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Welsh Government

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Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste

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Introduction

1. 1 Radioactive waste disposal¹ is a devolved matter: the Welsh Government is therefore responsible for determining the policy for the disposal within Wales of radioactive waste.
1. 2 The Welsh Government has decided to adopt a policy for geological disposal for the long term management of higher activity radioactive waste (HAW)². Although the Welsh Government has adopted a policy for geological disposal for HAW, this does not mean that a geological disposal facility (GDF) will necessarily be sited in Wales. The Welsh Government continues to support the policy of voluntary engagement where potential host communities are able to seek discussions, without prior commitment, about potentially hosting a GDF. The Welsh Government considers that a GDF can only be built in Wales if a community is willing to host it.

The UK's legacy of radioactive waste

1. 3 For over half a century, the United Kingdom has accumulated a substantial legacy of HAW, initially from military nuclear programmes and subsequently from the generation of electricity in nuclear power stations, from the associated production and processing of nuclear fuel and from the use of radioactive materials in industry, medicine and research. Some of this has already arisen as waste and is being safely managed and stored on an interim basis at nuclear sites across the UK. However, much will only become waste over the next century or so as existing facilities reach the end of their lifetime and are decommissioned; and nuclear sites are cleaned up safely and securely. This legacy waste will exist even if no new nuclear power stations are built.

Current management and ongoing storage of HAW and spent fuel

1. 4 Some HAW and spent fuel can remain radioactive, and potentially harmful, for hundreds of thousands of years. Modern, safe and secure interim storage can contain this material in the short to medium term, but storage requires ongoing human intervention to monitor the material with the likely need in due

¹ This policy document refers to the adoption of a policy for the disposal of radioactive waste. Disposal is distinct from storage: storage implies the need to intervene further in the management of the waste by e.g. repackaging or transporting the waste for final disposal. With disposal, although provision may be made for monitoring or future intervention, no requirement is placed on future generations to intervene further with the waste once it is emplaced.

² In the context of this policy document the term HAW is used to cover the types of radioactive waste which constitute HAW (high level waste, intermediate level waste and a small amount of low level waste), spent fuel, should it be declared as waste and other materials not currently declared as waste which may be declared as waste in the future, and includes HAW and spent fuel from new nuclear power stations. This is discussed further in Annex 1 [Paragraphs 2.3-2.4].

course to repackage and further to manage the waste to ensure that it does not cause any risk to human health or the environment. Repackaging itself can create the risk of worker exposure to radioactivity and creates more radioactive waste for disposal. Ongoing storage retains the need for ongoing management of HAW: permanent disposal would remove that need.

These matters are discussed more fully in Annex 1.

HAW in Wales

1. 5 HAW in Wales arises from a range of activities and forms part of the overall radioactive waste inventory.

- HAW arises from and is stored at Wales' two nuclear power stations at Trawsfynydd and Wylfa which are owned by the Nuclear Decommissioning Authority. Decommissioning work at these sites will generate HAW at intervals for around 100 years
- Spent fuel from the two power stations is transported to Sellafield in Cumbria and reprocessed, so the HAW from this spent fuel is generated, and currently stored, at Sellafield.
- HAW arising from decades of work with radiopharmaceuticals is stored at the GE Healthcare site in North Cardiff pending a disposal route.
- HAW arises from the activities of businesses, hospitals and universities in Wales.

This is discussed in more detail in Annex 1.

Background to the Welsh Government's policy review

1. 6 In the 2008 White Paper *Managing Radioactive Waste Safely*³ the Welsh Government stated that it had reserved its position on the UK Government's policy of geological disposal for HAW: it neither supported nor opposed that policy, nor did it support any other policy for the disposal of HAW.

1. 7 In April 2014⁴ the Welsh Government issued a call for evidence seeking views on whether it should review this policy and gave reasons why such a review might be necessary. Having carefully considered the outcome of this call for evidence and other evidence available to it the Welsh Government decided to review its policy on the management and disposal of HAW and issued a consultation paper on 23 October 2014⁵. The consultation paper included

³ Defra, BERR and the devolved administrations for Wales and Northern Ireland: Managing radioactive waste safely: a framework for implementing geological disposal. June 2008

⁴ Welsh Government, Call for Evidence: Review of Current Policy on the Disposal of Higher Activity Radioactive Waste, April 2014 <http://wales.gov.uk/consultations/environmentandcountryside/disposing-of-higher-activity-radioactive-waste/?lang=en>

⁵ Welsh Government, Consultation: Review of Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste. October 2014

reference to the policy drivers influencing the Welsh Government's policy review and the Welsh Government's preferred options. The consultation closed on 22 January.

- 1.8 This policy document reflects the outcomes of the consultation and consideration of other evidence available to the Welsh Government. It should be read in conjunction with the Welsh Government's analysis of the responses received to the consultation⁶.

Scope of the Welsh Government policy review

- 1.9 Although the Welsh Government has devolved responsibility for policy relating to the disposal of radioactive waste in Wales this does not mean that waste arising from activities in Wales needs to be disposed of in Wales. For example, the Welsh Government supports the four country UK wide strategies for the management and disposal of low level radioactive waste (LLW)⁷. Currently the only radioactive waste disposed of in Wales is low volume very low level radioactive waste (VLLW) which can be sent to appropriately permitted facilities such as municipal landfill sites. All other LLW arising in Wales is sent either to the UK Low Level Waste Repository (LLWR) in Cumbria or to other appropriately permitted waste disposal facilities outside Wales.
- 1.10 The Welsh Government is establishing a policy for the disposal of HAW in Wales within a UK context. Waste arising from activities in Wales forms part of the overall inventory for disposal (paragraphs 2.15 to 2.17) which includes waste from Wales, England and very small amounts of intermediate level radioactive waste (ILW) from Northern Ireland. The Welsh Government is part of the Managing Radioactive Waste Safely programme together with the UK Government and the Northern Ireland Executive. Part of the programme is aimed at providing one or more GDFs for the overall inventory for disposal. Depending on the successful outcome of discussions with a willing host community and regulatory approval of a safety case, (paragraphs 4.21 to 4.28), a GDF, which could be sited either in Wales, England or Northern Ireland, would take waste from both Wales and England and the small amounts of ILW generated by activities in Northern Ireland.

<http://gov.wales/consultations/environmentandcountryside/disposal-higher-activity-radioactive-waste/?lang=en>

⁶ Review of Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste.

⁷ NDA, UK Strategy for the Management of Solid Low Level Radioactive Waste from the Nuclear Industry, August 2010

<http://www.nda.gov.uk/publication/uk-strategy-for-the-management-of-solid-low-level-radioactive-waste-from-the-nuclear-industry-august-2010/>

DECC, Scottish Executive, Welsh Assembly Government, Department of the Environment Northern Ireland, Strategy for the management of solid low level radioactive waste from the non-nuclear industry in the United Kingdom, 2012

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48291/4616-strategy-low-level-radioactive-waste.pdf

1. 11 Therefore, although the Welsh Government has adopted a policy for geological disposal for HAW, as stated in paragraph 1.2 above this does not mean that a GDF will necessarily be sited in Wales. The Welsh Government supports the recommendation by Committee on Radioactive Waste Management (CoRWM) 1⁸, and considers that, in Wales, geological disposal should only proceed on the basis of the willing participation of a potential volunteer host community or communities. This is consistent with Welsh Government policy since 2008⁹ which has allowed for communities from Wales to seek to open discussions with the Welsh Government about potentially hosting a GDF.
1. 12 In adopting a policy for geological disposal the Welsh Government has noted comments by CoRWM and others, that only geological disposal can accommodate the whole inventory for disposal. The Welsh Government also notes and supports the other main recommendations by CoRWM 1 for safe and secure interim storage prior to geological disposal and ongoing research for the management and disposal of HAW.

Consideration of the policy drivers in the Welsh Government consultation on the management and disposal of HAW

1. 13 The Welsh Government consultation between October 2014 and January 2015 set down three main policy drivers influencing the Welsh Government policy review. The consultation also set down the Welsh Government's preferred options of adopting a policy for the disposal of HAW, and for the method of disposal to be geological disposal.
1. 14 The Welsh Government has carefully considered the responses to the consultation and other evidence available to it. It appears to the Welsh Government that only a policy for the disposal of HAW can meet the objectives identified in the policy drivers. It also appears to the Welsh Government that while other options may allow for the disposal of part of the HAW inventory, and should be considered where there is advantage in doing so, only geological disposal will allow for the disposal of the whole inventory of HAW and fulfil the requirements set by the policy drivers. This is discussed below.

Support for new nuclear power stations in Wales

1. 15 In its policy document '*Energy Wales: A Low Carbon transition*'¹⁰ the Welsh Government recognises the importance of a new nuclear power station at Wylfa on Anglesey (Wylfa Newydd) to provide a constant, reliable low carbon

⁸ CoRWM Managing our Radioactive Waste Safely: CoRWM's Recommendations to Government July 2006

⁹ Defra, BERR and the devolved administrations for Wales and Northern Ireland: Managing radioactive waste safely: a framework for implementing geological disposal. June 2008

¹⁰ Welsh Government Energy Wales: a low carbon transition, 2012

<http://wales.gov.uk/topics/environmentcountryside/energy/energywales/?lang=en>

energy source to complement the range of renewable energy developments in Wales. Its development also offers significant long term benefits to the economy of Wales. The Welsh Government accepts that Wylfa Newydd, and other new nuclear power stations, will produce HAW which will add to the legacy of waste mentioned above. There are currently no proposals to reprocess the spent fuel from new nuclear power stations and therefore it will also need appropriate management, storage and eventual disposal as waste alongside the HAW that will be produced by new nuclear power stations.

1. 16 The Welsh Government considers that its policy on the management and disposal of HAW should be consistent with its support for new nuclear power stations at existing locations in Wales. Adopting a policy for the geological disposal of HAW and spent fuel, if it is declared as waste, from new nuclear power stations, provides this consistency of policy.

The Spent Fuel and Radioactive Waste Directive

1. 17 The Spent Fuel and Radioactive Waste (SF&RW) Directive¹¹, came into force in 2011 and requires Member States to establish and maintain a national policy for the safe and responsible management and disposal of radioactive waste, to be implemented through a national programme, and to report on that policy and programme to the European Commission by 23 August 2015.

Recital 28 of the Directive states:

“Member States should establish national programmes to ensure the transposition of political decisions into clear provisions for the timely implementation of all steps of spent fuel and radioactive waste management from generation to disposal.”

Article 2. states:

“1. This Directive shall apply to all stages of:
(b) radioactive waste management, from generation to disposal...”

Recital 21 states:

The storage of radioactive waste, including long term storage, is an interim position, but not an alternative to disposal.”

1. 18 The Directive therefore requires the management of radioactive waste to include its eventual disposal. Paragraph 3.3 discusses the work of CORWM 1 between 2003 and 2006 in considering the options for the disposal of HAW and its recommendation that geological disposal is the best option for the long term management of HAW¹². CoRWM was reconstituted in 2007¹³ and in

¹¹ <http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1403100988892&uri=CELEX:32011L0070>

¹² CoRWM Managing our Radioactive Waste Safely: CoRWM’s Recommendations to Government July 2006

¹³ Discussed in more detail in Annex 2

2013 confirmed the recommendation of CoRWM 1 supporting geological disposal¹⁴.

1. 19 The SF&RW Directive also recognises that geological disposal is the best option:

Recital 23 states:

“It is broadly accepted at the technical level that, at this time, deep geological disposal represents the safest and most sustainable option as the end point of the management of high-level waste and spent fuel considered as waste.”

1. 20 Radioactive waste disposal is a devolved function and maintaining a reserved position on the disposal of HAW so as not to have a policy for the disposal of HAW in Wales may not meet the Directive’s requirements. To ensure that its policy does comply with the requirements of the Directive the Welsh Government has adopted a policy for the geological disposal of HAW.

Intergenerational equity

1. 21 Annex 1 shows that there is already a considerable volume of HAW, for which there is currently no disposal route and which exists or will exist irrespective of whether any new nuclear power stations are built. Further quantities will be generated through the use of radioactive substances in non-nuclear practices e.g. in hospitals, businesses and universities. While this waste can be and is being safely and securely managed and stored at present and for the foreseeable future, it represents an ongoing burden for future generations. Taking action now avoids leaving responsibility for decisions on waste disposal to future generations. While it may take several generations to complete the disposal of this legacy waste, unless this generation starts the process of disposal the eventual burden will fall to generations further and further into the future.
1. 22 The SF&RW Directive also stresses the importance of intergenerational equity.

Recital 24 states:

“It should be an ethical obligation of each Member State to avoid any undue burden on future generations in respect of spent fuel and radioactive waste including any radioactive waste expected from decommissioning of existing nuclear installations. Through the implementation of this Directive Member States will have demonstrated that they have taken reasonable steps to ensure that that objective is met.”

¹⁴ Statement on Geological Disposal: The Committee on Radioactive Waste Management's (CoRWM's) recommendations on the benefits of geological waste disposal. Published 25 July 2013
<https://www.gov.uk/government/publications/statement-on-geological-disposal>

Article 1 states:

“1. This Directive establishes a Community framework for ensuring responsible and safe management of spent fuel and radioactive waste to avoid imposing undue burdens on future generations.”

1. 23 Current generations have benefited from the energy generated by existing nuclear power stations and by the other medical and industrial uses of radioactivity which have created the current HAW legacy. Current generations have also benefited from the economic activity and the employment opportunities provided by nuclear power stations (and not just in the area of the power stations themselves). The Welsh Government considers that there is a responsibility on the current generation to put in place the means to dispose of legacy HAW. Further, the Welsh Government supports the building of new nuclear power stations on existing sites in Wales. These will also benefit current generations who should therefore take responsibility for making provision for the safe disposal of the waste that they will produce.
1. 24 Making provision for the safe disposal of the legacy of radioactive waste and also for the waste arising from new nuclear power stations will not only reduce the burdens on future generations but will also provide for a safer future. HAW can be and is being safely and securely managed and stored at present. However, the future is inevitably uncertain and geological disposal will protect generations into the future from additional and perhaps unforeseeable risks arising from e.g. climate change, political uncertainty or other factors and will prevent harmful amounts of radioactivity ever being released to the surface environment.
1. 25 The Welsh Government therefore considers that adopting a policy for the geological disposal of HAW contributes to the objective of promoting intergenerational equity.

Considerations affecting the siting of a geological disposal facility

1. 26 Paragraph 1.2 above confirms the Welsh Government policy for working with a potential host community or communities on a voluntary basis. Therefore a GDF will only be developed in Wales if a community is prepared to enter discussions with the Welsh Government and with the developer (Radioactive Waste Management (RWM) Ltd). Those discussions are likely to last for over a decade. Only after extensive surveys, including borehole investigation, have taken place and it has been demonstrated that a safety case to support initial licensing has been made will a public test of community support be taken and a potential host community be expected to take a final decision. Up to that point the potential host community can withdraw from the discussions at any point and the siting process for that site will immediately come to an end.

Consultation on siting processes for a geological disposal facility

1. 27 The Welsh Government will set down a clear process by which, should a community in Wales wish to do so, it can enter and take forward discussions about potentially hosting a GDF. To this end the Welsh Government has issued a further consultation about the siting processes for a GDF in Wales including proposals for arrangements for discussions with potential host communities. This consultation on the Processes for Implementing Geological Disposal¹⁵ will run from May to August 2015.
1. 28 The Welsh Government emphasises that it has not identified any potential sites in Wales for developing a GDF. Unless a community in Wales is prepared to enter discussions about potentially hosting a GDF and a suitable site is identified for which a satisfactory safety case can be made, and the community agrees to host it, a GDF will not be developed in Wales. The Welsh Government will also be part of any discussions between a potential host community and the developer with the aim of ensuring that the interests of that community are fully protected.

Regulatory control

1. 29 In addition to the willing participation of a potential host community or communities, siting a GDF, whether in Wales or elsewhere in England or Northern Ireland, will require the developer to produce a safety case which meets the requirements of the Office for Nuclear Regulation (ONR) and the environmental regulator. The geological suitability of a candidate site is an important part of the safety case. In Wales the environmental regulator is Natural Resources Wales. This is discussed further in Annex 3.

Appraisal of sustainability

1. 30 The Welsh Government will take forward an appraisal of sustainability (AOS) to support its policy for geological disposal. The AOS will include:
 - health impact assessment;
 - strategic environmental assessment;
 - Habitats Regulation assessment;
 - equality impact assessment;
 - Welsh language impact assessment;
 - assessment of socio economic impacts; and,
 - assessment of the rights of the child and young people.
1. 31 In advance of a community participating in discussions with the Welsh Government and therefore before the identification of any potential site for a GDF, these assessments can only be taken forward on a generic basis. As

¹⁵ <http://gov.wales/consultations/environmentandcountryside/?lang=en>

similar considerations apply at the generic level in England, where appropriate this work will be taken forward together with similar work being taken forward by the UK Government Department for Energy and Climate Change. In doing this the Welsh Government will ensure that any considerations specific to Wales are included in the generic AOS for Wales. The Welsh Government will take forward work on the AOS in an open and transparent way and with appropriate consultation. This work is expected to take place in 2015 and 2016. It is not expected that any discussions with potential voluntary host communities will start before 2016. This is discussed further in the consultation paper.

1. 32 Should a community in Wales enter discussions with the Welsh Government about potentially hosting a GDF, and should a potential site for a GDF be identified, it will then be necessary to carry out a range of assessments similar to those listed above on a site specific basis to ensure the suitability of that site.

Planning

1. 33 The development planning process for radioactive waste disposal is a devolved matter. Should a community in Wales enter discussion with the Welsh Government any planning decisions for a GDF in Wales resulting from those discussions would be taken through the planning system in Wales. The Welsh Government is considering what provision might be needed in the Welsh planning system to allow for the potential development of a GDF and will consult on proposals to ensure that appropriate planning mechanisms are put in place to enable any decisions to be taken in an open and transparent way. This will be done taking into account any changes to the planning system in Wales should the Planning Bill receive Royal Assent in the summer of 2015. Any changes to the planning system in Wales will not however alter the Welsh Government's position that geological disposal can only be delivered in Wales on the basis of voluntary partnership with a willing community or communities.

ANNEX 1: RADIOACTIVE WASTE

2. 1 This policy document sets down the Welsh Government's adoption of a policy for geological disposal as the long term management route for higher activity radioactive waste (HAW). This annex gives information about the types of waste under consideration and how HAW is currently managed. HAW may arise from both nuclear and non-nuclear activities. This information was also included in Annex 1 to the consultation issued by the Welsh Government between 24 October 2014 and 22 January 2015. It is repeated here to ensure that this information is available to be read in the context of the Welsh Government policy for geological disposal.

The UK's legacy of radioactive waste

2. 2 For over half a century, the United Kingdom has accumulated a substantial legacy of HAW, initially from military nuclear programmes and subsequently from the generation of electricity in nuclear power stations, from the associated production and processing of nuclear fuel and from the use of radioactive materials in industry, medicine and research. Some of this has already arisen as waste and is being safely managed and stored on an interim basis at nuclear sites across the UK. However, much will only become waste over the next century or so as existing facilities reach the end of their lifetime and are decommissioned; and nuclear sites are cleaned up safely and securely. Apart from waste arising from nuclear sites, both existing and any new nuclear power stations, there will be an ongoing need to make provision for HAW management to accommodate non-nuclear applications of radioactive materials in e.g. industry, hospitals and universities.

What is higher activity radioactive waste?

2. 3 HAW comprises several categories of radioactive waste – high level waste (HLW), intermediate level waste (ILW), and the proportion of low level waste (LLW) for which existing disposal options are not suitable, principally due to the presence of certain long-lived radionuclides.
2. 4 HAW is produced as a result of the generation of electricity in nuclear power stations, from the associated production and processing of the nuclear fuel, from the use of radioactive materials in industry, medicine and research, and from defence-related nuclear programmes.
2. 5 In addition to existing wastes, there are some radioactive materials that are not currently classified as waste but would, if it were decided at some point that they had no further use, need to be managed as wastes, and for which a disposal route will be necessary. These include spent fuel, plutonium and uranium.

Types of higher activity radioactive waste

High level waste

2. 6 This is waste in which the temperature may rise significantly as a result of radioactivity, so that this factor has to be taken into account in designing storage or disposal facilities. High level waste (HLW) arises in the UK initially as a liquid that is a by-product from the reprocessing of spent nuclear fuel. High level waste is being converted into a solid form using a treatment process called 'vitrification'.
2. 7 Current plans are that this solid HLW will be stored for at least fifty years, to allow a significant proportion of the radioactivity to undergo a natural decay process, and for the waste to become cooler, which will make it easier to transport and dispose of.

Intermediate level waste

2. 8 Intermediate level waste (ILW) is defined in the UK as waste with radioactivity levels exceeding the upper boundaries for low-level wastes, but which does not require heating to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel and from general operations and maintenance at nuclear sites, and can include solid metal items such as fuel cladding and reactor components, and sludges from the treatment of radioactive liquid effluents. As decommissioning and clean-up of nuclear sites proceeds, more ILW will arise. Intermediate level waste is usually encapsulated in a solid cement form, in highly-engineered stainless steel drums, or in higher capacity steel or concrete boxes.

Low level waste

2. 9 Low level waste (LLW) is the lowest activity category of radioactive waste considered here. LLW currently being generated consists largely of paper, plastics and scrap metal items that have been used in hospitals, industry, research establishments and the nuclear industry. Although LLW makes up more than ninety per cent of the UK's waste legacy by volume, it contains less than one-tenth of one per cent of the total radioactivity. Much operational LLW in the UK is sent for disposal at the national low level waste repository (LLWR) near the village of Drigg in west Cumbria, where it is encapsulated in cement and packaged in large steel containers, which are then placed in an engineered vault a few metres below the surface. LLW arising from decommissioning of nuclear sites, and from non-nuclear activities from e.g. steel manufacturing in Wales, may also be sent to appropriately regulated landfill sites, metal treatment facilities or incinerators. A small fraction of the total volume of LLW will be managed as HAW due to its radionuclide content or its physical / chemical properties.

Other nuclear materials

Spent fuel

2. 10 Spent fuel arises in the reactors of the ten operational reactor sites in the UK. It consists mostly of uranium, although it also includes plutonium and fission products. There are three main types of reactor in the UK, and spent fuel from each is handled differently. Spent fuel from Magnox reactors is reprocessed; spent fuel from Advanced Gas-cooled Reactors (AGR) is either reprocessed or stored awaiting disposal; and spent fuel from the pressurised water reactor (PWR) at Sizewell B nuclear power station is stored awaiting disposal.
2. 11 There will also be some holdings of spent fuel from research reactors previously operating at sites such as Sellafield and Dounreay that is stored awaiting disposal. Spent fuel will also arise from the operation of any new nuclear power stations.

Plutonium

2. 12 Plutonium is produced during the irradiation of fuel in a nuclear reactor. Reprocessing of spent fuel separates the plutonium from all the other products and converts it into the oxide form in which it is stored. Plutonium is currently stored mostly in metal containers over packed¹⁶ with impermeable material in a secure store.

Uranium

2. 13 Uranium as a waste arises from either fuel manufacture, enrichment of uranium or from reprocessing spent fuel after irradiation in a nuclear reactor. Uranium is currently stored securely, in different forms, on fuel manufacture, enrichment and reprocessing sites.

Nuclear materials arising from the UK defence programme

2. 14 The Ministry of Defence may need to dispose of stocks of plutonium and highly enriched uranium from defence programmes and depleted uranium from enrichment activities, as well as spent fuel from submarines. Defence operations including the dismantling of nuclear powered submarines may also give rise to a range of radioactive wastes, some of which may be HAW.

¹⁶ Over Packed: Placed within a secondary or additional outer container used for the handling, transport, storage or disposal of waste packages or nuclear materials.

The radioactive waste inventory: how much higher activity radioactive waste is there?

2. 15 The amount of HAW needing disposal is referred to as the 'inventory for disposal' and is set out in the 2014 White Paper *Implementing Geological Disposal*¹⁷. The volumes of all radioactive wastes in the UK are regularly reviewed, revised and made publicly available as part of the UK Radioactive Waste Inventory (UK RWI). RWM Ltd have used information from the 2013 UK RWI¹⁸ and other appropriate information sources to estimate the inventory for disposal set out in the 2014 White Paper by:

- Including additional wastes and spent fuel arising from the proposed 16 GW(e) programme of new nuclear power stations.
- Including additional defence related materials (in line with the 1998 strategic defence review).
- Removal of wastes that can be managed via routes other than geological disposal.
- Including plutonium based on the assumption that it is converted to MOX and allowance is made for this and for the resulting spent fuel.
- Removing wastes that can be managed via routes other than geological disposal.
- Removing wastes covered by Scottish Policy.

Table 1: UK inventory for disposal: packaged waste volumes.

- Table 1 lists the UK inventory for disposal, i.e. the waste it is expected may need geological disposal. The table includes the estimated inventory including waste from the ongoing operation and eventual decommissioning of existing nuclear power stations, and not just the waste currently in store.
- The table also includes spent fuel from existing nuclear power stations which has not yet been declared as waste, and uranium and plutonium which similarly have not yet been declared as waste. Other management options may mean that some or all of these materials may not eventually be sent for geological disposal.
- The table identifies the contribution to the inventory from a 16 GW(e) programme of new nuclear power stations. There **are** currently no proposals to reprocess spent fuel from new nuclear power stations and it is therefore assumed that this spent fuel will be sent, in due course, for geological disposal.
- The table separately identifies waste for existing sites in Wales and includes waste currently in store and that expected to arise in future as part of decommissioning and site clearance. However, the table excludes waste from the reprocessing at Sellafield of spent fuel from existing nuclear reactors in Wales as it is assumed that this waste will continue to be stored at Sellafield.

¹⁷ <https://www.gov.uk/government/publications/implementing-geological-disposal>

¹⁸ <http://www.nda.gov.uk/ukinventory/>

- The table also excludes a separate assessment of waste and spent fuel expected from the new nuclear power station at Wylfa Newydd, although this is included within the 16 GW(e) programme of new nuclear power stations for which an estimate of waste and spent fuel arisings has been provided. The reactor design proposed for this power station is currently undergoing a generic design assessment (GDA) part of which will assess the eventual waste and spent fuel arisings from this power station. Waste and spent fuel from Wylfa Newydd is not expected to raise any new feasibility issues with respect to disposal.

	Estimated UK inventory for geological disposal ¹	Estimated contribution of a 16GW(e) new nuclear power programme to the inventory for geological disposal	Estimated inventory for geological disposal excluding waste and spent fuel from a 16GW(e) new nuclear power programme.	Estimated inventory from existing nuclear sites in Wales. ^{2,3}
Waste category	Packaged volume (m ³)	Packaged volume (m ³)	Packaged volume (m ³)	Packaged volume (m ³)
HLW	9,290	0	9,290	0
ILW	456,000	41,000	415,000	22,400
LLW	11,800	0	11,800	3,440
Pu	620	0	620	0
SF	66,100	39,400	26,700	0
U	112,000	0	112,000	0
Total	656,000	80,400	575,000	25,800

1. Excludes waste covered by Scottish Government's Higher Activity Waste Policy.
2. Excludes waste from the reprocessing of spent fuel from existing nuclear reactors in Wales at Sellafield as it is assumed the waste will continue to be stored at Sellafield
3. Excludes waste and spent fuel from proposed Wylfa Newydd power station. The packaged waste volume arising from Wylfa Newydd has not been separately identified in RWM's inventory estimates at this stage. However waste and spent fuel from Wylfa Newydd is not expected to raise any new feasibility issues with respect to disposal. This is being considered further as part of the Generic Design Assessment Process.

2. 16 On this basis RWM's current estimate of the volume of all the wastes and materials which will need geological disposal in the UK is around 650,000 cubic metres as described in the 2014 White Paper. This is the estimated packaged volume and may change as a result of future packaging decisions as well as other uncertainties in predicted future waste arisings.

2. 17 Volumes are subject to change due to a number of factors, including improvements to the estimates of waste that will arise from planned operations and decommissioning programmes. The inventory is less certain about volumes of HAW arising from non-nuclear industries including the use of radioactive sources in hospitals and universities, and also Naturally Occurring Radioactive Materials (NORM)¹⁹ wastes.

2. 18 The inventory for disposal is currently managed by waste owners:

- The Nuclear Decommissioning Authority;
- EdF Energy;
- Urenco UK Ltd;
- Ministry of Defence;
- GE Healthcare and others

2. 19 Nuclear operators provide interim storage of waste on their sites across the UK, and will continue to do so for as long as it takes to deliver a disposal route. Similarly, in terms of HAW sources from non-nuclear sources, the UK provides access to a 'recognised installation' pending disposal.

New nuclear power stations

2. 20 Legacy HAW is HAW that already exists or which will arise from the operation or decommissioning of existing nuclear facilities. The programme of new nuclear power stations proposed for the UK will also give rise, in due course, to HAW needing a disposal route. New nuclear power stations will also give rise to spent fuel. Currently there are no plans to reprocess spent fuel from new nuclear power stations and in this case the fuel would be declared as waste and would therefore also need a disposal route. The NDA estimates that the current proposals for a 16 Gigawatt programme of new nuclear power stations could add, by 2200, around 12% to the total packaged volume of wastes for disposal and 73% to the total amount of radioactivity. However, the proportion of the total amount of radioactivity resulting from new nuclear power stations as well as the total amount of radioactivity will decline over time due to the effect of natural radioactive decay. This estimate is based on a number of assumptions (such as the timing of new nuclear power stations being built and the level and time for which they operate. These may be subject to change in the future.

¹⁹ Naturally Occurring Radioactive Materials arise naturally in the Earth's crust as a result of radioactive elements created through cosmic processes, and radionuclides created through radioactive decay of these elements. NORM wastes arise when these materials are concentrated through industrial activities, for example mining and mineral processing. NORM wastes are distinct from anthropogenic radioactive wastes, which arise as a result of activities that deliberately process and use materials for their radioactive, fissile or fertile properties. NORM wastes may also arise from the remediation of contaminated land where the radioactivity is associated with natural radionuclides, such as those generated during radium luminising or from manufacturing thorium gas mantles.

Current management of radioactive wastes and spent fuel

Interim storage

2. 21 In 2006 the independent Committee on Radioactive Waste Management (CoRWM) recommended geological disposal as the best available approach for the long-term management of the UK's HAW (paragraph 3.3). CoRWM also recommended a continued commitment to safe and secure interim storage.
2. 22 Interim waste storage is an essential component of HAW management. It is not itself a disposal solution, but it provides a safe and secure environment for waste packages that are awaiting final disposal.
2. 23 Interim stores for packaged HAW are robust, engineered facilities. They provide safe and secure protection for waste packages, preventing hazardous releases to the outside environment via a number of engineered barriers and environmental controls. Interim stores are resistant to foreseeable incidents such as earthquakes and severe weather, and they perform a security role by being a barrier to intrusion.
2. 24 Existing interim stores are safe and secure because they are actively managed and maintained. The ILW store at Trawsfynydd nuclear power station is a good example of a modern, effective interim store. New stores currently being built typically have a design life of one hundred years, however, if surface storage is required much beyond one hundred years, then eventually the stores will need to be rebuilt and the wastes within them repackaged.
2. 25 It is this requirement for human monitoring, maintenance, rebuilding and repackaging which means that, given the very long timescales that HAW needs to be isolated from people and the environment, interim storage is not a permanent disposal solution.

Waste packaging and passive safety

2. 26 Early conditioning is a significant part of HAW management. This reduces its hazard and makes wastes passively safe as soon as practicable so that they are physically and chemically stable and stored in a manner which minimises the need for control and safety systems.
2. 27 In the context of current UK Government policy Radioactive Waste Management Ltd (RWM, paragraph 4.35) provides advice on the compatibility of waste conditioning with future geological disposal, with the objective of avoiding the need for repackaging and the "double handling" of wastes. This is undertaken using an established process, recognised by ONR and the Environment Agencies.

2. 28 A series of robust storage arrangements, together with disposability advice, provides confidence that packages will be disposable at the end of the storage period. Progress with packaging of HAW is reported annually by RWM and the Environment Agency.

Transportation

2. 29 The UK has more than 50 years' experience of transporting radioactive waste and materials safely by road, rail and sea. Nuclear fuel is transported routinely from fuel fabrication plants to nuclear power stations, and spent nuclear fuel is transported from power stations to Sellafield for reprocessing and storage.
2. 30 This transportation is subject to strict controls and is robustly and independently regulated in order to protect people, property and the environment. There have been no transport incidents resulting in any significant radiation dose to an individual in connection with the transport of radioactive waste and materials between UK nuclear facilities.

Ongoing research and development

2. 31 In recommending geological disposal as the best available approach for the long-term management of the UK's HAW, and spent fuel declared as waste, CoRWM also recommended that developments in alternative management options should be actively pursued through monitoring of, and participation in, national or international research and development programmes.
2. 32 Other long-term management options could emerge as practical alternatives to geological disposal for some wastes in future. In line with this, the NDA and RWM continue to review appropriate solutions including learning from and engaging with overseas programmes, which could have the potential to improve the long-term management of some of the UK's higher activity radioactive wastes.
2. 33 The Welsh Government supports ongoing research into future management options for HAW and spent fuel, should it be declared as waste. At the moment, no credible alternatives to geological disposal have emerged that would accommodate all of the categories of waste in the inventory for disposal. Therefore, in any realistic future scenario, some form of geological disposal facility will remain necessary.

ANNEX 2: BACKGROUND TO THE DECISION TO ADOPT GEOLOGICAL DISPOSAL FOR THE LONG TERM MANAGEMENT OF HIGHER ACTIVITY RADIOACTIVE WASTE

3.1 This annex discusses the background to the Welsh Government policy for geological disposal as the long term solution for the management of higher activity radioactive waste (HAW). This annex also refers to the policies adopted by the UK Government and the other devolved administrations. This information was included in Chapter 1 of the Welsh Government consultation paper issued between 24 October 2014 and 22 January 2015²⁰. It is included in this policy document to ensure that this information is available to be read in the context of the Welsh Government policy for geological disposal.

Background

3.2 Paragraph 1.3 and Annex 1 identify that the UK has a substantial legacy of HAW. To date, the UK has not implemented a disposal solution for HAW. A disposal solution for would obviate the need for future intervention and would ensure that no harmful amounts of radioactivity are released to the environment in the future.

3.3 In 2003 the UK Government and the devolved administrations (Government) set up the independent Committee on Radioactive Waste Management (CoRWM) to consider options for the management and disposal of the HAW already existing and expected to arise from existing nuclear power stations in the UK ("legacy waste"). In 2006 CoRWM reported²¹ to Government recommending geological disposal for legacy radioactive wastes and community involvement based on the principle of voluntarism and an expressed willingness to participate in potentially hosting a geological disposal facility (GDF). CoRWM also recommended safe and secure interim storage and further research and development. CoRWM was reconstituted in 2007 (CoRWM 2)²² and in 2013 confirmed its support for geological

²⁰ Welsh Government, Consultation: Review of Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste. October 2014

<http://gov.wales/consultations/environmentandcountryside/disposal-higher-activity-radioactive-waste/?lang=en>

²¹ CoRWM Managing our Radioactive Waste Safely: CoRWM's Recommendations to Government July 2006.

²² The first Committee on Radioactive Waste Management (CoRWM 1) was established by the UK Government and the devolved administrations for Wales, Scotland and Northern Ireland in 2003 to advise on the future management of higher activity radioactive waste and spent fuel. In 2007 CoRWM was reconstituted (CoRWM 2) to advise on the implementation of Government policy in these areas. Where appropriate CoRWM advises the UK Government and each devolved administration on their separate policies.

disposal²³. In 2010 CoRWM commented on the applicability of DECC's proposals for geological disposal of HAW in its response to DECC's consultation on the draft National Policy Statements for Energy Infrastructure and in a statement of its position on new build wastes^{24, 25}.

Government response to CoRWM's 2006 recommendations

3.4 Following a public consultation in 2007²⁶ the UK Government and the devolved administrations for Wales and Northern Ireland issued a White Paper in June 2008, *Managing Radioactive Waste Safely: a Framework for Implementing Geological Disposal*²⁷. In the White Paper the UK Government announced its support for a policy of geological disposal that was based on a preferred approach of voluntarism and partnership. Geological disposal would be taken forward in parallel with safe and secure interim storage and ongoing research and development.

Northern Ireland

3.5 The Department of the Environment in Northern Ireland (DoENI) supported the Managing Radioactive Waste Safely (MRWS) programme.

Scotland

3.6 The Scottish Government did not sponsor the 2007 Managing Radioactive Waste Safely consultation or the 2008 White Paper and is implementing its own policy for HAW management²⁸. Scottish Government Policy is that the long-term management of higher activity radioactive waste should be in near-surface facilities. 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 waste packages, or waste, could be retrieved.

Welsh Assembly Government response

3.7 In the 2008 White Paper the then Welsh Assembly Government reserved its position on geological disposal and neither supported nor opposed the policy while stating its intention to continue to play a full part in the Managing

²³ Statement on Geological Disposal: The Committee on Radioactive Waste Management's (CoRWM's) recommendations on the benefits of geological waste disposal. Published 25 July 2013

<https://www.gov.uk/government/publications/statement-on-geological-disposal>

²⁴ Response from the Committee on Radioactive Waste Management to the Government consultation on the Draft National Policy Statements for Energy Infrastructure (CoRWM document 2748, 2 March 2010).

²⁵ CoRWM Statement of its position on new build wastes (CoRWM document 2749, 2 March 2010)

²⁶ Defra, DTI and the devolved administrations for Wales and Northern Ireland: *Managing radioactive waste safely: a framework for implementing geological disposal*. June 2007.

²⁷ Defra, BERR and the devolved administrations for Wales and Northern Ireland: *Managing radioactive waste safely: a framework for implementing geological disposal*. June 2008

²⁸ Scottish Government: *Scotland's Higher Activity Radioactive Waste Policy 2011*. January 2011.

Radioactive Waste Safely programme in order to secure the long term safety of radioactive wastes, to ensure the implementation of a framework appropriate to the needs of Wales and to ensure that the interests of Wales are taken into account in the development of policies in this area. The Assembly Government also supported CoRWM's recommendations regarding the safe and secure interim storage of waste, maintaining the security of such storage against terrorist attack, and the need for research and development to support the optimised management and disposal of waste.

- 3.8 The Assembly Government also stated that should a community within Wales wish to put forward an Expression of Interest in potentially hosting a GDF it should do so to the Welsh Assembly Government, and that if this were to happen the Assembly Government would at that point consider its position in respect of the geological disposal programme and the specific Expression of Interest.

Consultation by the UK Department for Energy and Climate Change

- 3.9 Following the 2008 White Paper the UK Department for Energy and Climate Change (DECC) received three formal expressions of interest from three local authorities in west Cumbria (in respect of the areas of Copeland Borough Council and Allerdale Borough Council). However these discussions ended in January 2013 following a vote in which Cumbria County Council decided not to proceed further with the site-selection process (an earlier agreement reached by DECC and councils in west Cumbria, about how the siting process would operate in west Cumbria, required agreement at the Borough, County and Central Government levels for the process to proceed.).
- 3.10 In addition to the three expressions of interest received by the UK Government in respect of west Cumbria, Shepway District Council in Kent took 'soundings' from local residents about whether to make an expression of interest in the siting process, but ultimately decided against doing so.
- 3.11 The UK Government remains committed to geological disposal as the right policy for the long term, safe and secure management of higher activity radioactive waste. The UK Government also continues to favour an approach to site selection based on working in partnership with interested communities.
- 3.12 Following the closure of the site selection process in Cumbria, DECC considered changes to the site selection process and issued a consultation paper in September 2013²⁹. The consultation ended in December 2013 and the UK Government has published its response to the consultation along with the individual submissions which were received³⁰.

²⁹ DECC, Welsh Government and the Department of the Environment, Northern Ireland: *Review of the Siting Process for a Geological Disposal Facility*. September 2013

<https://www.gov.uk/government/consultations/geological-disposal-facility-siting-process-review>

³⁰ DECC *Government Response to Consultation: Review of the Siting Process for a Geological Disposal Facility*. July 2014 <https://www.gov.uk/government/consultations/geological-disposal-facility-siting-process-review>

- 3.13 The Welsh Government considered that the consultation discussed issues about which the people of Wales had a right to be informed and upon which they should have an opportunity to comment. It therefore issued the consultation paper in Wales. This was also consistent with ongoing involvement by the Welsh Government in the Managing Radioactive Waste Safely programme. However in issuing the consultation paper in Wales for comment, the Welsh Government made it clear that it was not committing itself to adopting the policies outlined in the consultation paper. Six responses were received from Wales to the consultation.
- 3.14 The Department of the Environment, Northern Ireland (DOENI) also issued the consultation.
- 3.15 DECC considered the outcome of the consultation following its conclusion in December 2013 and issued a White Paper in July 2014³¹. This White Paper discusses policies and makes proposals which refer to England. DOENI has also accepted the application of these policies and proposals to Northern Ireland. However, in line with the Welsh Government position in the consultation paper issued in September 2013, the policies and proposals contained in the DECC White Paper do not apply in Wales³².

Welsh Government policy review

- 3.16 The Welsh Government issued a consultation between 24 October 2014 and 22 January 2015³³ as part of a review of its policy for the management and disposal of HAW. In that consultation the Welsh Government stated that should it adopt a policy for the geological disposal of HAW it would consult further about the processes by which this may be taken forward in Wales in the event that a community or communities in Wales should indicate a willingness to enter discussions about potentially hosting a GDF. This policy document confirms that the Welsh Government has adopted a policy for geological disposal. The Welsh Government has therefore issued a further consultation, in parallel with this policy document, about proposals for the siting processes should a community in Wales seek to open discussions about potentially hosting a GDF³⁴.

³¹ DECC, *Implementing Geological Disposal: A Framework for the long-term management of higher activity radioactive waste*. July 2014 <https://www.gov.uk/government/publications/implementing-geological-disposal>

³² The national geological screening exercise, referred to in the DECC 2014 White Paper, will be applied to Wales in order for the information that it will contain to be available to communities in Wales for them to consider.

³³ Welsh Government, *Consultation: Review of Welsh Government Policy on the Management and Disposal of Higher Activity Radioactive Waste*. October 2014 <http://gov.wales/consultations/environmentandcountryside/disposal-higher-activity-radioactive-waste/?lang=en>

³⁴ <http://gov.wales/consultations/environmentandcountryside/?lang=en>

ANNEX 3: GEOLOGICAL DISPOSAL

4.1 The Welsh Government has adopted a policy for geological disposal as the only viable long term method for managing the whole inventory of higher activity radioactive waste (HAW). This annex discusses general concepts of what is meant by geological disposal. The discussion and illustrations in this chapter are based on information drawn from the UK Government 2014 White Paper *Implementing Geological Disposal*³⁵ as this gives information both about geological disposal in general terms and about how it may be implemented in the UK. This information was included in Annex 2 to the consultation paper issued by the Welsh Government between 24 October 2014 and 22 January 2015. It is included here to ensure that comprehensive information is available with this policy.

What is geological disposal?

- 4.2 Geological disposal is intended to dispose of waste permanently, thus removing burdens from future generations. Disposal therefore requires no further intervention by future generations. Storage of radioactive waste implies the need and intention to intervene further to manage the waste. While it may be possible to make provision for ongoing monitoring for a period and to build in provision for retrieving the waste, the concept of disposal places no requirements on future generations to do this.
- 4.3 Geological disposal isolates radioactive waste from the surface environment. It contains and isolates the waste in a way that provides long-term protection against harmful levels of radioactivity reaching the surface environment.
- 4.4 This is achieved through the use of multiple barriers that work together to provide protection over hundreds of thousands of years. It is not a case of simply depositing waste underground. The multiple barriers that provide safety for geological waste disposal are a combination of the:
- form of the radioactive waste itself. For example, high level waste (HLW) that arises initially as a liquid is converted into a durable, stable solid glass form before storage and disposal;
 - packaging of the waste;
 - engineered facility that the waste packages are emplaced in; and
 - stable geological setting in which the facility is sited.
- 4.5 Unlike other hazardous materials, radioactive materials will decay and become less hazardous over time. The majority of radioactivity will decay within the first few hundred years.

³⁵ <https://www.gov.uk/government/publications/implementing-geological-disposal>

- 4.6 By constructing the disposal facility deep within a setting that has been stable for 'geological' time scales – instead of on or near the surface – it can be demonstrated that the geology will continue to protect the waste while isolating and containing the radioactivity for a very long period, thus providing long-term protection against harmful amounts of radioactivity being released into the surface environment.
- 4.7 Once a geological disposal facility (GDF) is closed, in accordance with a safety case accepted by the regulators, it will no longer require any human intervention. This avoids placing the burden of dealing with these wastes on future generations.

International situation

- 4.8 Many countries around the world have nuclear power programmes, significant inventories of radioactive waste from the use of radioactive materials in industry, medicine and research, or both.
- 4.9 There is general agreement internationally that geological disposal provides the safest long-term management solution for higher activity radioactive waste. Countries that have decided on a policy of geological disposal include Belgium, Canada, Finland, France, Switzerland, Sweden and the United States of America.
- 4.10 There are several programmes at an advanced stage in different parts of the world, focussing on very different geological settings, but each designed to achieve the same end of the long term isolation of wastes from the surface. Sweden and Finland are taking forward facilities designed to work in hard, fractured rock environments, while the French and Swiss programmes are utilising designs based in lower-strength sedimentary clay rocks. Other facilities are designed for evaporite (salt) rock environments and there are examples of such facilities in Germany and the United States of America.

International developments

- 4.11 Geological disposal is the preferred approach internationally for safely and securely managing higher activity radioactive waste in the long-term. There are a number of geological disposal programmes in other countries, which are at various stages of development. Key recent developments in some of these programmes are set out below:

Canada – The process to identify a willing host for a GDF was launched in 2010 and 22 communities expressed interest in learning more about Canada's plan for the long-term management of used nuclear fuel (a). The opportunity for expressions of interest was suspended in 2012 (b) to allow the Nuclear Waste Management Organization (NWMO) to carry out initial assessments with these communities. A process of narrowing down has begun as NWMO carries out preliminary assessments with the communities that expressed interest and passed an initial screening. These assessments are carried out in two phases. A number of communities have considered the results of the initial phase of these assessments and the second phase of preliminary assessments including airborne geophysical surveys was ongoing in 9 communities as of the beginning of March 2015. The

planned programme of preliminary assessments will build up the information necessary to guide a decision on one or two sites to proceed to site characterisation.

a. http://www.nwmo.ca/sitingprocess_whatsnew

b. http://www.nwmo.ca/news?news_id=418

Finland – Posiva submitted its application for a construction licence for a GDF for nuclear spent fuel in in Olkiluoto, Eurajoki in December 2012 (c). The regulators produced a safety evaluation of the application and issued a statement to the Finnish government in February 2015 confirming that the spent nuclear fuel encapsulation plant and final disposal facility designed by Posiva can be built to be safe (d). Provided a licence is granted, waste emplacement is expected to start in the 2020's (e).

c. http://www.posiva.fi/en/media/news/posiva_submits_construction_licence_application_for_final_repository_to_the_government.1154.news

d. http://www.stuk.fi/ajankohtaista/tiedotteet/en_GB/news_941/?t=2015-1-12-10-38

e. http://www.posiva.fi/en/final_disposal/general_time_schedule_for_final_disposal

France – A public debate on Andra's Cigéo project for the management of higher activity waste was held in 2013 (f). In May 2014 Andra set out its response setting out a number of specific changes to its implementation programme and making a number of commitments for the project going forward (g). Andra proposes to develop the licence application for the GDF in two stages in 2015 and 2017. Subject to receiving the necessary regulatory approvals, the construction of the disposal facility could begin in 2020 and the commissioning, beginning with a pilot industrial phase, could take place in 2025.

f. <http://www.xn--cigo-dpa.com/en/the-public-debate>

g. <http://www.andra.fr/international/download/site-principal/document/communque-de-presse/press-release-on-the-cigeo-public-debate-follow-up.pdf>

Germany – A political agreement has been reached at Federal and State level to restart the siting of a geological disposal facility based on a new Repository Site Selection Act passed in 2013. This Act establishes a 33 member Commission for High Level Waste Disposal to find a geological disposal facility for waste from Germany's nuclear power stations (h). The Commission is expected to report to the German Bundestag, Bundesrat and Federal Government by the end of 2015 providing detailed recommendations on site selection criteria, the selection process and participation. Building on the Commission's report, it is expected that the German Bundestag will adopt a law laying down criteria for the identification and selection of potential final repository sites. Once the Commission has completed its assigned work and the Bundestag has laid down the decision-making criteria the actual site selection process will begin (i).

h. <http://www.bundestag.de/bundestag/ausschuesse18/a16/standortauswahl>

i. <http://www.bfe.bund.de/en/repository-site-selection-process/the-process/>

Sweden – In March 2011 SKB (the Swedish Nuclear Fuel and Waste Management Company) submitted a licence application to build a GDF for spent nuclear fuel at Forsmark (j). The application is currently being reviewed by the Swedish regulators. Subject to approval it is hoped that construction will start in the 2020's (k).

j. http://www.skb.se/Templates/Standard____31004.aspx

k. http://www.skb.se/Templates/Standard____33926.aspx

United States – [Following the suspension of federal funding for the development of a disposal facility at Yucca Mountain in 2011] in January 2013, the Department of Energy published its Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste (l). It states that the site selection and implementation process for a facility should be consent-based, transparent, adaptive, and technically sound. Under this framework, the US Administration has planned a programme to construct a repository and begin operations by 2048.

In addition to this programme a separate facility, the Waste Isolation Pilot Plant (WIPP), has been developed by the Department of Energy to dispose of transuranic waste from defence programmes. WIPP began operations in 2001. [The facility is currently implementing a recovery plan to resume waste disposal operations after an underground truck fire and a radiological release in February 2014. While investigations into these events identified a number of operational issues they did not identify any fundamental problem with geological disposal or the use of deep salt formations.]

l. <http://energy.gov/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste>

m. <http://www.wipp.energy.gov/>

The NDA report on international siting processes (published in September 2013) provides more detail on aspects of the siting processes in other countries at that time (n):

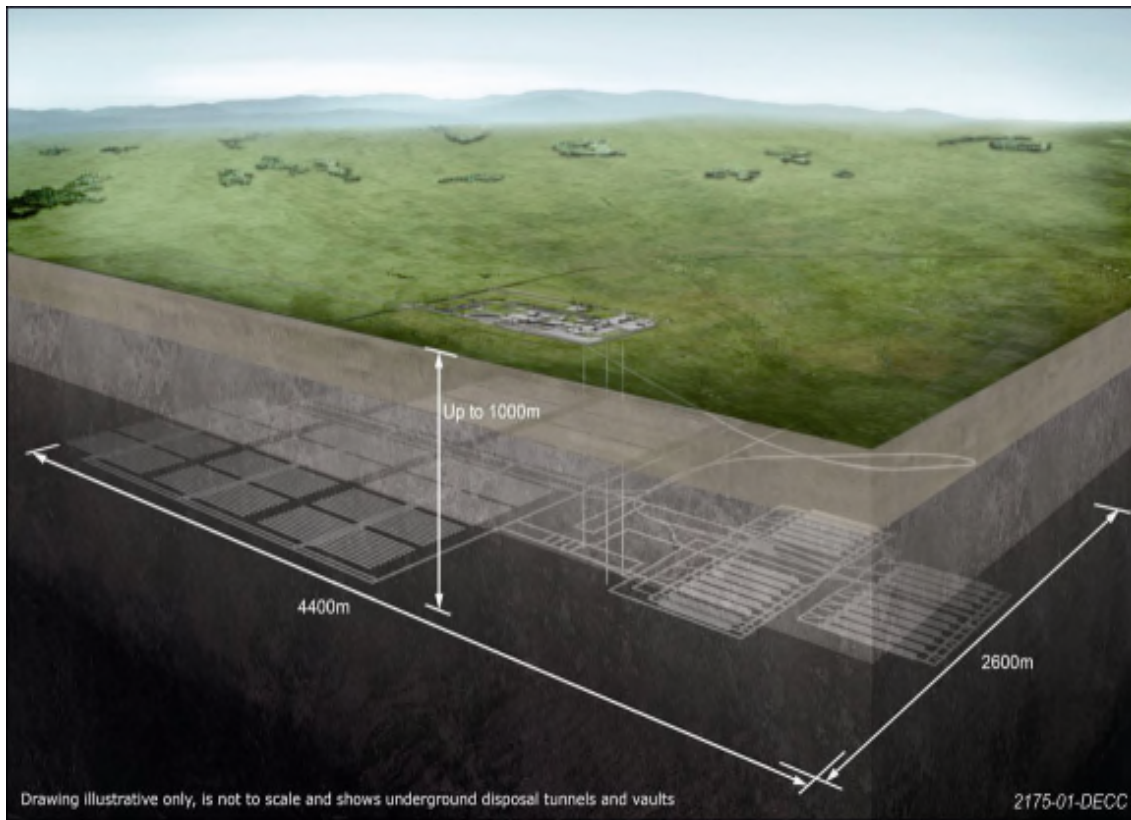
n. <http://www.nda.gov.uk/publication/geological-disposal-overview-of-international-siting-processes/>

While there are many countries that have yet to decide or issue long-term waste management policies, no country has adopted a permanent disposal solution other than geological disposal.

Facility design

- 4.12 A GDF will have both surface and underground facilities. They will be linked by an access tunnel and / or shaft, depending on the layout of these facilities. The underground facilities do not need to be located directly below the surface facilities – they could be separated by a distance of several kilometres.
- 4.13 The precise layout and design of the facilities will depend on the inventory and the specific geological characteristics at the site in question. An artist's impression of one potential layout of a GDF is set out below.
- 4.14 The surface facilities of a typical GDF are expected to cover an area of approximately 1 square kilometre. The primary purpose of the surface facilities will be to receive waste packages from the rail and road network, and transfer them to the underground disposal facilities.
- 4.15 The underground facilities will comprise a system of vaults for the disposal of intermediate level waste (ILW), and an array of engineered tunnels, for the disposal of high level waste (HLW) and spent fuel (if it is declared as waste). HLW and spent fuel require different disposal structures from ILW and other radioactive wastes because they generate heat. The disposal vaults and tunnels of a GDF are expected to be between 200 and 1,000 metres underground depending on the geology at the site in question.
- 4.16 The figure below illustrates a disposal facility with two distinct disposal areas, at depths of between 200 metres and 1 kilometre. They are separated such that there are no interactions between the engineered barriers of each disposal area that could compromise safety.

Figure 1: Diagrammatic illustration of a geological disposal facility



4.17 One or more GDFs may be necessary to accommodate all the waste currently identified in the UK inventory for potential disposal. There is no technical reason why the development of one GDF to manage the inventory for disposal should not be possible but this would depend on whether a large enough volume of suitable rock exists in which the underground facilities can be constructed (in a community willing to host a GDF). If a single GDF is possible it is estimated that it would have underground footprint of around 10 square kilometres to 20 square kilometres, depending on the type of geological setting. If a single GDF could be developed to provide safe containment there could be major cost savings and lower environmental impacts compared with developing more than one site.

Retrievability

4.18 Paragraph 4.2 discusses that the purpose of geological disposal is to dispose of waste permanently and not to store it which would require management by future generations.

4.19 During the operational stage of a GDF (that is, when it is accepting and emplacing waste), waste that has been emplaced in a GDF could be retrieved if there were a compelling reason to do so. Retrieving emplaced waste would tend to become more difficult as time went by, particularly after the end of its operational stage (that is, once a GDF has been closed permanently).

4.20 Permanently closing a GDF at the earliest possible opportunity once operations have ceased provides for greater safety, greater security, and minimises the burdens on future generations. The regulators would expect closure of a GDF without unnecessary delay after disposal operations have ceased and UK Government policy does not intend for waste that has been disposed of in a GDF to be retrieved at a later date. The Welsh Government endorses this approach.

Regulatory control

4.21 The purpose of geological disposal is to ensure the safety of public health and the environment into the future. The regulatory regime for the uses of radioactivity in the UK is among the most thorough and stringent in the World. In the UK all aspects of a proposed GDF, from preparing waste for disposal, transporting waste to the facility, to design, construction and operation of the facility, and safety in the long-term following closure, will require regulatory approval. The developer will be responsible for providing a safety case for a GDF which meets all the regulatory requirements (Annex 4, paragraphs 5.4 onward).

4.22 The independent regulators (the Office for Nuclear Regulation (ONR), and the relevant environmental regulator, (Natural Resources Wales, the Environment Agency, and the Northern Ireland Environment Agency) will only allow a GDF to be built, operated and closed if they are satisfied that it will meet their

demanding regulatory requirements. These requirements implement the protection standards established nationally and internationally.

- 4.23 As independent regulators, the environmental regulators do not have a formal role in the decision-making process for selecting sites for investigation but may provide advice and comment on matters within their remits.
- 4.24 Environmental regulatory requirements will be applied using a process known as 'staged regulation'³⁶. Staged regulation will provide regulatory control from very early in the development of a GDF and enables the environmental regulator to maintain regulatory control throughout each stage of development from the start of intrusive site investigation, through construction and operation, and eventually to closure. The developer will need regulatory approval before each stage of development can begin and, in particular, the disposal of radioactive waste will not be allowed without the appropriate environmental permit. Regulatory approval will also be required for closure of a GDF and subsequent surrender of the operator's environmental permit.
- 4.25 ONR has no formal regulatory role in selecting a site for geological disposal, but it will advise on safety and transport matters. Once a site had been confirmed and should a GDF be developed ONR would have a formal regulatory role which will include regulation of safety and transport matters. ONR also has a key role in regulating the storage of higher activity waste on nuclear licensed sites until a GDF is available.
- 4.26 The UK Government has stated that GDF will be a licensed nuclear installation and, as such, it will be ONR's role to grant a licence for the site, with attached site licence conditions, and then to enforce the requirements of that licence.
- 4.27 ONR will also be responsible for assessing the security of and approving security arrangements for the disposal facility, and for securing compliance with those arrangements. It will also be responsible for regulating the transport of radioactive materials from nuclear licensed sites to a GDF.
- 4.28 Building a GDF will require the development and maintenance of a number of safety cases and security plans to demonstrate high standards of safety, security and environmental protection throughout the lifecycle of the facility, all of which will be subject to scrutiny by the independent nuclear and environmental regulators.

³⁶ Staged regulation is a requirement in Wales and England under the Environmental Permitting (England and Wales) Regulations 2010. The extant legislation in Northern Ireland does not allow for staged regulation, but the same process would be applied by agreement.

Costs

- 4.29 A GDF would be a major infrastructure project and a significant long-term investment for the UK.
- 4.30 The precise costs of developing a GDF will depend on a number of factors, including the type of rock in which the facility is constructed and exactly how long it operates before being closed. As the developer, RWM updates the estimated costs of the GDF programme on an annual basis. These figures are made publicly available in the NDA Annual Report and Accounts.
- 4.31 The costs of the development and operation of a GDF are and will be met by the waste owners. In the case of wastes from existing public sector civil nuclear sites, these are public liabilities, owned by the NDA, and so the costs of geological disposal in connection with these will be met by the UK Government. The same applies to wastes owned by the Ministry of Defence. Any private companies (in both the nuclear and non-nuclear sectors) which produce higher activity waste will need to meet their full share of waste management and disposal costs. This includes operators of any new nuclear power stations.
- 4.32 The UK Government requires operators of new nuclear power stations to have a Funded Decommissioning Programme (FDP)³⁷ approved by the Secretary of State before nuclear-related construction can begin. Alongside the approval of an Operator's FDP, the UK Government will expect to enter into a contract with the Operator regarding the terms on which the Government will take title to and liability for the Operator's spent fuel and HAW. In particular, this agreement will need to set out how the price that will be charged for this waste transfer will be determined. The waste transfer price will be set at a level consistent with the Government's policy that Operators of new nuclear power stations should meet their full share of waste management costs.

Roles and responsibilities

- 4.33 Radioactive waste disposal is a devolved issue, meaning that the UK Government has responsibility for policy in respect of England, the Welsh Government in respect of Wales, the Scottish Government in respect of Scotland and the Northern Ireland Executive in respect of Northern Ireland. The Welsh Government has adopted a policy for geological disposal similar to the policies already adopted by the UK Government and Northern Ireland Executive.
- 4.34 The Nuclear Decommissioning Authority (NDA) is a non-departmental public body that was created through the Energy Act 2004. It is responsible for

³⁷ www.gov.uk/government/uploads/system/uploads/attachment_data/file/42628/3797-guidance-funded-decommissioning-programme-consult.pdf

cleaning-up existing civil nuclear sites across the whole of the UK and making them available for other purposes. It is responsible for implementing Government policy on the long-term management of nuclear waste.

- 4.35 RWMD has now become Radioactive Waste Management Limited (RWM), a wholly owned subsidiary of the NDA, which is responsible for implementing Government policy on geological disposal of higher activity radioactive waste. As the developer of a GDF, RWM is responsible for safety, security and environmental protection throughout the lifetime of the programme. RWM is responsible for complying with all the regulatory requirements on geological disposal.
- 4.36 The independent Office for Nuclear Regulation (ONR) is responsible for the regulation of the nuclear sector across the UK. To assure the safety of nuclear installations in Great Britain, ONR grants licences that allow licence holders to use nuclear sites for specified activities. ONR also regulates the safety and security of nuclear installations, and the transport of radioactive materials.
- 4.37 The environmental regulators in each of the UK home countries are responsible for environmental regulation of the nuclear sector within their respective jurisdictions. In Wales Natural Resources Wales is responsible for the enforcement of environmental protection legislation, regulating radioactive and non-radioactive discharges and disposals to air, water (both surface and groundwater) and land, including disposal by transfer to another site. This responsibility sits with the Environment Agency in England, the Scottish Environmental Protection Agency in Scotland and the Northern Ireland Environment Agency in Northern Ireland.
- 4.38 The ONR and the appropriate environmental regulator, who work closely together, must be consulted in any application for development consent for a GDF. The appropriate environmental regulator must be consulted in any application for development consent for borehole investigations to characterise potential candidate sites. The environmental regulators will be responsible for regulating borehole investigations, either through legislation (in England and Wales) or by agreement (in Northern Ireland). (For reference to the Welsh planning system please see paragraph 1.33).
- 4.39 The Committee on Radioactive Waste Management (CoRWM) provides independent advice and scrutiny to Government (UK, Wales, Scotland and Northern Ireland) on the plans and programmes for the future management of HAW including delivering geological disposal and also including the safe and secure interim storage that precedes disposal.
- 4.40 Communities sit at the heart of the voluntarist siting approach and are able to enter into formal discussions with the developer about the GDF siting process, and have a right to withdraw from these formal discussions at any time. In Wales a community wishing to initiate these discussions should do so by contacting the Welsh Government. The Welsh Government considers that geological disposal can only be delivered in Wales on a voluntarist basis with

the willing participation of a potential host community or communities. The Welsh Government has issued a consultation³⁸ about proposals for the processes which could lead to the siting of a GDF should a community in Wales wish to open discussions about potentially hosting one.

³⁸ <http://gov.wales/consultations/environmentandcountryside/?lang=en>

ANNEX 4: NATIONAL GEOLOGICAL SCREENING

Carrying out national geological screening

- 5.1 Annex 3 above gives background information about geological disposal, the role that geology plays in the overall package (“safety case”) of measures to deliver the safe disposal of higher activity radioactive waste (HAW), and experience in other countries. This annex gives information about a programme of geological screening and how this screening can inform discussions between potential volunteer host communities and the developer.
- 5.2 The DECC White Paper of July 2014³⁹ gives information about the geological screening programme which the UK Government has asked Radioactive Waste Management (RWM, the developer) to deliver. Information from the White Paper has been used to inform this annex.
- 5.3 Since 2008⁴⁰ Welsh Government policy, (then the Welsh Assembly Government), has allowed communities in Wales to approach the Welsh Government with a view to opening discussions about potentially hosting a geological disposal facility (GDF). In line with this the Welsh Government announced in the DECC 2014 White Paper that it considered that the geological screening information should be available to communities in Wales for them to consider. Information from the geological screening programme will therefore continue to be available to communities in Wales for them to consider, together with any other relevant information, following the publication of the Welsh Government policy.

Geology as part of the safety case

- 5.4 The underground environment in which a GDF is engineered provides an important element of the multi-barrier containment system. Developing a detailed understanding of the sub-surface characteristics of a potential site is therefore of great importance in developing a safety case for any proposed facility. The ultimate safety of any GDF proposal will rest on a range of factors – not just the basic geological setting (e.g. rock type, faults and fractures), but a detailed understanding of features such as the hydrogeology, geochemistry, and how the developer proposes to design, engineer and operate a facility within that setting.
- 5.5 All the relevant factors are brought together in what is known as a ‘safety case’. This will be a series of detailed documents created, owned and updated by the developer throughout the lifetime of GDF design, construction and operations. For a GDF, there will be a number of safety cases required,

³⁹ DECC, *Implementing Geological Disposal: A Framework for the long-term management of higher activity radioactive waste*. July 2014

<https://www.gov.uk/government/publications/implementing-geological-disposal>

⁴⁰ Defra, BERR and the devolved administrations for Wales and Northern Ireland: *Managing radioactive waste safely: a framework for implementing geological disposal*. June 2008

covering operational safety, environmental safety, and transport. A safety case may also relate to a particular stage of development (e.g. site investigations, commissioning, operations, closure, post-closure etc.). The various safety case documents will be considered by the independent regulators in their assessment of the safety, security and long-term environmental protection aspects of a GDF as they assess whether to issue a site licence and the authorisations required for the facility to operate.

- 5.6 There is a large range of potentially suitable geological settings in the UK, and no single 'best' or 'most suitable' generic type of geology for a GDF.
- 5.7 There are several programmes at an advanced stage in different parts of the world, focussing on very different geological settings, but each designed to achieve the same end of long-term isolation of waste from the surface. Sweden and Finland are taking forward facilities designed to work in hard, fractured rock environments, while the French and Swiss programmes are utilising designs based in lower-strength sedimentary clay rocks. Developments in Germany and the United States of America are using evaporite (salt) rock environments (see Annex 3 above for details).
- 5.8 A great deal is known about the subsurface geology of the UK, but not in sufficient detail to fully inform the siting of a GDF at this stage. This is because the particular questions which will need to be addressed for this purpose have not always been the object of geological investigations carried out in the past for other purposes. Without further, detailed, site-specific investigative work ('site investigations'), it is not possible to identify areas of the country that would definitely be suitable for hosting a GDF.
- 5.9 Responses to a consultation by DECC⁴¹ indicated a desire for early consideration of geology as a crucial step in building public understanding of GDF development, and confidence in the process to identify and consider safe potential siting areas. While it is not possible to identify sites as definitely suitable on the basis of a national, high level consideration, there is merit in carrying out an open consideration of what could be achieved through an early screening exercise.
- 5.10 The UK Government has therefore asked the developer, Radioactive Waste Management Ltd (RWM Ltd), (paragraph 4.35) as an initial action, to carry out a national geological screening exercise based on the requirements of the existing generic GDF safety cases (paragraphs 4.21 to 4.28). This exercise will first consider openly what geological attributes should be considered in producing national, high level screening guidance, using existing geological information and based on the requirements of the generic GDF safety cases.

⁴¹ DECC, Welsh Government and the Department of the Environment, Northern Ireland: *Review of the Siting Process for a Geological Disposal Facility*. September 2013.

<https://www.gov.uk/government/consultations/geological-disposal-facility-siting-process-review>

The high level guidance will then be applied across the country, to bring together high level geological information relevant to the GDF safety cases.

- 5.11 The outputs from this exercise will allow the developer to engage openly on questions about local geological prospects that are likely to be raised early in any community's thinking about possible GDF developments.

Long-term environmental safety case

The main principle of geological disposal for higher activity radioactive waste is to put a number of engineered and natural barriers between the wastes and the surface to ensure that the materials are protected and isolated from the surface environment for the time required for the levels of radioactivity associated with them to naturally reduce.

The aim of the long-term safety case for geological disposal is to demonstrate that this combination of barriers can provide the necessary long-term safety. The barriers include the form of the waste, the waste containers, the buffer material around the containers, and the natural geological barrier.

The geological barrier is provided by the rock in which the GDF is constructed and the surrounding and overlying rocks. Many rocks in the UK have been stable for many millions of years and so have the ability to isolate the wastes from the surface environment over the long timescales required. In suitable formations deep underground (typically 200 - 1000 metres), the GDF is protected from significant climate or landform changes at the surface and any movement from earthquakes is much reduced. The rock in which the GDF is constructed will also protect the engineered components around the wastes. An important factor in some rock types is the hydrogeological setting, which would be such that groundwater moving through the disposal vaults will take many thousands of years at least to return to the surface, so that any radioactivity present will have decayed to very low levels. The International Atomic Energy Agency (IAEA), part of the United Nations, works to promote safe, secure and peaceful use of nuclear technologies. The IAEA publishes guidance on geological disposal of higher activity wastes. The IAEA guidance includes an indication of the characteristics expected from the geological setting based on the requirements of the long-term safety case.

Development of guidance

- 5.12 Geology must be considered within the bigger picture of the developing safety case, which will be managed by the developer. For this reason, and in line with the internationally recognised IAEA Safety Guide⁴², the UK Government has decided to ask the developer to lead on the creation and application of national, high level screening guidance, as part of its role in developing generic safety cases for a GDF in different ecological environments.
- 5.13 The developer will be expected to undertake this work in a suitably open and transparent manner, engaging the public and expert stakeholder communities from the outset in consideration of what geological attributes could and should be included in high level screening guidance.

⁴² <http://www-pub.iaea.org/books/IAEABooks/8535/Geological-Disposal-Facilities-for-Radioactive-Waste-Specific-Safety-Guide>

- 5.14 In drafting guidance, the developer will utilise its own expertise, and that of external organisations such as the British Geological Survey. It will also benefit from international experience through its relationships with overseas waste management organisations. Guidance will be developed through open discussion and engagement with the public and experts, taking account of known information across the UK (excluding Scotland) and its implications on the prospects for developing a robust safety case.
- 5.15 The Committee on Radioactive Waste Management (CoRWM) will play a scrutiny role throughout this work, providing oversight of the process to develop this guidance through open public and stakeholder engagement.
- 5.16 An independent review panel will review and evaluate the draft national screening guidance. The UK Government has asked the Geological Society to be responsible for overseeing the establishment of this independent review panel, having access to a broad range of well-respected national and international geoscience expertise and other learned bodies.
- 5.17 The remit of the independent review panel will be to assess whether the national geological screening guidance developed is technically robust, whether it can be implemented using the existing geological information available, and whether it provides an appropriate assessment of the prospects for developing a robust long-term safety case in a range of geological settings to accommodate the UK inventory of higher activity waste. This assessment should be achieved through open discussion and engagement with the developer, the public and interested stakeholders.
- 5.18 The resulting draft guidance will be subject to public consultation by the developer, including in Wales, during 2015, before being finalised.

Application of guidance

- 5.19 Once finalised, following public consultation, the guidance will be applied – across England, Wales and Northern Ireland – using the specialist expertise of the British Geological Survey, which holds much of the definitive existing information on British geology and has access to many other data sources. The independent review panel will also be asked to assess the application of the guidance.

Output of national geological screening

- 5.20 The exact nature of the results will depend on the high level guidance adopted. However, it is expected that this will include some maps, and accompanying narrative, setting out what geological information may be of potential interest to the developer of a GDF across the regions of England, Wales and Northern Ireland. In line with the existing, generic Disposal System Safety Case⁴³ these are likely to include, as a minimum, areas that may

⁴³ <http://bit.ly/1YIU03>

include volumes of appropriate lower strength sedimentary rocks (e.g. clay), higher strength rock (e.g. granite) or evaporite (e.g. salt) rocks at the appropriate depths.

- 5.21 Inevitably, there will be uncertainty about exactly what rock types are present, and in what conditions they may exist, including hydrogeology at the appropriate depths in some parts of England, Wales and Northern Ireland. As noted above, definitive data are not available everywhere at all depths. In parts of England, Wales and Northern Ireland, even some large scale geological structures at depth are modelled from information available at the surface and limited data gathered at depth.
- 5.22 For these reasons, no national exercise will be able to definitively rule all areas as either 'suitable' or 'unsuitable'. Neither will it seek to target individual sites for development. What the proposed national geological screening exercise should do is make available existing, national level information in an accessible form, in order to assist the developer in engaging with communities across the country on early questions of their geological potential to host a GDF safely.
- 5.23 Outputs from this screening exercise will be made publicly available, and will inform the formal process of working with communities that is expected to begin in 2016.
- 5.24 This national geological screening exercise will provide information to help answer questions about potential geological suitability for GDF development across the country. It will not select sites and it will not replace the statutory planning and regulatory processes that will continue to apply to a development of this nature. The planning aspects of the process will require separate consideration and will be done so in the context of the changes anticipated should the Planning Bill receive Royal Assent in the summer.

Further assessments of local geology

- 5.25 During the early stages of the formal process of working with communities, the developer might commission the British Geological Survey to carry out further, more detailed and focussed assessments of the known geological information within a local area (or areas), in order to produce a geological report for the community (or communities) engaging in the process to consider, on a no-commitment basis.
- 5.26 The information generated could be used by the developer as the basis for making an early judgement on whether there were reasonable prospects for siting a GDF in the area specified and inform discussions with the community (or communities). This judgement would need to take account of IAEA Guidance on siting geological disposal facilities and RWM's own generic Disposal System Safety Case, which has been reviewed by the regulators.

- 5.27 Subsequent, extensive, detailed investigative work would be required to identify and characterise potentially suitable sites to a sufficiently detailed level to support a robust safety case at later stages in the siting process.
- 5.28 These investigations would begin with non-intrusive geophysical surveys (which could include aerial and ground-based surveys) to build on the existing understanding of the geology. This understanding will be used to identify locations for the drilling of boreholes, which will test the geophysical interpretations, provide samples for testing (including determination of groundwater composition and age) and allow underground measurements of rock and groundwater properties. Data from these detailed investigations will allow site-specific models to be developed, aided by expertise from the hydrocarbon and mining industries, to predict the long-term geological characteristics of the site.