numerical and descriptive information for 1,312 waste streams. The data have been provided by the organisations that produce radioactive wastes in the UK. These organisations are referred to as "waste producers". Waste producers have made forecasts of radioactive waste arisings in the UK based on assumptions as to the nature and scale of their future operations and activities. However, these forecasts, particularly in the longer term, may change for policy, commercial, technological or regulatory reasons, and current information may be subsequently refined.

In the UK radioactive wastes are classified in terms of the nature and quantity of radioactivity they contain and their heat-generating capacity, as High Level Waste, Intermediate Level Waste and Low Level Waste.

High Level Waste (HLW)

Wastes in which the temperature may rise significantly as a result of their radioactivity, so this factor has to be taken into account in the design of storage or disposal facilities.

Intermediate Level Waste (ILW)

Wastes exceeding the upper boundaries for LLW, but which do not need heat to be taken into account in the design of storage or disposal facilities.

Low Level Waste (LLW)

Wastes having a radioactive content not exceeding 4GBq (gigabecquerels) per tonne of alpha, or 12GBq per tonne of beta/gamma activity.

Very Low Level Waste (VLLW) is a sub-category of LLW that comprises:

- Low Volume VLLW ('dustbin loads') - wastes that can be safely disposed of to an unspecified destination with municipal, commercial or industrial waste, each 0.1 cubic metre of material containing less than 400kBq (kilobecquerels) of total activity, or single items containing less than 40kBq of total activity. There are additional limits for C14 and tritium in wastes containing these radionuclides.
- High Volume VLLW (bulk disposals) – wastes with maximum concentrations of 4MBq (megabecquerels) per tonne of total activity that can be disposed of to specified landfill sites. There is an additional limit for tritium in wastes containing this radionuclide.

1 Introduction

The principal difference between the two VLLW categories is the need for controls on the total volumes of High Volume VLLW being deposited at any one particular landfill site.

The UK Radioactive Waste Inventory includes HLW, ILW, LLW, and some High Volume VLLW where there is reasonable certainty of the total waste arisings.

The Inventory does not include liquid and gaseous wastes containing very low concentrations of radioactivity that are routinely discharged to the environment in accordance with statutory regulators. Discharges are made within authorised limits, usually after some form of treatment. Also excluded are small quantities of solid wastes with very low concentrations of radioactivity typically from hospitals, universities and the non-nuclear industry (small users) that can be disposed of with domestic refuse to landfill, either directly or after incineration.

The major producers of waste in the UK are the civil nuclear industry, MoD and its civilian contractors, and GE Healthcare Ltd. UK data relating to all activities, including defence, have been included on a voluntary basis.

2 INTERNATIONAL REPORTING ON RADIOACTIVE WASTES

2.1 EUROPEAN UNION

As a Member State of the European Union (EU), most UK activities involving radioactive substances are governed by legislation set down under the Euratom Treaty. The Euratom Treaty established the European Atomic Energy Community. The UK became a signatory of the Treaty on its accession to the European Union in 1972.

EU activities in the field of radioactive waste have been guided to a large extent by the "*Community Plan of Action in the Field of Radioactive Waste*" prepared initially in 1980 and renewed in 1992. A later Council¹ Resolution in December 1994 helped to define the EU strategy in this field.

Although the Plan as such is no longer in force, the requirement for continuous analysis of the situation regarding radioactive waste in the EU remains, and the Commission² is requested to provide the Council periodically with a report of the situation and prospects in the Member States (the so-called Situation Report). The 6th Situation Report [4] is the latest to be published and reports the position at the end of 2004. It includes radioactive waste and spent fuel quantities, a summary of national strategies and other pertinent information.

The Situation Report includes the following data on radioactive wastes and spent fuel³:

- Waste volumes disposed of for each type of disposal. For the UK, figures are given for ocean disposal, and the Low Level Waste Repository (LLWR) and Dounreay disposal facilities;
- Waste volumes in interim storage (in terms of final conditioned form) for LILW-SL⁴, LILW-LL⁵ and HLW⁶, and the mass of spent fuel;
- Waste volumes produced in 2004 (in terms of final conditioned form) for LILW-SL, LILW-LL and HLW, and the mass of spent fuel;
- Future waste production to 2020 (in terms of final conditioned volumes) for LILW-SL, LILW-LL and HLW, and the mass of spent fuel;

¹ The Council of the EU represents the governments of the member states, and is the main decision making body of the EU.

² The European Commission is the executive body of the EU.

³ The waste categories reported are those in the Commission Recommendation (SEC(1999) 1302 final, 1999/669/EC, Euratom) on a classification system for solid radioactive waste. The classification system is used for reporting purposes only (i.e. it is not related to management and disposal routes for the waste).

⁴ LILW-SL is short-lived low and intermediate level radioactive waste. This is waste that is contaminated mainly with radionuclides that have half-lives of 30 years or less and for which there is negligible heat generation as a result of radioactive decay. Its long-lived alpha emitting radionuclide content is limited to 400Bq/g in the total conditioned waste volume. The volumes of LILW-SL given in this report are for wastes that satisfy this alpha-emitting radionuclide limit and also contain no beta/gamma emitting radionuclides that have half-lives of more than 30 years.

⁵ LILW-LL is long-lived low and intermediate level radioactive waste with a concentration of long half-life radionuclides above the limit for classification as short-lived waste. The waste also generates negligible heat. The volumes of LILW-LL given in this report are for wastes with a long-lived alpha-emitting radionuclide content above the stated limit or contain beta/gamma emitting radionuclides that have half-lives of more than 30 years.

⁶ HLW is high-level waste. This is waste for which the heat generated by radioactive decay must be taken into consideration during storage and disposal. This category is the same as the UK HLW category.

2 International Reporting on Radioactive Wastes

2.2 INTERNATIONAL ATOMIC ENERGY AGENCY

The UK is a Member State of the United Nations International Atomic Energy Agency (IAEA), which promotes the safe use of radioactive substances through a series of Safety Standard documents setting down best practice in the fields of nuclear energy production, radioactive waste management, radioactive materials transport, safety and radiation protection.

On 12 March 2001 the UK ratified the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management that was negotiated under the auspices of the IAEA. The Convention's primary objective is to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management. It came into force on 18 June 2001.

Article 32 includes an obligation to submit *“an inventory of radioactive waste that:*

- *Is being held in storage at radioactive waste management and nuclear fuel cycle facilities;*
- *Has been disposed of; or*
- *Has resulted from past practices.*

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides.”

Article 32 also includes an obligation to submit *“an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity”.*

The UK's latest national report, demonstrating compliance with the Convention, was provided to the IAEA in May 2008 [5]. National reports are subject to a process of peer review and are updated every three years.

The report includes the following data on radioactive wastes and spent fuel:

- Volumes of HLW, ILW and LLW in stocks (that not yet packaged and that already packaged⁷).
- Expected total volumes of HLW, ILW and LLW (in terms of final packaged volume) for stocks and projected future arisings.
- Annual disposals of LLW in the period 2002-2006.
- Mass of spent fuel in stocks.

2.3 OTHER INTERNATIONAL BODIES

The UK is also a Member State of the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA). The general objective of the NEA in the field of radioactive waste management is to contribute to the adoption of safe and efficient policies and practices in member countries, notably through technical feasibility and long-term safety studies. The main focus of the programme is on the strategies for the

⁷ Wastes that are not yet packaged exist in an untreated or partly treated state. Packaging is the loading of the waste into a container for long-term management. The packaged waste volume is the displacement volume of the container.

2 International Reporting on Radioactive Wastes

disposal of long-lived radioactive waste, mostly spent fuel and high-level waste from fuel reprocessing, and on the assessment of long-term safety and the evaluation of geological sites potentially suitable for the construction of underground disposal facilities.

Currently the NEA does not compile or maintain information on the quantities of radioactive wastes generated in the member countries.

3.1 REPORTING TO THE EUROPEAN UNION

The following tables provide information from the 2010 Inventory in the appropriate form. All values are given to two significant figures. The volume of packaged waste is now reported (Tables 3.2, 3.3 and 3.4) where the volume of conditioned waste was given in the latest Situation Report [4]. The volume of packaged waste is the displacement volume of the containers in which the waste is conditioned, whereas the volume of conditioned waste is the volume of the waste plus immobilising medium within the container. The volume of packaged waste is between 20% and 50% greater than the volume of conditioned waste depending on the type of container.

Table 3.1: Wastes quantities either disposed of or in interim storage at 1 April 2010 for which a disposal route exists

Quantity (m ³)	Period	Type of disposal	Site	Still in use? ⁽¹⁾
20,000	Until 1983	Sea	North Atlantic	No
13,000	Until 1976	Sea	UK coastal waters	No
800,000	Up to 1995	Near surface (trenches)	LLWR (nr Drigg)	No
200,000	Up to 2010	Near surface (vault)		Yes
33,600 (+ 9,400 in buffer storage)	Up to 2010	Near surface	Dounreay	No

(1) The UK currently operates one LLW disposal facility, the Low Level Waste Repository (LLWR). This is a near-surface facility located near the village of Drigg, owned by the NDA and run by LLW Repository Ltd. This takes waste that meets the site's Waste Acceptance Criteria. There are currently no facilities for disposal of ILW and HLW in the UK. Disposal of waste to sea no longer takes place.

**Table 3.2: Waste quantities in interim storage at 1 April 2010 for which no disposal route is available
Volumes when packaged**

Quantity of waste in storage ⁽¹⁾			
LILW-SL (m ³) ⁽²⁾	LILW-LL (m ³) ⁽³⁾	HLW (m ³)	Comments
1,350	166,000	1,330	ILW and HLW volumes include waste from reprocessing overseas spent fuel.

(1) Volumes are for wastes when packaged for long-term management based on the probable conditioning method and container type. Volumes are given to 3 significant figures.

(2) Comprises waste classified as ILW (1,340m³) and LLW (8m³) where the concentration of long-lived (half-life greater than 30 years) alpha emitting radionuclides is limited to 400Bq/g in the conditioned wastefrom and where there are no beta/gamma emitting radionuclides with half-lives of more than 30 years.

(3) Comprises waste classified as ILW (166,000m³) and LLW (314m³) that do not meet the conditions for short-lived waste.

3 2010 Inventory Data

Table 3.3: Estimated arisings of waste Volumes when packaged

Period ⁽¹⁾	Quantity of waste arising during period (m ³) ⁽²⁾			Notes
	LILW-SL ⁽³⁾	LILW-LL ⁽⁴⁾	HLW	
2010	20,500	30,800	-7.1	Spent fuel reprocessing is assumed to end in 2021. Volumes are net of HLW exports to overseas customers (hence some negative figures) and assume substitution arrangements are implemented. ⁽⁵⁾
2011-2014	61,300	104,000	-86	
2015-2019	63,100	162,000	-64	
2020-2024	36,800	164,000	118	
2025-2029	17,300	127,000	32.3	
2030-2039	11,500	241,000	0	
2040-2049	115,000	451,000	0	
2050-2059	1,110	368,000	0	
2060-2099	2,070	1,670,000	0	
Post-2099	77,900	1,060,000	0	
Total	406,000	4,390,000	-7.5	Principally large volumes of building rubble and contaminated soil from decommissioning.

(1) Financial years 1 April to 31 March.

(2) Volumes are for wastes when packaged for long-term management based on the probable conditioning method and container type. Volumes are given to 3 significant figures.

(3) Comprises waste classified as ILW (730m³) and LLW (405,000m³) where the concentration of long-lived (half-life greater than 30 years) alpha emitting radionuclides is limited to 400Bq/g in the conditioned wasteform and where there are no beta/gamma emitting radionuclides with half-lives of more than 30 years.

(4) Comprises waste classified as ILW (329,000m³) and LLW (4,060,000m³) that do not meet the conditions for short-lived waste.

(5) Government policy is that wastes resulting from reprocessing of overseas spent fuel should be returned to the country of origin. The policy allows waste substitution. This is a process whereby an additional amount of HLW from reprocessing would be returned, which is smaller in volume but equivalent in radiological terms to customers' ILW and LLW that would otherwise be returned. In total about 278m³ of vitrified HLW is planned for export.

**Table 3.4: Estimated annual waste production for reactor types
Volumes when packaged**

Reactor type	Quantity of waste (m ³ per GW(e).y) ⁽¹⁾			Comments
	LILW-SL ⁽²⁾	LILW-LL ⁽³⁾	HLW	
Magnox	0	2,800	0	Operating stations only: Oldbury & Wylfa
AGR	0	920	0	
PWR	0	520	0	

(1) Volumes are for wastes when packaged for long-term management based on the probable conditioning method and container type. Station operational and decommissioning wastes are included. Spent fuel reprocessing wastes are excluded. Volumes are given to 2 significant figures.

(2) Comprises waste classified as ILW and LLW where the concentration of long-lived (half-life greater than 30 years) alpha emitting radionuclides is limited to 400Bq/g in the conditioned wastefrom and where there are no beta/gamma emitting radionuclides with half-lives of more than 30 years.

(3) Comprises waste classified as ILW and LLW that do not meet the conditions for short-lived waste.

3.2 REPORTING TO THE INTERNATIONAL ATOMIC ENERGY AGENCY

The following tables provide information from the 2010 Inventory in a form compliant with the obligations of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. All values are given to three significant figures. The volume of packaged waste is reported, which is consistent with the information in the latest National Report [5]. The volume of packaged waste is the displacement volume of the containers in which the waste is conditioned.

**Table 3.5: Radioactive wastes existing at 1 April 2010 from all sources
Packaged and unpackaged volumes**

Waste type	At 1.4.2010	Volume (m ³) ⁽¹⁾
HLW	Total	1,850
	Packaged	1,000
	Unpackaged	850
ILW	Total	103,000⁽²⁾
	Packaged	33,000
	Unpackaged	69,800
LLW	Total	69,100⁽³⁾
	Packaged	24,900
	Unpackaged	44,300

(1) Volumes are given to 3 significant figures.

(2) Can be categorised as 638m³ of LILW-SL and 102,000m³ of LILW-LL.

(3) Can be categorised as 14,600m³ of LILW-SL and 54,600m³ of LILW-LL.

3 2010 Inventory Data

**Table 3.6: Expected total waste volumes from existing facilities to end of life
Volumes when packaged ⁽¹⁾**

Waste type	At 1.4.2010	Future arisings (m ³)	Total (m ³)
HLW	1,330	-7.5 ⁽²⁾	1,330
ILW	159,000	329,000	488,000
LLW	80,200	4,460,000	4,550,000
Total	240,000⁽³⁾	4,790,000⁽⁴⁾	5,210,000

(1) Volumes are given to 3 significant figures.

(2) Volume is net of HLW exports to overseas customers (hence negative figure).

(3) Can be categorised as 18,100m³ of LILW-SL and 221,000m³ of LILW-LL.

(4) Can be categorised as 406,000m³ of LILW-SL and 4,390,000m³ of LILW-LL.

Table 3.7: Annual consignments of LLW (2005-2009) ⁽¹⁾

Year	Total volume (m ³) ⁽²⁾
2005	12,800
2006	12,900
2007	9,100
2008	8,600
2009	7,000

(1) Total volume of waste packages consigned to the LLWR.

(2) Volumes are given to 3 significant figures.

4 REFERENCES

- 1 *The 2010 UK Radioactive Waste Inventory - Main Report.* URN 10D/985, NDA/ST/STY(11)0004. February 2011.
- 2 *Radioactive Wastes in the UK - A Summary of the 2010 Inventory.* URN 10D/986, NDA/ST/STY(11)0005. February 2011.
- 3 *Radioactive Materials Not Reported in the 2010 UK Radioactive Waste Inventory.* URN 10D/988, NDA/ST/STY(11)0007. February 2011.
- 4 *Sixth Situation Report on Radioactive Waste and Spent Fuel Management in the European Union.* SEC(2008)2416, September 2008.
- 5 HSE. *The United Kingdom's Third National Report on Compliance with the Obligations of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.* 30 May 2008.



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Further copies of this and other 2010 Inventory documents can be obtained from the NDA (see contact details below) or via the UK Radioactive Waste Inventory website www.nda.gov.uk/ukinventory

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Front cover images: top left - Redundant facilities being demolished at Dounreay in 2007, top right - Asbestos removal at Chapelcross, bottom left - Trawsfynydd ILW store, bottom right - ILW storage at Winfrith.