



A permanent solution
for higher-activity
radioactive waste

Doing
The
Right
Thing

“*In common with many other countries around the world, successive governments in the UK, supported by scientific advice, have concluded that creating a permanent deep underground disposal facility is the best long-term solution to deal with our higher-activity radioactive waste.*”

CEO Foreword

Providing a permanent solution for the UK's higher-activity radioactive waste is one of our most challenging environmental problems. Without action now, we would be extending for decades the risks and costs of handling this waste above ground, and leaving future generations to deliver a permanent solution. Scientists and experts across the world have agreed that the safest long-term solution for such waste is geological disposal, and many countries with a similar legacy already have well developed programmes in place to build geological disposal facilities to isolate radioactive waste many hundreds of metres underground.

That's why the UK government has decided we must press ahead with our own facility and Radioactive Waste Management Ltd (RWM), part of the Nuclear Decommissioning Authority (NDA) group, has been tasked with planning and implementing a Geological Disposal Facility (GDF).

This is not only massively important for resolving a long-outstanding environmental issue, it is also a major engineering and infrastructure project, which will create significant investment and employment opportunities which will last for decades for those in the chosen location.

So we will work in partnership with communities across the country, exploring the potential for them to host a GDF and the impact and potentially transformational benefits the programme could provide to a consenting community. Working together, we will help shape a community's vision of how it could benefit from the investment, infrastructure and employment opportunities that a GDF would bring over future decades.

This is a hugely important, challenging and exciting project for the country and for the community that elects to host the GDF, and one I am proud and delighted to lead as RWM's Chief Executive Officer.

Karen Wheeler CBE
Chief Executive Officer
Radioactive Waste Management



A challenge like no other



Nuclear technology has been a part of our daily lives in this country for more than 60 years. Ever since the first electricity generating plant opened at Calder Hall in 1956, nuclear energy has provided electricity for our homes and businesses - a fifth of our overall supply today. Nuclear technology also plays a critical role in our NHS, helping to diagnose and treat serious illnesses, as well as performing key tasks in industry such as assessing the quality of welds in key assets, and in the defence of our country.

People have strongly held views on nuclear, both for and against. That debate, no doubt, will go on, but whatever your view on the future of nuclear, one thing is clear: we have to deal with the legacy of the waste that has accumulated during those past decades, as well as that which will come from the already planned decommissioning of existing power plants in the coming years.

Most of that waste is classified as low-level in terms of radioactivity and is already disposed of safely, but higher-activity waste needs particularly careful management. Waste destined for a GDF is currently packaged and held in secure interim stores on the surface at over twenty sites around

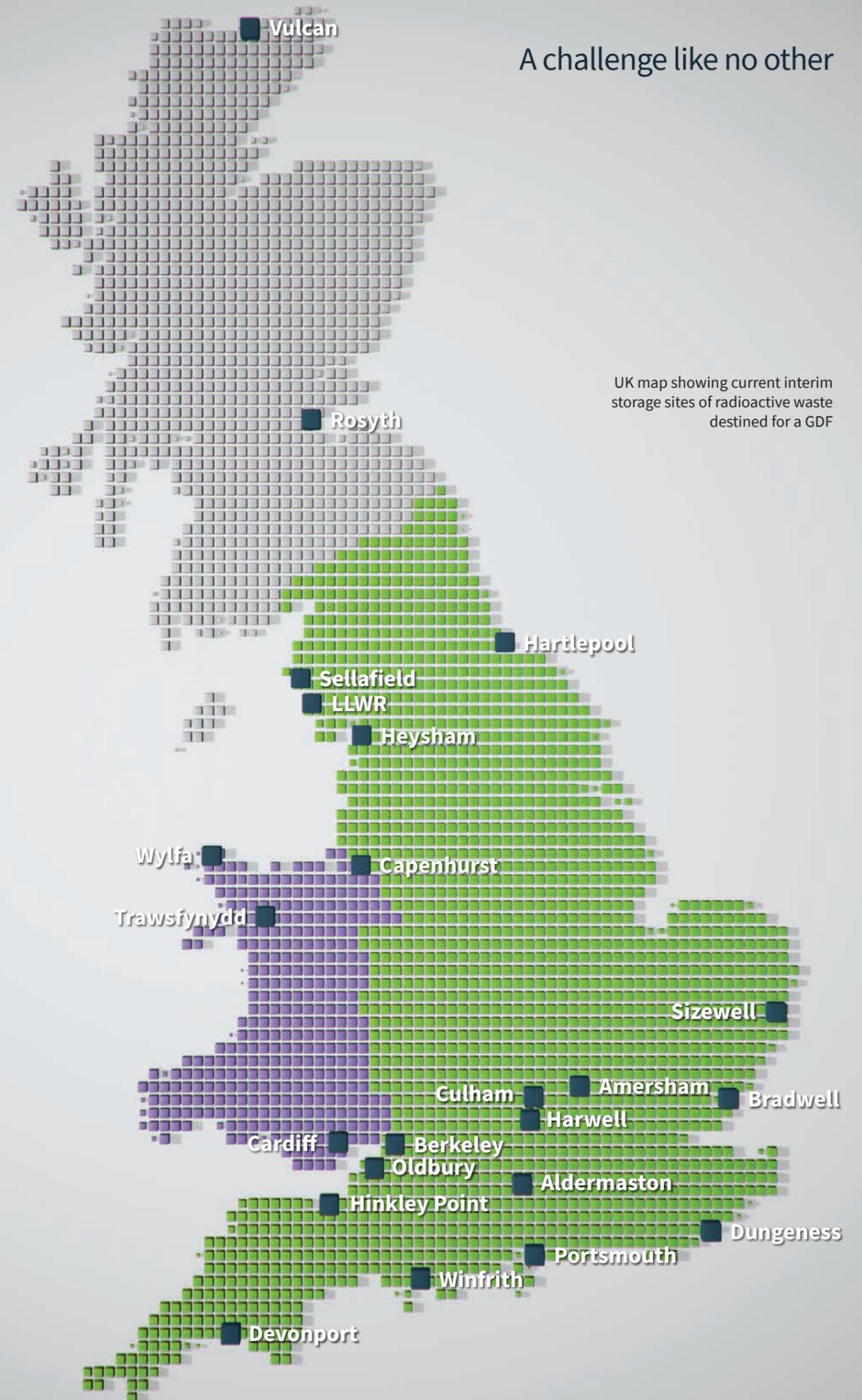
the country. Those stores need to be constantly monitored, carefully managed, and refurbished on a regular basis, and the buildings replaced every hundred years or so - that will continue to be the case for as long as the material is there.

In common with many other countries around the world, successive governments in the UK, supported by scientific advice, have concluded that creating a permanent disposal facility deep underground, is the best long-term solution for waste which will take many thousands of years to decay to safe levels.

A GDF will be hundreds of metres beneath the surface - this could be three times deeper than the height of Britain's tallest building: the Shard in London - and use multiple barriers of human engineering and stable rock working together, to protect people and the environment.

And while government, regulators and industry continue to explore alternative ways of managing some of this waste, the deep, protective isolation of a GDF will always be necessary for waste that has higher or long-lived levels of radioactivity.

A challenge like no other



“The sooner we make progress, the sooner we can remove this environmental burden from our society and future generations.”

Government policy is clear that continuing to store the material above ground in interim surface stores around the country indefinitely is not an option. With the constant management and ongoing maintenance this would require for many thousands of years into the future and with all the additional cost and risk to people and the environment, at best this would be a short-term solution. At worst it would be passing on the burden of finding a permanent solution to future generations.

As Professor Neil Hyatt, professor of Nuclear Materials Chemistry at the University of Sheffield, has put it:

“Technically it is feasible to repackage the waste every few decades and build new stores. However, this is effectively kicking the waste can down a never-ending road; it would be leaving the cost, risk and responsibility of managing and safely disposing of the waste to future generations who did not benefit from the energy generation.”

Hence this report. It aims to explain why we need to deliver a permanent solution for our higher-activity radioactive waste, and why, given the long planning and construction timelines, we need to move forward now. The sooner we make progress, the sooner we can remove this environmental burden from our society and future generations. It describes how communities will be supported practically and financially as they consider whether to support their locality being considered for a GDF, and it also sets out the benefits in terms of highly skilled jobs, infrastructure and public facilities a consenting host community can anticipate.

A GDF will be one of the most significant national infrastructure assets in this country and, therefore, it is only right that a local community should have all the evidence it needs in choosing whether to host it. That is why this report should be regarded as only the start of a conversation, and not the last word. This is a conversation we need to have if we are to avoid passing on the legacy of dealing with our higher-activity radioactive waste to future generations.

A challenge like no other



The radioactive waste legacy

The United Kingdom has been accumulating radioactive waste since the 1940s.

To help meet its energy needs, it has built a number of nuclear reactors, of which 15 are still operating. A new nuclear power station is being built at Hinkley Point in Somerset and others may be built in the future.

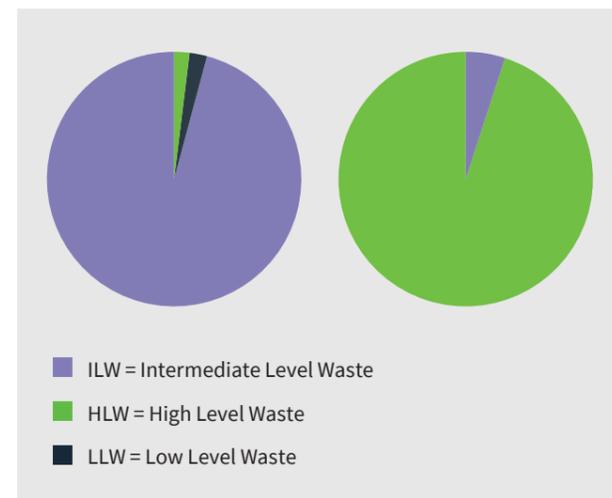
In the UK, we've used nuclear technologies to power our homes, for medical advances, and to drive industry for more than 60 years. And, as a result, we've produced different types of radioactive waste.

The vast majority of this waste - over 90% by volume - is classified as low level and, therefore, can be safely disposed of at either the Low Level Waste Repository (LLWR) in Cumbria, or at specially designated and licensed landfill sites.

The remainder, however, is classified as higher-activity waste which, because it is more radioactive or will remain so for longer, needs to be managed differently. This category of waste includes waste from reprocessing of used fuel, as well as items such as reactor components from general operations and the decommissioning of nuclear facilities.

The planning for a GDF also takes into consideration some nuclear materials which are not waste today, but where it may be decided in the future that they have no further use.

Types of radioactive waste destined for a GDF, by volume (left) and radioactivity (right)

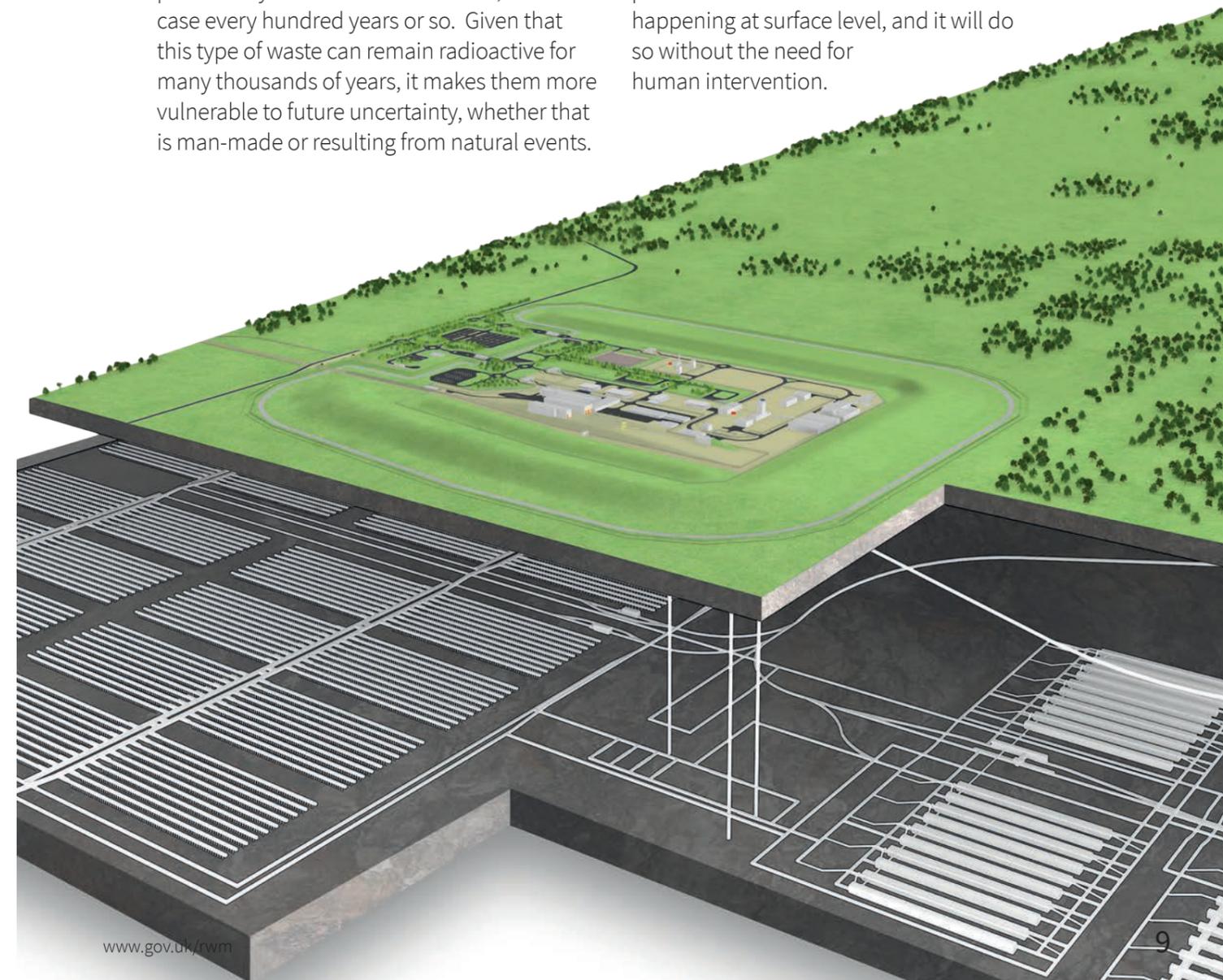


It is estimated, therefore, that if all of the anticipated new build stations in the UK came to fruition and all of the nuclear materials not classified as waste were to require disposal, then there could be around 750,000 cubic metres of higher-activity waste, to be permanently disposed of in a GDF. This is equivalent to filling around two-thirds of Wembley stadium. And even if all nuclear activities were to stop tomorrow, about 90% of this volume would still exist.

A permanent solution

Some of the higher-activity radioactive waste which would go into a GDF is currently stored safely at over twenty surface sites around the country. The buildings in which they are stored are designed and built to be safe and secure, but, like any object or building, they have to be constantly managed and periodically renewed or refurbished, in this case every hundred years or so. Given that this type of waste can remain radioactive for many thousands of years, it makes them more vulnerable to future uncertainty, whether that is man-made or resulting from natural events.

That is why, internationally, it is recognised that a permanent deep disposal facility, which would not be subject to the uncertainties of the economic, political, security or future environmental changes at the surface, is the safest and most secure way to manage higher-activity waste for the long term. A GDF will protect and isolate the waste from whatever is happening at surface level, and it will do so without the need for human intervention.



“There has long been strong support for the final repository and now, more than ever are in favour of the plans. SKB has always stressed the importance of broad, local support for the final repository and the opinion poll shows that this is really the case”

SKB’s CEO Johan Dasht

A GDF will consist of two separate elements: a surface facility to receive the radioactive waste, which would be about 1km² - the size of an average industrial park; and a series of underground tunnels and vaults covering an area of between 10km² and 20km² where the waste would be disposed of. These vaults and tunnels would be between 200m and 1km deep - much deeper than either the deepest London Underground station or the Channel Tunnel.

Higher-activity waste is immobilised, often in glass or cement, which serves as the first of its multi-barriers. It is secured in containers typically made of metal. Once placed in a GDF, these containers are surrounded by a further barrier, such as a cement grout backfill, or a self-sealing buffer, typically a form of clay called bentonite. Any remaining space, such as access tunnels, is backfilled with crushed

bedrock, cement or bentonite. As the whole facility is located deep underground in up to 1000m of solid rock, this forms the last and most substantive protective barrier. The materials used in the engineered barriers will be tailored to the radioactive properties of the waste and the natural environment of the geology where it is to be located.

Only sites with geology that can provide the necessary levels of protection for hundreds of thousands of years will be considered for the permanent disposal of our radioactive waste.

Deep geological disposal was adopted following a review carried out by the independent Committee on Radioactive Waste Management (CoRWM) between 2003 and 2006, to consider all the available options for the long-term management of our waste. After considering many other alternative options, including disposal at sea or space and ongoing surface storage, it concluded that, while it was important to continue to explore practical alternatives, geological disposal was the best available approach to deliver safety, security and public confidence. And the Committee has consistently repeated that view in a series of published reports since then.

The same conclusion has been reached by other countries around the world - some of whom are ahead of the UK in implementing their GDF programmes.

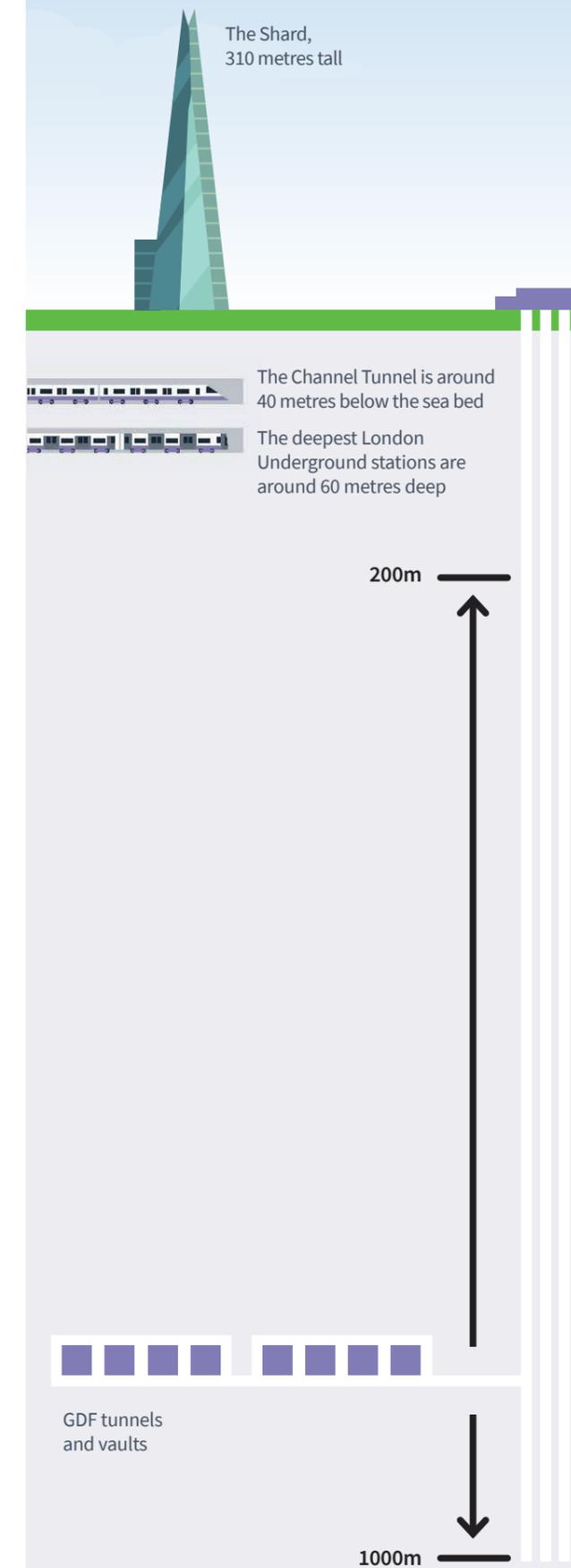
In Finland, Posiva, the organisation responsible for the final disposal of spent fuel, has received a construction licence to begin building at Olkiluoto. Construction is well under way and Posiva expects to submit its operating licence application this year and begin disposal this decade.

In Sweden a preferred site has been identified at Forsmark with strong support from the two communities, Östhammar and Oskarshamn, and it is anticipated that construction of a Spent Fuel disposal facility could begin in the early 2020s and take about ten years to complete.

“There has long been strong support for the final repository and now, more than ever are in favour of the plans. SKB has always stressed the importance of broad, local support for the final repository and the opinion poll shows that this is really the case”
SKB’s CEO Johan Dasht

France has also identified a suitable site and both Canada and Switzerland are well advanced in the process of selecting sites for a disposal facility.

How deep will a GDF be?



Taking the time to get it right

Our timeline for delivering a GDF

Constructing a GDF will, like any major infrastructure project, be a massive undertaking. It involves not just tunneling deep into the ground, but also highly specialised engineering to ensure that the waste will be kept both safe and secure. Initial construction, it is estimated, could take ten years, whilst the rest of the facility will then be completed and filled with the waste in stages over the next century.

But that work may not begin for many years, because before it starts we have to make sure that not only are we building the facility in a suitable geological place, but that we are doing so with the local community's full and informed consent.

The consent principle is the cornerstone of the search for a suitable permanent site for our radioactive waste. This means that the local community will have to expressly consent to hosting a GDF before RWM seeks the necessary permission to build or operate it.

The process of engaging with communities will, therefore, run in parallel with the underground and environmental investigations necessary to identify a suitable site. We will work with the community on the geological assessment of the site's suitability, the inventory of what material would be disposed of there, and the measures to be taken to ensure that it is safe and secure.

Government policies for England and Wales now give clear commitments that:

- *accessible information will be provided to communities, in order to support informed discussion of all the issues of interest around geological disposal;*
- *there will be early community investment funding (of £1m - £2.5m per year) for areas that take part in the siting process, with a commitment to developing a longer term community vision that could enable larger significant additional investment for the long-term wellbeing of any community that hosts a facility;*
- *when a community is ready, a final decision will be put to a public test. Without a positive demonstration of support a GDF will not proceed;*
- *equally, there will be a Right of Withdrawal for communities at any point up to the Test of Public Support if they decide they do not want to proceed.*

Each community will need to work out whether the investment in a GDF is right for them and reach a judgement in a fully informed way in a timescale that they are comfortable with.

The starting point is for an individual or group to initiate a discussion with RWM about whether their area might be a suitable location for the GDF. That discussion can be informed by information from a National Geological Screening exercise



carried out by RWM which the public can use to check whether their area could have potentially suitable geology for a GDF.

If both the interested party and RWM agree it is worth continuing discussions, a Working Group can then be formed, including not just the party and RWM, but also the relevant local authority or authorities, if they wish to take part, along with an independent Chair and Facilitator. Out of pocket expenses will be paid as appropriate to recognise the time, effort and commitment being made.

The main task of the Working Group will be to identify the area to be considered for a potential facility and to establish a formal Community Partnership which will need to include at least one relevant principal local authority and engage with the views of the local community. RWM will meet the costs of the Community Partnership's work and, in addition, the community will have access to £1m of Community Investment Funding each year as it continues its discussions and deliberations with RWM. That money can be used to fund projects, schemes and initiatives that drive the economic development of their area, or improve the local environment, or the community's wellbeing.

In the areas with the best prospects for a GDF, a suite of technical investigations will be conducted, including the drilling of boreholes up to 2km deep to help the geological assessment on which a final decision would be based.

In recognition of the community's continued engagement with the process as it moves into these physical investigations, the Community Investment Funding would increase at this stage to £2.5m per year for each community still taking part.

When they are ready, the principal local authorities on the Community Partnership will need to decide when to seek the agreement of the community as a whole through an explicit Test of Public Support. Only if that is passed can RWM apply for the necessary development consents and regulatory permissions for a facility in that community.

And that independent oversight will continue with the final word on whether a GDF is safe to operate continuing to rest, not with RWM, but with those who regulate it. If they do not agree, a GDF cannot be built. It's as simple as that. A GDF will only be built if it can be shown to be safe.

A permanent benefit from a permanent site

A GDF will be operational for well over a century. During that time it will not just provide highly skilled, secure jobs for hundreds of people every year directly, it will also be the catalyst for a long-term uplift in the physical and social infrastructure of the area in which it is placed. Significant investment will be injected into the local economy. Local people will be able to look forward to long-term careers in the facility, and local supply chains will have the ability to bid for long-term contracts. It could be transformational.

Many of the jobs, initially, will come during the first construction phase, not just of a GDF itself, but also, potentially, of the surrounding infrastructure that may be needed to support it. The intention is to ensure that infrastructure is fully aligned with the local area's own plans and needs, and that it is properly funded.

But the long lead in time to the opening of a GDF means that proper consideration can also be given to ensuring that the right educational and training facilities are established to ensure that local people are fully qualified to fill a high proportion of the jobs required during the long operational phase.

And those jobs will not just be in a GDF itself. Its successful operation will depend on the creation of a high value supply chain capable of supplying the right mix of skills, practical support and research and development the facility will need on an ongoing basis.

That, in turn, will create the opportunity for other employers to enter the local jobs market to take advantage of the uplift in skills and available talent a GDF will create so producing a virtuous circle of increased opportunity, investment and reward for the local population.

RWM will work with communities to help them develop their own long-term vision for the future that could underpin the significant additional investment committed to by government in any community that ultimately hosts a facility.

The precise details of that long-term investment will be a matter for discussion between local representatives, RWM and government. The aim is to deliver a solution that would bring a mutual long-term benefit for the host community and for the country as a whole.

“The aim is to deliver a solution that would bring a mutual long-term benefit for the host community and for the country as a whole.”

How we will work with communities

	for 1 – 5yrs	for 5 – 20yrs	for 100+yrs
People	 <p>Initial conversations, Working Group, establishing partnerships with communities, providing information</p>	 <p>Developing a vision, providing information, funding and support for each community Realising local plans for benefits and investment</p>	 <p>Continued investment in supply chain, skills, infrastructure, etc</p>
Place	 <p>Desktop research and site evaluation</p>	 <p>Site investigations, designing and planning Site selection and final decision</p>	 <p>Construction, operation and closure</p>
Investment	 <p>£1m Up to £1m per year per community</p>	 <p>£2.5m Up to £2.5m per year per community during borehole investigations</p>	 <p>tbc Significant investment package for a host community</p>

Conclusion

The decision to invest in and build a permanent Geological Disposal Facility for the UK's higher-activity radioactive waste is clearly a big one for the country and for the community who will eventually decide to host it.

But it is also a huge opportunity for an area to transform its economic potential not just through the construction of a GDF, but also through the creation of hundreds of secure, highly skilled and paid jobs which will, in turn, depend on new social and educational facilities to support them.

For the right community, in the right place, it could be truly transformational.

At the same time RWM recognises that a community will only take on that role if it feels reassured that a GDF, and the radioactive waste it will contain, will remain safe and secure, isolated deep underground in the rock, far from the surface, not just for this decade, or even this century, but for many thousands of years to come.

That trust, and that confidence will only be established through a process of dialogue - and that dialogue has to be both genuine and two-way. Communities have to feel that they can ask any question, talk to whoever they need to, seek whatever expert opinion they want - and be given the time and space to reach a properly informed, local decision.

The process outlined in this report is designed to do that. It is the result of the lessons learned from previous experience. It provides the means

to supply communities with the geological, socio-economic and potential investment information they need and want to make a balanced judgement. It also commits to supporting those who take the time and effort to engage in the process - and to recognising the commitment of the communities they represent. The process will be long but it will also be worthwhile.

For more than sixty years, nuclear technology has been a big part of our lives, helping us meet our energy needs. It has also played a key part in medical diagnosis and treatment, as well as industry and defence.

Those advances, however, have left and will continue to leave a legacy of higher-activity radioactive waste which must be kept safe and secure for the many thousands of years during which its radioactivity will naturally reduce.

That is why government is clear that we need to find a permanent solution for that waste. The interim stores in which it is currently kept were never intended as a permanent solution. This would leave future generations to bear that cost and risk, for no reward, in the face of whatever political, economic, environmental uncertainty they will face. So it seems only right that we should face up to the responsibility of delivering the permanent, safe solution to deal with this legacy.

A Geological Disposal Facility can be that solution, not just for the country, but also for a community that can see the positive benefits it could bring to their area. It's time to join the conversation.

“For the right community, in the right place, a GDF could be truly transformational.”





Getting in touch

To learn more about the UK's mission to deal with higher-activity radioactive waste

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Follow us on Twitter [@rwm_gdf_uk](https://twitter.com/rwm_gdf_uk)

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