Department for
Business, Energy
& Industrial Strategy

2019 Summary of UK Radioactive Waste and Material Inventory for International Reporting

December 2019

2019 SUMMARY OF UK RADIOACTIVE WASTE AND MATERIAL INVENTORY FOR INTERNATIONAL REPORTING

Report prepared for the Department for Business, Energy & Industrial Strategy (BEIS)
and the Nuclear Decommissioning Authority (NDA)
by Pöyry Energy Ltd and Wood Nuclear Ltd

PREFACE

The 2019 United Kingdom Radioactive Waste & Materials Inventory (the 2019 Inventory) provides detailed information on radioactive wastes and materials in the United Kingdom (UK). It is produced by the Department for Business, Energy & Industrial Strategy (BEIS) and the Nuclear Decommissioning Authority (NDA).

The 2019 Inventory provides information on radioactive waste stocks (at 1 April 2019) and forecasts of future waste arisings. Information on radioactive materials that may be classed as waste in the future is also presented. The 2019 Inventory aims to provide data in an open and transparent manner for those interested in radioactive wastes and materials.

Information collected for the 2019 Inventory is presented in a suite of four reports:

- 2019 UK Radioactive Waste Inventory
- 2019 UK Radioactive Material Inventory
- 2019 UK Radioactive Waste Detailed Data
- 2019 Summary of UK Radioactive Waste and Material Inventory for International Reporting.

All documents have been prepared using information supplied by the radioactive waste producers and custodians to the 2019 Inventory contractors, Wood and Pöyry Energy. This information was verified in accordance with arrangements established by Wood and Pöyry Energy in agreement with NDA.

This report presents summary information in support of the UK's international reporting obligations on radioactive waste and nuclear materials.

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Feedback

We welcome feedback on the content, clarity and presentation of the 2019 Inventory reports. Please do not hesitate to contact us if you would like to provide feedback or if you would like further information about radioactive waste issues:

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Aerial view of the Low Level Waste Repository, West Cumbria

1 INTRODUCTION

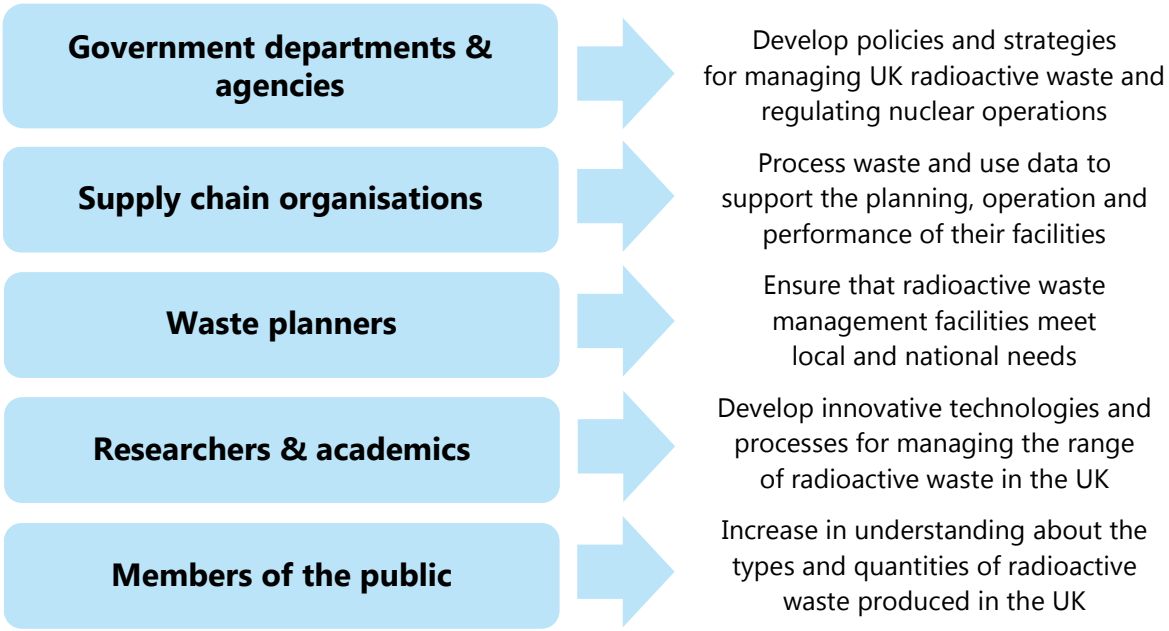
1.1 The Inventory

An inventory of radioactive waste and materials in the UK is compiled every three years by the Department for Business, Energy & Industrial Strategy (BEIS) and the Nuclear Decommissioning Authority (NDA).

The inventory provides up-to-date information about radioactive waste to:

- Enable the UK to meet international reporting obligations
- Inform policy and strategy development
- Aid radioactive waste and material management planning
- Support stakeholder engagement.

The inventory is used by a wide range of stakeholders:



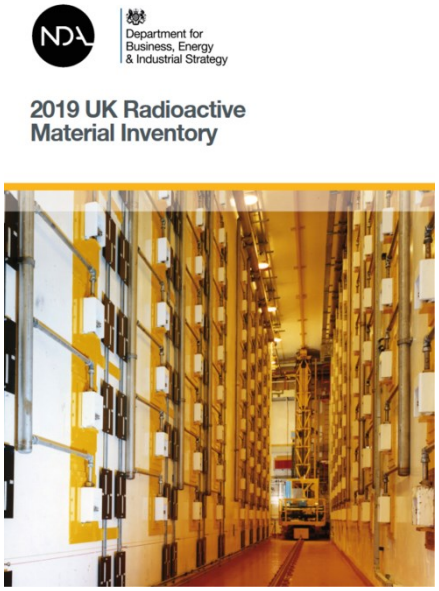
The 2019 UK Radioactive Waste & Materials Inventory (the 2019 Inventory) is the latest public record on the sources, quantities and properties of radioactive waste and materials in the UK at 1 April 2019 and predicted to arise after that date.

1.2 Inventory documents

The 2019 Inventory comprises four reports:

Radioactive Waste Inventory

Describes the sources, volume, composition and activity of radioactive waste in the UK, and a comparison with the previous inventory



Radioactive Material Inventory

Summarises the quantities of UK civil nuclear materials that might have to be managed as waste in the future

Waste Detailed Data

Provides further information on the radioactive waste inventory including a list of waste streams

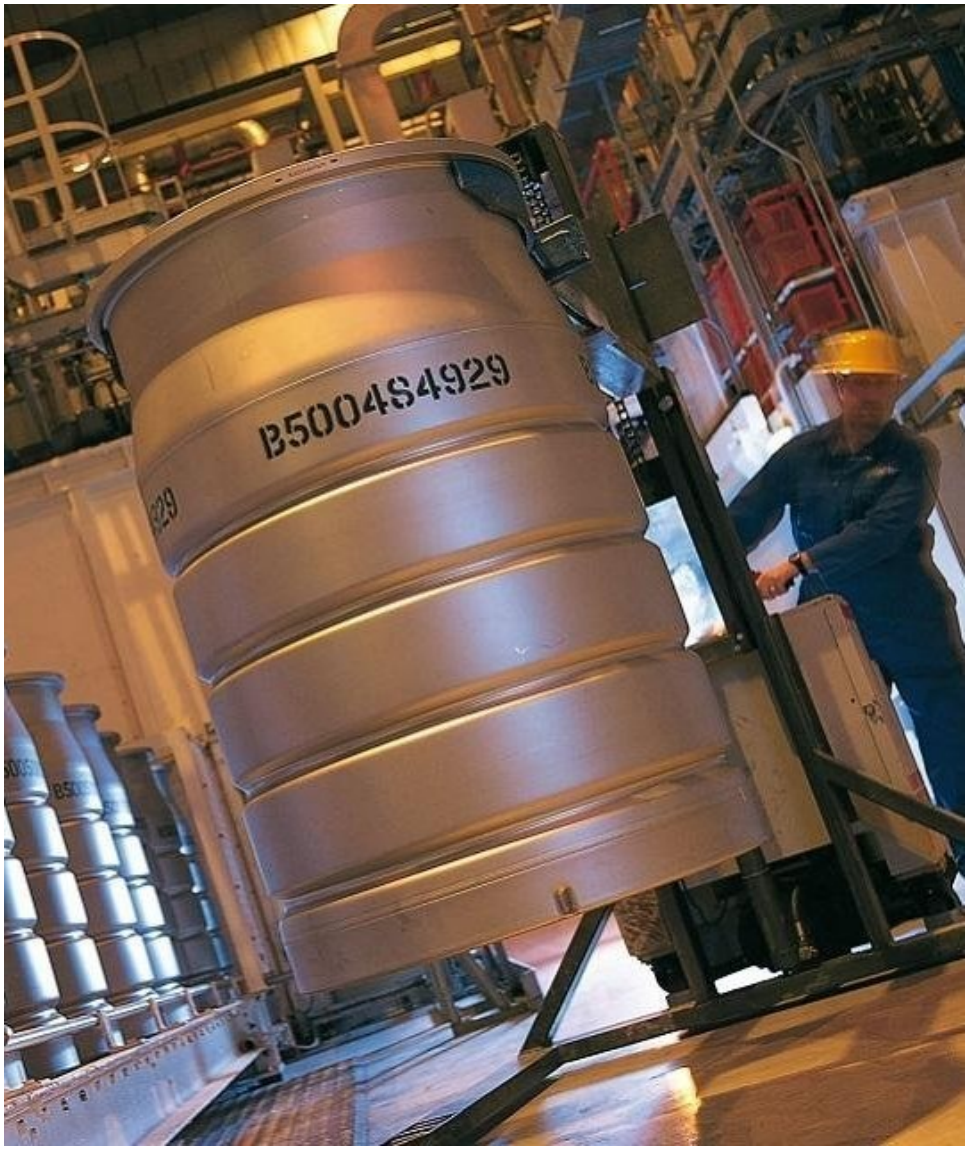
Summary for International Reporting

Gives information to meet the UK's international reporting obligations in the field of radioactive waste and materials

As part of the commitment to openness, NDA has created a website dedicated to the Inventory, www.nda.gov.uk/ukinventory, where all of the 2019 Inventory reports can be found together with other information about radioactive waste.

1.3 This report

This report presents summary information in support of the UK's international reporting obligations on radioactive wastes and materials. This comprises reporting to the European Union (section 2), to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (section 3), and to the 'Status and Trends Project' (section 4).[1]

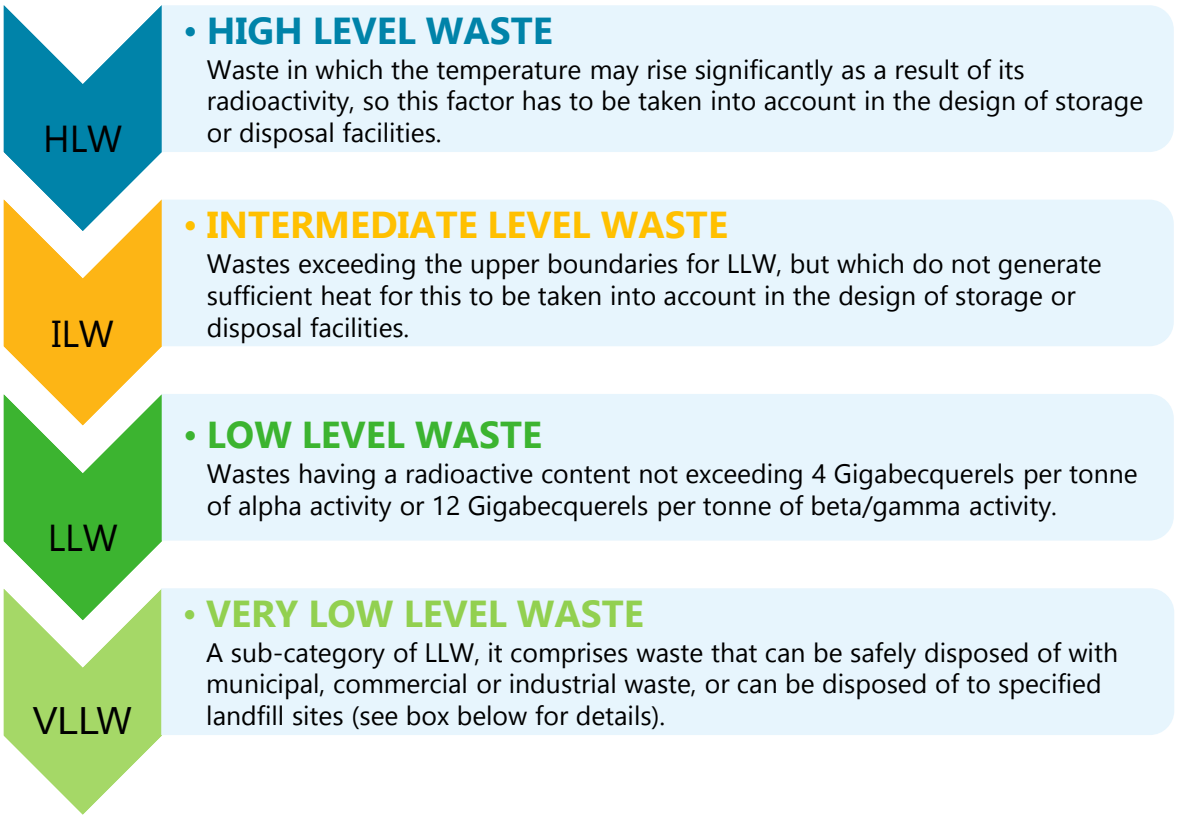


500 litre radioactive waste drum

1 The UK is also a Member State of the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency (NEA). The NEA seeks to assist its member countries in developing safe, sustainable and societally acceptable strategies for the management of all types of radioactive materials, with particular emphasis on the management of long-lived waste and spent fuel and on decommissioning of disused nuclear facilities. The NEA does not currently compile or maintain information on the quantities of radioactive wastes generated in the member countries.

2 WASTE CLASSIFICATION

Material that has no further use, and is contaminated by, or incorporates, activity above certain levels defined in UK legislation[2,3] is known as radioactive waste. In the UK radioactive waste is classified according to how much activity it contains and the heat that this activity produces. Categories are High Level Waste (HLW), Intermediate Level Waste (ILW), Low Level Waste (LLW) and Very Low Level Waste (VLLW).



Very Low Level Waste comprises:

- High Volume VLLW – wastes with maximum concentrations of 4 MBq (megabecquerels) per tonne of total activity that can be disposed to specified landfill sites. There is an additional limit for tritium in wastes containing this radionuclide.
- Low Volume VLLW – wastes that can be safely disposed of to an unspecified destination with municipal, commercial or industrial waste, each 0.1 m^3 of material containing less than 400 kBq (kilobecquerels) of total activity, or single items containing less than 40 kBq of total activity. There are additional limits for C-14 and tritium in wastes containing these radionuclides.

[2] *Radioactive Substances Act 1993 (as amended), 27 May 1993.*
[3] *Statutory Instruments 2016 No. 1154. Environmental Permitting (England and Wales) Regulations 2016 11 December 2016.*

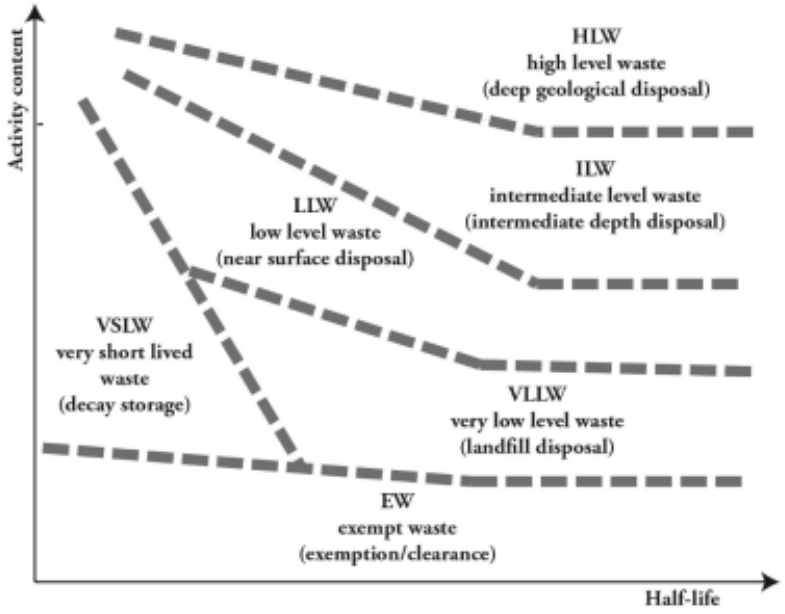
The 2009 IAEA classification scheme for radioactive waste[4] is used throughout this report where quantities of radioactive waste are given.

The IAEA classification scheme is based on consideration of long-term safety provided by the different disposal options currently adopted or envisaged for radioactive waste. The IAEA classification scheme provides international bodies with a common framework for the purposes of reporting to them.

There are six classes of waste:

- Exempt Waste (EW)
- Very Short Lived Waste (VSLW)
- Very Low Level Waste (VLLW)
- Low Level Waste (LLW)
- Intermediate Level Waste (ILW)
- High Level Waste (HLW).

A conceptual illustration of the classification scheme (see below) shows the disposal options for each waste class and the relationship with activity content and half-life.



Information on EW and VSLW is not collected for the UK Inventory. EW is out of scope of regulatory control (i.e. not radioactive for the purposes of UK legislation). VSLW requires limited storage time before it is out of scope of regulatory control. The other four classes of waste remain subject to regulatory control and so are recorded in the UK Inventory.

Table 1 describes how the UK classifications are mapped to the IAEA classes for the purpose of international reporting. The criteria used to allocate individual waste streams within the classification are determined by their known or planned disposal routes. 'Waste stream' is the fundamental designation used in the UK Inventory. A waste stream includes waste or a collection of waste items at

4 International Atomic Energy Agency, "IAEA Safety Guide Classification of Radioactive Waste," GSG-1, 2009.

a particular site, usually in a particular facility and/or from a particular process or operation. It is often distinguishable by its radionuclide content and in many cases also by its physical and chemical characteristics.

Table 1: Waste classification

IAEA class	Criteria (UK classification)
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. Such landfill type facilities may also contain other hazardous waste. Typical waste in this class includes soil and rubble with low levels of activity concentration. Concentrations of longer lived radionuclides are generally very limited.	VLLW stream expected to be consigned for disposal at an appropriately permitted landfill site LLW stream expected to be consigned for disposal at an appropriately permitted landfill site
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 of up to a few hundred years and is suitable for disposal in engineered near surface facilities. This class covers a very broad range of waste. LLW may include short lived radionuclides at higher levels of activity concentration, and also long lived radionuclides, but only at relatively low levels of activity concentration.	LLW stream expected to be consigned for disposal to the Low Level Waste Repository (LLWR) or the Dounreay LLW facility LLW stream expected to be consigned for incineration or to a metal treatment facility LLW stream expected to be recycled LLW stream where the disposal route is not yet known ILW stream decay stored / reclassified for disposal as LLW
Intermediate Level Waste (ILW) Waste that, because of its content, particularly of long lived radionuclides, requires a greater degree of containment and isolation than that provided by near surface disposal. However, ILW needs no provision, or only limited provision, for heat dissipation during its storage and disposal. ILW may contain long lived radionuclides, in particular, alpha emitting radionuclides that will not decay to a level of activity concentration acceptable for near surface disposal during the time for which institutional controls can be relied upon. Therefore, waste in this class requires disposal at greater depths, of the order of tens of metres to a few hundred metres.	ILW stream LLW stream unsuitable for disposal to the LLWR or the Dounreay LLW facility
High Level Waste (HLW) Waste with levels of activity concentration high enough to generate significant quantities of heat by the radioactive decay process or waste with large amounts of long lived radionuclides that need to be considered in the design of a disposal facility for such waste. Disposal in deep, stable geological formations usually several hundred metres or more below the surface is the generally recognised option.	HLW stream

Dounreay LLW facility

3 REPORTING TO THE 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.

Council Directive 2011/70/Euratom requires Member States to have a national programme which includes details of their inventory. Article 12.1(c) includes an obligation to include:

"An inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste."

Article 14(1) states:

"Member States shall submit a report to the Commission every three years on the implementation of this Directive for the first time by 23 August 2015, and every 3 years thereafter, taking advantage of the review and reporting under the Joint Convention."

The UK's first national report was issued in August 2015[5]. Due to the complexity of the UK programme the UK has issued, at the same time, a 'lead document' providing information and guidance[6]. This lead document covers the inventory of spent fuel and radioactive waste. The UK submitted its second national report to the Commission in December 2018.

The following tables provide information from the 2019 Inventory in a form for reporting to the EU. The waste types listed use the 2009 IAEA classification system.

Table 2: Waste quantities either disposed of or in interim storage at 1 April 2019 for which a disposal route exists

Quantity (m^3)	Period	Type of disposal	Site	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	No
233,000	Up to 2019	Near-surface (vaults)	LLWR	Yes
33,600(2)	Up to 2005	Near-surface (pits)	Dounreay	No
4,670	Up to 2019	Near-surface (vaults)	Dounreay	Yes

(1) The UK currently operates a national LLW disposal facility (the LLWR). This is a near-surface facility owned by the NDA and run by LLW Repository Ltd. This takes waste that meets the site's Waste Acceptance Criteria. A LLW disposal facility at Dounreay, which opened in 2015, receives LLW from decommissioning the Dounreay site, as well as retrieved and repackaged LLW from the historical disposal pits. It will also receive waste from the neighbouring Vulcan nuclear site that cannot be recycled. There are currently no facilities for disposal of ILW and HLW in the UK. Disposal of waste to sea no longer takes place. Does not include disposals at appropriately permitted landfill sites.

(2) Waste is to be retrieved, repackaged and consigned to vaults at the new LLW disposal facility at Dounreay.

[5] *Department of Energy and Climate Change, "United Kingdom's National Report on Compliance with European Council Directive (2011/70/Euratom)," URN 15D/390, August 2015.*
[6] *Department of Energy & Climate Change, "Lead Document setting out the United Kingdom's National Programme for the Responsible and Safe Management of Spent Fuel and Radioactive Waste," URN 15D/389, August 2015.*

Table 3: Waste quantities in interim storage at 1 April 2019 for which no disposal route is currently available
Volumes when packaged

Quantity of waste in storage[1]				
VLLW (m^3)	LLW (m^3)[2]	ILW (m^3)	HLW (m^3)	Comments
0	316	162,000	1,790	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. The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container. Volumes are given to three significant figures.

(2) Waste for which the disposal route is yet to be identified, comprising UK classification LLW (313 m^3) and ILW (3 m^3) that will be managed as LLW following decay storage. This volume is lower than the previous sumission.

Table 4: Estimated arisings of waste
Volumes when packaged

Period[1]	Quantity of waste arising during period (m^3)[2]				Notes
	VLLW[3]	LLW[4]	ILW	HLW	
2019	23,300	36,100	2,940	see note 5	
2020-2024	101,000	139,000	15,000	see note 5	
2025-2029	58,900	65,800	15,700	see note 5	
2030-2039	120,000	51,000	41,800	0	
2040-2049	273,000	163,000	40,400	0	
2050-2059	197,000	26,200	24,600	0	Post-2050 principally large volumes of building rubble & soil from decommissioning and site clean up
2060-2099	1,360,000	175,000	131,000	0	
Post-2099	982,000	168,000	55,700	0	
Total	**3,120,000**	**824,000**	**328,000**	**see note 5**	

(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. The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container. Volumes are given to three significant figures.

(3) Comprises UK classification VLLW (114,000 m^3) and LLW (427,000 m^3), and mixed LLW/VLLW (2,580,000 m^3).

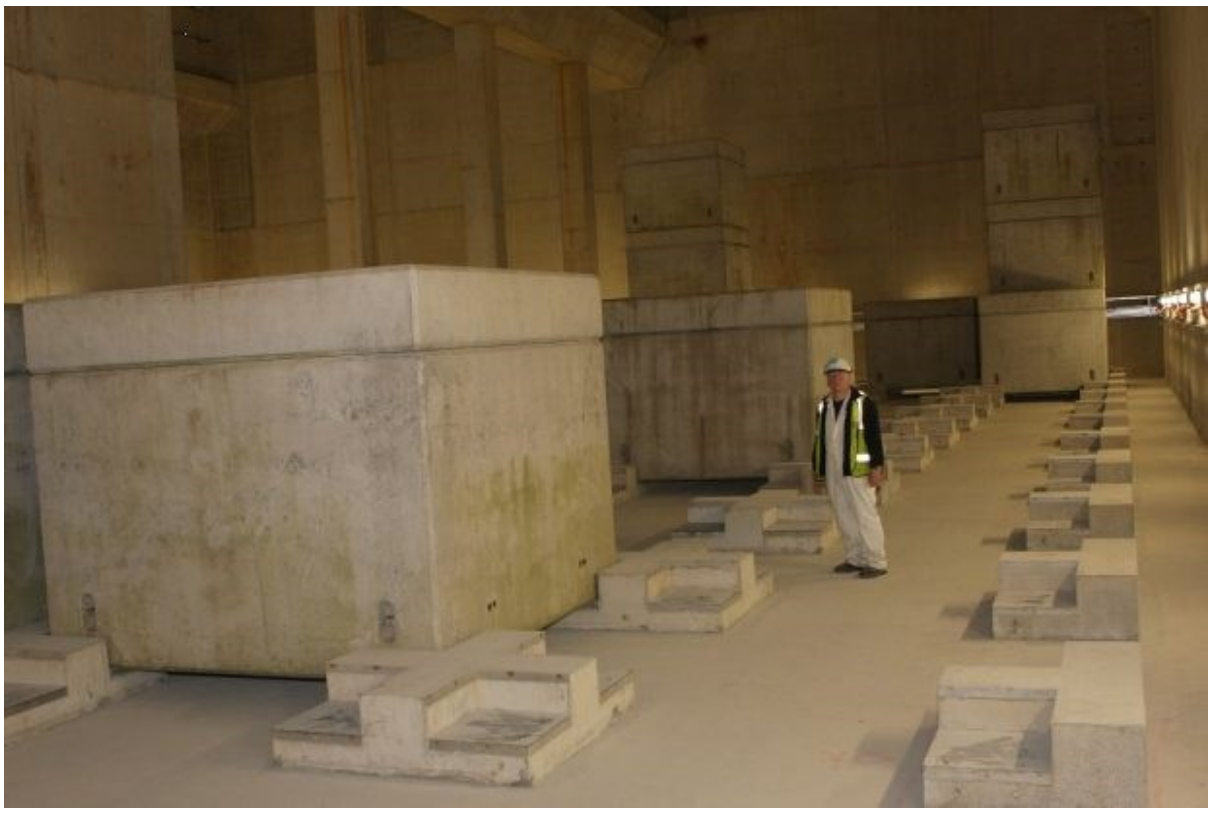
(4) Comprises UK classification LLW (512,000 m^3) and ILW (7,800 m^3), and mixed LLW/VLLW (304,000 m^3).

(5) There is a net decrease in HLW over the period 2019-2029 because accumulated Highly Active Liquor (HAL) is being conditioned, which reduces its volume by about two-thirds, and also because vitrified HLW is being exported to overseas customers.

Table 5: Estimated waste production for reactor types as a function of electrical power output
Volumes when packaged

Reactor type	Quantity of waste (m^3 per GW(e).y)[1]				Comments
	VLLW	LLW	ILW	HLW	
AGR	0	321	170	0	Based on average reactor lifetime of 43.5 years and deferred decommissioning strategy
PWR	0	71.1	57.6	0	Based on Sizewell B reactor lifetime of 40 years and early decommissioning strategy

(1) Volumes are for wastes when packaged for long-term management based on the probable conditioning method and container type. The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container. Station operational and decommissioning wastes are included. Wastes from spent fuel storage and spent fuel reprocessing are excluded. Volumes are given to three significant figures.



Inside the ILW store at Trawsfynydd

4 REPORTING TO THE JOINT CONVENTION

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was negotiated under the auspices of the International Atomic Energy Agency (IAEA). Its primary objective is to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management. The Joint Convention 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 Joint Convention, was provided in October 2017[7]. National reports are subject to a process of peer review by the Contracting Parties 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 (including wastes that are packaged and not yet packaged[8])
- 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 2014-2019
- Mass of spent fuel in stocks, reported as either fuel still within reactor cores or fuel that has been removed from reactor cores and transferred to storage facilities.

The following tables provide information from the 2019 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. The waste types listed use the 2009 IAEA classification system.

[7] *Department for Business, Energy and Industrial Strategy, "The United Kingdom's Sixth 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," October 2017.*

[8] *Wastes that are not yet packaged exist in an untreated or partly treated state. Packaging is the preparation of waste for long-term management or disposal. The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container.*

Table 6: Radioactive wastes existing at 1 April 2019 from all sources Packaged and unpackaged volumes

Waste type	At 1.4.2019	Volume (m^3)(1)
HLW	Packaged	1,200
	Unpackaged	1,240
	Total	**2,430**
ILW	Packaged	46,300
	Unpackaged	65,500
	Total	**112,000**
LLW (2)	Packaged	6,990
	Unpackaged	23,900
	Total(2)	**30,900**
VLLW(3)	Packaged	0
	Unpackaged	1,370
	Total(3)	**1,370**

(1) The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container. Volumes are given to three significant figures.

(2) Comprise UK classification ILW (1,490 m^3) and LLW (24,600 m^3), and mixed LLW/VLLW (4,740 m^3).

(3) Comprises UK classification LLW (322 m^3) and VLLW (194 m^3), and mixed LLW/VLLW (850 m^3).

Table 7: Expected total waste volumes from existing facilities to end of life Volumes when packaged (1) (2)

Waste type	At 1.4.2019	Future arisings (m^3)	Total (m^3)
HLW	1,790	see note 3	1,500
ILW	162,000	328,000	489,000
LLW(4)	37,300	824,000	861,000
VLLW(5)	1,120	3,120,000	3,120,000
Total	**202,000**	**4,270,000**	**4,470,000**

(1) The packaged waste volume is the total volume taken up by the waste, the immobilising medium and the waste container. Volumes are given to three significant figures.

(2) There are changes in total waste volumes compared with the previous (2016) Inventory. The increase in ILW volume is due principally to changes in packaging assumptions for Sellafield decommissioning wastes. The decrease in LLW is due principally to more waste being diverted from the LLWR to incineration and metal treatment.

(3) There is a net decrease in the quantity of HLW after 1 April 2019 because accumulated HAL is being conditioned, which reduces its volume by about two-thirds, and also because vitrified HLW is being exported to overseas customers.

(4) Comprises UK classification ILW (9,660 m^3) and LLW (544,000 m^3), and mixed LLW/VLLW (308,000 m^3).

(5) Comprises UK classification LLW (427,000 m^3), VLLW (115,000 m^3), and mixed LLW/VLLW (2,580,000 m^3).

Table 8: Consignments of LLW to disposal facilities (2014-2018) (1)

Year(2)	Total volume (m^3)(3)
2014	3,650
2015	5,840
2016	4,940
2017	2,290
2018	1,800

(1) Total volume of waste packages consigned to the LLWR and Dounreay LLW facility. The first consignment at Dounreay was in 2015.

(2) For period 1 April to 31 March.

(3) Volumes are given to three significant figures.

Table 9: Inventory of spent fuel at 1 April 2019 (1)

Location	Description	Approximate quantity of UK-owned irradiated fuel (tHM)(2)	
		In reactor	In storage
Magnox power stations(3)	Magnox fuel	149	73
AGR power stations	AGR fuel	1,500	150
PWR power station	PWR fuel	90	530
Sellafield	Magnox fuel	(4)	625
	AGR fuel		2,050
	SGHWR fuel		68
	WAGR fuel		21
	Other fuel		790(5)
Dounreay	DFR breeder fuel	21	3
	PFR		10
	Other fuels		1
Harwell	Various(6)		1

(1) Spent fuel is nuclear fuel that has been used (i.e. irradiated) in nuclear reactors and is no longer capable of efficient fission due to the loss of fissile material.

(2) Fuel 'In reactor' is that in reactor cores; fuel 'In storage' has been removed from reactor cores to storage facilities.

(3) Includes Calder Hall on the Sellafield site.

(4) Fuel at Calder Hall is included under 'Magnox power stations'.

(5) Includes miscellaneous fuels (~720 tHM), overseas Light Water Reactor (LWR) fuel transferred to UK ownership (~66 tHM) and DFR breeder fuel transferred from Dounreay (~1.5 tHM).

(6) Comprises low irradiated fuels.

Robot removing surface-contaminated concrete

5 REPORTING TO THE STATUS AND TRENDS PROJECT

In June 2014 the IAEA, the OECD/NEA and the European Commission established a Joint Working Group to co-ordinate and support the preparation of a report providing a global perspective on radioactive waste and spent fuel management, including information on current inventories and future arisings. This initiative is known as the "*Status and Trends Project*". It is envisaged that the planned report will serve as a comprehensive and authoritative reference for worldwide status and trends concerning arisings of spent fuel and radioactive waste and provisions for the long-term management of these materials. The reporting of inventories should be compatible with that provided in reports required by the Joint Convention and the European Council Directive 2011/70/Euratom.

The first project report was published in 2018[9]. Beyond this, further reporting cycles are envisaged in line with the reporting cycles under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and the reporting cycle under the Council Directive 2011/70/Euratom.

The tables in the Appendix provide information from the 2019 Inventory in a form for the Status and Trends Project. The waste types listed use the 2009 IAEA classification system.

[9] *IAEA, "IAEA Nuclear Energy Series No. NW-T-1.14. Status and Trends in Spent Fuel and Radioactive Waste Management," 2018.*

Spent fuel storage, Sellafield

APPENDIX:
INFORMATION FOR THE STATUS AND TRENDS PROJECT

Radioactive waste classification, waste and spent fuel quantities (inventory) (including disused sources that are declared radioactive waste)

Table A1: Radioactive waste in storage at 1 April 2019 (including spent fuel that is considered waste)

Route waste class	Processed (type)/ Unprocessed)	Total current volume (m^3)	Estimated disposal volume (m^3)	Distribution (%)							Planned disposal route (if known)
				RO	FFE	RP	NA	DF	DC / RE	ND	
Total of all classes		**133,000**	**202,000**	**16.0**	**<0.1**	**60.0**	**15.1**	**1.57**	**7.27**	**0**	
HLW		2,150	1,790	0	0	0.9	0	0	0	0	GDF
ILW		101,000	162,000	13.9	<0.001	58.7	4.4	0.8	2.28	0	GDF(1)
LLW		28,500	37,300	1.85	<0.01	0.4	10.7	0.7	4.9	0	Near surface
VLLW		1,370	1,120	0.2	<0.1	0	<0.1	0.1	0.1	0	VLLW landfill

(1) Total current volume (column 3) and estimated disposal volume (column 4) include 9,130 m^3 and 15,400 m^3 ILW respectively that are managed under the Scottish Government's policy for higher activity waste, which is that long-term management should be in near-surface facilities.

Net Enabled Waste Management Database (NEWMDB) waste origin type codes:
RO – reactor operations
FFE – fuel fabrication & enrichment
RP – fuel reprocessing
NA – nuclear applications
DF - defence
DC/RE – decommissioning & remediation
ND – not determined

Table A2: Radioactive waste disposed (as disposed volume)

Waste class	Processed (not)	Total volume (m^3)	Distribution (%)							Disposal route used
			RO	FFE	RP	NA	DF	DC / RE	ND	
Total of all classes		**~1,000,000**							**100**	
HLW		0								
ILW		~33,000							100	N Atlantic and UK coastal waters(1)
LLW		~1,000,000							100	Near surface(2)
VLLW		Not reported in UK Inventory							100	Landfill

(1) 1949 – 1982

(2) Comprises ~1,000,000 cubic metres at LLWR and ~4,700 cubic metres at Dounreay.

(Note: abbreviations as in Table A1)

Table A3: Spent fuel in storage (MtHM)

Type	Current amount (NPPs) (MtHM)	Current amount (research reactors) (MtHM)
Total Spent Fuel Storage:	**4,300**	**130**
Wet storage (AR)	720	0
Wet storage (AFR)	3,500 (1)	120
Dry storage (AR)	70	0
Dry storage (AFR)	0	10
Total spent fuel held in storage for other countries (amounts also included above)	0	0.7

(1) Includes ~720 MtHM 'miscellaneous fuels' stored at Sellafield.

AR = "at reactor site", including fuel pools at NPP

AFR = "away from reactor site"

Table A4: Spent fuel sent for reprocessing (in the country or sent to another country)[10] (MtHM)

Type	Current amount (NPPs) (MtHM)	Current amount (research reactors) (MtHM)
Total amount of Spent Fuel sent to Reprocessing (in your country)	60,000	Not known
Total amount of Spent Fuel sent to Reprocessing (in another country)	0	Not known
Total amount of Spent Fuel received from another country for reprocessing and recycling	4,400	Not known
Total amount of Spent Fuel (MtHM) or radioactive waste (cubic metres) returned to country of origin for storage/disposal	236 m^3 (1)	Not known

(1) Total (already returned plus future scheduled). Comprises vitrified HLW, including an additional amount that is smaller in volume but equivalent in radiological terms to customers' ILW and LLW that would otherwise be returned (in line with the UK's policy of waste substitution).

Table A5: Translation of waste volumes from UK classification system to IAEA classification system

National waste classification name	IAEA classification (1)			
	VLLW	LLW	ILW	HLW
Very Low Level Waste	100%			
Low Level Waste	28.9%	71.1%		
Intermediate Level Waste		3.5%	96.5%	
High Level Waste				100%

(1) Percentages in terms of actual reported volumes in stocks and forecast future arisings.

[10] *All years.*

Table A6: Overview of waste and materials management facilities [1]

Type	Planned	Construction	Commissioning	In Operation	Shutdown	Decomm	Other	Total
Spent Fuel storage [2]				15		10		**26**
Spent Fuel reprocessing & recycling [3]				1	1	3		**5**
Spent Fuel conditioning	1 [4]							**1**
Spent Fuel disposal	1 [5]							**1**
Waste processing:								
HLW				1 [6]				**1**
ILW [7]	17	2	2	14	2			**Not quantified**
LLW				see note 8				**Not quantified**
VLLW								
Waste storage:								
HLW [9]	1			2				**3**
ILW [10]	21	4		>35	3			**Not quantified**
LLW				see note 11				**Not quantified**
VLLW								
Waste disposal:								
HLW	1 [5]							**1**
ILW	1 [5]							**1**
LLW [12]				2	2			**3**
VLLW				4 [13]	see note 14			**4**

(1) The table does not include all UK radioactive waste and material management facilities. The number of facilities is subject to future change.

(2) **In operation**: Storage ponds at Advanced Gas-cooled Reactors (AGRs) (7); Sizewell B PWR (1); Magnox Wylfa (Dry cells); Sellafield (4); Dounreay (1). Sizewell B Dry Store. **Decommissioning**: Magnox stations (10).

(3) **In operation**: Magnox reprocessing plant at Sellafield. **Shutdown**: Thorp reprocessing plant at Sellafield. **Decommissioning**: First Generation Reprocessing Plant at Sellafield; Prototype Fast Reactor (PFR) Reprocessing Plant and Materials Testing Reactor (MTR) Reprocessing Plant at Dounreay.

(4) AGR Fuel Final Conditioning Plant at Sellafield.

(5) Geological Disposal Facility (GDF).

(6) Waste Vitrification Plant (WVP) at Sellafield.

(7) **Planned**: There are plans for 15 waste processing plants at Sellafield; a number of plants proposed at Dounreay (PFR Size Reduction Facility; DFR Packaging Plant; DMTR Packaging Plant; Drummed RHILW Packaging Facility; Shaft & Silo Waste Treatment Plant); Berkeley Encapsulation Plant; Hinkley Point A Encapsulation Plant; Sizewell A AVDS; Oldbury AVDS; Wylfa AVDS; Winfrith Encapsulation Plant. **Construction**: Sellafield Box Encapsulation Plant (BEP); Hunterston A Solid ILW Encapsulation Plant. **Commissioning**: Harwell Waste Encapsulation Plant; Trawsfynydd Fuel Element Debris (FED) Retrieval & Processing Plant; Hunterston A Solid ILW Encapsulation Plant (SILWEP); AVDS at Chapelcross. **In operation**: Magnox Encapsulation Plant (MEP), Waste Encapsulation Plant (WEP), Waste Packaging & Encapsulation Plant (WPEP), Waste Treatment Complex (WTC) 1, AGR Dismantler Drum Packaging Plant and Pile Fuel Storage Pond (PFSP) Drum Filling Plant at Sellafield; Dounreay Cementation Plant (DCP); ILW Solid Waste Complex at Harwell; Waste Conditioning Plant at Berkeley; Dungeness A Conditioning Plant; Resin Solidification Plant and Miscellaneous Activated Components (MAC) Encapsulation Plant at Trawsfynydd; Hunterston A Wet ILW Retrieval and Encapsulation Plant (WILWREP). **Shutdown**: Windscale Advanced Gas-cooled Reactor (WAGR) Packaging Plant at Sellafield; FED Dissolution Plant at Dungeness A; FAVORIT, AVDS and FED Dissolution Plant at Bradwell.

(8) LLW producers use a range of processes to minimise waste volumes – size reduction; decontamination; compaction (low force and high force). There are three high force compaction facilities in the UK (Dounreay; Sellafield; Winfrith), a metal recycling facility (Lillyhall) and a number of incinerators available to the nuclear industry.

(9) **Planned**: Vitrified Product Store (VPS) 2 at Sellafield. **In operation**: VPS1 and Highly Active Liquor (HAL) tanks at Sellafield.

(10) **Planned**: BEP Product Stores 2, 3 & 4, Class 2 Store & Extension, Engineered Drum Stores (EDS) 4 & 5 at Sellafield; DCP Store Extension 2, Unshielded ILW Store at Dounreay; Wylfa ILW Store; ILW stores at AGR reactor sites (7). **Construction**: BEP Product Store Direct Import Facility, First Generation Magnox Storage Pond (FGMSP) ISF at Sellafield. **Commissioning**: Harwell ILW Store; Chapelcross ISF; Hinkley Point A ISF. **In operation**: Encapsulated Product Stores (EPS) 1-3, EDS 1-3, WPEP Store, Miscellaneous Beta Gamma Waste Store (MBGWS), WAGR Store at Sellafield; DCP Store & Extension at Dounreay; Harwell Vault Store; Trawsfynydd ILW Store; Hunterston A ILW Store; Berkeley ISF; Bradwell ISF; Aldermaston HAW Stores 1-4; Amersham ILW Store; Cardiff ILW Store. There are legacy ILW stores in operation: including Magnox Swarf Storage Silos (MSSS), FGMSP, Pile Fuel Storage Pond (PFSP), Pile Fuel Cladding Silo (PFCS), Solid Waste Storage Cells (SWSC), Plutonium Contaminated Materials (PCM) stores and Floc Storage Tanks at Sellafield; Shielded Drum Store and Unshielded Drum Store at Dounreay. **Shutdown: Legacy** PCM stores at Sellafield; Wet silo and shaft at Dounreay. At reactor station sites untreated waste storage facilities include underground/above-ground vaults, reactor voids, tanks, drum stores.

(11) LLW is held in short-term storage at sites before consignment for disposal or other management routes.

(12) **In operation**: LLWR in West Cumbria; Dounreay LLW disposal facility in Caithness. There are plans to construct further disposal vaults at these sites. **Shutdown**: LLWR trenches, Dounreay LLW pits.

(13) Clifton Marsh, Lillyhall, East Northants, Calder Landfill Extension Segregated Area (CLESA).

(14) There have been on-site disposals to pits and trenches at several sites.

Table A7: Summary of major sources of waste – number of facilities [1]

Type	Planned	Construction	Commission	In Operation	Shutdown	Decomm	Other	Total
Research reactors* [2]				1		10		**11**
Nuclear power reactors [3]	6	2		15		26		**49**
Spent fuel reprocessing & recycling [4]				1	1	3		**5**
Other (define)**								
Uranium enrichment [5]				1		1		**2**
Fuel manufacture [6]				3	3			**5**
Defence activities [7]				6		1		**7**
Medical & industrial [8]				2	1			**3**

(1) The table does not include all sources of UK radioactive waste. The number of facilities is subject to future change.

(2) **In operation**: Joint European Torus (JET). **Decommissioning**: PFR; Dounreay Fast Reactor (DFR); Dounreay MTR; Piles 1&2; Windscale Advanced Gas-cooled Reactor (WAGR); Steam Generating Heavy Water Reactor (SGHWR); Dragon; DIDO; PLUTO.

(3) **Planned**: Sizewell C (2); Anglesey (2); Oldbury (2). **Construction**: Hinkley Point C (2). **In operation**: Advanced Gas-cooled Reactors (AGRs) (14); Pressurised Water Reactor (PWR) (1). **Decommissioning**: Magnox reactors (26).

(4) **In operation**: Magnox reprocessing plant. **Shutdown:** Thorp reprocessing plant. **Decommissioning**: First Generation Reprocessing Plant; PFR Reprocessing Plant; MTR Reprocessing Plant.

(5) **In operation**: Centrifuge plant. **Decommissioning**: Diffusion plant incl. associated facilities.

(6) **In operation**: Oxide Fuels Complex; uranium conversion plants. **Shutdown:** Magnox Canning Plant; U Metal Plant; Sellafield MOX Plant (SMP).

(7) **In operation**: Aldermaston; Burghfield; Devonport; Clyde, Rosyth; Derby. **Decommissioning**: Vulcan.

(8) **In operation**: Amersham; Rutherford Appleton Laboratory. **Decommissioning**: Cardiff.

** Research reactors with medium or high power from RRDB.*
*** If applicable, where included in national inventory, e.g. decommissioning of contaminated facilities, clean-up of accident related sites.*
Note: "Planned" means it has been identified in a national report, strategy, or formal plan. It includes: Planned, Under Study-Assessment, Siting-Design phases.

Table A8: Trends and future prospects (estimation of volumes of waste and spent fuel arising, waste and spent fuel management facilities)

Type	Current amount	Estimated current amount when prepared for disposal	Current disposal capacity	Total forecast at 2030	Total forecast at 2050
Spent fuel storage:	**(MtHM)**			**(MtHM)**	**(MtHM)**
Wet storage (AR)	720	Unknown		Unknown	Unknown
Wet storage (AFR)	3,600	Unknown		Unknown	Unknown
Dry storage (AR)	70	Unknown		Unknown	Unknown
Dry storage (AFR)	10	Unknown		Unknown	Unknown
Total amount of spent fuel sent to reprocessing and recycling	64,000 (Sellafield only, includes overseas LWR)	Unknown		65,000	65,000
Total amount of spent fuel disposed	0	0		Unknown	Unknown
Waste in storage:	**Reported volume (m^3)**	**Packaged volume (m^3)**		**Packaged volume (m^3)**	**Packaged volume (m^3)**
HLW	2,150	1,790		1,500	1,500
ILW	101,000	162,000		195,000	277,000
LLW	28,500	37,300		278,000	492,000
VLLW	1,370	1,120		185,000	578,000

Type	Current amount	Estimated current amount when prepared for disposal	Current disposal capacity	Total forecast at 2030	Total forecast at 2050
Waste disposal:	**(m^3)**	**(m^3)**	**(m^3)**	**(m^3)**	**(m^3)**
HLW	0	0	0	0	Unknown
ILW	0	0	0	0	Unknown
LLW	0	0	310,000 (1)	Unknown	Unknown
VLLW	Unknown	Unknown	Unknown	Unknown	Unknown

(1) Capacity (in cubic metres) for Vault 8 and Vault 9 at the LLWR. Excludes disposal capacity at Dounreay LLW facility (sufficient capacity will be constructed to dispose of the site's LLW, forecast to be about 100,000 m^3 reported volume).

AR = "at reactor site".
AFR = "away from reactor site".

Fuel skip being removed from legacy pond, Sellafield

GLOSSARY

A	**AGR**	Advanced Gas-cooled Reactor.
B	**Becquerel (Bq)**	The standard international unit of measurement of radioactivity – corresponding to one disintegration per second (see also kBq, MBq and GBq).
	BEIS	The Department for Business, Energy & Industrial Strategy is a ministerial department that brings together responsibilities for business, industrial strategy, science, innovation, energy, and climate change.
D	**DFR**	Dounreay Fast Reactor (shut down in 1977).
E	**EU**	European Union.
G	**GBq**	Gigabecquerel (equal to 1,000,000,000 Becquerels).
	GDF	Geological Disposal Facility.
H	**Half-life**	For a radionuclide, the time required for the activity to decrease, by a radioactive decay process, by half.
	HAL	Highly Active Liquor.
	HLW	High Level Waste.
I	**IAEA**	International Atomic Energy Agency.
	ILW	Intermediate Level Waste.
K	**kBq**	Kilobecquerel (equal to 1,000 Becquerels).
L	**LLW**	Low Level Waste.
	LLWR	Low Level Waste Repository. The LLWR in West Cumbria has operated as a national disposal facility for LLW since 1959.
	LWR	Light Water Reactor.
M	**Magnox**	An alloy of magnesium used for fuel element cladding in natural uranium fuelled gas-cooled power reactors, and a generic name for this type of reactor.
	MBq	Megabecquerel (equal to 1,000,000 Becquerels).
	MtHM	Metric tonnes heavy metal.
N	**NDA**	Nuclear Decommissioning Authority. A non-departmental public body responsible for overseeing the decommissioning and cleanup of 17 of the UK's civil public sector nuclear sites.
	NEA	Nuclear Energy Agency.
	NORM	Naturally Occurring Radioactive Material. These are materials that typically accumulate as scale on pipework during the extraction of oil and gas, and have raised levels of naturally occurring radioactivity.
O	**OECD**	Organisation for Economic Co-operation and Development.
P	**PFR**	Prototype Fast Reactor (at Dounreay; shut down in 1994).
	PWR	Pressurised Water Reactor.
S	**SGHWR**	Steam Generating Heavy Water Reactor (at Winfrith site; shut down in 1990).
T	**tHM**	Tonnes of heavy metal. A unit of mass used to quantify uranium, plutonium and thorium including mixtures of these elements.
	Thorp	Thermal Oxide Reprocessing Plant (at Sellafield).
V	**VLLW**	Very Low Level Waste.
W	**WAGR**	Windscale Advanced Gas-cooled Reactor (at Sellafield site; shut down in 1981).