

GDF Annual Report 2020–2021



The GDF programme is about acting now to deliver for future generations, an essential solution to radioactive waste which will protect our environment, boost our economy, and invest in local communities.

Introduction

Providing a safe, secure, and permanent solution for the UK's higher-activity radioactive waste represents one of the most significant challenges and opportunities of our time.

The UK's current legacy of radioactive waste has been building up for 60 years and while it is currently stored safely at UK sites above ground, that is not a viable and sustainable position for the many thousands of years while the waste continues to be a hazard.

A Geological Disposal Facility (GDF) is the internationally agreed, and only viable permanent answer to the UK's existing radioactive waste. Scientists around the world agree that a GDF - which will contain the waste deep underground in highly engineered vaults and tunnels - will keep it safe and secure over the hundreds of thousands of years it will take for the radioactivity to naturally decay.

As a nationally significant infrastructure project which will span decades, a GDF will also provide a unique opportunity to sustainably boost the economy of the host region and local community to transform itself for many generations.

The UK Government's approach is that a GDF will only be built where there is a suitable site and a willing community, and we have responsibility for the planning and delivery. Our work is subject to independent scrutiny from a range of organisations including independent regulators, the Environment Agency, Natural Resources Wales, and the Office for Nuclear Regulation, as well as the government's advisory group, the Committee on Radioactive Waste Management (CoRWM).

Introduction





Karen Wheeler **Deputy Chief Executive** Officer / Major Capital **Programmes Director**

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The GDF programme, which is delivering government policy, builds on years of scientific research, international experience, and collaboration. This GDF Annual report describes the substantial progress we have made since the siting process launched in England¹ in December 2018 and Wales² in 2019, including:

- The first three GDF Community Partnerships formed in Mid Copeland, South Copeland, and Allerdale in Cumbria. These groups are providing platforms for long-term community engagement, local investment funding, and investigations to assess potential site suitability.
- The GDF Working Group in Theddlethorpe, Lincolnshire, formed and is beginning discussions with the local community.
- Detailed studies are underway to inform the delivery of a GDF, building on a comprehensive body of research, and we are working with academics in many universities on the dedicated research required for the development of a GDF in practice.
- We have developed enhanced planning, ranging from identifying the kinds of information the independent regulators will need to ensure a GDF will be safe, to establishing an updated cost range for the programme which is outlined in this document.
- Other countries, such as Sweden, Finland, France, Canada, Switzerland, and Japan, are also making great strides in developing their own GDF programmes, and we have continued to work with them and learn from their experience.

Central to this progress has been constructive and early discussions with communities. The development of these local relationships will shape the pace and progress of the GDF programme as it goes forward.

This significant progress has been achieved despite the challenges created by COVID-19. Within the GDF Working Groups, we helped establish new digital platforms to support community engagement, including the creation of a GDF 'virtual exhibition' for each GDF Working Group, giving their communities the opportunity to learn more and consider the opportunities of this hugely significant project. We are continuing to harness these platforms alongside the face-to-face discussions we are now able to have.



¹ gov.uk/government/publications/implementing-geological-disposal-working-with-communities-long-term-management-of-higher-activityradioactive-waste

² gov.wales/geological-disposal-radioactive-waste



While this report covers activity in 2020-21, at the time of writing in early 2022 we have seen progress continue apace. Major developments include the formation of the Allerdale GDF Community Partnership, the Theddlethorpe GDF Working Group recommendation of a proposed search area for a GDF, and the Swedish Government's final approval for an underground repository for spent nuclear fuel at the Forsmark site in Östhammar.

On 31 January 2022, Radioactive Waste Management joined with Low Level Waste Repository and the Nuclear Decommissioning Authority's (NDA) Integrated Waste Management Programme. Together, we are now part of a single waste organisation, called Nuclear Waste Services (NWS), within the NDA group. The GDF programme remains a very high priority and major infrastructure programme of NDA.

A GDF will be one of the biggest infrastructure programmes in the UK and will provide a major investment for the host local community and its economy, as well as being a vital project for the UK. It will create thousands of jobs over its lifetime of 100-plus years, bringing opportunities to develop a sustainable local workforce with the skills and expertise that will be needed. A GDF will also attract further investment, together with business opportunities, over the course of many decades and into the next century.

The GDF programme is about acting now to deliver for future generations, an essential solution to radioactive waste which will protect our environment, boost our economy, and invest in local communities.

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Background

Policy overview

Nuclear technology has been a part of our lives in the UK for over 60 years. It provides almost a fifth of the UK's electricity and is used in industry, medicine, and defence.

These activities have created a legacy of radioactive waste which we need to manage safely today and for many thousands of years.

Currently, the UK's most hazardous radioactive waste is treated and safely packaged in solid form and held safely and securely at over 20 surface storage facilities across the country.

While these facilities are safe for the short to medium term, they need to be rebuilt every 50-100 years to ensure they continue to be safe and secure.

Since 2006, it has been UK Government policy to manage higher activity radioactive waste for the long-term through geological disposal, as recommended by CoRWM, which provides independent scrutiny and advice.

Geological disposal is internationally recognised as a safe and secure way to dispose of higher-activity radioactive waste. It involves a series of highly engineered vaults and tunnels located up to 1,000 metres deep in a suitable rock formation. Combined with man-made barriers, this protects the environment and keeps the waste safe and secure while the radioactivity decays naturally to safe levels.

The UK Government established a process for England based on identifying a suitable site for a GDF with a willing community as set out in *Implementing* Geological Disposal - Working with Communities: An updated framework for the long-term management of higher activity radioactive waste, which was published in December 2018. An equivalent policy for Wales was published in January 2019. These policies are commonly referred to as the 'Working With Communities' or 'WWC' policies. These policies marked the launch of a new process to identify a location to develop a GDF.

We are working closely with waste producers across all nuclear sectors to ensure that treatment, storage, and packaging solutions are compatible with final disposal in a GDF.



Community engagement and site evaluation

We were established to deliver geological disposal and our approach, in line with government policy, is to find a suitable site and a community that is willing to host a GDF.

The first step is engaging with people, groups, and organisations across the country to help them find out more about the opportunities this longterm investment programme could offer, so they can decide whether their community might be interested.

As a result of positive early engagements, several communities across the country are now involved in Working Groups and Community Partnerships including the relevant local authorities.

In working with communities, one of the key tasks is to look for potential GDF sites. We will then evaluate each potential site to establish whether it is suitable, based on siting factors³ which include safety and security, community, environment, engineering feasibility, transport, and value for money.

³ How we will evaluate sites in England (gov.uk/guidance/communities-and-gdf)

Timeline for the siting process

The GDF siting process: Working **Groups and Community Partnerships**

GDF Working Groups are made up of individuals and organisations who approach us to consider whether a GDF could be located in the area, together with an independent Chair, independent facilitator, the GDF Team at Nuclear Waste Services, and others, such as Local Authorities from the area.

Establishing a GDF Working Group is just the starting point in a process that will take several years. Importantly, it does not mean that a GDF will be built in that location.

The GDF Working Group will identify and propose a search area for further consideration and engage citizens across the community to begin to understand their views. The group will also recruit initial members for a GDF Community Partnership that could then take the process further forward, without initial commitment to hosting a facility.



A GDF Community Partnership would need to involve at least one relevant Principal Local Authority (e.g. district, county, or unitary authority) from the search area. Setting up the longer-term Community Partnership will provide a platform to increase public engagement and help the community create a long-term vision for itself.

It also triggers £1m per year of community investment funding. This funding is available for projects and initiatives that support economic development opportunities, improve community well-being, or enhance the local environment (including cultural and natural heritage). This figure will increase to £2.5m per year if deep borehole drilling investigations are undertaken.

Every GDF Community Partnership will also have access to independent advice to inform its thinking.

When ready, the relevant Principal Local Authorities on the GDF Community Partnership will decide on a timeframe for seeking full community agreement through a Test of Public Support. The community directly affected by a GDF gets to choose whether to say yes to a GDF.

A decision to withdraw from the process can also be taken at any time up until a Test of Public Support and must be agreed between the relevant Principal Local Authorities on a GDF Community Partnership.

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Real progress: GDF in 2020-2021

In November 2021, we saw an important development in the process to find a location for a GDF with the formation of the first GDF Community Partnership in Copeland. This came a year after the Copeland GDF Working Group was formed and followed extensive community engagement. There are now two Community Partnerships in Copeland.

Mid Copeland GDF Community Partnership

Mid Copeland GDF Community Partnership is focusing its engagement activities within a search area covering Gosforth & Seascale and Beckermet, where a GDF might be based.

We are part of the initial membership of this GDF Community Partnership, with Copeland Borough Council, Cumbria Association of Local Councils (CALC), and local councillors.





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South Copeland GDF Community Partnership

In December 2021, a second GDF Community Partnership was formed. The South Copeland GDF Community Partnership will focus its engagement activities in a search area covering the electoral wards of Millom and Black Combe & Scafell.

Again, we are part of the initial membership of this GDF Community Partnership, with Copeland Borough Council, Cumbria Association of Local Councils (CALC), and local councillors.

As recommended by the Copeland GDF Working Group, we will focus initially on exploring the deep geology beyond the coastline for the underground elements of a GDF. This means a land-based surface facility could provide access to a disposal area deep in rock beyond the coast. The Lake District National Park (and any proposed extension to the park) will not be considered for either the underground or surface parts of a GDF.

Following the WWC policy, GDF Community Partnerships will increase public engagement in order to help the community create a long-term vision for itself, and trigger community investment funding available.



Alongside the councils and the representatives from the GDF Team at Nuclear Waste Services, GDF Community Partnerships will also have other community members, with the aim being for membership to reflect the local community. More members will be recruited over the next few months.



Allerdale GDF Working Group

Since its formation in January 2021, Allerdale GDF Working Group has also made significant progress. In November 2021, it recommended the formation of a GDF Community Partnership. The proposed search area for the GDF Community Partnership comprises 13 electoral wards of Allerdale Borough Council (including, Aspatria; Broughton St Bridgets; Dalton; Ellen & Gilcrux; Flimby; Harrington & Salterbeck; Maryport North; Maryport South; Moorclose & Moss Bay; Seaton & Northside; St John's; St Michael's and Stainburn & Clifton), and the deep geology off the coastline could be considered for the underground elements of a GDF. Any land inside the boundary of the Lake District National Park and the Solway Coast Area of Oustanding Natural Beauty are excluded from consideration for both the underground and surface parts of a GDF.

Allerdale GDF Working Group has been discussing geological disposal with local people since its formation and identified the search area using existing information which includes local geology, environmental issues, transport infrastructure and safety. Local views were also considered following a series of public events and online engagement.

While this report covers activity in 2020-21, at the time of writing in early 2022 Allerdale GDF Community Partnership has formed.

Theddlethorpe GDF Working Group

In October 2021, Theddlethorpe GDF Working Group was established in Lincolnshire.

We are a member of this GDF Working Group, alongside Lincolnshire County Council, Theddlethorpe Parish Council, East Lindsey District Council, and an independent Chair Jon Collins (former leader of Nottingham City Council).

The group is beginning its engagement with people living around Theddlethorpe and the surrounding areas. It is focusing on gathering information about the area, sharing information about geological disposal, and beginning to understand any issues or questions the local community might have. A programme of face-to-face community events is underway, leaflets are being sent to local households and information packs are also available on the Theddlethorpe GDF Working Group website. The Theddlethorpe former gas terminal will be an initial area of focus for the surface access point to a deep underground facility, which could be located in the deep rock layers off the coastline.

Jon Collins, independent Chair of the Theddlethorpe GDF Working Group, said: "The GDF is a project of national importance and it's unique in that it can only proceed with two things – a suitable site and a willing community.

"Wherever the GDF is built, it could be a major boost to an area's future

Wherever the GDF is built, it could be a major boost to an area's future prosperity, skill base of its workforce, and unlock major investment such as infrastructure.

Jon Collins, Independent Chair of the Theddlethorpe GDF Working Group.

prosperity, skill base of its workforce, and unlock major investment such as infrastructure.

"As independent Chair I see it as my role to support the start of a long-term process that can make sure local people know about what is being considered and have a chance to decide what happens."

More Working Groups and the formation of Community Partnerships

We continue to hold conversations in various parts of England as we engage and raise awareness of this programme nationally. We hope to see the formation of more GDF Working Groups in the future as more people find out about the programme and wish to engage with their communities on the possibilities. We are also anticipating that existing GDF Working Groups will want to develop into GDF Community Partnerships and take the process forward with their local communities and the relevant local authorities.



Marine geophysical surveys

As we continue discussions with communities about the siting process for a GDF, an emerging key issue is that local people want to know whether the geology in their area has the potential to safely host a GDF.

To build public confidence and to better understand the local geology being explored for a possible GDF, various environmental and geophysical investigations and surveys will be undertaken. Following good progress in the siting process, marine geophysical surveys will be carried out in coastal waters for potential sites identified by the GDF Community Partnerships.

Work to commission the first marine surveys - as part of a continuing datagathering process working in partnership with each GDF Community Partnership - is under way and could start around summer 2022. We have already published the findings of a nationwide geological screening exercise based on existing data. The marine surveys will provide significantly increased understanding of the deep geology in coastal environments.

The marine surveys will use techniques that are routine in the oil, gas, and offshore wind industries, similar to the ultrasound imaging that's widely used in medicine.

They can generate three dimensional images of the deep geology, either below the land or below the seabed, providing detailed information about the thickness, layering, and depths of the different rock types in particular geographical areas.

The information they gather will help us to further consider the suitability of an area to host a GDF, which will in turn facilitate a more productive, informed dialogue with the communities that are at the heart of the siting process.





Research for a GDF

We have been undertaking significant technical work and research over recent years to ensure we have the scientific evidence to support the GDF programme, and in particular to inform our GDF design and safety case. This work continues and will focus on specific areas, including advanced manufacturing, applied social science, environmental science, geoscience, materials science, public communication of science, radiochemistry, and training.

To facilitate this work, we recently launched the Research Support Office (RSO) in partnership with University of Manchester and University of Sheffield to harness the UK's extensive array of research capabilities related to geo-disposal science and technology. The RSO will provide the GDF programme with world-class, independent evidence to guide its work around safety and design in support of the delivery of a GDF.

The RSO is already reaching out to universities across the UK to harness cutting edge research in the multiple disciplines relevant to delivering a GDF, supported by around £20m funding to undertake the research for a period of up to 10 years.



We continue to work closely with colleagues across the globe to incorporate the latest knowledge and technologies relating to radioactive waste management and geological disposal.

International

We continue to work closely with colleagues across the globe to incorporate the latest knowledge and technologies relating to radioactive waste management and geological disposal. Real progress is being made in several other countries which is already informing our approach in the UK.

One highlight over the past year is the progress in Olkiluoto, Finland, where Posiva Oy, the developer of the Finnish GDF, has started excavation of the disposal tunnels for its GDF. This is a significant milestone for Posiva Oy, and it comes after years of research and methodology development on for rock construction.

Posiva Oy's Construction Manager, Juha Riihimäki, said: "The years of research and development of rock construction that have produced procedures for construction of a nuclear facility suited for the Finnish bedrock culminate in this moment."

Construction of its underground disposal facility, to a depth of 400- 430 metres, started in 2015, and it is currently expected to be operational from 2024.

In the same way that the procedures have been adapted for Finnish geology at Olkiluoto, work on a UK GDF will also be adapted to local environments. Partly learning from the international experience of others, our GDF programme and technical teams are working to develop and improve our research, geological, engineering and site investigation capabilities and expertise to ensure we will be able to construct a safe GDF suitable for potential locations identified in the UK.



GDF Conference

In December 2021, we hosted the first national conference focused on the GDF programme. We welcomed 150 delegates, representing a broad range of national and international stakeholders from government, parliament, the public sector, industry, supply chain, major projects, regulators, academia, unions, NGOs, skills and learned societies. In a series of panel sessions and presentations, details were shared about the progress of the programme, planned activities for the next 20-30 years, and the significant economic stimulus and social value of the GDF programme.



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Constructing and operating a GDF is a multi-billion-pound major engineering and infrastructure project. It will generate many thousands of jobs and apprenticeships over its 100-plus year lifetime.

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Benefits and cost of a GDF

Benefits

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The benefits of a GDF are wide-ranging and will span many future generations.

It is an essential environmental protection project - by finally disposing of legacy radioactive waste and providing a safe, permanent solution we are avoiding the costs and risks of keeping the waste safe and secure in storage facilities above ground for many thousands of years.

But it is also a transformational opportunity for its host community by creating thousands of jobs, a highly skilled local workforce, and business opportunities for more than 100 years.

Constructing and operating a GDF is a multi-billion-pound major engineering and infrastructure project. It will generate many thousands of jobs and apprenticeships over its 100-plus year lifetime, both at the facility, in the wider supply chain, and by generating a range of contract opportunities for businesses.

The long duration of the GDF programme and its operation means that there will be opportunities for supporting the establishment of educational and training facilities to maximise opportunities for local people to develop the skills and qualifications necessary to work at the facility.

In addition to jobs at a GDF itself, operations will require development of a high-value supply chain capable of providing the relevant combination of skills, practical support, and research and development needed on an ongoing basis.

That, in turn, will attract other employers to take advantage of the talent and uplift in skills, producing a virtuous circle of increased opportunity, investment, and reward for the local population.

We will work in partnership with communities across the country, exploring the potential for them to host a GDF and understand the transformational benefits for the area. This could include better transport links, broadband, education, healthcare facilities or environmental improvements.

We will shortly publish a new detailed study on the range of economic impacts associated with a GDF, building on existing data and analysis.

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How much will a GDF cost?

A GDF will be a major piece of national infrastructure that will operate for over 100 years and continue to provide protection for future generations.

That means investing in finding a suitable site that has been properly investigated to ensure it provides the necessary geological characteristics and designing and constructing the facility using the most robust and upto-date engineering techniques. Of necessity, these investigations will take many years to complete.

At this early stage, the total whole life cost of the programme, including the design, construction, operation, and closure of a GDF up to 150 uears

of a GDF up to 150 years from now, is estimated to be in the region of £20-£53 billion. This work will ensure that a GDF provides environmental protection and includes measures to be delivered sustainably.

In looking at the costs for a GDF, two factors need to be borne in mind. The first is that the UK already spends significant amounts of money on storing higher activity nuclear waste – without a GDF these costs would continue for thousands of years. Therefore, building a GDF is by no means all new costs but in large part a replacement for costs already incurred at places like Sellafield. The second point is that a GDF will be constructed and operate for well over 100 years, and the costs will be spread over the lifetime of the project.

A GDF is a long-term and high-cost investment project, and it is our responsibility to ensure that the cost calculations represent value for money at each potential location.

There are two main ways to look at the cost of the GDF programme – the cost of getting it ready to receive the first waste; and its lifetime cost well over a hundred years.

The cost of design and early construction to get a GDF ready to receive waste could be in the range of **£4-£12bn** (figures in 2017/18 monetary values).

At this early stage, the total whole life cost of the programme, including the design, construction, operation, and closure of a GDF up to 150 years from now, is estimated to be in the region of **£20-£53 billion**.



The wide range of costs is due to two key reasons:

• A GDF location has not yet been identified. There are significant levels of variability, stemming in large part from uncertainty about a location. This means that estimates are based only on generic designs which make broad assumptions about possible geological complexities While safety will always be our priority, our approach to evaluating potential GDF sites is be based on a range of factors including value for money.

that might be encountered, and the engineering and technical work required. The selection of a site will also determine whether additional investment is required in supporting transport infrastructure.

• The inventory is not yet finalised. The final inventory of waste for disposal is also subject to uncertainty. While we are clear about the current legacy of waste which already exists, a GDF would have to handle additional waste from new facilities being developed. In the event that no further use is found for spent nuclear fuel and nuclear materials such as uranium, the inventory for a GDF will also include these materials. Given the long timeframe involved, it is likely that the costs of activities, their duration, scope, and timing may be different in practice.

Our previously published estimate was in the region of £12bn. This was because that figure only represented a lower-end single-point estimate based on the costs of disposing of legacy waste only alongside some basic assumptions about a single type of geology and depth. In line with latest guidance from the Infrastructure and Projects Authority, the revised cost estimate is derived from a range of different credible scenarios.

The updated cost estimate also takes account of uncertainty, optimism bias⁴ and risk. Uncertainty will be reduced as we progress through the siting process and narrow down the options for a site. We will understand the specific geology and associated engineering and technical requirements, allowing us to refine our cost estimates. **Table 1** gives a breakdown of baseline costs and the uplift in costs for uncertainty, risk, and optimism bias (the costs are in 2017/18 monetary values).

Inventory	Cost estimates
Legacy waste (includes waste already accumulated and waste from current fleet of nuclear power stations)	Baseline minimum cost estimate
	Upper estimate including risk, optimism bias and uncertainty
Full potential inventory (includes legacy waste, waste from new nuclear and nuclear materials that could be categorised as waste in the future, such as unreprocessed spent fuel)	Baseline minimum cost estimate
	Upper estimate including risk, optimism bias and uncertainty

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Lower technical complexity	Higher technical complexity
£12.1 billion	£18.0 billion
£20.3 billion	£32.2 billion
£20.3 billion	£30.5 billion
£33.1 billion	£53.3 billion (upper bound)

⁴ Optimism bias is a demonstrated systematic tendency for project appraisers to be overly optimistic. This is a worldwide phenomenon that affects both the private and public sectors. HMT Green Book recommends adjusting for this bias by increasing estimates of the costs and decreasing, and delaying the receipt of, estimated benefits.

The actual cost will also depend on the number of new nuclear projects that the UK develops in future and any additional waste from those stations. The operators of new nuclear facilities will meet the costs of disposing of the waste they produce.

The remainder of the costs will be met by the current waste owners, including the UK Government. The UK Government owns the majority of the legacy waste and is therefore responsible for the cost of its disposal in a GDF.

Further updates on costs will become available after key milestones, such as once we select locations for more detailed survey work and following completion of the design and environmental assessments.

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A GDF is a major infrastructure project and will therefore undergo the highest levels of assurance to deliver value for money for the taxpayer and waste producers. We will continue to refine our estimates as more information becomes available, and to look for efficiencies whilst maintaining the highest standards of safety and security.

> By finally disposing of legacy radioactive waste and providing a safe, permanent solution we are avoiding the costs and risks of keeping the waste safe and secure in storage facilities above ground for many thousands of years.

Where to find more information

You can find more information about geological disposal online or by contacting Nuclear Waste Services directly.

Information about the current GDF Community Partnerships

- Mid Copeland GDF Community Partnership www.midcopeland.workinginpartnership.org.uk
- South Copeland GDF Community Partnership www.southcopeland.workinginpartnership.org.uk
- Allerdale GDF Community Partnership www.allerdale.workinginpartnership.org.uk

Information about the current GDF Working Group

• Theddlethorpe GDF Working Group www.theddlethorpe.workinginpartnership.org.uk

More from Nuclear Waste Services

- About a GDF www.gov.uk/guidance/gdf-geological-disposal-facility
- About our organisation www.nuclearwasteservices.uk
- Twitter @Nuclear_WS

You can subscribe for e-mail updates.

https://public.govdelivery.com/accounts/UKNDA_RWM/subscriber/new

We also have a contact centre specifically for enquiries about the GDF programme:

- 0300 369 0000
- gdfenquiries@nda.gov.uk





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Nuclear Waste Services is a joint trading name of LLW Repository Limited (Company Registration No. 05608448) and Radioactive Waste Management Limited (Company Registration No. 08920190). Both of these companies are registered in England and Wales with their registered office located at Pelham House, Pelham Drive, Calderbridge, Cumbria CA20 1DB.

