CoRWM Position Paper: GDF Should only Target Best Geology
25 October 2018

This Position Paper reflects the Committee on Radioactive Waste Management (CoRWM) current position on selecting a site based on the 'best geology' for a Geological Disposal Facility (GDF). This is to respond to Consultation responses such as '*finding the best geology and informing the local community that they were about to host a GDF*'. The paper will be updated and revised when more information becomes available.

1. Introduction

Several stakeholder replies to consultations on a UK Geological Disposal Facility (GDF) have suggested that the siting process should be led by a search for the 'best' geology, and that other considerations are secondary to this. In effect, this would rule out any concept of a Community volunteering to host the GDF, unless this community happened to be situated above the 'best' geology. The GDF process would consist of '*finding the best geology and informing the local community that they were about to host a GDF*'.

This paper addresses this '*geology first*' proposal in the context of the science and technical processes behind GDF siting and the presently proposed volunteer community process.

2. Technical Aspects of GDF siting

A Geological Disposal Facility must isolate the waste it contains from people and the environment such that the risk levels to individuals that are most susceptible is kept within 1 in 1 million (10^{-6})[1] into the very distant future. This is assured by developing a Safety Case which models the behaviour of the repository system.

The GDF concept relies on a 'defence in depth' process. The GDF Safety Case models how the behaviour of (a) the waste, whose activity will reduce with time (b) the containers the waste is in, (3) the engineering of the repository[2] and (4) the surrounding geology combine to ensure that the standards of safety will be met. These safety standards must be met even while using pessimistic assumptions for the parameters that are modelled. The general concepts of a GDF and its safety case are illustrated in the 2014 Implementing Geological Disposal White Paper[3] and the gDSSC Part A High Level Requirements.[1]

[1] Geological Disposal Systems Safety Case Part A: High Level Requirements, Page 25, Table 6, RWM 2016

[2] This is taken to include the filler material ('backfill') which is put into the space between the waste package and the GDF excavation

[3] Implementing Geological Disposal: A framework for the long term management of higher activity waste, DECC, 2014

The relative importance on these four 'levels of defence' will change depending on the particular waste inventory, GDF design and geological setting. However, the requirements to meet the Safety Case, and optimise the GDF design in terms of safety performance remains dominant. Technical assessments confirm that safety standards can be met, for a given packaged waste inventory, within various combinations of geology and GDF design.

This was recognised in CoRWM's 'Managing Radioactive Waste Safely: CoRWM's Recommendations to Government' (CoRWM doc 700.),[4] which stated (Page 106):

> *The design of a geological repository is a multi-barrier concept that can be fitted in detail to the particular (suitable) geology of a repository site, which can be crystalline rock, salt, shale or clay, all of which exist in the UK and underly over 30% of its area.*
> *The waste form and packaging, the waste container, the 'backfill' material used and the geological suitability of the chosen site should all act to delay and retard the movement of radionuclides when, after a very long period, radioactivity escapes from the waste package and enters the geosphere.*

Radioactive Waste Management (RWM), the UK's delivery body for a GDF have developed generic environmental safety cases (gESC)[5] for the three rock types: hard rocks (metamorphic and igneous rocks), soft rocks (clays and mudstones) and evaporites (salt deposits).

The recognition that three very different rock types can provide for a safe GDF highlights the difficulty associated with selecting a '*best*' geology as each rock type have their own advantages and disadvantages. For example, from the technical assessment carried out to support CoRWM's initial work (CoRWM doc 682.):[6]

> *Strong indurated[7] rocks can provide repository concepts at depth that could provide long pathways and isolation from human intrusion. Weak indurated rocks could provide hydrogeological isolation but be constrained by depth limitations. Evaporites could provide hydrogeological isolation and low gas permeability. Excavations of some evaporites would be difficult to maintain over long time periods.*

This statement illustrates that the geology affects the practicality of construction of a GDF and that the safety attributes of one rock type are not the same as the safety attributes of another. Therefore, geologic attributes or parameters cannot be compared across rock types, and the concept of a site which scores 'highest' on all parameters' simply cannot occur. The different and various roles played by geological settings proposed for GDFs across the world highlight this issue, for example:

- Finland and Sweden have selected hard igneous rocks which are good for repository construction but do have significant groundwater flows. Here the emphasis is on the waste container and the material packed around it to ensure that groundwater contact with waste is minimised for very long times. The role of the geology, hydrology and geochemistry of the host rock is not isolation, but the provision of assurance that the chemical conditions around the waste canisters will maximise the waste package lifetime.

[4] Managing our Radioactive Waste Safely, CoRWM's Recommendations to Government, Doc 700, July 2006
[5] Geological Disposal Generic Environmental Safety Case: Main Report, Radioactive Waste Management, December 2016
[6] Deep Disposal: Current Position with Respect to Safety, CoRWM document 682, September 2004
[7] Rocks hardened by heat or baking; also the hardening of sediments through cementation or compaction, or both, without the introduction of heat.

- France has selected a site with clay geology. Here excavation is considerably more difficult, but groundwater flows are very small and there is greater adsorption of radionuclides to mineral surfaces, so the reliance on waste packaging and backfill will be reduced.

This emphasises that the design of a GDF is a complex system. Geological attributes are important but need to be considered in context and in combination with all other aspects of the GDF design.

It must also be remembered that the amount of knowledge of any candidate site in the early stages of evaluation in the currently proposed process is likely to be very limited. The case for the suitability of the site for a GDF must be built by progressively detailed investigations of the site. These investigations would cover not only the site's geological suitability when considered with the wasteforms and repository engineering. It also covers its ability to host the surface facilities of a GDF, and to be accessible to the level of transport needed for both construction and operation. Only when these factors have been acceptably demonstrated would the Host Community be ready to hold its Test of Acceptability.

3. Stakeholder and Community Aspects of GDF siting

Interestingly, the concept of '*only considering the Best Geology*' does not seem to have been raised during CoRWM's extensive stakeholder engagement work that led up to its 2006 Recommendations to Government. Since then there have been stakeholder view that suitable geology should be identified prior to asking for volunteer communities. For example:[8]

> *Some members of the audience felt that sites with suitable geology should be identified first in the process for siting a geological disposal facility, rather than the Government's chosen approach (as published alongside its June 2008 White Paper) for volunteer communities to express an interest in hosting a geological disposal facility.*

The pros and cons of such a 'screening out' process have been debated by CoRWM. The Committee recommended[9] that geological screening should not be used to 'screen out' 'unsuitable' areas, '*as the design of the facility needs to consider other aspects*'. They also recommended this because the level of knowledge of the geology of much of the UK at the depths under consideration is in any case too rudimentary to support a 'screening out/in' process. This position could only be changed by introducing, country-wide, a level of geological investigation, including investigative boreholes, that would clearly be unsupportable on both economic and public acceptability grounds.

4. CoRWM Current Stance

CoRWM's work has led to the conclusion that any move towards '*choosing the best geology*' at the start of the GDF siting process is not justified on technical grounds as each geological setting has its advantages and disadvantages. CoRWM's work led to the recommendation of a voluntary approach (CoRWM Document 700, Recommendations 9 to 14. This would become unachievable if the 'best' geology was chosen, using what would inevitably be an arbitrary and scientifically unsupportable process.

[8] Document 2503 PSE event in Saxmundham, Suffolk, November 2008
[9] CoRWM Advice on National Geological Screening Events, November 2014