Nuclear Waste Services

2022 Inventory for Geological Disposal

Key Changes Report

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Introduction

The generic Disposal System Safety Case

Nuclear Waste Services (NWS) (formerly Radioactive Waste Management Ltd) is the organisation responsible for delivering a programme for the safe, secure and permanent geological disposal of the UK's most hazardous radioactive waste. Information on the approach of the UK Government and devolved administrations of Wales and Northern Ireland[1] to implementing geological disposal is included in an overview of the generic Disposal System Safety Case (DSSC) [1].

A geological disposal facility (GDF) will be a highly engineered facility, located deep underground, where the waste will be isolated within a system of multiple engineered and natural barriers designed to prevent harmful quantities of radioactivity and non-radioactive contaminants from being released to the surface environment.

To identify potentially suitable sites for a GDF, the Government has developed an approach based on consent: working with interested communities that are willing to participate in the siting process [2]. No site has yet been identified for a GDF although several search areas are being investigated.

To make progress during the siting process, NWS has developed illustrative disposal concepts for three types of host rock. These host rocks are typical of those being considered in other countries and have been chosen because they represent the range that may need to be addressed when developing a GDF in the UK. The host rocks considered are:

- higher strength rock (HSR), for example, granite
- lower strength sedimentary rock (LSSR), for example, clay
- evaporite rock (EVR), for example, halite

The inventory for disposal in the GDF is defined in the UK policy framework for managing radioactive substances and nuclear decommissioning [2]. The inventory includes radioactive wastes and nuclear materials that could, potentially, be classified as wastes in the future. For the purposes of developing disposal concepts, these wastes have been grouped as follows:

- high heat generating wastes (HHGW): that is, spent fuel from existing and future power stations and high level waste (HLW) from spent fuel reprocessing. High fissile activity wastes, that is, plutonium (Pu) and highly enriched uranium (HEU), are also included in this group. These have similar disposal requirements, even though they don't generate significant amounts of heat
- low heat generating wastes (LHGW): that is, intermediate level waste (ILW) arising from the operation and decommissioning of reactors and other nuclear facilities,

[1] Hereafter, references to Government mean the UK Government including the devolved administrations of Wales and Northern Ireland. Scottish Government policy is that the long-term management of higher-activity radioactive waste should be in near-surface facilities and that these should be located as near as possible to the site where the waste is produced. In Scottish policy the term 'higher activity' radioactive waste refers to ILW and LLW which is not currently suitable for disposal in existing LLW facilities.

together with a small amount of low level waste (LLW) that is unsuitable for near-surface disposal, and stocks of depleted, natural and low enriched uranium (DNLEU)

NWS has developed six illustrative geological disposal concepts, comprising separate concepts for HHGW and LHGW for each of the three host rock types. Designs and safety assessments for the GDF are based on these concepts.

High-level information on the illustrative disposal concepts and other aspects of the disposal system is collated in a technical background document (the Technical Background [3]) that supports this generic DSSC.

The generic DSSC plays a key role in the iterative development of a geological disposal system. This process starts with the identification of the requirements for the disposal system, from which a disposal system specification is developed. Designs, based on the illustrative disposal concepts, are developed to meet these requirements. These designs are then assessed for safety and environmental impacts. An ongoing programme of research and development informs these activities. Conclusions from the safety and environmental assessments identify where further research is needed, and these advances in understanding feed back into the disposal system specification and facility designs.

The generic DSSC demonstrates that geological disposal can be implemented safely and forms a benchmark for NWS to provide waste producers with advice on the packaging of waste for disposal. The suite of documents that make up the generic DSSC, and its high-level structure, are shown in Figure 1.

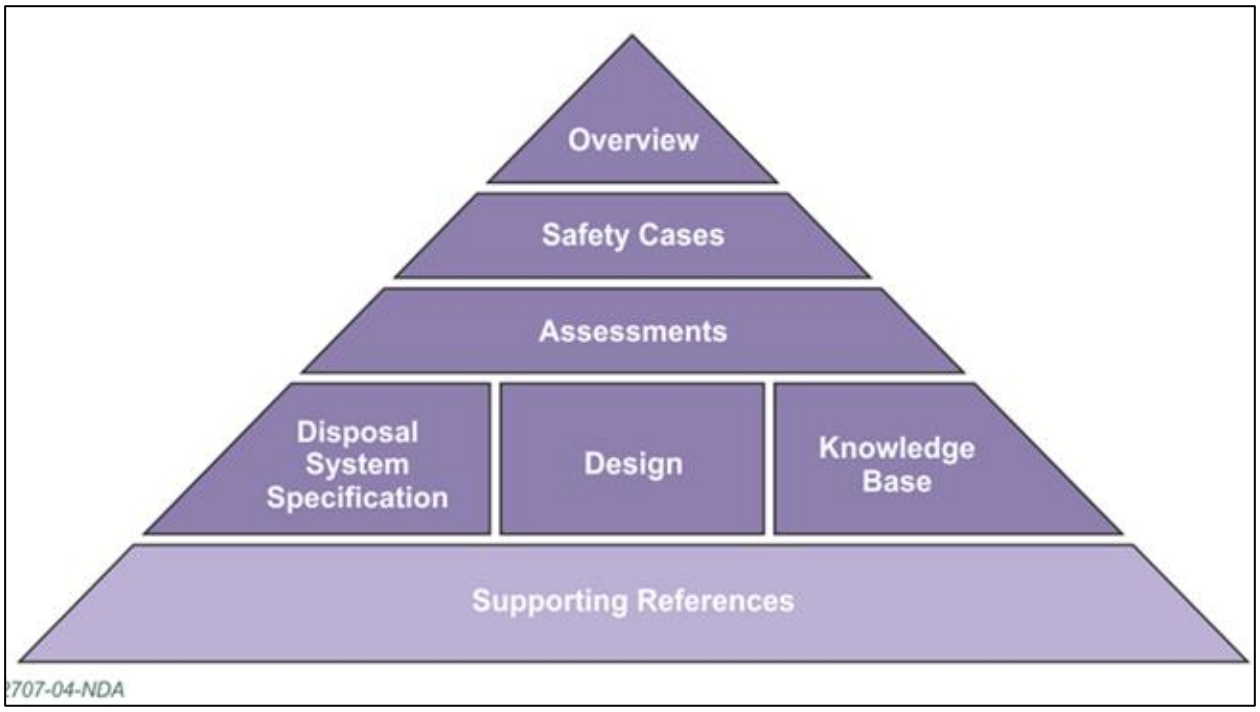

Figure 1 Structure of the generic DSSC.

The 2022 Inventory for Geological Disposal

Objectives of the Inventory for Geological Disposal

The objective of the inventory for geological disposal (IGD) is to provide information on the quantities and characteristics of the components of the inventory of waste destined for geological disposal that is sufficiently detailed for use in NWS' design and safety and environmental assessment work.

The information presented in the inventory includes the volumes, physical and chemical compositions, and activities of conditioned wastes and materials, and details of the containers in which they are assumed to be placed for disposal.

The 2022 IGD scenario was agreed in 2022 and the assumptions that have been made broadly reflect the policies, strategies and intentions at that point in time. However, these are all subject to change and the assumptions in the 2022 IGD may not reflect the current position.

Development of the IGD

The IGD is based on the UK Radioactive Waste and Materials Inventory (known as the UK Inventory or UK RWI). The process for producing the UK Inventory has been improved iteratively over many decades and is now well-established. Each UK Inventory contains details of stocks and projected arisings of all radioactive waste from existing sources (often called legacy wastes).

Currently, the UK Inventory is updated every three years, after which the IGD is updated, as shown in Figure 2. Waste in the UK Inventory dataset that will be managed through other routes (e.g. alternative disposal options and treatment routes) is discounted; the remaining data are reviewed and, where appropriate, enhanced[2]. The dataset is further enhanced to take account of Government policy and industry plans to produce the IGD. Finally, following the production of the UK Inventory (and IGD), Nuclear Decommissioning Authority (NDA) and key users of the UK Inventory (including NWS) meet with waste producers to discuss key inventory improvements. In addition, further characterisation of wastes is carried out, leading to improvements in the inventory data. This iterative process drives continuous improvements in the UK Inventory data and, consequently, the IGD.

[2] For the purposes of this work: 'Review' is defined as the process of identifying omissions, differences, and inconsistencies within the 2022 UK Inventory itself, and with other sources of data; 'Enhancement' is defined as the process of filling gaps and providing justified numeric and other data where these are not reported in the 2022 UK Inventory. For example, the UK Inventory only provides the mass of spent fuels; the enhancement process adds the radionuclide activities and materials and packaging assumptions.

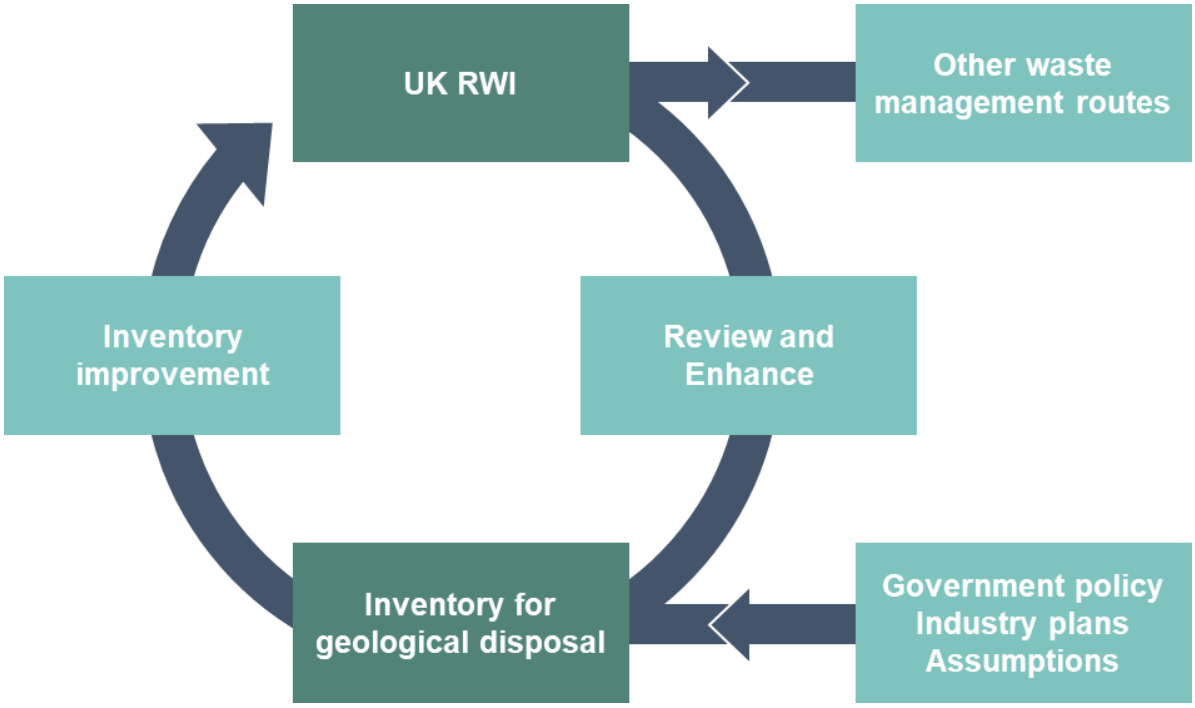

Figure 2 *The iterative development of the inventory for geological disposal.*

The IGD can also be updated in response to inventory data that becomes available between the current three-year cycle of the UK Inventory. Information may become available from several sources, for example from work ongoing within NWS or waste producing organisations.

Scope

Scope of the 2022 Inventory for Geological Disposal

The waste and material types that comprise the IGD are defined in paragraph 8.63 of the UK policy framework for managing radioactive substances and nuclear decommissioning [2]:

2.15 The specific types of higher activity radioactive waste (and nuclear materials that could be declared as waste) which would comprise the inventory for disposal in a GDF are:

- HLW arising from the reprocessed spent nuclear fuel at Sellafield;
- ILW arising from existing nuclear licensed sites, defence, medical, industrial, research and educational facilities that is not suitable for disposal in near surface facilities;
- the small proportion of LLW that is not suitable for disposal in near surface facilities;
- spent fuel from existing commercial reactors (yet to be declared waste) and from research reactors that is not reprocessed;
- spent fuel (yet to be declared waste) from new nuclear projects (including small modular reactors);
- spent fuel (yet to be declared waste) from advanced modular reactors if it is suitable for disposal in a GDF;
- ILW from new nuclear projects not suitable for disposal in near surface facilities;
- the plutonium inventory (yet to be declared waste) – either as spent fuel following reuse or in an immobilised form suitable for geological disposal;
- uranium stocks – including that arising from enrichment and fuel fabrication activities and reprocessing activities (yet to be declared waste); and
- irradiated fuel and nuclear materials (yet to be declared waste) from the UK defence programme.

Updates to the IGD can be either

- a full update, which includes a rigorous examination of the entire UK Inventory dataset: the dataset is reviewed and, where appropriate enhanced. Parameters such as those required to support the gas pathway analysis are calculated and the assumptions that underpin the inventory are also reviewed.
- a light update, in which the full review and enhancement process is not carried out: where waste streams are unchanged, the enhancements from the previous inventory are carried over. In addition, some calculations (e.g. calculations of metal geometry to support the gas pathway analysis) are not carried out.

The 2022 IGD is a full update to the IGD while the 2019 IGD [4] was a light update.

Scope of this report

This report presents the key differences between the 2019 and 2022 IGDs in order to support an assessment of the impact of the changes on the conclusions of the generic DSSC. The report presents detailed technical information and is targeted at an audience of scientists and engineers, in particular NWS staff and contractors and contains detailed technical information.

Conventions used

Waste Groups

NWS's generic disposal facility designs [5] recognise the different packaging and disposal processes for different types of radioactive waste: LLW, ILW and DNLEU are assumed to be disposed of in a LHGW area; HLW, spent fuels (SFs), plutonium and HEU are assumed to be disposed of in a HHGW area. The inventory for geological disposal has been broken down into waste groups (shown in light green boxes in Figure 3) that have been chosen to reflect the different sources of waste and how they will be disposed of in the GDF. The sources of waste considered are:

- legacy: wastes and materials that already exist or that will arise in the future as a result of the operation of existing nuclear facilities
- new build: wastes and spent fuels from the proposed new build programme
- mixed oxide (MOX): at this stage only spent fuel is included.

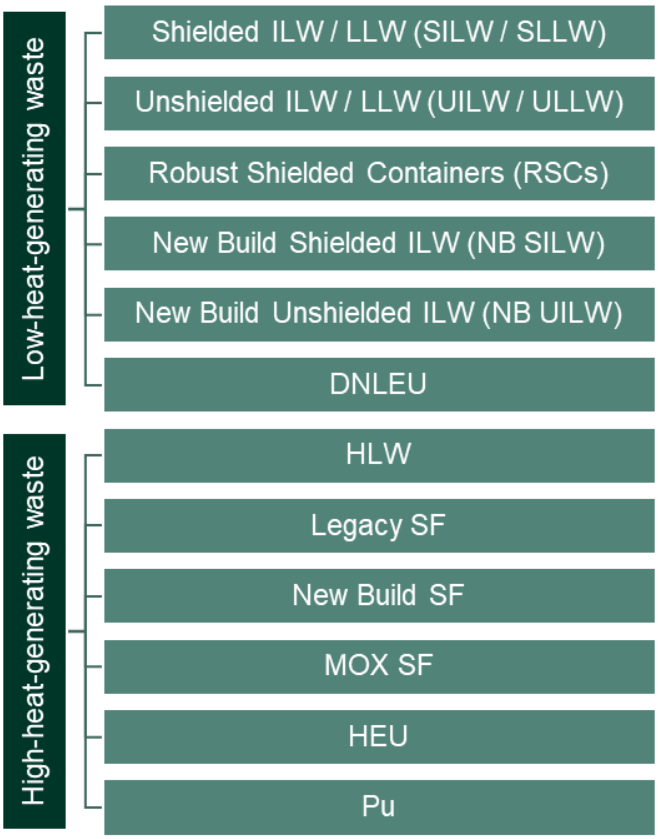

Figure 3 *The two high-level partitions of the inventory (dark boxes) and the waste groups (light boxes).*

Data

The 2022 IGD includes data for:

- volumes: the stored, conditioned, and packaged volume of the inventory
- activities: information for 112 radionuclides identified as being relevant to geological disposal [6]. Data on selected 'priority' radionuclides[3] are presented along with the total activity from all 112 'relevant radionuclides' and their progeny
- the number of disposal units[4] associated with each type of package
- waste material masses: composition data on two levels: (i) the bulk materials that make up the wastes, and (ii) elemental composition of the wastes
- the properties of the inventory that are relevant to the gas pathway analysis.

All data are presented to three significant figures; this is considered to provide an appropriate quantification of the inventory data. In some cases the data are not available or are not specified to three significant figures. In these cases the data are presented to the level of precision to which they are known.

As a result of the rounding some tables will show totals that may not represent the sum of the rounded data that are presented within them. Instead, the totals represent the sum of the data

[3] More detail on priority radionuclides is presented in the Underpinning report.

[4] A disposal unit is a waste package, or group of waste packages, which is handled as a single unit for the purposes of transport and disposal.

rounded to three significant figures. This approach ensures an appropriate and consistent level of precision in all the data.

The 2022 IGD reporting structure

The 2022 IGD reports

This document is the '2022 IGD Key Changes' and is one of five reports that deal with the various aspects of the 2022 IGD; the full suite of reports comprises:

- The 'Main Report' [7], which describes the key features of the IGD to a technical audience
- The 'Underpinning Report' [8], which describes how IGDs are developed and updated
- The 'Implications Report' [9], which describes the implications of the changes introduced by the 2022 IGD for the generic DSSC
- The 'Key Changes Report', which sets out the differences between the 2022 IGD and the previous iteration (the 2019 IGD)
- The 'Summary' [10], which describes the key features of the report to a non-technical audience

Report structure

The remainder of this report is structured as follows:

- *Changes to the scenario for the Inventory for Geological Disposal* describes the changes in the assumptions used as the basis for the IGD
- *Changes to the underpinning data* presents the changes to the quantities in the IGD
- *Conclusions* summarises the above

In addition, there are two appendices:

- *Appendix A: Waste Group Datasheets* provides a summary of the differences to the previous IGD broken down by for each waste group

Changes to the scenario for the Inventory for Geological Disposal

The waste and material types that comprise the IGD are defined in the UK policy framework for managing radioactive substances and nuclear decommissioning [2]. An inventory scenario describes how and when these waste and material types arise. This section presents the changes between the 2019 IGD and 2022 IGD reference scenarios.

Changes to assumed dates of operation and decommissioning

The IGD is compiled using data sourced predominantly from the UK Inventory. The data for future waste arisings in the UK Inventory are projections made by the organisations that operate the sites where radioactive waste is generated. The projections are based on assumptions as to the nature, scale and timing of future operations and activities. In addition, NWS make assumptions about, e.g. the timing of a new build programme. A high-level comparison of the timing of the activities in the 2019 and 2022 IGDs is presented in Figure 4, with full details in Table 1. Changes include:

- reduced operational periods for AGR stations
- increased operational period for JET
- increased decommissioning periods at Harwell and Winfrith
- increased nuclear new build programme.

Government policy

Management of radioactive wastes

The policies for the management of radioactive wastes have not substantially changed between the 2019 and 2022 IGDs, however the individual government policies have now been consolidated into a single UK Policy Framework document [2].

Radioactive waste disposal is a devolved issue and policies differ across the UK:

- The policies of the UK Government and Northern Ireland Executive as well as the Welsh Government are that the most hazardous radioactive wastes in England and Wales should be managed in the long term through geological disposal, coupled with safe and secure interim storage and ongoing research and development to support its optimised implementation
- The Scottish Government's policy[5] is for the higher activity radioactive waste arising in Scotland to be managed in near surface facilities[6] and this waste is therefore excluded from the IGD.

[5] The policy does not cover radioactive wastes arising from the nuclear submarine bases on the Clyde, the Vulcan naval reactor test establishment, or the decommissioning and dismantling of redundant nuclear submarines. The policy does not apply to wastes that have been dealt with under the policies of previous governments.

[6] Facilities should be located as near to the site where the waste is produced as possible. Developers will need to demonstrate how the facilities will be monitored and how the waste

Management of Plutonium

The way in which plutonium is assumed to be managed has not changed between the 2019 and 2022 IGDs.

At the time the 2022 IGD was developed, the UK Government's preferred policy for the long-term management of plutonium was that it should be re-used in the form of mixed oxide fuel [11]. Since the development of the IGD scenarios, the UK Government has taken the policy decision to immobilise the UK's inventory of civil separated plutonium at Sellafield [12].

The 2019 and 2022 IGDs assume that there will be 115 t of UK-owned civil plutonium at the end of reprocessing and that 95% of this will be converted into MOX fuel and irradiated in light water reactors.

New build

The 2019 IGD was based on a new build programme of approximately 16 GW(e) starting operations between 2023 and 2028. This was assumed to comprise six UK EPRs (each producing 1.6 GW(e)) and six AP1000s (each producing 1.14 GW(e)).

The 2022 IGD scenario for new build assumes:

- Hinkley Point C: a new twin-unit UK EPR starting operations in 2027 and capable of generating 3,260 MW(e) for 60 years (currently being constructed)
- Sizewell C: a new twin-unit UK EPR starting operations in 2035 and capable of generating 3,260 MW(e) for 60 years (currently in planning)
- the remaining 18 GW(e) of nuclear generation capacity is assumed to be made up of SMRs / AMRs based upon 1 GW(e) coming online every year from 2033 - 2050. There is a lack of inventory data for small and advanced modular reactors, so a per-gigawatt inventory has been developed based on a scaling of the UK EPR inventory data. These data will be updated when additional data become available through the Generic Design Assessment (GDA) process.

Defence materials

MOD's uranium, plutonium and irradiated submarine fuel are not reported in the UK Inventory.

There has been a change in the underpinning reference for the defence materials: the data in the 2019 IGD were taken from the MOD's 2011 Nuclear Liabilities Management Strategy [13] and the 1998 Strategic Defence Review [14]; the 2022 IGD is based on MOD's 2022 Nuclear Liabilities Management Strategy [15].

In both the 2019 and 2022 IGDs the MOD materials are assumed to be managed in the same way as the equivalent civil material.

packages, or waste, could be retrieved. All long-term waste management options will be subject to robust regulatory requirements. See paragraph 1.19 of [19].

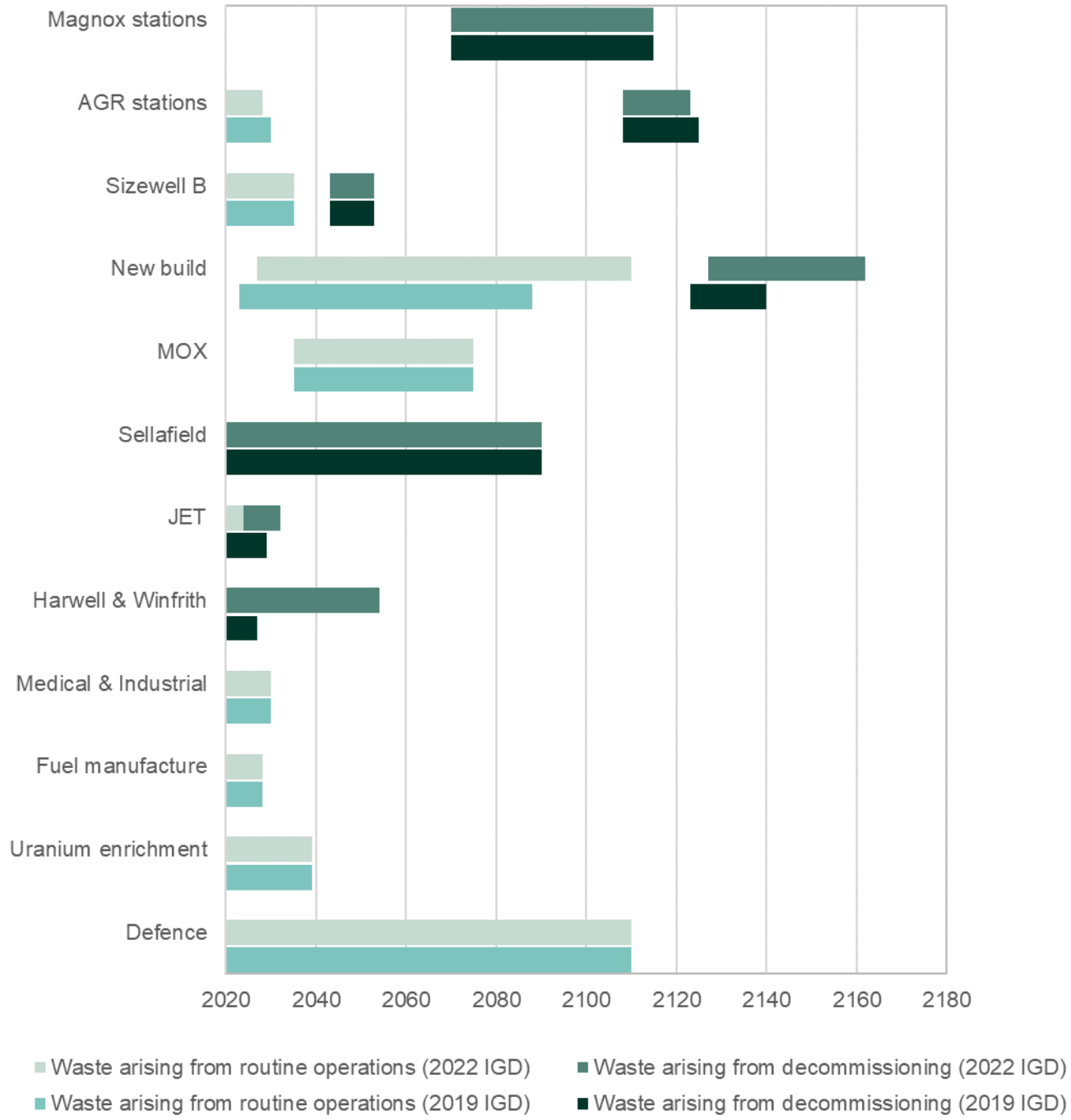

Figure 4 *Assumed dates of operations and decommissioning waste arisings in the 2019 and 2022 IGDs*[7]

[7] Decommissioning of the Magnox reprocessing plant and Thermal Oxide Reprocessing Plant (THORP) are covered by Sellafield decommissioning. Magnox reprocessing continued until July 2022 and is not shown on this chart. No decommissioning dates have been specified for 'Fuel fabrication', 'Medical and industrial', 'Enrichment' or 'Defence' as there is either no decommissioning waste destined for GDF anticipated or the waste producer has not included an estimate of the decommissioning waste in the UK Inventory. JET is the Joint European Torus.

Table 1 Key assumptions for each industry sector in the 2019 and 2022 IGDs (differences in bold)

Sector	2019 IGD assumptions	2022 IGD assumptions
Policy	Wastes to be managed under Scottish Government's policy are excluded	
Civil nuclear power stations	AGRs – Operate for between 41 and 47 years (site dependent) Deferral of Magnox & AGR final stage decommissioning for up to ~85 years after shutdown; all decommissioning complete by 2125 16 GW(e) new build programme comprising 6 UK EPRs: 2 start operations in each of 2023, 2024 and 2025 and operate for 60 years 6 AP1000s: 2 start operations in each of 2026, 2027 and 2028 and operate for 60 years	AGRs – Operate for between **39** and 47 years (site dependent) Deferral of Magnox & AGR final stage decommissioning for up to ~85 years after shutdown; all decommissioning complete by **2123** **24 GW(e) new build programme comprising** **Hinkley Point C: 2 UK EPRs starting operations 2027 and operating for 60 years** **Sizewell C: 2 UK EPRs starting operations in 2035 and operating for 60 years** **18 GW(e) SMRs / AMRs: 1 GW(e) becoming operation each year between 2033 and 2050, and operating for 60 years**
	Sizewell B operates 40 years; prompt decommissioning complete by 2053	
Enrichment	Continues to 2039 at Capenhurst	
Spent fuel reprocessing	Magnox fuel reprocessing continues until 2020 (55,000 tU in total) 5,500 tU AGR SF is not reprocessed	Magnox fuel reprocessing continues until **2022** (55,000 tU in total) **289** tU Magnox SF is not reprocessed[8] **4,530** tU AGR SF is not reprocessed
Research and development	JET operates to 2020 Harwell & Winfrith facilities fully decommissioned by 2027	JET operates to **2024** Harwell & Winfrith facilities fully decommissioned by **2054**
	Sellafield[9] decommissioned by 2090	
Defence	Nuclear weapon programme – waste estimated to 2080 Nuclear powered submarine programme -waste estimated to 2110	
Medical & industrial	GE Healthcare waste estimated to 2030	

[8] Reprocessing of spent fuel from Magnox reactors continued until July 2022. The remaining spent fuel will be stored at Sellafield

[9] Includes the historically separate licensed site of Windscale.

Changes to the underpinning data

The changes to the IGD are driven by changes to the inventory scenario (discussed in the previous section) and changes to the underpinning data used in the IGD, which are discussed in this section.

A summary of the changes to the quantities of each of the waste groups is presented in Table 2 with more detail included in the sub-sections below.

UK Inventory changes

The 2022 IGD is based on the 2022 UK Inventory, and changes that are present in the UK Inventory are incorporated into the IGD. These changes include improvements to waste characterisation data, development of packaging plans and progress in packaging. The 2022 UK Inventory includes:

- lower estimates of HLW arisings from reprocessing operations and transfers to the Waste Vitrification Plant, and an increase in the volume of liquid waste that will be loaded into a HLW canister for waste that has not yet been vitrified
- updated packaging data for several ILW waste streams
- an additional 2,677 packages in store, as legacy wastes continue to be retrieved from stores and packaged for long-term management

In addition, the 2022 IGD includes new waste streams, most of which represent wastes that have previously been reported under a different identifier. The reason for such renumbering of streams is usually associated with evolving plans for waste retrieval, processing and packaging, or where waste is now being packaged (indicated by a /C suffix in the identifier). There are also some new streams for individual wastes forecast to arise from current and future operations that were not previously reported.

Changes to legacy spent fuels

The quantities of legacy spent fuels have been updated to reflect changes in the UK Inventory. Whilst the UK Inventory includes data on the quantity of spent fuels, it does not include any details of the materials that comprise the fuels, or their radionuclide inventories. It is necessary for NWS to make assumptions that allow the inventories to be calculated.

Table 3 presents representative parameters for each of the fuel types. The assumptions regarding AGR and Sizewell B spent fuel have been simplified between the 2019 and 2022 IGDs to a single representative set of irradiation parameters.

Changes to packaging assumptions for UK Inventory waste streams

The packaging assignment of legacy waste streams in non-standard containers has been updated. Waste streams in the UK Inventory that are to be packaged in 500 l Robust Shielded (RS) drums containing lead shielding[10] have been reassigned with a 1:1 mapping to 500 l RS

[10] Waste stream with 500 l RS drums may have a range of thicknesses of internal lead inserts for site operations but these cannot be consigned to a GDF in this format as requirement C130 in the waste package specification [20] stipulates: *where it is not already a component of the waste, lead shall not be deliberately added to a waste package.*

drums without any added lead shielding for the 2022 IGD. Full details of the packaging assumptions can be found in the 'Underpinning Report' [16].

NWS has two basic design variants of illustrative HHGW disposal containers:

- Variant 1: Fabricated from copper, with a cast iron insert (i.e. based on the KBS-3 container concept designed by the Swedish radioactive waste management organisation SKB [17]), for compatibility with the needs of a GDF constructed in a HSR; and
- Variant 2: Fabricated from carbon steel (i.e. based on the container designed by the Swiss radioactive waste management organisation NAGRA [18]), for compatibility with the needs of a GDF constructed in LSSR or EVR.

The choice of variant used for disposal of HHGW in a GDF will depend on the host rock in which it is constructed but for the purposes of quantifying a single inventory for the 2022 IGD, variant 2 has been assumed. This is a change from the 2019 IGD, which assumed variant 1. This does not affect the number of packages, only the materials inventory associated with them. There are also small changes (±~3%) in the packaged volumes of the waste containers due to the small difference in dimensions between the two variants.

Changes to MOD materials

The 2019 IGD assumes that all the MOD DNLEU is MDU; however, the 2022 Nuclear Liabilities Management strategy states that the largest component of the MOD DNLEU is in the form of UF_6[11]; as such, the assumed composition of the MOD DNLEU has been modified to include a depleted uranium tails component, with the remainder assumed to be MDU.

As previously noted, MOD HEU is no longer considered in the 2022 IGD.

The assumed total quantities of MOD materials are shown in Table 2.

[11] The nuclear liabilities management strategy also notes that ownership of this material has been transferred to NDA; this change has not been incorporated into the 2022 IGD and will be reflected in future inventories.

Table 2 Waste and material quantities in the 2019 and 2022 IGDs by waste group (differences in bold)

Waste Group	2019 IGD	2022 IGD
Legacy waste	2019 UK Inventory waste[12]	**2022** UK Inventory waste[13]
Legacy SILW / SLLW	In shielded waste containers (Stored volume 59,000 m^3)	In shielded waste containers (Stored volume **55,300** m^3)
Legacy UILW / ULLW	In unshielded waste containers (Stored volume 165,000 m^3)	unshielded waste containers (Stored volume **154,000** m^3)
RSCs	In robust shielded waste containers (Stored volume 1,200 m^3)	In robust shielded waste containers (Stored volume 1,200 m^3)
HLW	7,660 HLW WVP canisters	**7,520** HLW WVP canisters
New build (NB)	From a 16 GW(e) NB programme	From a **24 GW(e)** NB programme
NB SILW	ILW in shielded waste containers (stored volume 3,740 m^3)	ILW in shielded waste containers (stored volume **3,100** m^3)
NB UILW	ILW in unshielded waste containers (stored volume 4,700 m^3)	ILW in unshielded waste containers (stored volume **6,830** m^3)
NB SF	14,300 tU new build SF	**21,000** tU new build SF
DNLEU	184,000 tU from civil enrichment and reprocessing activities 8,000 tU from defence programmes	**198,000** tU from civil enrichment and reprocessing activities **9,000** tU from defence programmes
Legacy SF	5,500 tU AGR SF 1,050 tU Sizewell B SF 723 tU metallic SF 68 tU SGHWR SF 20.8 tU WAGR SF 66 tU Miscellaneous LWR SF 10 tHM PFR SF	**4,530** tU AGR SF **1,020** tU Sizewell B PWR SF **1,040** tU Magnox SF **68.1** tU SGHWR SF **21.0** tU WAGR SF **69.0** tU Miscellaneous LWR SF **8.21** tHM PFR SF
	Irradiated submarine fuel not quantified	
MOX SF	1,460 tHM MOX SF from 95% of civil Pu (109 tPu) & all MOD Pu (7.6 tPu)	**1,390** tHM MOX SF from 95% of civil Pu (109 tPu) & all MOD Pu (2 tPu)
HEU	1.0 tU from civil programmes and 21.9 tU from defence programmes	1.0 tU from civil programmes
Pu	5.75 tPu separated Pu residues from reprocessing of civil SFs	

[12] Waste that will be managed via other routes is excluded.

[13] Waste for which the baseline management route is not GDF is excluded.

Table 3 Representative parameters for the spent fuel inventories in the IGD.

Spent fuel	2019 IGD	2022 IGD
AGR	Enrichment (pre-2013) 2.9 %, burn-up 28 GWd/tHM, cooling time 12 years Enrichment (post-2013) 3.2 / 3.78 %, burn-up 33 GWd/tHM, cooling time – arises as one year cooled	**Enrichment 3.2 / 3.78 %, burn-up 33 GWd/tHM, cooling time – arises as one year cooled**
Sizewell B	Enrichment (pre-2013) 4.2 %, burn-up 45 GWd/tHM, cooling time 14 years Enrichment (post-2013) 4.4 %, burn-up 55 GWd/tHM, arises as one year cooled	**Enrichment 4.6 %, burn-up 45 GWd/tHM, arises as one year cooled**
WAGR	Enrichment 2.85 %, burn-up 18.2 GWd/tHM, arising in 1981	
SGHWR	Enrichment 3.9 %, burn-up 40 GWd/tHM, arising in 1990	
Miscellaneous LWR	Enrichment 3.9 %, burn-up 40 GWd/tHM, arising in 2000	
Magnox[14]	Enrichment 0.71 %, burn-up 4.1 GWd/tHM, cooling time 39 years	
PFR[15]	Enrichment Pu 29.5 %, burn-up 189 GWd/tHM, cooling time 25 years	

[14] This category represents the “other fuels” at Sellafield; the representative parameters included here are suitable for producing a high-level estimate, but may not be representative of the whole population.

[15] These parameters are considered bounding rather than representative.

Changes to the Inventory for Geological Disposal

This section summarises the changes to data between the 2019 and 2022 IGDs. Appendix C provides a breakdown by waste group.

Volumes

The overall change to the volume of waste between the 2019 and 2022 IGDs is small, as shown in Table 4, while Table 5 shows the changes to the packaged volume of each waste group. The changes to the packaged volume of the waste groups are consistent with the changes to the inventory scenario and the underpinning data and assumptions, most notably:

- A reduction of approximately 96% in the packaged volume of HEU as a result of there being no MOD HEU included in the 2022 IGD
- Changes to the assumed size and composition of the new build programme have resulted in
    - an increase of 53.1% in the packaged volume of new build spent fuel
    - reductions of 11.1% and 2.55% in the packaged volumes of NB SILW and NB UILW. This is attributable to two factors: firstly, the AP1000 is no longer included; based on the packaged volumes of waste presented in the GDA disposability assessment reports, this reactor produced a greater volume of packaged waste per unit electrical energy than the UK EPR. Basing the estimates solely on the UK EPR has therefore reduced the overall packaged volume of waste. The second factor is that the UK Inventory includes revised estimates for the operational wastes from the UK EPR. The changes to the volume of raw waste are not significant, but some wastes that were previously assumed to be packaged in shielded ILW containers are now assumed to be packaged in unshielded ILW containers and this also reduced the packaged volume of the waste. The result is that the reduction seen in the NB SILW waste group is more significant than that seen in the UILW waste group[16].
- A reduction of approximately 5% in the volume of both the shielded and unshielded legacy wastes; this is attributable to a number of factors, including the removal of wastes for which the baseline management route is disposal at the LLWR, changes to reported volumes of waste and changes to plans for the packaging of the waste
- the volume of HLW has decreased (by approximately 5%), mainly as a result of the revised packaging assumption, although an increase in the volume of HLW that will be encapsulated in a canister (for waste yet to be vitrified) also contributes
- the volume of legacy SF has decreased (by approximately 3%) as a result of decreases in the total masses of AGR and PWR spent fuels expected to arise

[16] It is anticipated that SMRs will produce more waste per GW(e) than the large (GW(e) scale) reactors on which the 2022 IGD data are based. There is considerable uncertainty in both the nature and quantity of waste from the assumed 24 GW(e) new build reactors.

- the packaged volume of DNLEU has increased by approximately 4% as a result of increased masses of DNLEU being reported in the 2022 UK Inventory
- the packaged volume of MOX spent fuel has decreased (by approximately 2%) mainly as a result of changes to the assumed mass of MOD plutonium liabilities.

Table 4 Changes to the total volume of waste between the 2022 and 2019 IGDs.

Volume	2019 IGD	2022 IGD	Difference [%]
Stored	342,000	337,000	-1.60
Conditioned	522,000	521,000	-0.191
Packaged	773,000	769,000	-0.498

Table 5 Changes to the packaged waste and material quantities that underpin the 2022 and 2019 IGDs.

Waste group	2019 IGD [m^3]	2022 IGD [m^3]	Difference [%]
Legacy SILW / SLLW	92,600	87,700	-5.30%
Legacy UILW / ULLW	372,000	350,000	-5.79%
RSCs	2,610	2,590	-0.573%
NB SILW	18,900	16,800	-11.1%
NB UILW	22,100	21,500	-2.55%
DNLEU	184,000	192,000	4.33%
HLW	9,880	9,370	-5.18
Legacy SF	17,000	16,600	-2.79
NB SF	39,400	60,400	53.1
MOX SF	11,900	11,700	-1.97
HEU	2,470	103	-95.8
Pu	620	594	-4.16

Disposal units

Table 6 shows the number of disposal units associated with each waste group in the 2019 and 2022 IGDs, along with the percentage change. The total number of disposal units has decreased from 178,000 to 172,000 (3.37%), between the 2019 and 2022 IGDs.

As would be expected from the changes in packaged volume in **Error! Reference source not found.**, the most significant percentage increase in the number of disposal units is for the NB SF waste group.

Table 6 Changes to the number of disposal units of each waste group.

Waste Group	2019 IGD	2022 IGD	Difference [%]
Legacy SILW/SLLW	5,050	4,780	-5.32
Legacy UILW/ULLW	126,000	119,000	-5.69
RSCs	948	1,070	+12.4
DNLEU	8,380	8,840	+5.45
NB SILW	10,100	7,020	-30.8
NB UILW	8,230	8,960	+8.93
HLW	2,550	2,510	-1.88
Legacy SF	4,160	4,010	-3.46
NB SF	8,940	13,300	+48.4
MOX SF	2,710	2,570	-4.97
HEU	779	35	-95.6
Pu	196	196	0

Activities

The total activity at 2200 has increased from 2.82 10^7 TBq in the 2019 IGD to 4.69 10^7 TBq in the 2022 IGD, an increase of approximately 66%; the evolution of the activity after 2200 (the assumed date of GDF closure) is shown in Figure 5. Table 7 presents the change in activity for each waste group at 2200. The new build waste groups have the largest percentage increases.

The increase in both the total activity and the activity of the new build waste groups is driven largely by two factors:

- firstly, the increase in the assumed size of the new build programme from 16 GW(e) to 24 GW(e) results in an increase in the quantity of spent fuel and ILW from this source
- secondly, because the spent fuel is assumed to arise later it has experienced less radioactive decay.

The activities of the priority radionuclides at 2200 are presented in Table 8. There are increases in the activities of all priority radionuclides, again this is mainly due to the increase in the size and timing of the assumed new build programme.

- The changes to the timing would be expected to disproportionately affect the shorter-lived radionuclides as they will correspond to several of their half-lives; indeed, the largest changes are observed for Co60 (half-life ~5.27 years), Kr85 (10.8 years) and Cs137 (30.1 years).
- The increases in Se79, Tc99 and Cs135 activity are largely a result of the re-calculation of HLW activities at Sellafield using a new tool and updated nuclear data libraries.
- increases in U235 and U238 activity are mainly due to the increase in the mass of DNLEU.
- The decrease in U233 activity is largely the result of the decreased masses of AGR and Sizewell B legacy spent fuels.

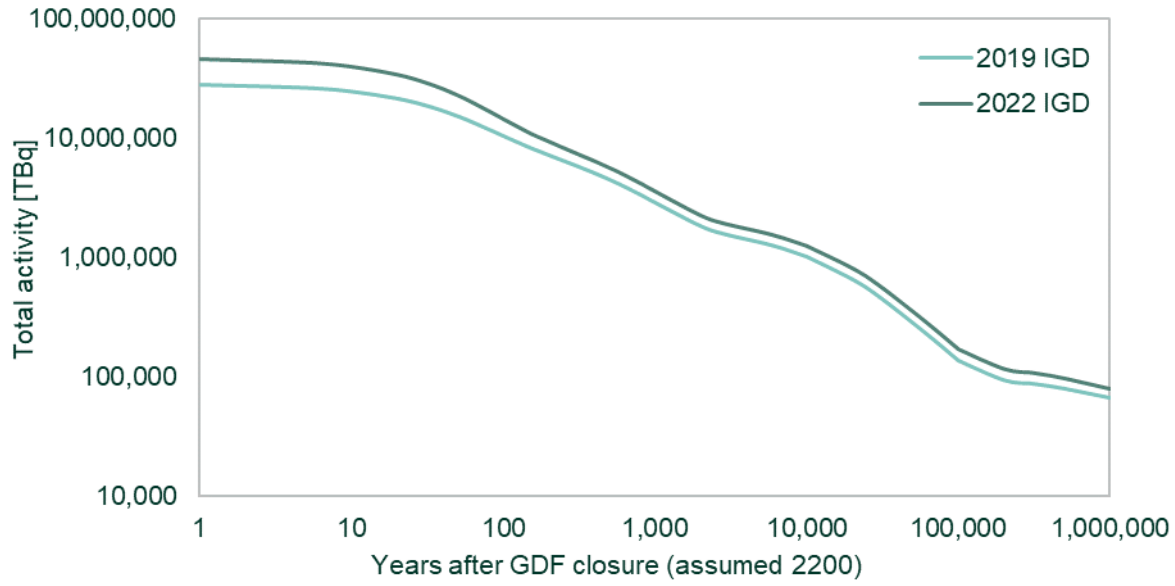

Figure 5 *The evolution of the activity in the 2019 and 2022 IGDs.*

Table 7 *Changes to the activity at 2200 of each waste group.*

Waste Group	2019 IGD [TBq]	2022 IGD [TBq]	Difference [%]
Legacy SILW/SLLW	19,400	21,600	+11.2
Legacy UILW/ULLW	398,000	372,000	-6.56
RSCs	3,180	2,680	-15.7
DNLEU	9,800	10,400	+6.48
NB SILW	154	338	+120
NB UILW	793,000	1,910,000	+141
HLW	1,460,000	1,900,000	+30.3
Legacy SF	2,780,000	2,110,000	-24.2
NB SF	19,000,000	37,000,000	+94.7
MOX SF	3,700,000	3,520,000	-4.79
HEU	53.7	2.34	-95.6
Pu	43,700	43,700	0

Table 8 Changes to the activity of the priority radionuclides at 2200.

Waste Group	2019 IGD	2022 IGD	Difference [%]
C14	17,800	26,200	+47.6
Cl36	110	192	+74.4
Co60	2.12	53.5	+2,420
Se79	103	145	+40.1
Kr85	1,250	5,060	+303
Tc99	20,700	27,900	+34.7
I129	43.6	60.2	+37.9
Cs135	986	1,260	+28.1
Cs137	5,210,000	9,740,000	+86.8
U233	2.49	2.15	-13.5
U235	72.2	79.7	+10.3
U238	2,850	3,110	+9.17
Np237	881	1,120	+26.7

Materials data

The IGD considers the following types of materials that will be present in the GDF:

- materials associated with wastes; these are discussed below
- materials associated with GDF construction and operating; the estimates of these materials have not changed since the 2019 IGD and no further discussion is presented
- materials associated with conditioning, capping and packaging of the waste; these are not discussed further

Other materials that are inadvertently left behind are referred to as ‘stray materials’ and have not been estimated.

Waste Materials

The changes to the material masses associated with the wastes in the 2019 and 2022 IGD are presented in Table 9. The changes are a result of changes in waste quantities and revised data included in the UK Inventory; these are discussed in the *Changes to the scenario for the Inventory for Geological Disposal* and *Changes to the underpinning data* sections.

Table 9. Changes to the material masses.

	Waste Material	2019IGD [t]	2022 IGD [t]	Difference [%]
Metals	Aluminium (and alloys)	1,030	852	-16.9
	Copper (and alloys)	305	310	+1.71
	Iron	3,190	3,200	+0.114
	Lead	754	490	-35.0
	Magnox / magnesium	6,670	5,890	-11.6
	Nickel (and alloys)	282	377	+33.5
	Other ferrous metals	46,100	44,900	-2.74
	Stainless steel	36,300	42,300	+16.6
	Uranium	1,820	2,040	+12.2
	Zircaloy / zirconium	6,330	8,490	+34.1
	Other metals	293	352	+20.2
	Total metals	103,000	109,000	+5.92
Organics	Cellulose	1,070	1,060	-0.761
	Halogenated plastics	3,100	3,300	+6.61
	Hydrocarbons	45.3	60.5	+33.5
	Non-halogenated plastics	1,480	2,260	+53.0
	Organic ion ex. Resins	3,460	3,190	-7.91
	Rubbers	1,100	1,250	+13.6
	Other organics	114	100	-11.9
	Total organics	10,400	11,200	+8.27
Other materials	Asbestos	65.9	64.8	-1.65
	Cementitious material	57,400	58,600	+2.15
	Glass, ceramics, sand	4,010	3,920	-2.22
	Graphite	70,700	65,900	-6.79
	Heavy metal oxide	253,000	277,000	+9.63
	Ion ex. Resins	5,160	3,150	-39.0
	Sludges & flocs	20,900	22,100	+6.05
	Soil, brick, stone & rubble	1,070	1,050	-1.65
	Other inorganics	10,400	7,470	-28.0
	Total other materials	422,000	439,000	+4.03
	Total unspecified	2,840	2,210	-22.3

Alternative Scenarios

Alternative scenarios are used to explore the effects of changes in assumptions and uncertainties in data in the IGD. In the 2019 IGD, the sensitivity of the inventory to individual assumptions was explored; however, in the 2022 IGD, the scenarios combine a number of different assumptions. As such, the way in which scenarios are explored in the 2022 IGD is fundamentally different to the 2019 IGD and they cannot straightforwardly or meaningfully be compared.

Conclusions

The 2022 and 2019 IGDs have been compared in terms of the underpinning scenario assumptions and data. Changes in the overall parameters have also been discussed.

The most significant change between the scenarios for the two inventories is the assumption of a 24 GW(e) (rather than a 16 GW(e)) nuclear new build programme in the 2022 IGD.

Notable changes to the quantities of waste include:

- An increase in the quantity of new build spent fuel along with an increase in the quantity of waste from new build. Changes to the packaging assumptions mean that the packaged volume of waste from new build actually reduces between the 2019 and 2022 IGDs
- a 96% reduction in the quantity of HEU resulting from improved assumptions regarding MOD materials
- an increase in the quantity of DNLEU from civil fuel enrichment, civil spent fuel reprocessing and defence programmes
- a decrease in the quantity of legacy SF as a result of revised estimates in the UK Inventory
- a small reduction in the volume of legacy wastes attributable to several factors, including the removal of wastes for which the baseline management route is disposal at the LLWR, changes to reported volumes of waste and changes to plans for the management of the waste

The impact of these changes on the IGD has been assessed:

- the packaged volume of the IGD has decreased slightly
- the overall activity at 2200 has increased by 66% due to the increase in NB SF.

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Glossary

Term	Definition
AGR	Advanced Gas-cooled Reactor
AMR	Advanced Modular Reactor
ANDRA	The French National Radioactive Waste Management Agency
BFS	Blast Furnace Slag
CEM I	Portland cement. Class of cement under EN 197-1
Conditioned volume	Volume of the wasteform (waste plus immobilising medium) within the container
Cooling time	Also known as decay period, measured from the end of irradiation
DF	Decontamination Factor
Disposal unit	A waste package, or group of waste packages, which is handled as a single unit for the purposes of transport and/or disposal
DNLEU	Depleted, Natural and Low Enriched Uranium
DSSC	Disposal System Safety Case
DU	Depleted Uranium
DU tails	Depleted uranium left over from enrichment operations
EDF	EDF Energy, the British subsidiary of French state owned Électricité de France
EPR	EPR is now used by AREVA as a reactor name. It was previously used to mean European Pressurized Reactor and Evolutionary Power Reactor.
EVR	Evaporite Rock
GDA	Generic Design Assessment
GDF	Geological Disposal Facility
GW(e)	Gigawatts electrical
GWd/tHM	Gigawatt days per tonne of heavy metal (1 tonne = 1,000 kg)
GWd/tU	Gigawatt days per tonne of uranium (1 tonne = 1,000 kg)
HAW	Higher Activity Waste
HDPE	High Density Polyethylene
HEU	Highly Enriched Uranium
HHGW	High Heat Generating Waste
HLW	High Level Waste
HSR	Higher Strength Rock
IAEA	International Atomic Energy Agency
IGD	Inventory for Geological Disposal
ILW	Intermediate Level Waste
ISO	International Organisation for Standardization
JET	Joint European Torus
LEU	Low Enriched Uranium

Term	Definition
Legacy waste	Radioactive waste which already exists or whose arising is committed in future by the operation of an existing facility
LDPE	Low Density Polyethylene
LHGW	Low Heat Generating Waste. Some wastes have negligible heat output; these are included in this category
LLW	Low Level Waste
LLWR	The Low Level Waste Repository
LSSR	Lower Strength Sedimentary Rock
LWR	Light Water Reactor
MBGWS	Miscellaneous Beta Gamma Waste Store
MDU	Magnox Depleted Uranium
MOD	Ministry of Defence
MOX	Mixed Oxide Fuel
MSSS	Magnox Swarf Storage Silo
NAPLs	Non-Aqueous Phase Liquids
NB	New build
NDA	Nuclear Decommissioning Authority
NWS	Nuclear Waste Services
Packaged volume	Volume occupied by waste package when waste has been packaged
Payload	Volume of waste (when conditioned) in each waste container
PCM	Plutonium Contaminated Material
PCSR	Pre-Construction Safety Report
PFA	Pulverised Fuel Ash
PFR	Prototype Fast Reactor
ppm	Parts per million
Pu	Plutonium
PVC	Polyvinyl Chloride
PWR	Pressurised Water Reactor
RS	Robust Shielded
RSC	Robust Shielded Container
SF	Spent Fuel(s): nuclear fuel removed from a reactor following irradiation that is no longer usable in its present form because of depletion of fissile material, poison build-up or radiation damage
SGHWR	Stream Generating Heavy Water Reactor
SILW	Shielded ILW
SKB	The Swedish Nuclear Fuel and Waste Management Company
SLLW	Shielded LLW
SMR	Small Modular Reactor
SS	Stainless Steel
SWTC	Standard Waste Transport Container

Term	Definition
TDC	Transport and Disposal Container
tHM	Tonnes of heavy metal (1 tonne = 1,000 kg)
THORP	Thermal Oxide Reprocessing Plant
TMF	Tails Management Facility
TPU	THORP product uranium
tPu	Tonnes of plutonium
tU	Tonnes of uranium (1 tonne = 1,000 kg)
U	Uranium
UILW	Unshielded ILW
UK Inventory	The UK Radioactive Waste and Materials Inventory, can also be referred to as the UK RWI or UK RWMI
ULLW	Unshielded LLW
WAGR	Windscale Advanced Gas-cooled Reactor
WVP	Waste Vitrification Plant

Appendix A: Waste Group Datasheets

Legacy shielded ILW / LLW

Details

This waste group deals with legacy wastes packaged in shielded waste containers. Notable changes associated with this waste group are:

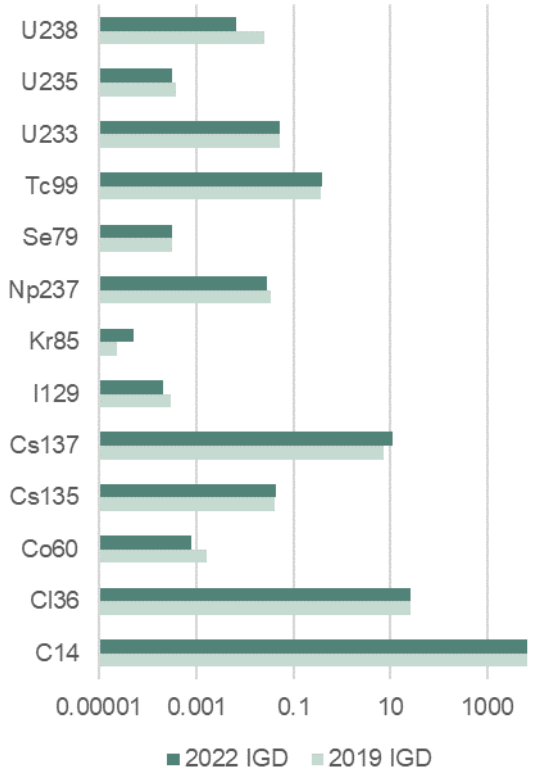
- The total activity at 2200 has increased by 11.2% from 19,400 TBq to 21,600 TBq
- The packaged volume has decreased by 5.3% from 92,600 m^3 to 87,700 m^3

The changes to the Legacy SILW / SLLW waste group are relatively small and are consistent with the revisions to the changes to the underpinning data and assumptions.

Disposal Units

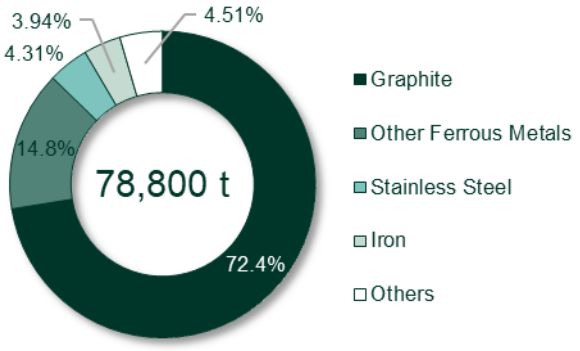
Package type	2019 IGD	2022 IGD
2 m box	24	24
4 m box	4,010	3,800
6 m^3 box	1,020	961

Activity [TBq] of priority radionuclides at 2200

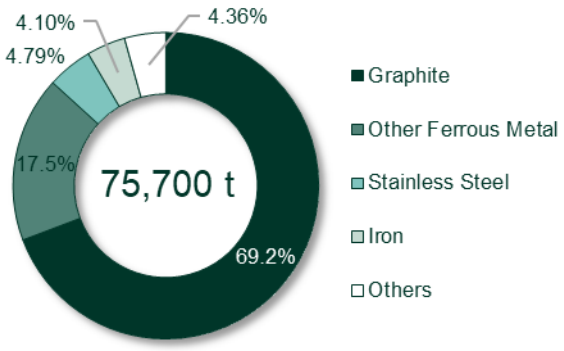


Materials

2019 IGD



2022 IGD



Legacy unshielded ILW / LLW

Details

Notable changes associated with this waste group are:

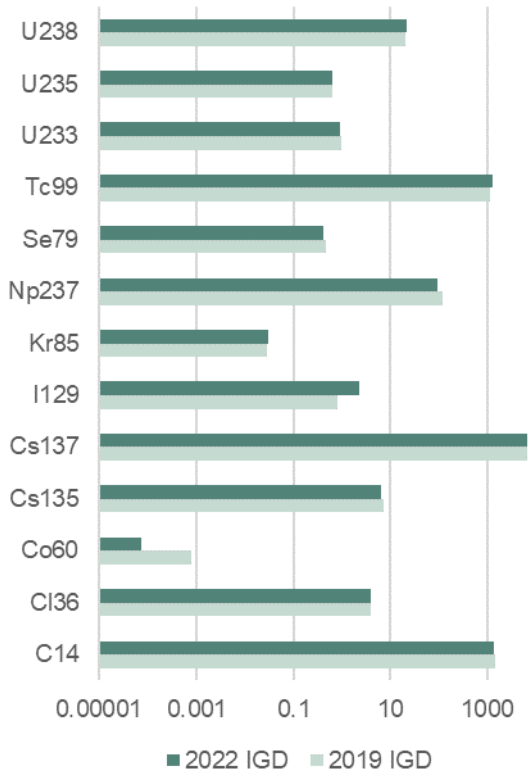
- The total activity at 2200 has decreased by 6.6% from 398,000 TBq to 372,000 TBq
- The packaged volume has decreased by 2.5% from 372,000 m^3 to 350,000 m^3

The changes to the Legacy UILW / ULLW waste group are relatively small and are consistent with the revisions to the changes to the underpinning data and assumptions.

Disposal Units

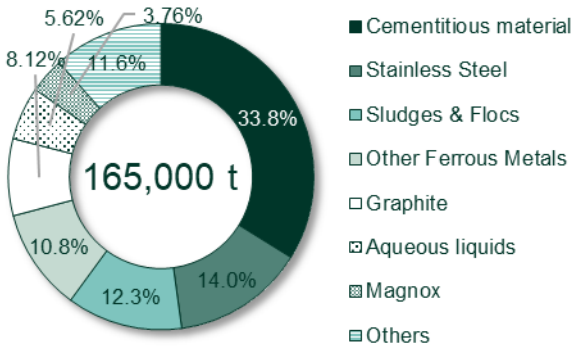
Package type	2019 IGD	2022 IGD
3 m^3 box (side lifting)	70,200	53,700
3 m^3 box (corner lifting)	8,090	18,700
3 m^3 drum	520	76
500 litre drum	45,500	44,500
MBGWS box	1,690	1,850

Activity [TBq] of priority radionuclides at 2200

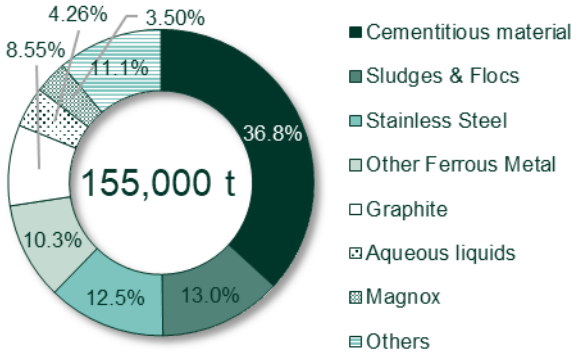


Materials

2019 IGD



2022 IGD



New Build shielded ILW

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has increased by 120% from 154 TBq to 338 TBq
- The packaged volume has decreased by 11.1% from 18,900 m^3 to 16,800 m^3

The reduction in the packaged volume is a result of changes to the basis for the new build waste inventories and the packaging assumptions.

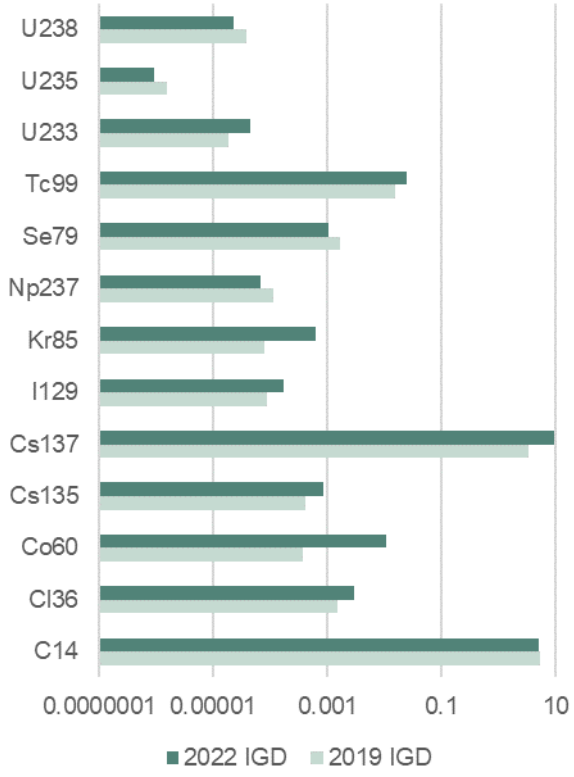
The increases in activity are due partly to the increased size of the new build programme and partly because the operational dates are later than in the 2019 IGD (and so there has been less radioactive decay).

Disposal Units

Package type	2019 IGD	2022 IGD
1 m^3 concrete drum	6,840	6,860
4 m box	60	153
500 l concrete drum	3,240	0

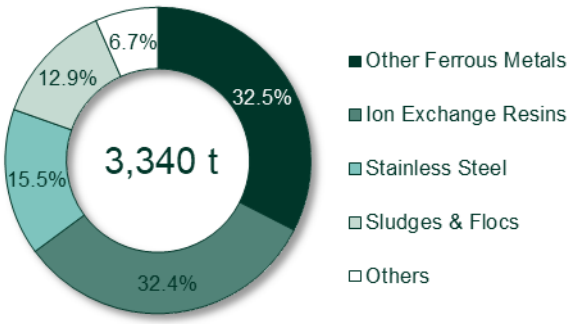
For the 2022 IGD the new build inventories are based solely on the data for the UK EPR. The waste previously in 500 l concrete drums was updated in the 2022 UK Inventory and is now assumed to be packaged in 500 l drums (NB UILW).

Activity [TBq] of priority radionuclides at 2200

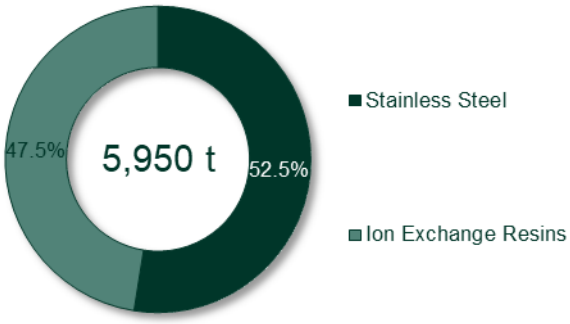


Materials

2019 IGD



2022 IGD



New Build unshielded ILW

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has increased by 141 % from 793,000 TBq to 1,910,000 TBq
- The packaged volume has decreased by 2.5% from 22,100 m^3 to 21,500 m^3

The reduction in the packaged volume is a result of changes to the basis for the new build waste inventories and the packaging assumptions.

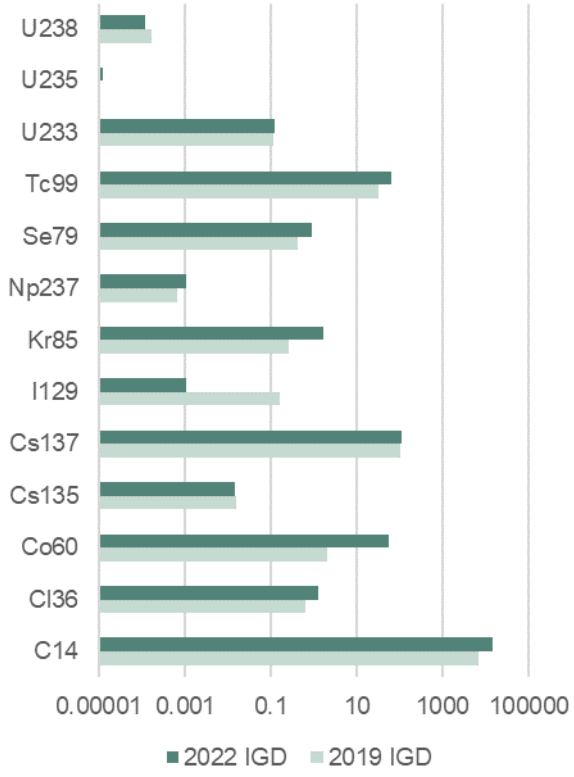
The increases in activity are due partly to the increased size of the new build programme and partly because the operational dates are later than in the 2019 IGD (and so there has been less radioactive decay).

Disposal Units

Package type	2019 IGD	2022 IGD
3 m^3 box (side lifting)	960	1,080
3 m^3 drum	7,270	0
500 litre drum	0	7,880

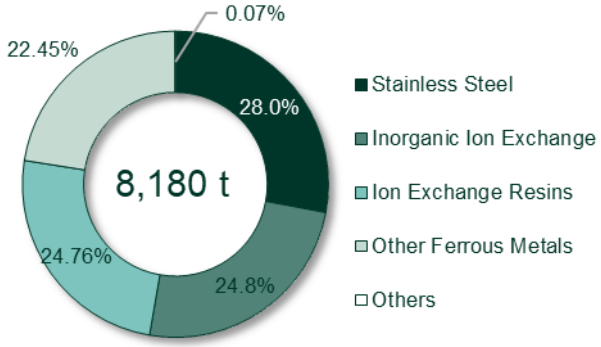
For the 2022 IGD the new build inventories are based solely on the data for the UK EPR. The 3 m^3 drums were associated with wastes from the AP1000 and no longer appear; the waste now in 500 l drums was previously assumed to be packaged in 500 l concrete drums (NB SILW) but was revised in the 2022 UK Inventory.

Activity [TBq] of priority radionuclides at 2200

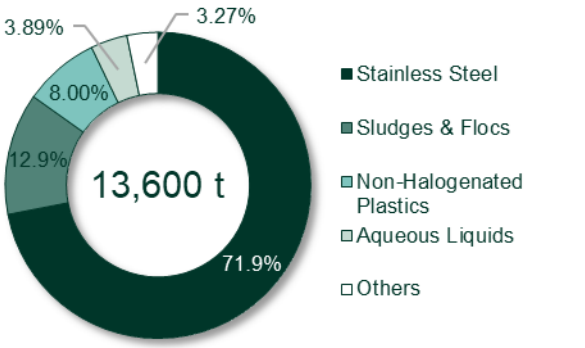


Materials

2019 IGD



2022 IGD



Robust Shielded Containers

Details

Notable changes associated with this waste group are:

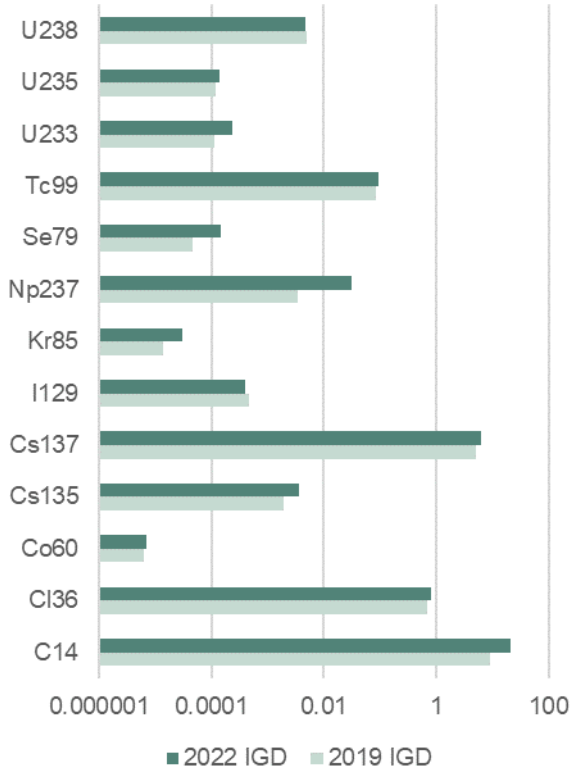
- The total activity at 2200 has decreased by 15.7% from 3,180 TBq to 2,680 TBq
- The packaged volume remains 2,600 m^3

Disposal Units

Package type	2019 IGD	2022 IGD
500 l RS drum	619	778
DCIC Cubical	329	288

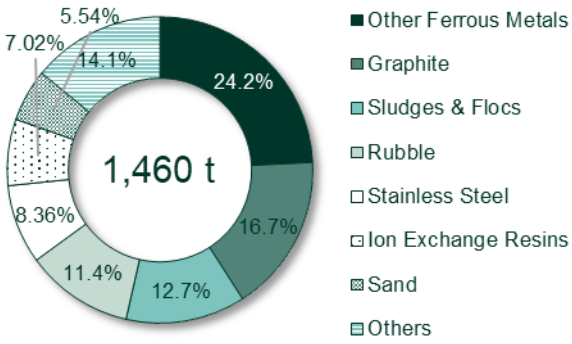
The 2022 IGD assumes that any 500 l RS drums with internal lead shielding are repackaged into a 500 l drum with no lead shielding.

Activity [TBq] of priority radionuclides at 2200

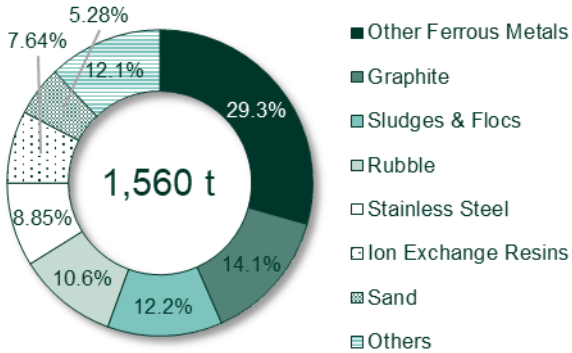


Materials

2019 IGD



2022 IGD



Depleted, Natural and Low Enriched Uranium (DNLEU)

Details

Notable changes associated with this waste group are:

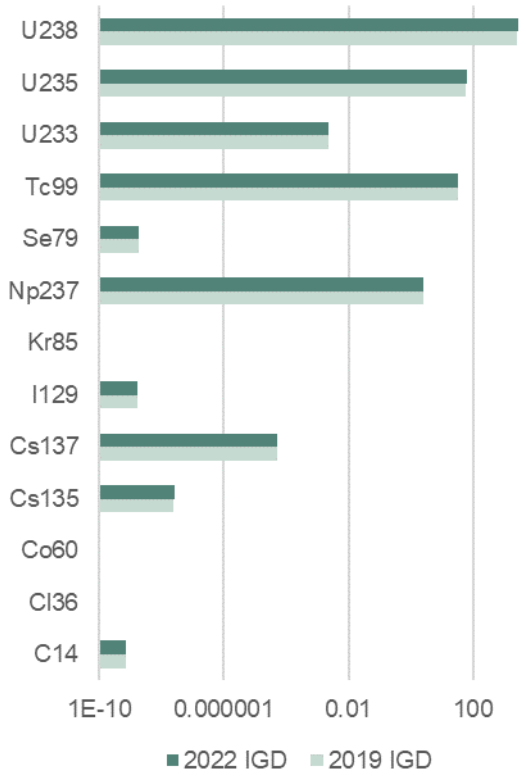
- The total activity at 2200 has increased by 6.5% from 9,800 TBq to 10,400 TBq
- The packaged volume has increased by 4.3% from 184,000 m^3 to 192,000 m^3

The changes are consistent with the increased quantity of DNLEU reported in the 2022 UK Inventory and the changes to the quantity and type of MOD DNLEU.

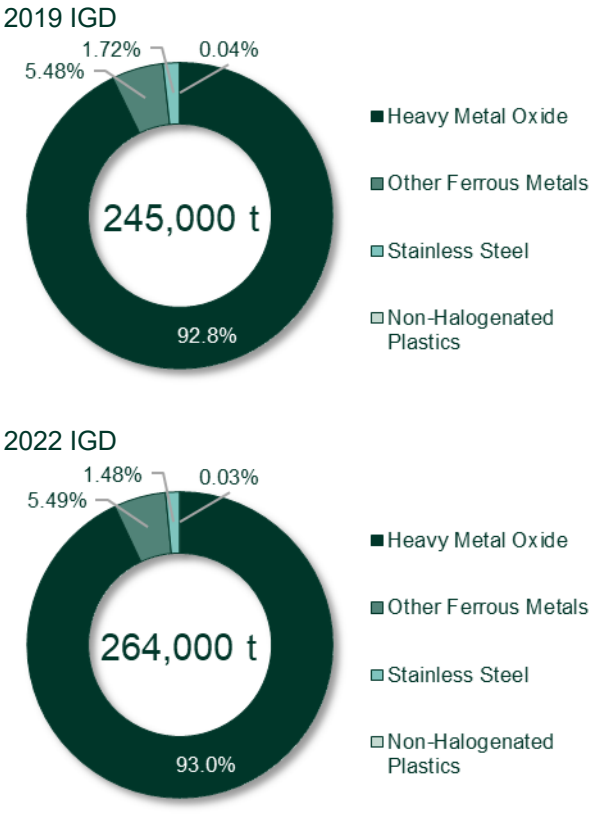
Disposal Units

Package type	2019 IGD	2022 IGD
500 litre drum	2,010	2,170
Uranium TDC (2.1m high)	316	459
Uranium TDC (2.3m high)	4,110	4,510
Uranium TDC (2.4m high)	1,950	1,700

Activity [TBq] of priority radionuclides at 2200



Materials



Highly Enriched Uranium (HEU)

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has decreased by 95.6% from 53.7 TBq to 2.34 TBq
- The packaged volume has decreased by 95.8% from 2,470 m^3 to 103 m^3

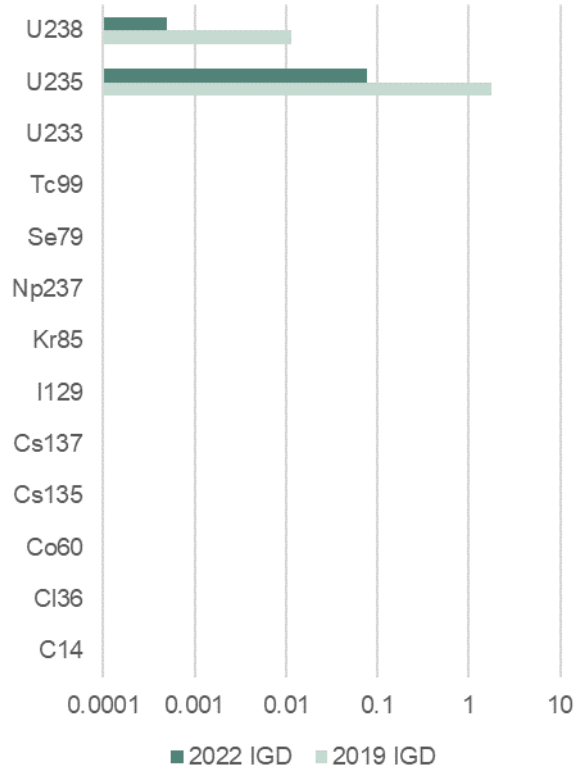
The assumptions for MOD materials have been updated in the 2022 IGD to be consistent with the MOD's Nuclear Liabilities Management Strategy; as such, no MOD HEU is included in the 2022 IGD and this is responsible for the significant reduction in the parameters reported here.

Disposal Units

Package type	2019 IGD	2022 IGD
Pu/HEU Disposal Container	779	34

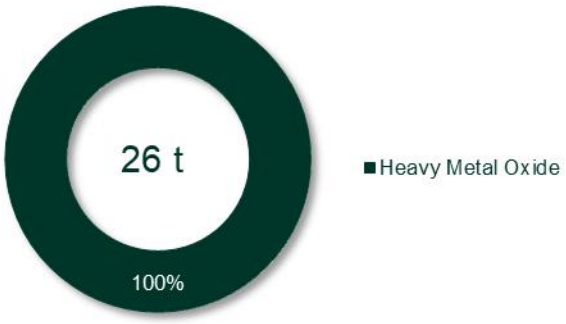
The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200

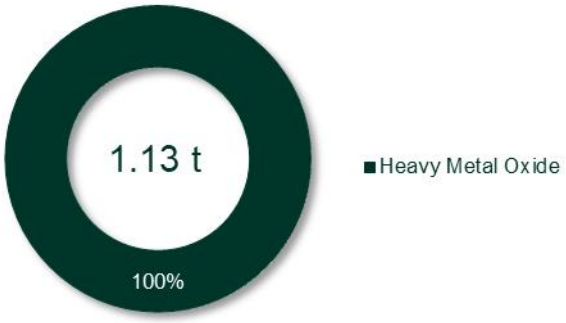


Materials

2019 IGD



2022 IGD



Plutonium (Pu)

Details

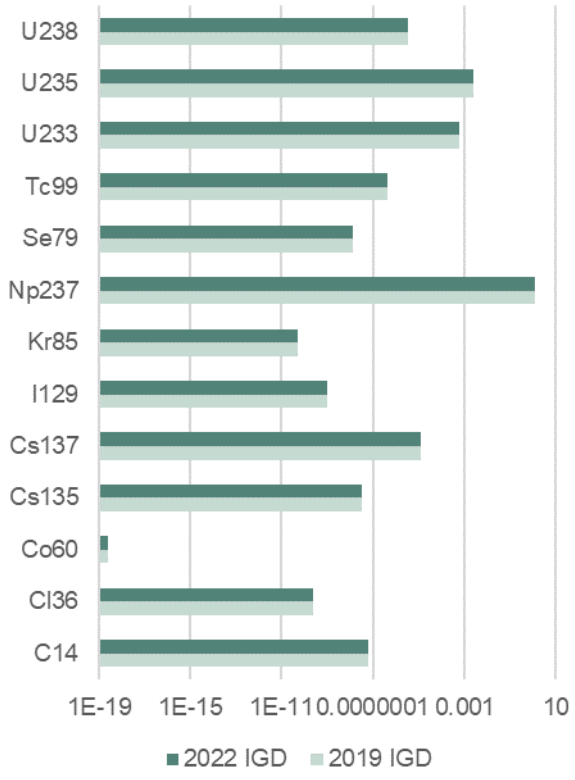
This quantity of Pu assumed for the 2022 IGD is unchanged from the 2019 IGD; however, the assumption of Variant 2 disposal containers rather than Variant 1 disposal containers mans that the packaged volume of this waste group has reduced slightly (by around 4%).

Disposal Units

Package type	2019 IGD	2022 IGD
Pu/HEU Disposal Container	196	196

The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200



Materials

2019 IGD

2022 IGD

High Level Waste (HLW)

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has increased by 30.3% from 1,460,000 TBq to 1,900,000 TBq
- The packaged volume has decreased by 5.2% from 9,890 m^3 to 9,380 m^3

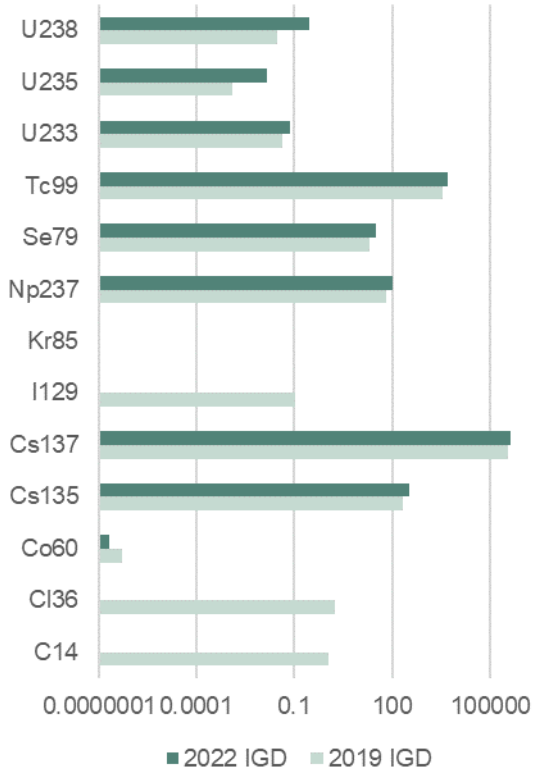
The removal of any activity associated with C14, Cl36 and I129 is a result of the revised Sellafield calculations and is consistent with the expectation that these radionuclides would be either be volatilised in the reprocessing plant dissolver or by the high-temperature vitrification process.

Disposal Units

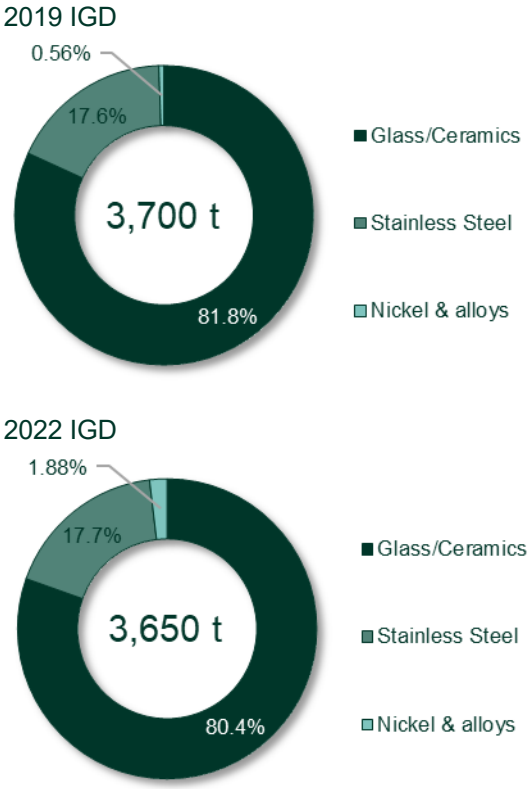
Package type	2019 IGD	2022 IGD
HLW Disposal Container	2,550	2,510

The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200



Materials



Legacy spent fuel

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has decreased by 24.2% from 2,780,000 TBq to 2,110,000 TBq
- The packaged volume has decreased by 2.8% from 17,000 m^3 to 16,600 m^3

The main reason for the reduction in packaged volume is a reduction in the quantity of AGR SF resulting from reduced operational lifetimes for these reactors.

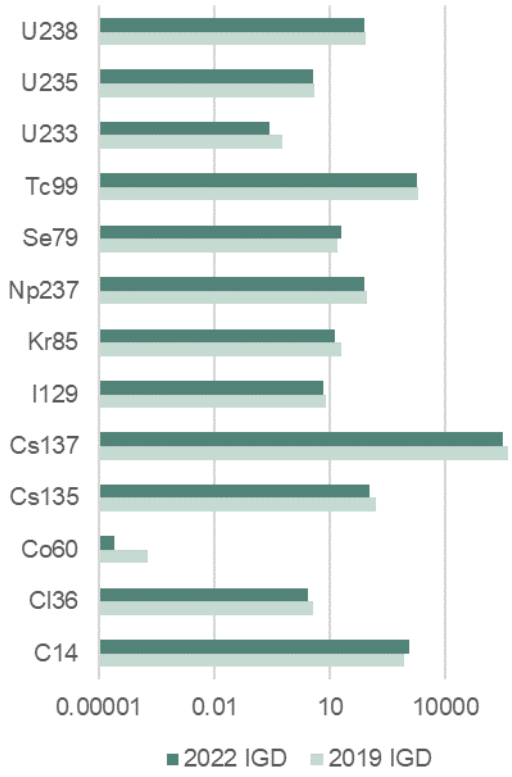
The increase in Magnox SF is associated with unprocessed fuel reported in the UK Inventory after Magnox reprocessing had finished; it was previously assumed all Magnox fuel would be reprocessed.

Disposal Units

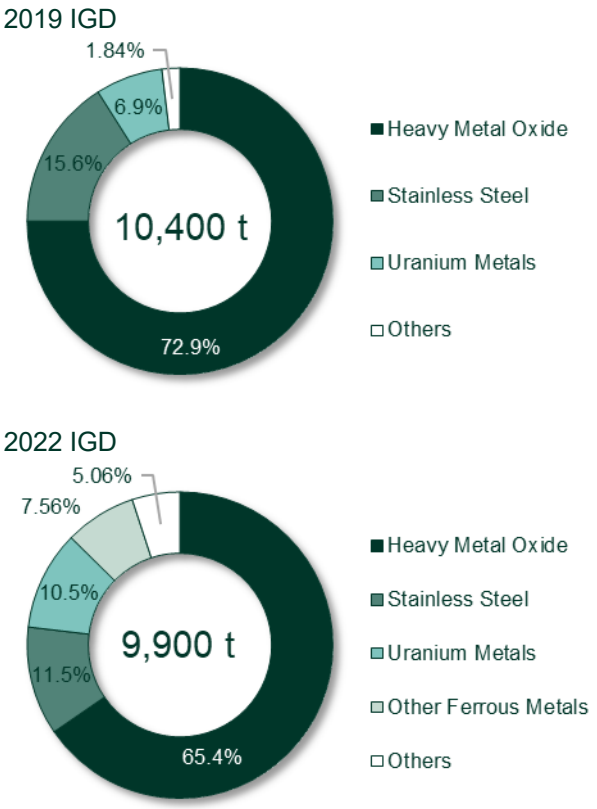
Package type	2019 IGD	2022 IGD
AGR Disposal Container	2,710	2,240
Magnox Disposal Container	817	1,170
PFR Disposal Container	18	17
PWR Disposal Container	608	586

The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200



Materials



New Build spent fuel

Details

This waste group consists of the spent fuel associated with the assumed new build programme within the IGD. Notable changes associated with this waste group are:

- The total activity at 2200 has increased by 94.7% from 19,000,000 TBq to 37,000,000 TBq
- The packaged volume has increased by 53.1% from 39,400 m^3 to 60,400 m^3

The main reason for the difference is the increased size in the assumed new build programme from 16 GW(e) to 24 GW(e). Additionally, the difference in assumed timings for new build reactor operations means that the activity is disproportionately increased at 2200.

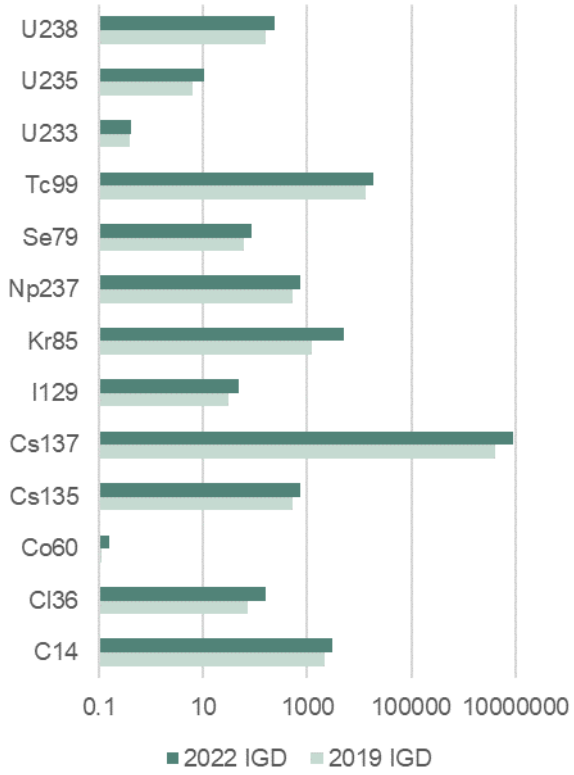
Disposal Units

Package type	2019 IGD	2022 IGD
New Build Disposal Container	8,940	13,300

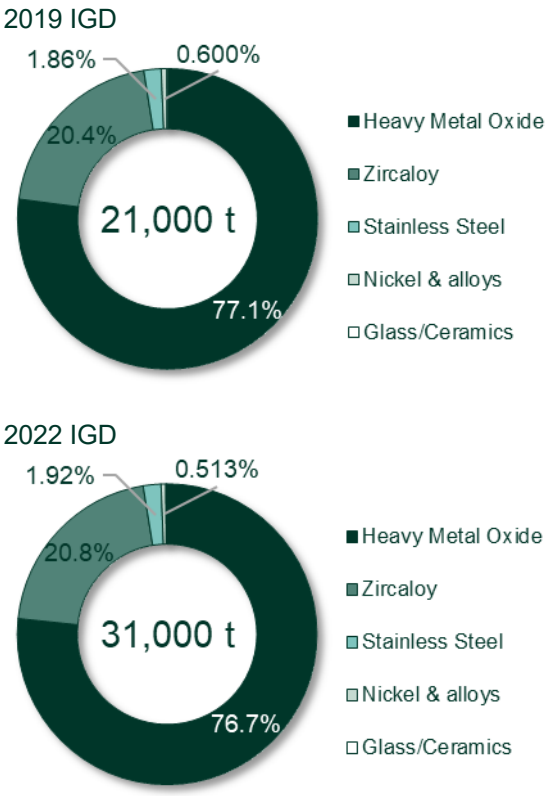
The increase in spent fuel disposal containers is approximately proportional to the increased size of the new build programme from 16 GW(e) to 24 GW(e)

The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200



Materials



MOX spent fuel

Details

Notable changes associated with this waste group are:

- The total activity at 2200 has decreased by 4.8% from 3,700,000 TBq to 3,520,000 TBq
- The packaged volume has decreased by 2% from 11,900 m^3 to 11,700 m^3

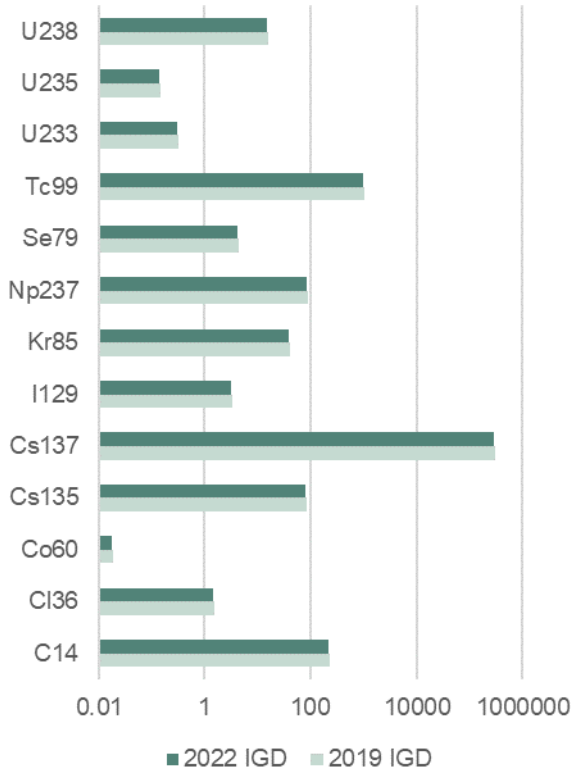
The quantity of MOX SF has reduced for the 2022 IGD as a result of a reduction in the assumed quantity MOD Pu (all of which is assumed to be suitable for re-use as MOX fuel). The reduction in the packaged volume is less noticeable as a result of differences in the volume of the Variant 1 and Variant 2 disposal containers.

Disposal Units

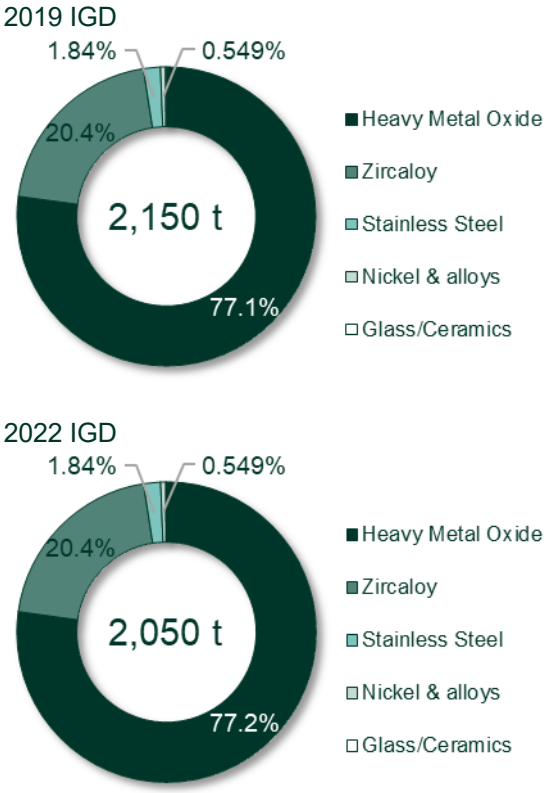
Package type	2019 IGD	2022 IGD
MOX Disposal Container	2,710	2,570

The assumption for the 2022 IGD is that the HHGW is packaged in mild steel (Variant 2) disposal containers; this is a change to the 2019 IGD, which assumed copper (Variant 1) disposal containers.

Activity [TBq] of priority radionuclides at 2200



Materials



Nuclear Waste Services

Nuclear Waste Services
Pelham House,
Pelham Drive,
Calderbridge,
Cumbria CA20 1DB
www.nuclearwasteservices.uk

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Part of the NDA group