GEOLOGICAL DISPOSAL AND RETRIEVABILITY

NuLeAF
NUCLEAR LEGACY ADVISORY FORUM

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1. Introduction

Retrievability (the ability to remove waste emplaced within a Geological Disposal Facility (GDF) is an issue that is regularly raised by communities and stakeholders. A proper understanding of it is therefore important to the local success of the siting process.

This Briefing explores:

- 'retrievability' and some associated but separate terms;
- the options that are potentially available in relation to the development and operation of a GDF; and
- the differing views on whether the ability to retrieve waste is desirable.

Current policy, as set out in **Working with Communities**, published in December 2018 (England[1]) and January 2019 (Wales[2]) is explained, along with the approach taken in some other countries.

NuLeAF has also prepared other papers which members may find useful in understanding geological disposal:

- **Policy Statement 3 – Geological Disposal**, published in June 2019. This sets out NuLeAF's agreed policy in this area.[3]
- **Briefing Paper 14 – Geological Disposal Facility Siting Process**, published in October 2019. This explains the various elements of the siting process.[4]
- **Briefing Paper 16** – which summarises the guidance on geological disposal provided by the UK Government advisory group, the Committee on Radioactive Waste Management (CoRWM).[5]

[1] https://www.gov.uk/government/publications/implementing-geological-disposal-working-with-communities-long-term-management-of-higher-activity-radioactive-waste
[2] https://gov.wales/written-statement-geological-disposal-radioactive-waste-working-potential-host-communities-0
[3] http://www.nuleaf.org.uk/wp-content/uploads/2019/06/PS3-Geological-Disposal-final.pdf
[4] http://www.nuleaf.org.uk/document-library/briefing-papers
[5] http://www.nuleaf.org.uk/document-library/briefing-papers

2. What is retrievability?

Geological disposal involves the emplacement of Higher Activity radioactive Wastes (HAW) in a highly engineered repository deep underground. In the case of a UK repository, it is envisaged that this will take over a century, with parallel processes of vault construction and waste emplacement underway throughout this time. Monitoring will take place throughout the operational period, and only when there is confidence that the facility is performing as expected will it be closed and sealed.

A GDF is designed to be a **permanent** solution, resulting in **disposal** of waste hundreds of metres below the surface with **no intent to retrieve**. Once the facility has been closed and sealed, it is expected to remain safe without any need for ongoing human management or even monitoring. This is called passive safety and is important in order to ensure safety is maintained for the very long time periods which will be required.

A GDF can therefore be distinguished from facilities for the **storage** of wastes, that is emplacement of waste with intent to retrieve, in **temporary** facilities that are **dependent on ongoing human intervention** to maintain safety and security. Discussion of retrievability within a repository should take place within this context.

While the intent of a GDF is to provide a permanent solution, it is recognised that during the operational stage of a GDF (when waste is being accepted), waste that has been placed into a GDF could be retrieved if there was a compelling reason to do so.

The term **retrievability** is often used as shorthand for a number of possible options. In principle, waste could be retrieved at any stage after emplacement. However, once access tunnels have been backfilled, and/or a geological disposal facility has been sealed, intrusive re-excavation operations would be required to recover the waste. Thus, in practice, consideration of retrievability is usually restricted to the operational phase; that is the time before access ways are closed and sealed.

Even before closure, retrievability of waste would be likely to pose greater technical challenges and be more expensive over time, as more of the engineered barriers are installed and as the facility and the emplaced packages become older and potentially start to degrade.

CoRWM issued a Position Paper in 2019[6] that sets out their current position on retrievability. It defines three types of retrieval:

> **'Reversibility'** – designed into the option to facilitate the recovery of material by reversing the original emplacement process.

[6] https://www.gov.uk/government/publications/retrievability-considerations-for-geological-disposal-corwm-position-paper

'Retrievability' – designed into the option to facilitate the physical retrieval of waste through means other than reversing the process, such as ensuring access to the waste and having (or being able to have) the retrieval mechanism in place.

'Recoverability' – addressing the retrievability issue by demonstrating that the waste is technically recoverable through mining or other means.

In all these cases, the waste is 'retrievable', but the cost and complexity of doing so increases as we go from **reversibility** through more difficult types of **recoverability**. In other words, the retrievability of the wastes decreases.

Some argue that the principle of retrievability should include an extended period where the facility is kept open after all the waste has been emplaced. However, such an approach is in essence long term storage rather than disposal. It is not in line with current UK and Welsh Government policy. CoRWM assessed and compared options for storage and disposal and the reasoning behind the clear recommendation for disposal is set out in their original report.

3. The pros and cons of retrievability

A range of factors should be taken into account in reaching a judgement about whether some degree of retrievability during the operational and monitoring phases is desirable.

Why retrieval might be considered	Disbenefits of retrieval
Wastes could be taken out of the repository in response to: • Technical safety concerns that are only recognised after waste emplacement e.g. advances in scientific understanding reveal unexpected characteristics or phenomena that are detrimental to the long-term safety of the repository. • A desire to extract resources from the wastes in the repository. • New technologies become available which enable the waste to be managed in other ways, potentially reducing its long-term hazard.	Reasons for not keeping a repository open for an extended period include: • Imposing burdens on future generations, including the need for continued active management of the wastes during underground storage, and ultimately the need to backfill and close the repository or retrieve the wastes. • Potential negative effects, including conventional safety and radiological exposure of workers engaged in extended storage operations. • Potential for failure to seal a repository properly due to loss of organisational, technical or financial capabilities.

• Changes in social acceptance and perceptions of risk or changed policy requirements. • Flexibility (the repository could be backfilled and closed at any time within the design life for the period of extended underground storage). That said there are technical limits to how long an underground space could be maintained. • To increase public and stakeholder support, enhance the prospect of acceptability to potential host communities, and potentially to inspire more confidence. • Including retrievability may create the potential to incorporate a research facility within the overall development and thus enhance the overall 'offer' to the host community.	• Increased opportunity for unauthorised access to the repository to retrieve or interfere with the wastes during times of social or political unrest. • Increased financial costs associated with more onerous design requirements and keeping the repository open for longer. • Questionable flexibility – once wastes are emplaced it is difficult to envisage circumstances where wastes would be removed, because this would require alternative facilities and potentially involve abandonment of an expensive repository. • It may result in greater exposure of waste packages to air or water than a sealed repository, leading to corrosion. It may also provide an easier route back to the surface for any radiation that does leak. • The geological conditions that favour retrievability may not always be geologically optimal for disposal.

In large part these pros and cons relate to the extent to which one's viewpoint is that it is **better to deal with waste now** (*based on a belief that the science is clear, that we should not pass on a waste burden to future generations and that we cannot depend on the capability of future society to properly manage the waste*) or **leave it until later** (*which tends to favour a view that the science may change or that the repository may not perform as predicted, and that we should therefore aim for options with the possibility of retrievability.)*

Neither of these views can be said to be 'right' or 'wrong' as they depend on the emphasis placed on certain aspects of the process. However, CoRWM did consider these arguments with a whole series of different weightings given to the various objectives and outcomes and disposal did come out as the best option every time.

Finally, it is worth noting that the design of a GDF, and the practical challenges of retrievability will vary greatly depending on the host rocks chosen for the repository; and also that different types of nuclear waste may require different approaches in terms of the design of a repository where retrievability is possible.

4. Current UK Government policy

Current UK[7] Government policy states that, during the operational phase, *'waste that has been placed into a GDF could be retrieved if there was a compelling case to do so'* but that *'The UK Government and regulators agree that the purpose of a GDF is to dispose of waste, not to store it.'* (3.19) and that *'Permanently closing a GDF at the earliest possible opportunity once operations have ceased provides for greater safety, greater security, and minimises the burden on future generations.'* (3.21)

The policy position also notes that *'Retrieving emplaced waste would tend to become more difficult with time, particularly after the end of its operational stage (that is, once a GDF has been closed permanently)'.* (3.20)

Welsh policy also supports the option of retrievability although this is not explicitly stated in their Working with Communities paper[8].

In their 2018 Position Paper on Retrievability, CoRWM state that geological disposal `*means the burial underground (200 – 1000m) of radioactive waste in a purpose-built facility with no intention to retrieve the waste once the facility is closed'.* CoRWM's position is that leaving a repository open for centuries after waste emplacement increases the risks disproportionately to any gains.

At the same time the Committee recognise that *'the issue of retrievability will be a significant concern for communities involved in the siting process'* and that *'it is inevitable that stakeholders will raise…questions of retrievability, and it would be prudent to design these considerations into the process.'*

5. International approaches

The approach to retrievability taken in other advanced GDF siting processes is summarised below[9]. While there is some variation, in general these programmes recognise that there may be a requirement for some form of retrievability during the operational phase of their repository. After the last waste has been emplaced, most envisage that the facility will be sealed and retrievability will not be possible. Some programmes include specific requirements to build in design features to aid retrievability and others specify a period of monitoring after the final waste container has been emplaced.

[7] https://www.gov.uk/government/publications/implementing-geological-disposal-working-with-communities-long-term-management-of-higher-activity-radioactive-waste
[8] https://gov.wales/sites/default/files/publications/2019-04/geological-disposal-of-higher-activity-radioactive-waste-guidance-for-communities.pdf
[9] https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1378_web.pdf

Canada	The Canadian approach for disposal of used fuel includes monitoring for an extended period of time after the final waste canister has been emplaced, prior to decommissioning, closure and post closure monitoring.
France	In France, the law states that radioactive waste disposal must be reversible. This has been defined as *'the capability of future generations either to continue building and operating successive phases of a disposal facility or to review the decisions made in the past'*. This flexibility is reduced over time as, for example, backfilling and sealing of the repository takes place to ensure long term safety.
Finland	In Finland, disposal of spent nuclear fuel is clearly specified as a permanent solution. However, it is also recognised that spent fuel can be retrieved from the repositories at any point of the final disposal process, if necessary. Closing and sealing of the facility is planned to occur as soon as waste emplacement is complete.
Germany	In Germany the policy commits to the option of retrievability during the operational phase and for up to 500 years after closure.
Sweden	Swedish legislation does not formally require that a repository should or should not make retrievability possible. Instead it is up to the developer to propose an approach and seek agreement from regulators[10]. Swedish legislation does note that the aim is 'safe final disposal'.
Switzerland	Swiss law specifically defines an observation period before final closure when waste can be easily recovered. The length of this period is not specified.

6. Reversibility and Decision Making

It should be noted that the idea of reversibility can also be applied to the decision-making process during siting: indeed the Nuclear Energy Agency (NEA) view reversibility primarily as related to decision making. They state that *'Reversibility describes the ability in principle to reverse decisions taken during the progressive implementation of a disposal system; reversal is the actual action of going back on (changing) a previous decision, either by changing direction, or perhaps even by restoring the situation that existed prior to that decision.*

Reversibility of decisions is a conceptual and operational tool that enables adaptability in decision making. It denotes the possibility of reconsideration of one or a series of steps at various stages of a RWM programme. This implies a need for review of earlier decisions, as well as a need for the means (technical, financial, etc.) enabling the reversal of a given step'.[11]

[10] https://inis.iaea.org/search/search.aspx?orig_q=RN:44052587
[11] https://www.oecd-nea.org/rwm/docs/2013/6988-fsc-glossary.pdf

Therefore, when referring to reversibility, it is important to be clear about whether reference is being made to steps in the siting process, or the design and operation of a repository.

7. NuLeAF's role

The issues around retrievability are complex and will need to be explored with any community involved with the siting process.

It is clear that the settled policy of the Government, and the stated position of the nuclear safety, security and environmental regulators is that a GDF is needed for permanent disposal of waste. The questions/issues around retrievability would therefore have to be discussed in the years of engagement that will precede any decisions around GDF construction and would likely apply primarily to the 100 plus year operational phase of the repository.

NuLeAF has a clear position on Geological Disposal which is set out in **Policy Statement 3**[12], agreed by our members in June 2019. This commits us to a range of actions in support of our members and the wider local government family.

As the Local Government Association's representative body on the UK's nuclear legacy, we will continue to engage with the UK and Welsh Government, RWM and the regulators to advocate our members' interests; and to build the capacity of our members to engage in the siting process if they wish.

On **retrievability**, our Policy commits NuLeAF to '*Encourage Government and RWM to engage with and listen to communities on the issue of retrievability of waste'.*

It is highly likely that communities and local authorities involved in the GDF siting process will want to discuss and understand the potential options around retrievability of waste, along with their implications for the siting process and for wider health and environmental considerations.

Informed by our members, we will continue to engage with RWM on issues around retrievability, to advise local Working Groups and Community Partnerships if invited, and to support any local authority who is seeking discussion of this issue.

[12] http://www.nuleaf.org.uk/wp-content/uploads/2019/06/PS3-Geological-Disposal-final.pdf