Review of the siting process for a Geological Disposal Facility: September 2013: URN 13D/250

Consultation response by Phil Davies, Director, Westlakes Nuclear Limited, November 2013

(no comments on Questions 1, 2, 3, 5, 9)

Question 4

Do you agree with this proposed approach to assessing geological suitability as part of the MRWS siting process? If not, what alternative approach would you propose and why?

This commentary and 'alternative approach' below represents an argument that the current emphasis on geology is over-simplistic and can lead to eventual confusion and disillusionment of stakeholders. Even worse, it could lead to accusations that stakeholders have been under-informed or misled.

It is suggested that a more sophisticated approach to site suitability is introduced from the earliest (pre-launch) stage on the assumption that many readers may not dig into the references to pick up the bigger picture, or understand it already. It is also suggested that the references themselves reflect 'yesterday's thinking'. The opportunity should be taken to use lessons from MRWS experience up to mid-2013. In 2012/13 scheme opponents opened up their own discussion on valid and interesting performance assessment issues (amongst other issues). This left the well-intentioned developer's position (trying to avoid ill-informed or premature engagement on performance assessment matters) accidentally appearing to be disingenuous.

Commentary

Condoc paras 3.9 and 3.10 are supported.

Geological suitability is a key issue, and it is probably valid to publish maps and models to illustrate the geological configuration of UK and specific regions.

However, geological and site suitability is a complicated matter, and it is simplistic to suggest that local authorities should receive general geological information and arrive at anything but some extremely generalised conclusions. Nevertheless, they are entitled to ask for such information and it is appropriate that the developer can respond.

While it can appear to be an excellent 'transparent' thing to do, putting too much emphasis on publishing geological maps can end up misleading or disillusioning the public. It would be preferable to start off at the *Pre-launch* stage with a more rounded position such as:

> The long term safety performance of the site is the most important factor, although it is also important to consider short term risks such as construction health and safety, safety of road transport, and so-on.
>
> The suitability of a site is linked to its geology (including groundwater), which influences the extent to which radioactive materials in a GDF can be kept away from people. The underground geological layout is variable in three dimensions. It's not a matter of ruling in or ruling out a single rock formation. It's the overall capability of the site and engineering measures that are applied to protect the public that matter. The holistic technique for examining this is called Performance Assessment.

If this approach is adopted, any geological maps prepared or published at the *Pre-launch* stage are for the general interest of stakeholders only. While these maps and 3D models don't really give the general public any information on which they can directly base opinions, they can be of use to specialists who may be advising interested parties. Geological maps and models do need to be publicised, however, to provide an indication of the extent (and limitation) of scientific knowledge that is already available. This is an important message that the developer will justifiably want to convey. But it's not helpful to suggest that the public should do anything much with them at this or the *Launch* stage.

The condoc appears to acknowledge the over-simplification problems associated with presenting geological information, but then to reinforce the concept in paras 3.14 to 3.16 and perhaps 3.19. The key objective steps to developing better-underpinned views on potential suitability are reflected in paras 3.17 and 3.18, which are rather brief compared to their importance.

Alternative approach

The following 'multi-attribute' approach is suggested. This leads through to discussion of geology rather than over-emphasising it 'up front'. The text is to illustrate a train of thought; it is not intended as draft material for publication. While this approach introduces more technical and complicated issues, it is considered preferable to encouraging a naïve dependency on generalised geology alone.

The suitability of a site depends on the assessment of many issues:

1. *Its capacity to protect current and future generations from the radioactivity in the disposed waste.*
2. *The engineering feasibility and construction cost of developing the GDF.*
3. *The level of site-specific risk entailed in developing a GDF at a given location (including risk to the public from transportation of construction materials, protection of health and safety of construction workers).*
4. *The environmental impact of developing the GDF.*

With regard to point 1, protection of people from radioactivity depends on the performance of the site over time. Part of the overall performance is influenced by the engineering measures applied at a given site. The concept of 'engineered barriers' relates to the capacity of the waste packages, the GDF construction and materials used to backfill around packages to prevent or slow down the release of radioactivity from the GDF.

The other factor providing protection to people is the ground itself – the 'geological barrier'. A key issue, therefore is to understand how the ground may allow radioactivity to move from the GDF towards the surface over very long timescales. Slow movement of radioactivity through the ground helps provide protection to people because the level of radioactivity decreases naturally over time.

It is possible to increase the extent and robustness of engineering barriers used at sites where the ground may otherwise transmit radioactivity too quickly to enable the protection of the public to be assured. Nevertheless, sites where the transmission of radioactivity through the ground is naturally slow tend to offer better overall feasibility.

RWMD's generic Disposal System Safety Case highlights three potential pathways for radioactivity to move towards people and the surface from a GDF:

1. *The risk of 'human intrusion'. In other words, the risk of people drilling or mining into the facility or the ground around it at some point in the future.*
2. *The gas migration pathway, where gas originating in the GDF migrates through the ground towards the surface.*
3. *The groundwater pathway, where contamination spreads through movement of groundwater.*

The assessment of site suitability informed by the assessment of the 'performance' of the site with regard to protection of people, and the local geological environment is one of the important factors.

The role of the geological environment in assessment performance can be considered to comprise the following characteristics.

1. *The performance of various intact rock (and soil) materials around the GDF with regard to the extent to which they allow or impede the movement of gas and water.*
2. *The performance of the overall rock mass with regard to allowing or impeding the movement of gas and water (the rock mass comprises the materials plus the various natural fractures that exist in most materials).*
3. *The performance of large natural fractures such as geological faults or fault zones with regard to allowing or impeding the movement of gas and water.*

Therefore the performance at any given site is influenced by the precise location and depth of the GDF, which determines the materials at, above and to the side of the GDF as well as the location and nature of fractures around the GDF. It is also influenced by the chemistry of the rocks and groundwater around the GDF. There is also a need to consider how the GDF itself interacts with the natural ground, including changes resulting from the heat produced by radioactive waste as the radioactivity decays over time. Thus the safety of the overall system depends on the interplay of many factors in three dimensions and over time, not just the rock type in which the GDF is constructed.

Simplified rock types at or around a GDF	***Features***
Hard igneous rocks such as granite and some volcanic types. Hard metamorphic rocks such as gneisses; some slates.	*Generally good for engineering construction. Rock materials are good at impeding the migration of groundwater and gas. Any such migration tends to be dominated by the characteristics of the natural fractures in the rock.*
Hard sedimentary rock types such as sandstone and limestone.	*Can be good for engineering construction. Some relatively porous and permeable sandstone materials allow groundwater and gas to move through them; others are cemented and impede flow. Limestone can be a good construction material, but where it has been (or could be in the future) influenced by solution widening of fissures it can provide a fast route for migration of groundwater and gas.*
Relatively weaker sedimentary rocks such as shale and mudrock ('argillaceous'). Some weaker metamorphic schist.	*The weakness of material can provide challenging construction conditions at depth. On the other hand these rock types can provide 'tight' rock masses that impede the migration of gas and groundwater. Some argillaceous rocks can be exploited for shale gas.*
Evaporites such as rock salt.	*Salt can be a good construction material and it impedes the migration of gas and groundwater. It*

	can 'creep' over time under the influence of pressure in the ground.
Coal (present as beds or 'seams' from a few millimetres to a few metres thick, interbedded with sandstone, mudstone and other sedimentary types)	*Weak from a construction point of view. Gas is held within some coal seams by the low permeability of the strata around them. An issue is possible future exploitation by mining or underground gasification.*

The nature of the in-situ groundwater is also relevant to performance assessment. Salt-laden brine is present in the rock mass at depth in many UK locations, generally forming a dense and static or slow moving mass beneath 'fresh' groundwater above.

Pre-launch

…. BGS information about the geology of the UK will be available for any communities wishing to learn more. It would be necessary to temper any early stage judgements regarding 'suitable' versus 'unsuitable' in recognition of complexities in three physical dimensions and time that have been introduced above.

Launch

… customised regional maps and models would be produced by BGS. This material would not provide definitive guidance on potential site suitability, but it would provide a framework for local authorities to understand some of the specific geological issues that might affect the feasibility of a GDF in their area.

At the same time, guidance on the performance assessment approach would be published to enable the preliminary geological information to be viewed in the wider context.

'Learning' phase

If a representative authority was interested …. a more detailed description or 'model' of the geological environments available in their area would be produced for themselves and any advisors. This would include known or estimated ground parameters (strength, permeability, etc) as well as the known or estimated disposition of different rock types and potentially important structures such as geological fault zones. The model would include actual or potential groundwater potential and discussion of past and possible future mineral extraction.

The model would include variants to reflect uncertainties and would provide an important tool for a preliminary performance assessment to be carried out. The key question would be about whether or not the area holds reasonable prospects for siting a GDF given assumptions and conclusions about the depth selected, the engineering arrangement adopted and the performance of the ground in protecting people from radioactivity.

(Para 3.20 is useful, except there's a need to say something like: … *The geological work will rely mainly on existing information together with examination of satellite and aerial images to build up a modern analysis. It may be useful to carry out some geological mapping on the ground together with non-intrusive geophysical surveys, subject to the appropriate consents being obtained.*

At the same time it would be appropriate to consider wider issues that influence site suitability: safety and environmental impacts of transportation of construction materials, protection of the health and *safety of construction workers and wider environmental impacts, for example. It would be expected that socio-economic aspects would also be considered in this phase, at least at a preliminary level to enable the representative authority to achieve a holistic view of the feasibility and implications of having such a project in their area.*

[These wider points emerge in paras 4.29 to 4.31, also 4.34, but there's an opportunity to integrate things so that without jumping around the document the reader can understand just what happens at each phase with regard to: geology and performance assessment thinking; socio-economic, health and transport effects. See Question 8 response.]

'Focusing' phase

Para 3.21 is supported in general – but the thrust of this present paper is to introduce this kind of multi-attribute thinking from the earliest stages.

The reference to *Managing Radioactive Waste Safely: A Framework for the Desk-Based Identification and Assessment of Potential Candidate Sites for Geological Disposal* is relevant (because this is an important existing document). However, it throws up two issues:

1. It refers readers to a document that describes a superseded site selection process, risking confusion; and
2. The 'geological setting' aspect plays into the over-simplification issue described above.

With regard to point 2 above, although the bullet-list in 3.21 reflects 'agreed national criteria' from the reference, some issues are:

- The term 'geological setting' tends to perpetuate the idea that some kind of generic 'setting' will provide meaningful guidance on site suitability. Specialists, or readers who take the trouble to examine the reference may pick up that 'setting' is actually shorthand for a more sophisticated interpretation of the geological environment and its behaviour, but readers of the condoc may miss this subtlety. It also throws up another term that might encourage erroneous simplistic views: 'host rock'.
- Use of the term 'host rock' tends to encourage people to think that just one rock will be involved. ('We need to find a good mass of granite'-type thinking). This sets people on the wrong track, particularly if later on they discover concepts such as 'basement under sedimentary cover' which immediately implies at least two entirely different rock types are involved, each with different characteristics.

These points play into the argument about accidental over-simplification of the role of geology in assessing site suitability. This needs to be ironed out in the condoc, even if it means revisiting the terms used and the philosophy implied in the 'framework' reference.

As an aside, it is noted that the term geological disposal facility also tends to play to a simplistic view of the role of geology. It may echo mid-1990s thinking, where the 'geology' was intended to provide all the containment required after closure of the facility. Since then there has been a move to considering the performance of the whole disposal system (including engineered barriers, containers and so-on). This might be a good time to rename as underground disposal facility to reflect this more sophisticated approach. It is acknowledged that this would be out of line with IAEA and other terminology, but this itself might be considered dated.

Question 6 – Do you agree with this clarification of the inventory for geological disposal – and how this will be communicated with the volunteer host community? If not, what alternative approach would you propose and why?

The general narrative on inventory is fine, although the insertion of a photo showing a Scandinavian used fuel disposal canister seems out of place, and might be deemed by readers to reflect the UK proposal.

The Baseline Inventory should be expressed in terms of baseline figures and wide upper and lower bounds to reflect current uncertainty. The safety assessment should cover a credible upper bound scenario from an early stage. It would be unproductive to negotiate acceptance with a community on the basis of a single 'best estimate' inventory scenario. The scheme needs to be accepted by the community on the basis that it might entail accepting the upper bound scenario – subject to demonstration of safety of course. It should be expressed as a matter of deciding whether to accept a large amount of higher activity waste or not.

It is recognised that some potential host communities might seek to constrain the inventory consigned to any local facility, for example wishing to exclude plutonium materials / used fuel. This is a difficult issue because it throws up the possibility of needing to seek a second GDF site for excluded waste. The developer needs to protect the freedom to dispose of any waste in line with current and future policy (assuming it is safe to do so), even if an initial agreement only covers a restricted part of the potential upper bound scenario.

The last bullet of 3.59 may be taken to reflect an assumption of future MOX production. It would be better to be more explicit: Any spent MOX fuel that might be produced in the future; any residual plutonium not suitable for fuel manufacture; or in the event that MOX production is not pursued, the suitably immobilised stocks of separated civil plutonium.

It's useful that fuels and radioactive wastes from military sources included in the list (3.59). There are security issues about this, emphasising the need to talk about 'upper bound scenarios' rather than definitive waste estimates. Some readers may still be concerned about the future introduction of waste from the weapons programme itself, not discussed in the condoc.

Question 7 – Do you endorse the proposed approach on community benefits associated with a GDF? If not, what alternative approach would you propose and why?

No comment on the existing text. In the case of future development of the text the basis of calculation of payment of community benefits might be introduced. This needs pre-planning, of course. Payment on the basis of amount of waste disposed of could prove problematic, and plays counter to the need to minimise quantity and volume of waste (the radioactive waste hierarchy). Payment should relate to the assessed value to the nation of having a disposal facility available at a given time.

The opportunity to more clearly describe everything that might happen in each stage (including community benefits) is noted in the response to Question 8.

Question 8 – Do you agree with the proposed approach to addressing potential socio-economic and environmental effects that might come from hosting a GDF? If not, what alternative approach would you propose and why?

The social-economic and environmental approach appears to be OK, but as noted in responses to Questions 4, 6 and 7, it would be better to explain in one place everything that might happen in each stage. After all, a potentially interested local authority will need to look at all issues from the very start.

This integration opportunity was not fully taken until Annex A (at a national level) in Managing Radioactive Waste Safely: A Framework for the Desk-Based Identification and Assessment of Potential Candidate Sites for Geological Disposal. There's now an opportunity to clarify things might work for local authorities in the context of the newly defined phased approach.

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