GUIDANCE ON GEOLOGICAL DISPOSAL FROM THE COMMITTEE ON RADIOACTIVE WASTE MANAGEMENT (CoRWM).

NuLeAF
NUCLEAR LEGACY ADVISORY FORUM

Briefing Paper 16

August 2019

1. Introduction

The **Committee on Radioactive Waste Management (CoRWM),** is the independent advisory body to the UK and Devolved Governments on the management of Higher Activity Radioactive Waste (HAW).

In 2002 CoRWM was tasked by Government with undertaking an in-depth review to determine the best options for the long-term management of the UK's Higher Activity Wastes. Following an extensive process of engagement and consultation, involving NuLeAF, their conclusions were published in the **Managing Radioactive Waste Safely**[1] report, published in 2006. The Committee's view was that, with a number of caveats, geological disposal was the best option for the long-term management of the UK's HAW inventory.

This view was reaffirmed by CoRWM in a series of position papers on geological disposal published in 2018 and 2019[2]. These more recent papers did not re-open their deliberations but instead *'provide an overview of CoRWM's work 2003-2006 providing a traceable outline of the path that led CoRWM to recommend geological disposal'.*[3]

Current UK and Welsh Government policy is supportive of Geological Disposal and is guided to a significant degree by the views of CoRWM. Given its importance to current policy in England and Wales, this Briefing Paper explains CoRWM's view on the key questions surrounding geological disposal.

It covers the following:

- What is geological disposal?
- Why choose geological disposal over other options?
- Is deep borehole disposal an alternative to a GDF?
- Can we be sure a GDF is safe?
- Should a GDF only target the best geology?
- What are the transport considerations?
- Should we be able to retrieve wastes?

It concludes by summarising CoRWM's overall conclusions.

[1] https://www.gov.uk/government/publications/managing-our-radioactive-waste-safely-corwm-doc-700
[2] https://www.gov.uk/government/collections/corwm-position-papers
[3] https://www.gov.uk/government/publications/why-geological-disposal-corwm-position-paper

2. What is Geological Disposal?

CoRWM's 2006 report to Government[4] states that '*Geological disposal is based on the concept of the retention of radioactive wastes by a combination of engineered containment within a geological barrier. Concepts for geological disposal are based on an extremely long period of containment of the waste during which time its level of radioactivity will diminish through the process of radioactive decay. It is acknowledged that at some point in the very far future radioactivity will eventually make its way into the biosphere, but at levels expected to be insignificant in terms of impact on health and the environment'.*

Current policy in England and Wales thus envisages the burial of wastes deep underground (200m to 1,000m) within an engineered facility, in which multiple barriers contain radioactive wastes for very long periods of time. Through decay, this should ensure that future human populations and the surface environment are not exposed to significant levels of harm at any point.

More information on the concept and potential design of a GDF is provided in NuLeAF's Briefing Paper 17.

3. Why choose Geological Disposal over other options?

In the early 2000s, the Committee on Radioactive Waste Management (CoRWM) was tasked by Government with evaluating the range of possible options for the management or disposal of the UK's Higher Activity radioactive Wastes (HAW). This review took 4 years and involved engagement with a wide range of stakeholders.

CoRWM considered six waste streams (High level waste; Spent Nuclear Fuel; Plutonium; Uranium (highly enriched, depleted, natural and low enriched); Intermediate and low-level waste not suitable for the Low-Level Waste Repository (LLWR); and Reactor decommissioning waste.)

For each of the waste streams, 15 possible management options were considered (Appendix 1). A process of shortlisting was then undertaken with options eliminated if they couldn't be implemented in the reasonably foreseeable future. This led to the exclusion of most options with only four taken forward for further study:

- Long term interim storage
- Near surface disposal of short-lived wastes (near surface disposal is not considered suitable for long lived wastes)
- Deep geological disposal
- Phased deep geological disposal.

[4] Committee on Radioactive Waste Management, 'CoRWM's Recommendations to Government', July 2006, Chapter 15.

These options were assessed using a weighted scoring system by experts in relevant fields, citizens' panels and stakeholder groups. Based on this, CoRWM's overall conclusions was that *'disposal options performed significantly better than storage options'* and that *'Phased geological disposal ranked slightly higher than geological disposal'.* CoRWM stated that `*the key discriminators between geological disposal and storage options were burdens on future generations and public safety (up to 300 years)*[5].

This outcome was consistent regardless of the different weightings that the various stakeholders placed on the assessment criteria. The weighting applied by Non-Governmental Organisations (NGOs), which gave much more emphasis on environment, amenity, flexibility and implementability still ranked geological disposal highest though it was followed extremely closely by underground local stores[6].

On this basis, CoRWM concluded in that geological disposal was the best approach to take. CoRWM also noted the adoption of geological disposal by many countries world-wide and that is it the subject of studies and recommendations by the International Atomic Energy Agency (IAEA) and European Union.

4. Is deep borehole disposal an alternative to a GDF?

As noted in Section 3, CoRWM considered a wide range of alternatives to geological disposal in their 2006 report. These included Deep Borehole Disposal which scored less highly than disposal in a GDF and was not shortlisted as an option for consideration.

In July 2019 CoRWM published a **Position Paper on Deep Borehole Disposal**[7], updating CoRWM's position on this issue in light of recent developments in borehole technology.

Having reviewed the evidence, CoRWM's view is that a number of significant challenges remain that limit the practicality of deep borehole disposal. These include the technical complexity and financial cost of constructing boreholes of an appropriate diameter to the depths required. They do however believe that it may be appropriate to consider borehole disposal for certain materials such as plutonium, enriched uranium and some spent fuel, if these materials are declared wastes.

Any such decision would require a proper assessment of costs and technical, environmental, safety and regulatory considerations. They suggest that one option may be to consider borehole disposal on the same site as a GDF.

[5] Managing our Radioactive Waste Safely, CoRWM's Recommendations to Government, CoRWM Doc. 700, July 2006
[6] https://www.gov.uk/government/publications/why-geological-disposal-corwm-position-paper
[7] https://www.gov.uk/government/publications/deep-borehole-disposal-corwm-position-paper

5. Can we be sure a GDF is safe?

CoRWM's paper on **Safety Requirements of Geological Disposal** states that *'a safe GDF should be deliverable.'*

Their evaluation of options concluded that geological disposal was preferable, in safety terms, to indefinite storage and that the robust regulatory regime in the UK should mean that a GDF couldn't be built unless it was safe.

Radioactive Waste Management (RWM) has published a generic Disposal System Safety Case (gDSSC) which will form the basis of a specific safety case as and when a site for a GDF is selected. CoRWM believes that *'any aspects which make the GDF unsafe, would be picked up by the regulators who would not license the facility or allow it to be constructed until these matters were resolved*.[8]'

6. Should a GDF only target the best geology?

The surrounding geology within which a GDF is developed is an important barrier that will, along with the nature of the waste being disposed, the waste containers, and the engineering of the repository, prevent radioactivity making it into the surface environment in dangerous concentrations. This has led some to propose that a GDF siting process should be led by a search for the 'best' geology, with other considerations being secondary.

In their 2018 paper **GDF should only Target Best Geology**[9], CoRWM considers this. They note that the option of only considering the best geology was not raised during the stakeholder engagement that informed its 2006 Recommendations to Government.

Their view is that any move towards *'choosing the best geology'* is not justified on technical grounds as each geological setting has various advantages and disadvantages. It is also the case that current knowledge of sub-surface geology is limited and thus any 'screening' on the basis of geology would, they argue, be arbitrary.

7. What are the transport considerations?

In their 2006 report CoRWM recognised that many stakeholders and members of the public had concerns about the transport of radioactive and nuclear materials and it was thus a material consideration in any GDF siting process. Issues raised by the public include nuclear and conventional accidents, the risk that material could get into the hands of terrorists, and the impact on the environment.

[8] https://www.gov.uk/government/publications/geological-disposal-of-radioactive-waste-safety-requirements-corwm-position-paper
[9] https://www.gov.uk/government/publications/selecting-a-geological-disposal-facility-gdf-site-based-on-the-best-geology-corwm-position-paper

CoRWM has undertaken a recent review of the transport issue taking into account recent developments. Their **Transport Considerations** paper concludes that the *'standards and regulations applied to radioactive material transport have been adequate to ensure an operation where any detriment suffered is very largely due to the conventional risks of transport'* and that a GDF does not present additional security challenges.

At the same time CoRWM does recognise that *'transport is an activity which should be minimised'* though this needs to be considered alongside other factors in determining the overall impacts of any radioactive waste management scheme.

CoRWM also states that the *'double movement' of radioactive wastes should be avoided as far as possible. This is the movement of radioactive wastes to centralised interim stores, followed by a second phase of transport to disposal facilities at a later date.'*

8. Should we be able to retrieve wastes?

CoRWM's paper on **Retrievability Considerations for Geological Disposal** recognises 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.'*

The reasons why some argue for the option of waste retrieval vary. Some believe it might be necessary due to issues identified with the repository and its safety; others that the material being emplaced may have a value at some future date. CoRWM's 2006 report defined 3 levels of retrieval:

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

The Committee identified a range of practical challenges and drawbacks in designing a repository for retrieval and, in their 2006 report set out their view that *'disposal in a GDF meant burial underground (200-1,000 m) of radioactive waste in a purpose-built facility with no intention to retrieve waste once the facility is closed.'* They do however note that there may be some scope to retrieve wastes during the operational phase and that the approach must be '*consistent with developing and maintaining public and stakeholder confidence.'*

The UK and Welsh Policy on Working with Communities recognises that, during the operational phase, *'wastes that has been placed into a GDF could be retrieved if there was a compelling case to do so'* but that permanently closing a GDF after operations have ceased *'provides for greater safety, greater security, and minimises the burden on future generations.*[10]*'*

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 preferred approach of CoRWM, the Government and the developer (RWM) is for permanent disposal. Any agreement around retrievability would have to be negotiated and would only apply to the 100 plus year operational phase of the repository, and not beyond that.

9. CoRWM's overall conclusions

CoRWM's 2006 Report includes a number of recommendations that are formulated in a way that takes into account the existence of varying levels of confidence in the long-term safety of geological disposal. These recommendations are broadly consistent with comments submitted to CoRWM by NuLeAF during the Committee's public and stakeholder engagement programme in the lead up to the 2006 Report.

They are expressed in the 2006 Report in the following terms:

> *'Within the present state of knowledge, CoRWM considers geological disposal to be the best available approach for … long term management ... when compared with the risks associated with other methods of management.'* [Recommendation 1]
>
> *'The aim should be to progress to disposal as soon as practicable, consistent with developing and maintaining public and stakeholder confidence.'* [Recommendation 1]
>
> *'There should be a commitment to an intensified programme of research and development into the long-term safety of geological disposal aimed at reducing uncertainties at generic and site-specific levels ...'* [Recommendation 4]
>
> *The commitment to ensuring flexibility in decision making should leave open the possibility that other long-term management options (for example, borehole disposal) could emerge as practical alternatives. Developments in alternative management options should be actively pursued through monitoring of and/or participation in national or international R&D programmes.'* [Recommendation 5]

CoRWM also recognises that a robust programme of interim storage must play an integral part in long-term management strategy and recommend that this must be *'robust against the risk of delay or failure in the repository programme.'* (Recommendation 2).

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[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766643/Implementing_Geological_Disposal_-_Working_with_Communities.pdf

APPENDICES

Appendix 1

Options considered by CoRWM for management of HAW. A full explanation of what each option involved can be found in the 2006 CoRWM report:

1. Storage
2. Near surface disposal
3. Deep disposal
4. Phased deep disposal
5. Direct injection
6. Disposal at sea
7. Sub-seabed disposal
8. Disposal in ice sheets
9. Disposal in subduction zones
10. Disposal in space
11. Dilute and disperse
12. Partitioning and transmutation
13. Burning in reactors
14. Melting of metals
15. Incineration.

Appendix 2

Criteria against which options were appraised. Number 1 was weighted as most important by experts and stakeholders, number 11 the least important.

1. Public safety – Individual, short term (up to 300 years)
2. Public safety, Individual – long term (longer than 300 years)
3. Worker Safety
4. Security
5. Environment
6. Socio-economic
7. Amenity
8. Burden on future generations
9. Implementability
10. Flexibility
11. Costs