Nuclear Decommissioning Authority

Department of Energy & Climate Change

2013 UK Radioactive Waste Inventory:

Radioactivity Content of Wastes

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The 2013 UK Radioactive Waste Inventory

Radioactivity Content of Wastes

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

PREFACE

The 2013 United Kingdom Radioactive Waste & Materials Inventory (hereafter referred to as the 2013 Inventory) will provide comprehensive and up-to-date information on radioactive waste and materials as at 1 April 2013. It is part of an ongoing programme of research jointly conducted by the Department of Energy and Climate Change (DECC) and the Nuclear Decommissioning Authority (NDA).

DECC and NDA have commissioned the 2013 Inventory to provide information on the status of radioactive waste stocks (at 1 April 2013) and forecasts of future arisings in the United Kingdom. Additional information on radioactive materials which may become wastes is collated. Its aim is to provide data in an open and transparent manner for those interested in radioactive waste and material issues.

Information collected for the 2013 Inventory is presented in a series of reports, as listed below:

- High Level Summary
- Summary of Data for International Reporting
- Scope and Conventions
- Scenario for Future Radioactive Waste & Material Arisings
- Waste Quantities from All Sources
- Radioactive Waste Composition
- Radioactivity Content of Wastes
- Radioactive Wastes & Materials Not Reported in the 2013 UK Radioactive Waste Inventory.

All documents have been prepared on the basis of information supplied to the 2013 Inventory contractors, Pöyry Energy and Amec. This information was verified in accordance with arrangements established by Pöyry Energy and Amec.

This reporting output provides summary information on the radioactivity content of radioactive wastes in the 2013 Inventory.

Conditions of Publication

Feedback

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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1 INTRODUCTION

Radioactivity is a property possessed by some atoms that split spontaneously, with release of energy through emission of a sub-atomic particle and/or radiation. This process of disintegration and energy release is known as radioactive decay. The term ‘radionuclide’ is used to describe an atom or nucleus of an element that undergoes radioactive decay. Each radionuclide has a unique half-life, which is the time required for one half of the atoms to decay.

There are about 2,300 known radionuclides, most of which are not naturally occurring. Several hundred of these are produced in nuclear reactors; many are of short half-life and so decay completely or to very low levels before they can appear in wastes.

The 2013 Inventory includes information on 112 radionuclides that have the potential to impact on the safe handling, transport, storage and disposal of radioactive waste generated in the UK.

Radionuclides are specified by the symbol of their chemical element and their atomic mass (for example Cl36 is the radioactive nuclide of chlorine with an atomic mass of 36). Some radionuclides exist in a metastable state: this is indicated by a suffix ‘m’ or ‘n’ (for example Ag110m).

This reporting output presents summary information on the radioactivity (hereafter shortened to ‘activity’) content of wastes in the 2013 Inventory.

Activities (in TBq) are derived from the reported specific activity (in TBq/m^3) and reported volume (in m^3) of each waste stream[1]. Values may be given using scientific notation (e.g. 16,000TBq is expressed as 1.6E+04TBq). In the 2013 Inventory there are a number of Intermediate Level Waste (ILW) and Low Level Waste (LLW) streams where specific activity is not quantified. In the case of ILW, the number of waste streams is small, all are of low volume, and specific activities are not anticipated to be significant. However, in the case of LLW, a number of decommissioning waste streams have high forecast volumes and therefore potentially significant total activities even though their specific activities are likely to be very low. Consequently, the total activity of LLW streams in the 2013 Inventory may be underestimated. Nonetheless, this activity remains a very small fraction of the total activity from all wastes.

Before reporting the activities of wastes, some background information is provided on the sources of radioactivity and the radionuclides to be found in radioactive wastes.

Summed waste stream activities are rounded to two significant figures.

Rounding errors affecting the last significant figure can occur if totals are compared with the sums of individual values within tables of data; this is purely an arithmetical effect and has no practical significance

[1] For conditioned waste streams the specific activity and volume reported are those for the conditioned product.

2 TOTAL FOR ALL WASTES

To determine total activities in waste at 1 April 2013, the activities of all relevant waste streams are summed. This is valid, because the activities of waste at 1 April 2013 refer to a particular point in time. However, this is not true for future arisings, where the specific activity of a waste stream is that estimated to exist at the time the waste arises. As different waste streams are generated over different periods of time, between 2013 and 2120, summed activities will not represent the actual total activity content of the wastes at any particular time.

To overcome this, the total activity of accumulated wastes at times after the reference date of 1 April 2013 is calculated by taking account of the radioactive decay of each waste stream. The period of decay for wastes that existed at 1 April 2013 is from that date, and for waste arisings after 1 April 2013 is from the time that the waste arises. All radionuclide activity data include contributions from short-lived daughter nuclides.

The activities given in Table 1 are those for accumulated wastes at 1 April 2013, 2050, 2100 and 2150[2]. The values show that most of the activity in radioactive waste is in HLW.

Table 1: Total activity of all wastes

Waste type	Total activity (TBq)			
	At 1.4.2013	**At 1.4.2050**	**At 1.4.2100**	**At 1.4.2150**
HLW	78,000,000	27,000,000	8,700,000	2,900,000
ILW	3,900,000	1,900,000	950,000	590,000
LLW	57	130	130	110
VLLW	<0.001	3.9	11	14
Total	82,000,000	29,000,000	9,700,000	3,500,000

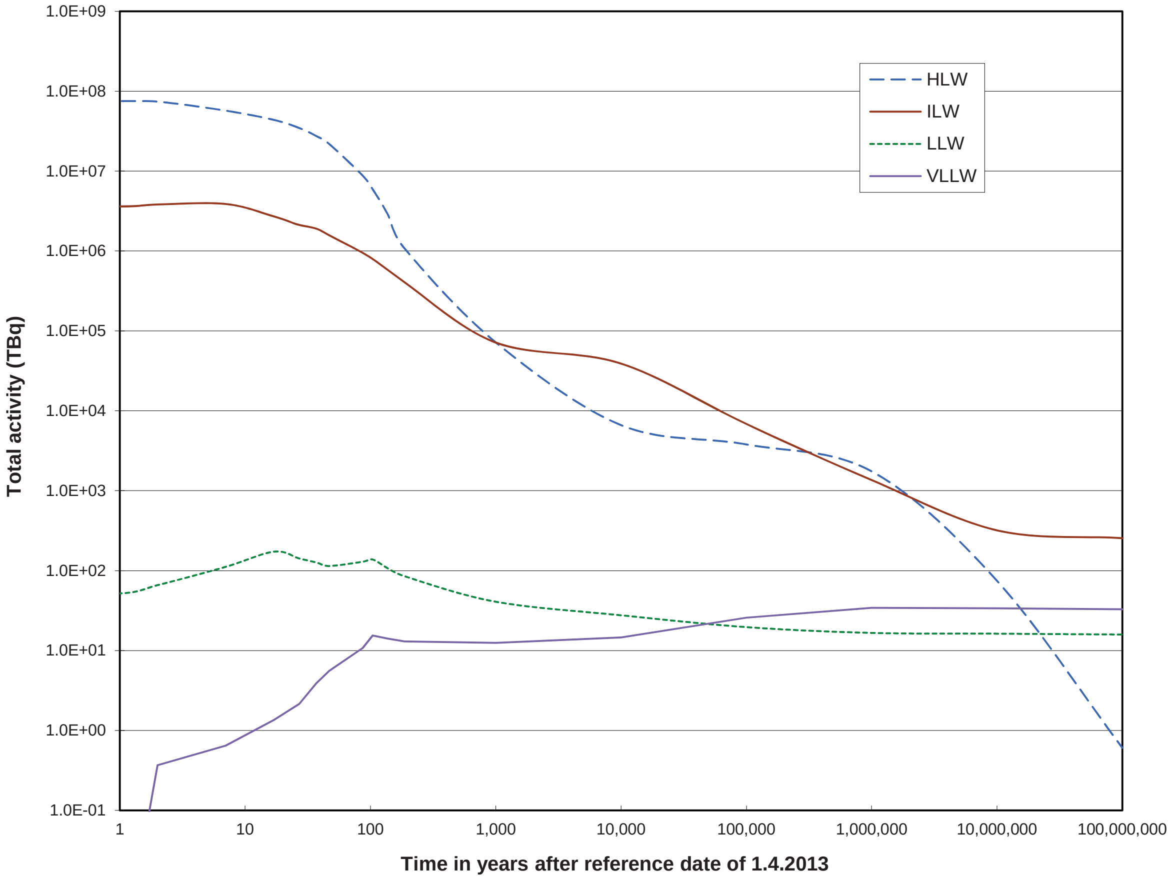
Figure 1 illustrates how the total activities of accumulated High Level Waste (HLW), ILW and LLW change with time after 1 April 2013. Total activities initially increase, as the additional activity in projected future arisings is greater than the reduction in activity from radioactive decay of the waste as a whole. This is particularly noticeable for Very Low Level Waste (VLLW) where stocks at 1 April 2013 are small and projected future arisings over the next 100 years are relatively very large.

Once all projected waste has arisen, total activities fall in a manner that reflects the decay of the major radionuclide species. No HLW is projected to arise after 2026. There are no further arisings of ILW, LLW and VLLW beyond 2120 when the final stage decommissioning of all power reactors, the dismantling of all reprocessing and associated plants and site clean-up activities are assumed to be complete.

At 2150 the total activity in all wastes is forecast to be 3,500,000TBq. About 91% of the activity is from beta/gamma-emitting radionuclides. The total alpha and beta/gamma activities are 330,000TBq and 3,200,000TBq respectively.

[2] Where stock activity data from the 2010 UK Radioactive Waste Inventory have been carried over into the 2013 Inventory, the authors have decayed these activities to 1 April 2013.

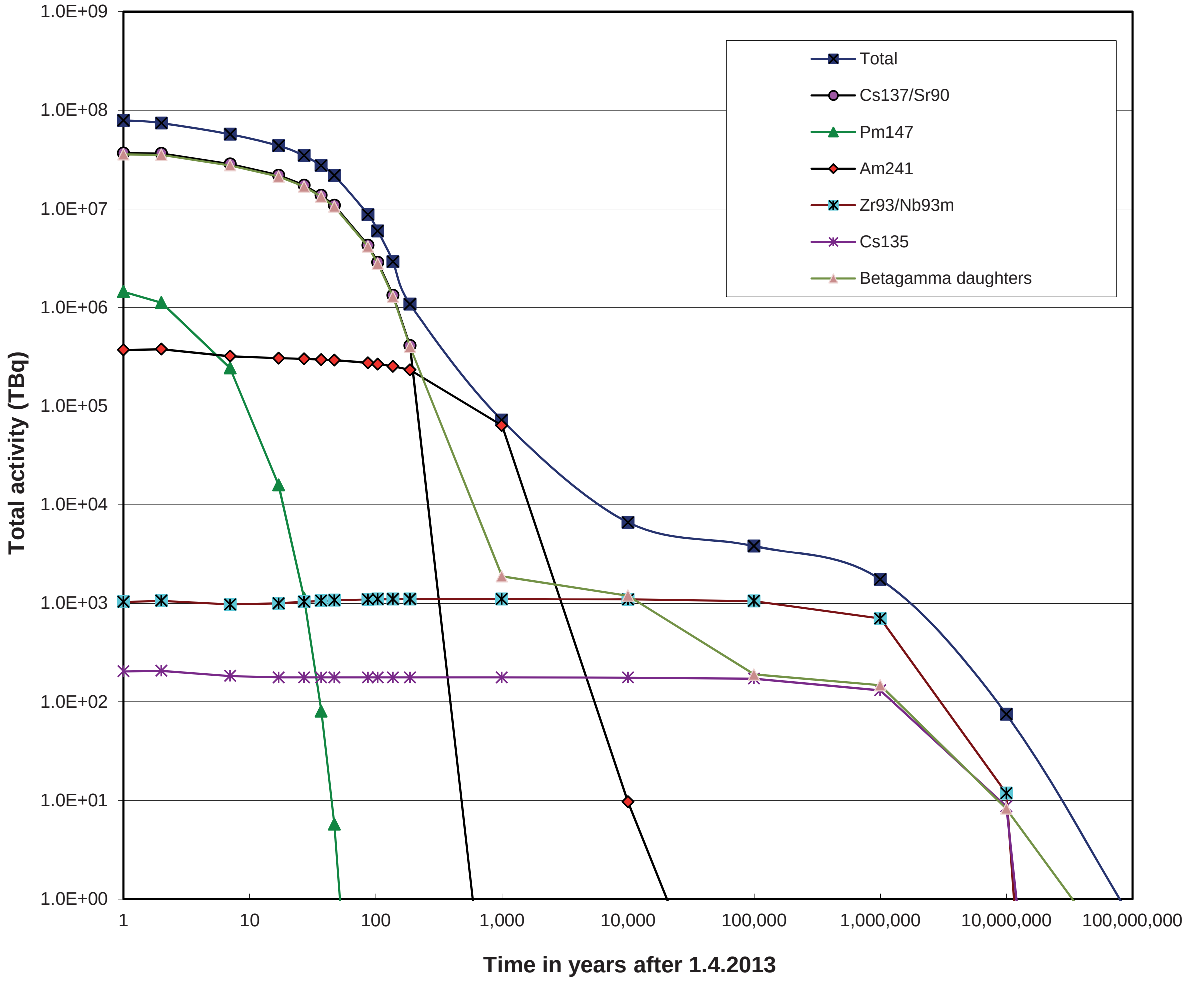
Figure 1: Total activity of HLW, ILW and LLW as a function of time post 1 April 2013



The total activities of HLW and ILW exhibit decreases of many orders of magnitude over time as radionuclide components with shorter half-lives decay. In time (between about one and ten million years) the total activity of HLW falls below that of ILW, LLW and VLLW because of the lower quantities of uranium in HLW, which with its daughter products is the major contributor to total activities beyond about 1 million years. LLW shows a markedly smaller decrease in activity over time from its peak level than either HLW or ILW. This is because a relatively high proportion of the activity of LLW at the time of arising is from uranium, which has a long half-life. There is an initial rise in the activity of VLLW as waste is generated over the next 100 years. Thereafter the activity of VLLW is dominated by uranium and its daughter products.

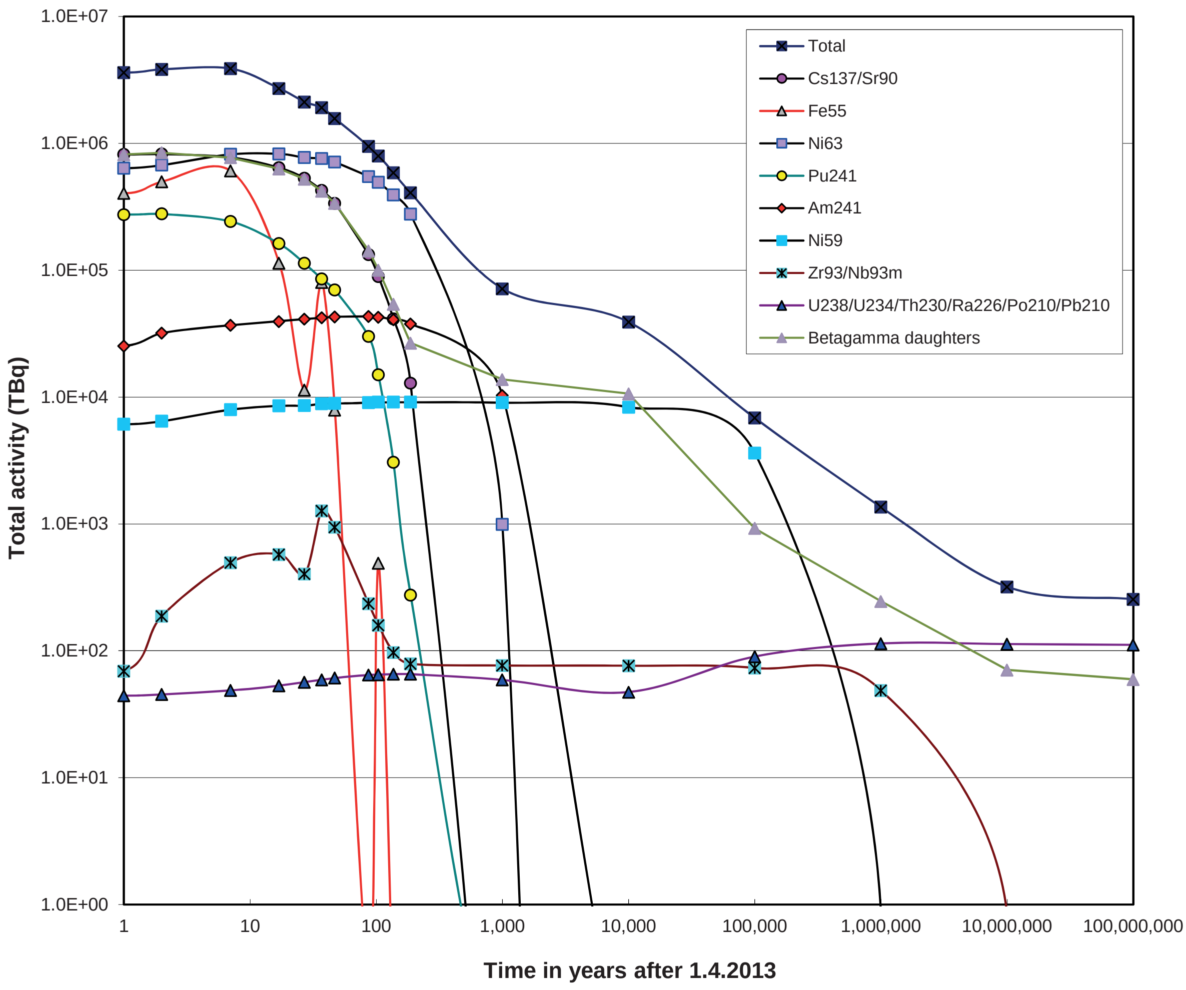
Figures 2-5 show those radionuclides that are the major contributors to the activities of HLW, ILW, LLW and VLLW, and how these contributions change with time.

Figure 2: Total activity of HLW as a function of time post 1 April 2013



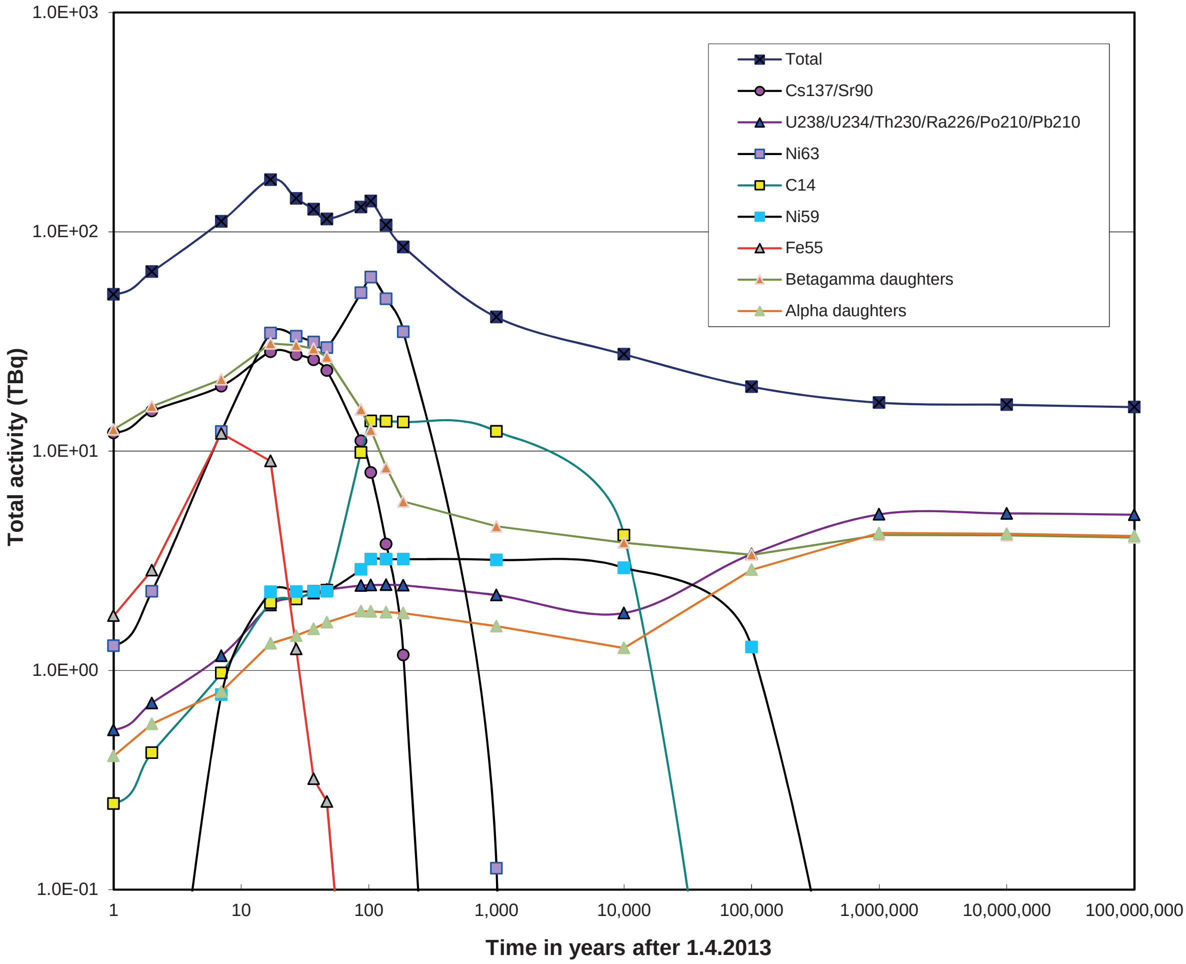
HLW comprises the waste fission products from reprocessing spent nuclear fuel. The total activity of HLW for about 300 years following 1 April 2013 is largely due to the activities of the fission products Sr90 and Cs137 and their short-lived daughters (Y90 and Ba137m respectively). Both Sr90 and Cs137 have a radioactive half-life of about 30 years. Thereafter a number of increasing longer half-life radionuclides make significant contributions, including Am241, Zr93 and Nb93m.

Figure 3: Total activity of ILW as a function of time post 1 April 2013



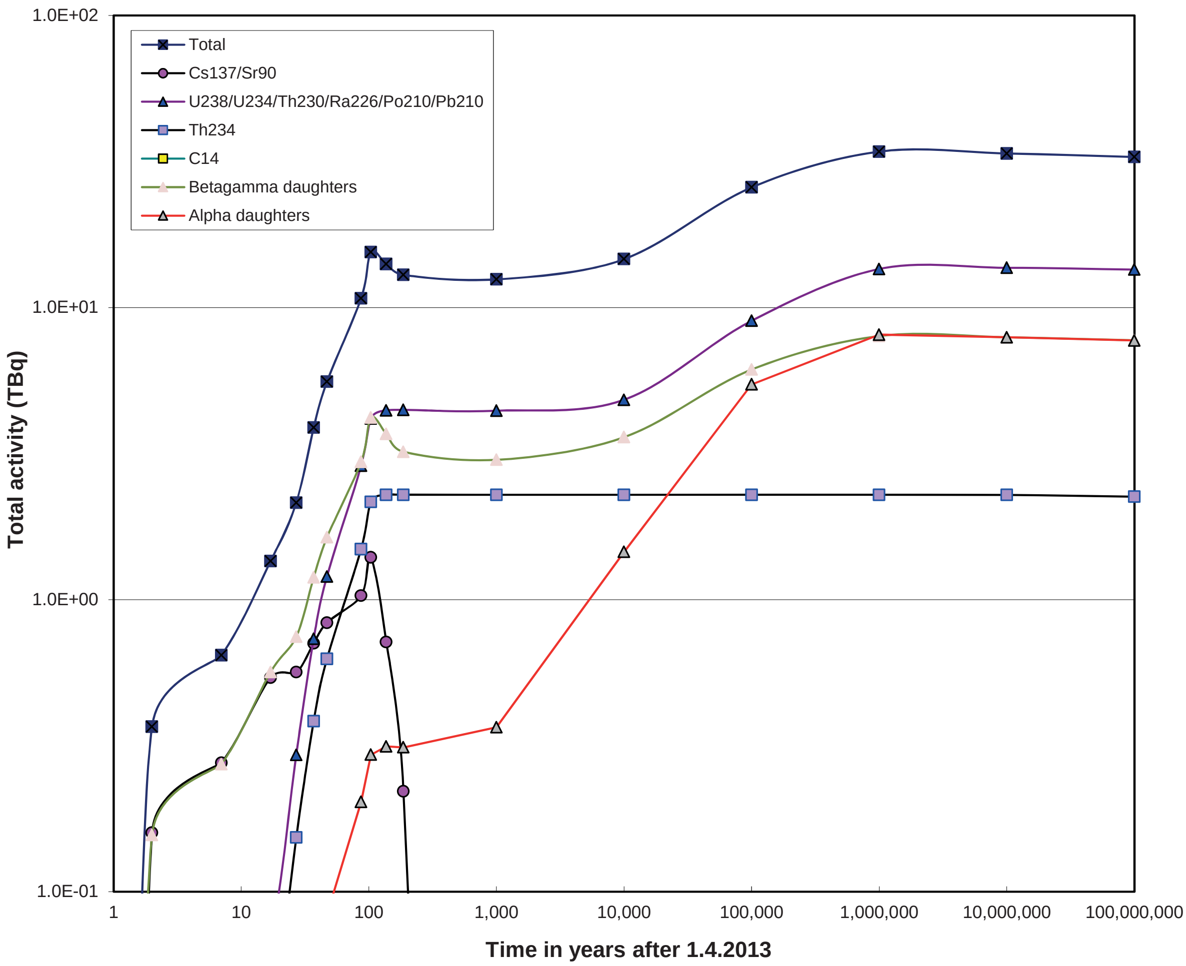
ILW comprises wastes that have been activated by neutrons in reactors as well as wastes that have been contaminated with fission products and/or uranium and its radioactive decay products. In the first 300 years following 1 April 2013 the major contributors to the total activity of ILW are the activation products Fe55 and Ni63 and the fission products Sr90 and Cs137 and their short-lived daughters (Y90 and Ba137m respectively). Thereafter a number of increasing longer half-life radionuclides make significant contributions, including Ni59. After a few millions of years uranium and its radioactive daughters are predominant.

Figure 4: Total activity of LLW as a function of time post 1 April 2013



LLW comprises wastes that have been activated by neutrons in reactors as well as wastes that have been contaminated with fission products and/or uranium and its radioactive decay products. In the first 300 years following 1 April 2013 the major contributors to the total activity of LLW are the activation products Ni63 and the fission products Sr90 and Cs137 and their short-lived daughters (Y90 and Ba137m respectively). Thereafter a number of increasing longer half-life radionuclides make significant contributions, including C14 and Ni59. After about 100,000 years uranium and its radioactive daughters are predominant.

Figure 5: Total activity of VLLW as a function of time post 1 April 2013



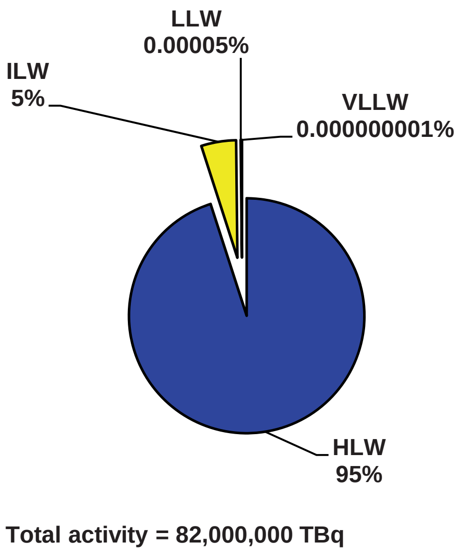
VLLW principally comprises wastes that have been have been contaminated with uranium and its radioactive decay products and with fission products. Apart from the first 100 years following 1 April 2013, the major contributor to the total activity of VLLW is uranium and its radioactive daughters.

3 WASTES AT 1 APRIL 2013

For most waste streams with stocks at 1 April 2013, the specific activities relate to that date. These activities take into account radioactive decay from the time the waste was generated.

Figure 6 shows the relative contributions of HLW, ILW, LLW and VLLW to the activity in waste at 1 April 2013 from all sources at that date. Most of the activity (78,000,000TBq) was contained in HLW. The total activity in ILW was lower (3,900,000TBq), while the activity content of LLW was very much lower still (57TBq). The activity content of VLLW was comparatively very small (<0.001TBq).

Figure 6: Proportions of activity by waste category at 1 April 2013

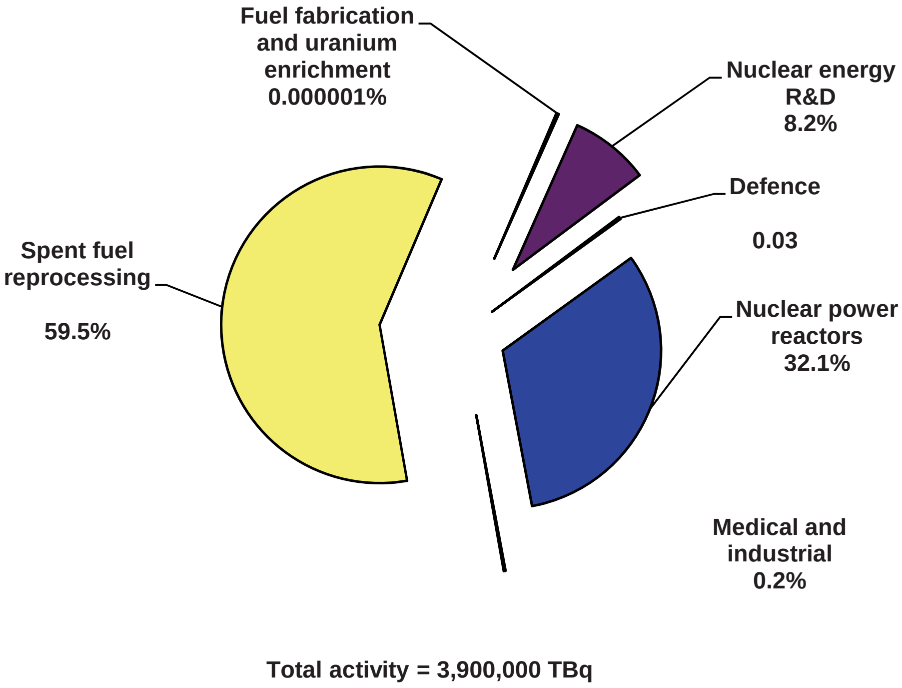


About 99% of the activity in waste at 1 April 2013 was from beta/gamma-emitting radionuclides. The total alpha and beta/gamma activities were 550,000TBq and 81,000,000TBq respectively.

All HLW is generated from spent fuel reprocessing at Sellafield.

Figure 7 illustrates the contributions of the different business activities to total activity in ILW at 1 April 2013. Spent fuel reprocessing and nuclear power reactors accounted for about 92% of the activity. For spent fuel reprocessing the activity is primarily from fission products that along with residual uranium are transferred in varying degrees to wastes. In the case of nuclear power reactors most of this activity arises as activation products in fuel element and reactor core components that have been subjected to neutron irradiation.

Figure 7: Proportions of activity by business activity in ILW at 1 April 2013



Note: 'Spent fuel reprocessing' comprises all wastes from Sellafield, where there are large waste volumes from legacy defence programmes in addition to those from commercial fuel reprocessing.

In terms of volume about 49% of all LLW at 1 April 2013 was stored in Vaults 8 and 9 at the LLWR. A further 20% is being stored in containers at Dounreay awaiting transfer to the new site LLW disposal facility. The other wastes were spread across the different business activities. Before LLW is consigned for disposal, recycling or incineration, it is usually held in interim storage on the site of arising for a short period only, so the proportion from each activity at any date is subject to continual change. For these reasons an analysis of the activity source has not been undertaken.

Similarly, VLLW is held in interim storage on the site of arising for a short period only before disposal to a suitable landfill site.

Table 2 gives the total activities of radionuclides in HLW, ILW and LLW at 1 April 2013. The table lists only those radionuclides that have a quantified activity.

Table 2: Radionuclide activities in all wastes

Nuclide	Half-life (years)	Radionuclide activity (TBq) (1)							
		At 1.4.2013				At 1.4.2150 (2)			
		HLW	ILW	LLW	VLLW	HLW	ILW	LLW	VLLW
H3	1.23E+01	1.3E+2	2.1E+4	9.7E+0	6.0E-4	2.1E-2	5.0E+1	1.4E+0	1.2E-1
Be10	1.60E+06	3.9E-2	3.7E-1	4.1E-6	-	3.5E-2	3.8E-1	1.5E-6	-
C14	5.73E+03	5.2E+0	7.2E+2	2.6E-1	7.3E-6	1.9E+0	9.8E+3	1.4E+1	6.4E-2
Cl36	3.02E+05	1.6E+0	1.1E+1	1.3E-1	4.6E-6	1.4E+0	4.7E+1	2.2E+0	3.6E-2
Ar39	2.69E+02	-	4.4E-1	-	-	-	1.2E+0	7.7E-4	-
Ar42	3.30E+01	-	3.3E-7	-	-	-	1.7E-5	2.1E-12	-
K40	1.28E+09	-	1.1E-2	7.0E-5	5.7E-6	1.6E-18	6.8E-2	3.5E-4	5.7E-6
Ca41	1.03E+05	1.9E-1	3.7E+0	1.4E-3	-	1.5E-1	2.1E+1	7.0E+0	2.7E-4
Mn53	3.70E+06	1.4E-7	5.6E-6	2.9E-11	-	1.2E-7	3.3E-3	6.1E-10	-
Mn54	8.56E-01	2.8E+0	3.9E+3	5.6E-2	5.6E-9	-	2.4E-18	1.9E-19	1.9E-15
Fe55	2.70E+00	3.8E+3	5.2E+5	2.9E+0	1.1E-4	1.5E-12	1.0E-1	3.6E-8	1.8E-5
Co60	5.27E+00	1.6E+4	5.6E+5	3.7E+0	4.1E-5	2.0E-4	1.9E+0	2.7E-4	1.1E-4
Ni59	7.49E+04	3.2E+0	6.1E+3	6.6E-4	-	2.8E+0	9.1E+3	3.2E+0	3.6E-5
Ni63	1.00E+02	3.6E+2	6.4E+5	1.4E+0	2.2E-5	1.2E+2	3.9E+5	4.9E+1	5.1E-2
Zn65	6.69E-01	3.1E-3	2.4E+2	5.9E-3	3.6E-9	-	-	-	-
Se79	3.77E+05	1.9E+1	8.2E-1	1.6E-7	-	1.6E+1	8.8E-1	6.9E-6	-
Kr81	2.10E+05	-	1.0E-5	3.0E-11	-	-	6.5E-2	1.2E-6	-
Kr85	1.07E+01	-	4.0E+3	5.0E-3	-	-	6.3E-1	8.1E-7	-
Rb87	4.80E+10	7.5E-3	2.3E-5	9.3E-12	-	6.5E-3	6.5E-4	2.0E-4	-
Sr90	2.91E+01	3.2E+7	6.1E+5	8.3E+0	1.2E-8	1.1E+6	2.6E+4	2.0E+0	8.9E-1
Zr93	1.53E+06	6.3E+2	3.5E+1	4.8E-4	-	5.5E+2	3.8E+1	6.4E-3	-
Nb91	6.80E+02	4.9E-12	3.4E-3	2.9E-9	-	3.8E-12	1.0E-1	8.4E-5	4.2E-5
Nb92	3.50E+07	1.1E-9	1.8E-5	9.3E-14	-	9.9E-10	5.5E-5	8.6E-8	-
Nb93m	1.64E+01	3.9E+2	3.5E+1	1.2E-4	-	5.5E+2	5.9E+1	7.0E-3	1.2E-5
Nb94	2.03E+04	2.0E-1	1.5E+2	5.2E-3	-	1.7E-1	2.7E+2	4.0E-2	1.2E-4
Mo93	3.50E+03	2.4E-1	3.9E+1	8.1E-6	-	1.9E-1	8.3E+1	4.7E-1	5.8E-6
Tc97	2.60E+06	9.6E-9	8.7E-9	3.3E-14	-	8.6E-9	4.3E-6	5.3E-9	-
Tc99	2.13E+05	3.0E+3	5.5E+2	4.2E-1	-	2.6E+3	9.8E+2	7.5E-1	2.2E-1
Ru106	1.01E+00	1.8E+5	3.7E+4	2.8E-1	-	-	2.9E-12	2.2E-13	2.4E-12
Pd107	6.50E+06	3.3E+1	6.0E-1	3.8E-8	-	2.9E+1	6.1E-1	1.8E-5	-
Ag108m	4.18E+02	2.5E-3	1.8E+3	1.0E-3	6.4E-9	1.8E-3	1.7E+3	1.4E-1	1.7E-7
Ag110m	6.84E-01	1.4E+1	1.3E+2	2.9E-3	2.3E-9	-	-	-	-
Cd109	1.27E+00	3.3E-3	2.0E+0	5.4E-4	-	-	-	-	-
Cd113m	1.41E+01	2.3E+3	3.1E+2	2.0E-3	-	2.3E+0	3.7E-1	2.2E-6	-
Sn119m	8.02E-01	1.2E+0	6.5E-3	1.4E-13	-	-	-	-	-
Sn121m	5.00E+01	5.2E+3	1.8E+2	7.5E-3	-	6.8E+2	3.4E+1	9.1E-3	-
Sn123	3.54E-01	5.1E-2	1.9E-4	3.5E-14	-	-	-	-	-
Sn126	2.30E+05	1.0E+2	2.3E+0	1.4E-7	-	9.0E+1	2.4E+0	1.6E-4	-
Sb125	2.73E+00	9.2E+4	5.0E+3	3.4E-2	3.7E-9	5.3E-11	2.2E-10	1.6E-10	4.1E-7
Sb126	3.39E-02	3.3E+1	2.6E+0	1.4E-4	-	1.3E+1	3.4E-1	2.3E-5	-
Te125m	1.59E-01	2.3E+4	5.1E+3	1.9E-3	4.0E-9	5.6E-11	2.4E-10	1.7E-10	4.4E-7
Te127m	2.98E-01	2.7E-2	5.8E-6	2.2E-5	-	-	-	-	-
I129	1.57E+07	9.9E-2	5.5E-1	1.2E-3	-	8.6E-2	6.5E-1	8.1E-3	6.7E-2
Cs134	2.06E+00	1.4E+5	5.3E+3	1.5E-1	2.6E-8	1.0E-15	4.1E-7	2.0E-8	2.4E-8
Cs135	2.30E+06	2.0E+2	7.0E+0	6.2E-6	-	1.8E+2	7.9E+0	1.8E-4	-
Cs137m	3.00E+01	4.2E+7	1.0E+6	1.7E+1	2.0E-6	1.6E+6	5.4E+4	5.4E+0	5.3E-1
Ba133	1.05E+01	4.5E-4	3.2E-1	1.6E-2	3.3E-9	4.7E-8	2.4E-3	1.2E-4	2.3E-11
La137	6.00E+04	5.4E-4	8.9E-3	1.2E-4	-	4.8E-4	1.6E-2	1.2E-5	-
La138	1.05E+11	1.6E-8	2.0E-10	5.6E-16	-	1.4E-8	1.8E-8	7.1E-10	-
Ce144	7.80E-01	1.0E+5	4.3E+4	1.3E-1	-	-	3.1E-15	2.6E-16	5.4E-15
Pm145	1.77E+01	2.7E-2	3.3E-1	1.3E-9	-	9.4E-5	2.9E-3	8.6E-5	-
Pm147	2.62E+00	1.9E+6	3.0E+4	1.9E-1	7.2E-9	2.7E-10	3.5E-8	3.5E-9	1.9E-6
Sm147	1.06E+11	2.8E-3	1.5E-5	3.7E-11	-	2.5E-3	1.7E-5	2.2E-8	2.0E-12
Sm151	8.87E+01	1.3E+5	4.4E+3	4.2E-2	-	3.8E+4	1.6E+3	5.6E-1	4.8E-4
Eu152	1.33E+01	1.1E+3	2.7E+4	2.7E-3	-	7.6E-1	2.1E+1	2.3E-1	2.4E-8
Eu154	8.60E+00	2.9E+5	6.8E+3	2.8E-2	1.3E-8	3.8E+0	1.3E-1	3.9E-3	4.5E-5
Eu155	4.96E+00	6.6E+4	2.3E+3	1.3E-2	5.3E-9	2.6E-4	2.4E-5	1.6E-6	1.3E-5
Gd153	6.61E-01	7.1E-2	5.2E+1	2.1E-16	-	-	-	-	-
Ho163	4.57E+03	9.5E-6	1.3E-5	1.8E-11	-	8.4E-6	7.4E-4	1.1E-4	-
Ho166m	1.20E+03	8.4E-2	2.0E-2	5.5E-9	-	6.8E-2	4.8E-1	7.7E-3	-
Tm170	3.52E-01	4.9E-7	4.0E-12	-	-	-	-	-	-
Tm171	1.92E+00	1.0E+0	3.9E-4	5.9E-10	-	-	1.0E-20	-	-
Lu174	3.31E+00	-	4.5E-6	4.6E-12	-	-	7.7E-16	-	-

Nuclide	Half-life (years)	Radionuclide activity (TBq) [1]							
		At 1.4.2013				At 1.4.2150 [2]			
		HLW	ILW	LLW	VLLW	HLW	ILW	LLW	VLLW
Lu176	3.61E+10	-	1.3E-8	5.8E-15	-	-	2.8E-7	6.5E-8	-
Hf178n	3.10E+01	-	7.3E-3	-	-	-	5.5E-2	2.1E-5	-
Hf182	8.99E+06	2.3E-10	4.2E-9	6.0E-15	-	2.0E-10	5.2E-5	2.5E-13	-
Pt193	5.07E+01	-	4.5E-2	2.5E-7	-	-	9.1E-1	1.9E-5	-
Tl204	3.78E+00	-	9.7E-2	4.5E-5	-	-	2.0E-8	8.0E-10	-
Pb205	1.52E+07	5.0E-7	1.3E-4	6.2E-6	-	4.4E-7	1.6E-4	7.8E-5	-
Pb210	2.23E+01	1.5E-4	4.5E-1	2.2E-2	-	2.9E-3	8.7E+0	2.9E-1	7.1E-2
Bi208	3.68E+05	-	1.8E-7	2.4E-13	-	-	2.3E-5	6.5E-10	-
Bi210m	3.00E+06	1.6E-11	2.4E-7	1.0E-9	-	1.4E-11	2.3E-5	1.6E-5	-
Po210	3.79E-01	1.5E-4	4.8E-1	1.6E-2	-	2.8E-3	8.7E+0	2.9E-1	7.0E-2
Ra223	3.13E-02	3.7E-3	2.2E-2	4.6E-8	-	6.6E-3	1.4E-1	1.4E-3	3.0E-4
Ra225	4.08E-02	2.0E-5	2.5E-3	2.6E-9	-	1.7E-4	2.6E-2	8.9E-6	2.1E-3
Ra226	1.60E+03	5.4E-4	9.0E+0	1.3E-1	-	3.6E-3	8.7E+0	2.9E-1	8.3E-2
Ra228	5.75E+00	3.9E-8	1.7E-1	7.5E-3	-	3.8E-8	1.9E-1	2.7E-1	1.1E-2
Ac227	2.18E+01	3.7E-3	7.6E-1	1.3E-5	-	6.6E-3	1.4E-1	1.4E-3	3.0E-4
Th227	5.12E-02	3.6E-3	2.2E-2	4.6E-8	-	6.5E-3	1.4E-1	1.4E-3	3.0E-4
Th228	1.91E+00	2.6E-1	1.1E+0	8.8E-3	1.1E-6	1.7E-4	6.4E-1	2.7E-1	1.5E-2
Th229	7.34E+03	2.0E-5	2.7E-3	3.1E-8	-	1.7E-4	2.6E-2	8.9E-6	2.1E-3
Th230	7.54E+04	6.4E-2	7.5E-2	1.3E-3	4.9E-6	5.4E-2	1.0E-1	4.2E-3	1.6E-2
Th232	1.41E+10	4.6E-8	1.8E-1	4.7E-3	1.6E-6	3.8E-8	1.9E-1	2.7E-1	1.1E-2
Th234	6.60E-02	2.9E-2	6.6E+0	1.2E-2	-	2.5E-2	1.9E+1	8.7E-1	2.3E+0
Pa231	3.28E+04	7.8E-3	1.1E-1	5.4E-5	-	6.7E-3	1.3E-1	1.6E-3	5.0E-4
Pa233	7.39E-02	3.6E+1	7.4E+1	7.5E-4	-	4.3E+1	1.1E+2	2.1E-2	7.6E-2
U232	6.98E+01	7.1E-4	1.1E+0	3.2E-4	-	1.7E-4	4.3E-1	3.5E-4	3.7E-3
U233	1.59E+05	1.7E-3	1.6E+0	3.6E-5	-	2.4E-2	1.8E+0	4.8E-4	3.3E-1
U234	2.46E+05	8.4E-2	1.7E+1	2.0E-1	6.0E-6	3.9E-1	2.0E+1	7.2E-1	1.9E+0
U235	7.04E+08	1.1E-3	5.4E-1	2.6E-2	2.8E-7	9.7E-4	6.2E-1	2.1E-1	3.4E-1
U236	2.34E+07	7.5E-3	1.5E+0	1.8E-2	-	9.1E-3	1.7E+0	3.4E-2	1.8E-1
U238	4.47E+09	2.9E-2	1.7E+1	1.7E-1	2.1E-5	2.5E-2	1.9E+1	8.7E-1	2.3E+0
Np237	2.14E+06	3.6E+1	7.8E+1	8.1E-3	-	4.3E+1	1.1E+2	2.1E-2	7.6E-2
Pu236	2.90E+00	1.6E-3	3.9E+0	7.7E-9	-	7.3E-18	1.5E-13	-	-
Pu238	8.77E+01	1.2E+3	5.4E+3	6.0E-1	1.6E-9	6.8E+2	3.3E+3	3.9E-1	3.0E-2
Pu239	2.41E+04	2.9E+2	9.0E+3	3.5E-1	1.4E-5	2.5E+2	1.4E+4	2.2E+0	1.4E-1
Pu240	6.56E+03	5.8E+2	9.7E+3	1.5E-1	4.8E-7	7.2E+2	1.4E+4	8.6E-1	1.6E-1
Pu241	1.44E+01	2.4E+4	2.9E+5	2.8E+0	4.9E-6	4.8E+1	3.0E+3	5.0E-2	2.6E-1
Pu242	3.74E+05	1.1E+0	6.2E+0	2.0E-4	-	9.0E-1	9.4E+0	3.3E-4	3.6E-3
Am241	4.33E+02	3.7E+5	2.5E+4	6.1E+0	6.1E-7	2.5E+5	4.1E+4	6.2E+0	1.9E-1
Am242m	1.41E+02	1.1E+3	2.0E+2	6.7E-4	-	4.8E+2	1.0E+2	2.9E-3	-
Am243	7.36E+03	1.9E+3	2.0E+1	2.7E-4	-	1.6E+3	2.1E+1	6.5E-4	-
Cm242	4.46E-01	9.1E+2	5.0E+2	1.6E-3	-	4.0E+2	8.6E+1	2.4E-3	-
Cm243	3.00E+01	1.3E+3	4.3E+1	1.5E-3	-	4.5E+1	1.9E+0	9.9E-5	-
Cm244	1.81E+01	1.2E+5	6.8E+2	7.8E-3	-	5.0E+2	4.5E+0	4.2E-4	1.0E-3
Cm245	8.50E+03	2.6E+1	4.3E-2	2.0E-6	-	2.0E+1	4.8E-2	8.9E-6	2.1E-1
Cm246	4.73E+03	5.5E+0	7.8E-3	1.1E-6	-	4.3E+0	8.7E-3	1.2E-6	1.9E-2
Cm248	3.40E+05	4.4E-5	4.2E-4	2.3E-5	-	3.4E-5	4.2E-4	2.3E-5	-
Cf249	3.51E+02	3.5E-4	4.2E-4	7.6E-7	-	2.1E-4	3.9E-4	5.8E-7	-
Cf250	1.31E+01	1.0E-3	2.9E-4	6.2E-8	-	5.4E-7	1.4E-6	4.4E-11	-
Cf251	8.98E+02	1.6E-5	1.4E-7	2.3E-7	-	1.1E-5	2.0E-7	2.0E-7	-
Cf252	2.65E+00	3.5E-5	4.0E-3	6.7E-6	-	-	1.8E-18	-	-
Alpha daughters		9.6E-1	3.1E+1	4.1E-1	4.0E-6	3.2E-2	2.9E+1	1.8E+0	3.1E-1
Beta/gamma daughters		3.7E+7	8.6E+5	1.4E+1	1.7E-5	1.3E+6	5.4E+4	8.4E+0	3.7E+0

(1) Only waste streams with a quantified radionuclide concentration contribute to this table.

(2) Activities at 1.4.2150 are decayed values.

4 COMPARISON WITH THE 2010 INVENTORY

Compared with wastes at 1 April 2010, the total activities of HLW, ILW and LLW at 1 April 2013 are very similar indicating that additional activity in further accumulations has been balanced by a decrease in activity from radioactive decay or from more recent and improved data.

The calculated total activities of HLW and ILW at 2150 are similar, as there has been no significant change to the inventory for these waste types.

The calculated total activity of LLW and VLLW at 2150 is about two-thirds the corresponding activity in the 2010 Inventory principally as a result of re-assessments of decommissioning wastes at a number of sites.

5 GLOSSARY

The glossary contains a list of specialised terms and abbreviations used in this reporting output.

3.4E+02, 4.6E-11 etc.	This is a convenient format that can represent very large and very small numbers. Its value is the number preceding ‘E’ multiplied by 10 to the power of the number following ‘E’.
Half life	For a radioactive species the time required for one half of the atomic nuclei to decay and the radioactivity to fall to one half of its original value.
HLW	High Level Waste
ILW	Intermediate Level Waste.
LLW	Low Level Waste.
LLWR	Low Level Waste Repository.
Radionuclide	A general term for an unstable nuclide that emits ionising radiation (e.g. cobalt-60).
TBq	Terabecquerel, one million million (10^{12}) Becquerels.
VLLW	Very Low Level Waste.

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www.nda.gov.uk/ukinventory

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Front cover images: left - waste packages at Dounreay, top - LLW vaults, bottom left - deplanting and demolition at Sizewell A, bottom right - demolition, making room for new facilities