Siting Process for a Deep Geological Disposal facility

Consultation response to DECC

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Prof. R. Stuart Haszeldine
OBE FRSE, C.Geol

University of Edinburgh

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1. Introduction

I am Stuart Haszeldine, Professor of Geology at the University of Edinburgh. I have worked on the geology of radioactive waste disposal since 1990, and undertaken research on nuclear power within the UK energy system since 2004. This submission is based on my personal research, and that of students and colleagues who have contributed advice discussion and comment, although there are certainly other groups in the institution who hold different views. This is an institutional distillation of those group opinions. This submission tackles the questions raised by the current consultation on siting a GDF. For a full appreciation, it should be read in conjunction with the evidence and commentaries presented to West Cumbria MRWS, and to the Nirex Inquiry of 1995-97.

2. Overall summary

This consultation, a siting process for a geological disposal facility provides some welcome changes of approach, in comparison to the recent experiences with MRWS. This submission considers the Consultation in three intertwined parts:

1) The technical issues about geology, siting and construction
2) The Governance issues around who controls and advises on what
3) Who is volunteering, for what ?

Welcome points are a greater commitment to recognize many of the difficulties experienced in MRWSwestCumbria, and to learn from those in order to improve the process.

Technical: The division into three stages is conceptually sensible, but is criticized here, because the divisions between the stages are not so clear as the diagram claims, and especially that the power to decide during and transitioning between stages all lies exclusively with Government or its close agents. Most control and influence from local people is deleted a very early stage, including the Right of Withdrawal. The information stage is good, but seems to be unrealistically fast, to provide tailored geological information to those communities making initial inquiries. Engagement and learning is also good. This may require desk studies in multiple layers of information during a confidence-building conversation with volunteers. During this stage new geological information can be acquired remotely from the surface, or by drilling intervention. Deciding on continued engagement will create a set of potential decision points. It is impossible to understand why the RoW does not persist through this stage; there is no point in more "learning" after a RoW has been lost. Greater clarity of the proposed waste inventory scope is very useful, but makes the technical challenge almost insuperable. Switzerland, explicitly plans for separate burial of HLW and fuel, from ILW because of the differing requirements. Why not the UK? Lastly, there is a claim to undertake a geological search for a GDF site beneath England, possibly with some other parts of the UK. If one, or multiple, new regions emerge as candidates, in competition with yet another bid

from West Cumbria, it is entirely unclear how government will be able to reconcile the different states of knowledge between these different candidates. Will government delay progress in West Cumbria to enable other candidates to achieve the same level of geological knowledge?

Governance: A re-examination of where MRWS went wrong is welcome, and the pinch-points can be agreed. There is however an 180 degree divergence on the remedies. These consultation proposals take full power and control to central Government under the disguise of local subsidiarity. These consultation proposals create more scope for central government to take control and dictate terms to local communities than has previously been the case. The commitments to a geologically-led investigation, and information flow between government, developer, and community control is still woefully insufficient. In particular the proposed timing change for the right of withdrawal is a very retrograde step which attempts to lock-in a community before most of the information is available. Likewise the proposed membership of the local decision-making body is not democratic, but acts to reinforce central government control, and provides no tensioning of local "pork-barrel" benefits, against regional strategic stakeholder interests. To achieve a robust and concensus result, which stands the test of time, a long established democratic method is to enable informed public debate, where each side holds power valuable to the other. The design proposed in this consultation does not do that, as all power is retained by Government. The potential structures are suggested in the consultation – a group of Conty council and parishes; a group at Minister or Secretary-of-State level to include NGOs and diverse local communities and national stakeholders. But all these merely give "advice" or "consultation", and so can be ignored. There is no group, or process, to encourage alternative technical opinions to be invented, formed and raise constructive challenge against central government and its agents. This is a vital function, and has exposed fundamental mistakes of design in the past and in other radwaste sites globally. Viewed through a positive lens, many of the desirable processes or groupings are potentially available from theis Consultation. But no true power has been vested in any of the tensioning groups. If those groups outside of the District hold the right of veto, then a better job, with genuine progress could emerge from this.

Overall, the proposals are criticised for proposing an approach which could appear, to a cynical view, to be carefully tailored to enable approaching groups in West Cumbria whom the government know to be most compliant and agreeable to developing a GDF. Their agreement at District (Borough) level will be obtainable, and the Right of Withdrawal removed at an early stage, with no deflecting decision points en-route to GDF development. This consultation falls far short of providing sufficient innovation to dispel the suspicion of predetermination, which has pervaded UK attempts to develop a GDF site since the mid-1970s.

Who Volunteers ? Retention of the volunteer principle is welcome, alternatives such as compulsory purchase or imposed development would be much less acceptable. The potential to make community benefits tangible at an earlier stage is useful, though the potential to claw-back should a community with draw

is more coercion than help. The definition of community is now proposed to be Borough (District), which is spurious and arbitrary; the truly local Parish, and strategic Region (County) have no voice and are relegated to advisors. Important omissions are the communities of National Parks, of National Trust – who are charged with guarding against inappropriate industrial developments. And AONB and SSSI are also omitted. Because these were specific learnings from MRWSwestCumbria, their omission is significant.

3. Who is the Community and what is its function ?

The definition of "community" is difficult. In reality, many people will be affected by a GDF investigation, followed by the GDF construction, followed by at GDF operation. Those affected include the local neighbours, at parish scale; immediate hinterland at Borough scale; and the wider setting at County or Region scale. This consultation proposes a change of focus from MRWS, such that both County and parish are ignored, or given only token roles of advice, rather than decision-making control.

The reason for the consultation to choose engagement with elected representatives only at Borough scale is poorly justified. It is clear that county and regional government holds many responsibilities on behalf of Boroughs, for example roads, traffic planning, and not least, waste management. To create a unitary authority where these powers are combined, especially to progress one project, albeit large, is a dangerous political and governance precedent. An impartial reader is left with a strong suspicion that the choice of engagement with Borough is strongly connected with a government perception that Copland and Allendale are receptive to a GDF for local employment reasons rather than geological suitability, whereas parishes and Cumbria County are not. This is gerrymandering.

4. Who is the Developer and how does that function ?

The current proposition places central government in strong in total control of the revised siting process. The local community (whoever that is) is systematically disadvantaged by the construction of the decision-making body. Local community will find it extremely difficult to generate any impartial advice on the planning, social, financial, and especially technical propositions being put to them.

This is very dangerous territory. For example in this consultation the cartoon illustrations other GDF (Fig 2, Fig 3) propose the smallest possible footprint, compared with the NDA documentation on the full range of options. If high-level waste, spent fuel, and potentially plutonium are to be included in the infantry, then the GDF illustrated in figure 3 is too small. GDF of this size, according to NDA, could only be constructed in hard crystalline impermeable rock. So, do we infer that a pre-determination has been made, or do we infer that the information presented has been sanitised to present the minimum problem?

Either way a nonexpert community representative, and a non-expert public need impartial technical advice to suggests alternatives.

This consultation proposes that central government, or its agent through the NDA, or a subset of the NDA, becomes the developer. All of these bodies are directly financially controlled by central government, and so cannot be truly independent. By contrast, a system could be devised where central government uses style of commercial provider who bears much of the risk. That provider cannot be so easily controlled by government policy, but by their contract.

Consultation argues (p 26) that decision should be made at the lowest practical level, yet also argues that parish councils are too low a level because they have no competency. It is clear from the recent MR WS West Cumbria process that Borough councils do not have the competency either, because numerous consultants and advisers were employed to produce that information to a group spanning county and borough and parish councils. Current experience with licensing capability for shale gas developments in the deep subsurface throughout England also demonstrates that Borough (District) do not hold the competency to evaluate complex technical propositions of national significance. It is, therefore entirely not logical to propose that district councils should hold the decision-making powers and right of withdrawal. These councils are clearly conflicted with the wish to obtain investment for development on the one hand, set against their responsibility to future generations and the wider county Community on the other. Consequently the proposal to set up a steering group (Page 30 sect 2.53), which is entirely composed of the local Borough central government an NDA is inherently biased and not fit for purpose. An explicit tensioning mechanism is needed, whereby parishes and County representatives can be independently informed and can hold the right of veto. It is recognised by the consultation in section 2.80, that this role cannot be taken by the UK regulators, who would then become part of the process rather than independent from it. This could be viewed as an adaptation of the Swedish style of successful community engagement where the developer is tensioned by an independent regulator and an independent NGO, who is responsibility is to represent citizens who hold a stake, but are disenfranchised from the district benefits payment. The proposed consultative partnership (Sect 2.54) could fulfil this role, but only if it has real power of veto, not just advice. The proposed increase role of the GDIB (Sect 2.83) is welcomed, but again is simply advisory rather than wielding real power in public.

5. Right of Withdrawal

The right of withdrawal is proposed to be terminated very early in the siting process. This means that government is requesting region, or a community, to agree to a full series of investigations leading to development, when very little information could be available. This is discussed him section “national search”.

Although this consultation proposes that critical decision points should not be part of the process, in reality information will rise progressively throughout

evaluation. Philosophically, government appears to have taken the approach that "all problems can be solved". Investigations are posed in terms of "confirming suitability" (page 7). That is neither logical, nor financially rational . By contrast problems may emerge which are unexpected, or show greater difficulty. Clear criteria are essential, for what constitutes success, and for what constitutes difficulty, and for what constitutes failure. These need to be specific and numerical. Process proposed in this consultation creates a clear risk of a slippery slope effect were a continuous flow of development once a right of withdrawal is given up, creates an inevitability towards GDF development whether the site is correct or incorrect . The affected community must, therefore, be able to retain their own right of withdrawal throughout the entire process, until a formal planning application is made. The present position, were central government can overrule all local decisions, is very unhelpful needs to be specifically changed in legislation if confidence is to be built and retained with local volunteerism.

6. National search

This consultation proposes a national search for a GDF host community, including improved information on subsurface geology. That is a welcome development. However it remains very unclear how this will be enacted. The approach appears to be somewhat passive, by informing regional local authorities that local benefits could be available, and then relying on local administrations to take an initiative in approaching central government. UK has a substantial legacy of social distrust concerning radioactive waste, derived from the military origins of civil nuclear power in the UK. And, especially for waste disposal, derived from the serial failures of the 1970s 1980s and 1990s and 2010s. This passive approach is very unlikely to succeed, and will both waste time and also enable government to claim that no volunteers were forthcoming.

A positive and proactive approach is suggested. Most UK citizens have little idea of the geology below their community. Even fewer will have a concept of the suitability of their geology for a GDF. This consultation provides a sensible suggestion is to provide potentially interested communities with accessible explanations of the geology deep beneath the feet. However, it is not clear that a sufficient level of detail can be provided by the British geological survey in the short time allocated during the engagement phase. Consideration could be given to the trade-off between a community report produced very generically within four weeks, first as the value gained by producing a more tailored and specific report with a lead time of two or three months.

During a national search, it is unclear what is being sought. The approach appears to be to exclude manifestly unsuitable regions. Whereas, an alternative approach could be to specifically seek the most generically suitable regions of the UK and for government to engage positively during an engagement phase with multiple regions or counties.

There has also been push back by government that a national evaluation of geology for a GDF would be unfeasibly expensive. I do not agree. The UK is well

surveyed, with an excellent digital database capable of rapid and high-quality interrogation for expert judgement purposes. There are also substantial numbers of legacy documents held by BGS and NDA concerning previous national searches for a GDF. These are still useful.

By analogy with site searches for civil construction projects, site searches for hydrocarbon and other resource development, or site searches for CH4 or CO2 storage, a very significant impact could be rapidly made through screening existing data as an desk study, for a cost less than £1 million. The five or 10 most suitable regions can then be evaluated more specifically, at a desk study, for a further one or £2 million. This provides an impartial evidence base for government to engage proactively with the most suitable UK regions.

Inevitably, the requirement for more specific, and fit for purpose modern information will emerge. This will include improved remote sensing of rock body geometry, unlikely fracture location and intensity, groundwater salinity, groundwater flow, groundwater geochemistry, subsurface pressure, temperature. All of these aspects can be estimated in advance, by professional expert judgement. But that is not a suitable basis for making a rational decision to progress. Additional, specific, information may be obtained through non-invasive geophysical surveying from the surface. At remote sensing needs also to be tested by invasive drilling to depths of one or 2 km. this process of work will occur during the proposed focusing phase. The results of such work may support initial optimism that the region could be suitable in its performance as a GDF, or this additional information could be detrimental to GDF performance. This potential workflow has three main consequences:

A) asking a community to cede their right of withdrawal before these investigations have occurred is premature and very unhelpful. That would amount to pre-determination of any regions moving from engagement to learning.
B) To enable clear communication during the focusing phase, then clear targets on hand criteria need to be established to describe what amounts to a successful how come from these preliminary investigations, and what amounts to an unsuccessful outcome. These criteria should be specific - for example numeric thresholds in terms of geology, groundwater, flow, and overall containment performance.
C) It is already known that some regions of the UK have been geologically investigated more than others. For the purposes of the GDF, West Cumbria has been intensely investigated, and Caithness partially investigated. To enable rational comparisons to be made, a sufficient quantity and quality of evidence is needed from multiple candidate regions. The process of investigation outlined above, from desk study, to remote sensing from the surface, to deep borehole, requires several years. Therefore government will need to wait for less well-developed investigations to catch up, before making any decision on progressing two more detailed focusing with a few promising regions. There is no recognition of this phasing problem within the consultation.

7. Geology first combined with engineering and its flaws

In all nations with successful progress on their radwaste disposal programmes (Finland, Switzerland, France, Canada), there is a very explicit commitment to two types of radwaste containment. These two types are an engineered barrier, AND a geological barrier. The UK is very unusual, possibly unique, in claiming reliance on an engineered barrier, with the function of geology being relegated to "containing the engineering ". NDA have stated that a less desirable geological site could still be made to perform, by spending more effort (and money) on the engineering. This surely means that there is large potential value in searching for candidate regions where the geology is inherently more suitable for containment, and so will be more resilient against mal-performing engineering, and will be cheaper to design and build. Resilience and fail-safe chacteristics are very important, as cleanup of leaking GDF is somewhere between expensive and impossible, as shown by Dounreay shaft in the UK, or Asse salt disposal and recovery in Germany.

From this it is apparent that reliance on engineered containment in a poor geological site is both more expensive, and less resilient to unexpected outcomes. In the recent history of UK radwaste, the NDA has claimed west Cumbria to show promise as a region to host a GDF, but has failed to provide any specific information on numerical performance criteria or on sites. By contrast the balance of probability is clearly that the west Cumbria region is not adequate, because of its basic geology – tested by the Nirex inquiry, completing in 1997, and by geological contestation during MRWS completing in 2013. To place all reliance for a complex and large UK GDF into one region, which is geologically suspect, is a high-risk search strategy. There is a risk that proceeding with just one region, even with multiple potential sites, is vulnerable to failure – as it has been before. Proceeding with several regions in parallel provides an "insurance" to achieve a greater probability that at least one region will be suitable as a storage site. Other countries have adopted this type of approach where several regions are evaluated, progressively reducing the number through clear pass/fail criteria of predicted performance. This results in a short list of 3 to 5 feasible sites, from which one has been chosen for detailed investigation.

8. Lessons (not) learned why engineered containment looks almost impossible, and geological containment is required

Reliance on engineered storage requires high-quality prediction of the performance of the constructed facility into the far future. This needs to scope the range of possible outcomes, not just the best case or 50% probability central case. To undertake engineered storage as the primary containment mechanism, with minimal reliance upon natural geological containment places the UK in the very difficult position of making extremely accurate predictions into the far future. This is impossible to the required level of accuracy,, this is natural justice system is imperfectly known, and natural processes are imperfectly known. That means, although extremely expensive and accurate measurements can be made at the present day, or during the next 10 decades, when predicted into the far

future and the uncertainty is propagated forwards, then the range of possibilities becomes ever wider. That is the opposite of what is required. Here are three examples, which show that there is sufficient uncertainty to render reliance on engineered containment persistently insecure. These are given as examples to demonstrate that geological containment is essential, engineered containment is a useful addition and backup. For a robust and resilient safety case each method, geological, and engineered, should be able to function to provide containment without the other. Consequently a secur geological site is needed, and a national search is required to identify potential candidates. The West Cumbria region is known to be unsuitable, and no definitive evidence has been produced by NDA to overturn the conclusions of the 1997 Nirex enquiry, which is conveniently ignored. In simple terms, a belt and braces approach is needed.

8A) problems from groundwater

It is now well understood that the Nirex investigations of 1980 to mid 1990s screened whole UK, to select West Cumbria in a way which still seems to defy the scientific evidence. Nirex undertook drilling campaign, producing extremely accurate and precise measurements of the rock architecture and groundwater. This was used by Norwich to simulate water flows in the subsurface as an essential part of the safety case. In their planning application, directs per trade the average probability results from their groundwater measurements, deliberately excluding the beneficial extremely low permeability of rock to fluid flow, and deliberately excluding the very high permeability fractured rock to fluid flow. That led to a presentation of results which produced an average safety case into the future. That means there is a 50% chance of performing better than that, but also a 50% chance of performing worse than that. Even odds. There are very few hazardous activities in UK public procurement individual lives, with people voluntarily take a 50-50 chance of being spectacularly or fatally wrong.

The detailed method flaws in the Nirex approach, including simulation of faults as the same flow properties compared to the surrounding rock (which is blatantly incorrect, the faults are at least 10 times more permeable), only became apparent by undertaking replicate work, through university researchers at the University of Glasgow. Their work investigated the potential ranges of outcomes rather than choosing a single most likely outcome. That clearly showed the prediction of groundwater flow patterns, rates, and the effects on GDF containment performance had persistently large range of possibility, about half of which produced a failure in the safety case criteria. This was one of them significant reasons in rejection of the Nirex GDF proposition, and is still as true today as it was in 1997. Similar stories can be outlined concerning the unexpected complexity and poor predictability of the geology, and the unexpected detailed complexity of geological faults revealed by detailed seismic reflection survey, and the unexpected detailed complexity and unpredictability of groundwater flow pathways between closely spaced adjacent boreholes.

The point here is that measurements of a natural system cannot be made to predict its behaviour into the far future with the required certainty for

radioactive waste disposal. Without such prediction, secure site performance has to rely completely on engineering.

8B) problems with copper canisters

The NDA proposed design for near-field storage includes explicit reliance on copper canisters. The theory being that these can seal waste physically, provide chemical containment (potentially to limit soluble iodine) and act to sterilize bacterial interactions. It is therefore a critical part of the complex layers of the near-field containment design.

The concept of copper canister containment was developed in Sweden during the mid-1970s. That design, of multilayer containment, became KSB-2.
That design concept was undertaken within weeks, due to external political constraints at the time within Sweden. During the following year in 1978, the concept was improved to become KSB-3. In this design process the information used by SKB in Sweden assumed that groundwater surrounding the canisters would be exceptionally pure. In the UK a similar short-term need emerged to develop a politically acceptable storage proposition. The UK adopted a Swedish KSB-3 design, without time for additional evaluation. The copper canister concept has remained an integral part of the design, without significant work to confirm that canisters enclosing radioactive waste would remain intact for at least 100,000 years. However in 2007 G. Hultquist and P. Szakálos of Stockholm published experimental results showing that copper corrosion can occur in water, via a novel and previously unknown reaction. A 2010 review by the nuclear industry (SKB from Sweden and Posiva from Finland) claims the original concept is robust. However testing by Prof Digby Macdonald, an independent USA laboratory outside the nuclear industry, shows that copper will corrode if the water is not pure, especially if the groundwater is a brine, or contains miniscule quantities of reduced sulphur H_2S, HS^-, $S^{2-}$and especially if the water is low in free hydrogen gas. This is still a scientifically controversial topic, but is important because the corrosion rate is at the heart of KBS-3 multi-layered engineered disposal design. That work was commissioned and published in 2011 by the SSM, Swedish radiation safety authority Stralsakerhetsmyndigheten. It is necessary to make accurate predictions stepwise for 100,000 years into the future in an extremely complex geochemical system of groundwater-surrounding heterogenous rock- engineered multiple layers- and the heterogenous waste itself.

The significance of this is that a critical part of the engineered design may prove to be founded upon a series of unjustified assumptions. This challenge has arisen at an extremely late stage of the evaluation process, after construction of the Finnish repository has started which intends to use this disposal system. Also, that the nuclear disposal industry itself seems unwilling to contemplate a challenge to its established system, and the challenge has had to come from unfunded science outside the nuclear industry, has initially been denied by the nuclear industry, and the challenge has later been confirmed by scientists from outwith the nuclear industry. Although the extremely complex geochemical calculations are not yet complete, in simple terms it seems that to reduce

corrosion of the canisters requires zero-sulphur groundwater and slow movement of hydrogen away from the canisters. The conflicts directly with the need for free gas escape (see below). In simple terms, the engineered system could be fundamentally flawed, and will need geological containment around it to ensure secure performance.

8C) problems with gas escape

It has long been recognised that gas will be generated within a GDF. In 1994 a Nirex science report stated *"During the post-closure phase of the repository significant quantities of gas will be generated, principally by the coupled processes of metal corrosion and microbial degradation of organic, particularly cellulosic wastes. The principal gases formed by these mechanisms are hydrogen, carbon dioxide and methane. In addition, hydrogen sulphide may also be formed in significant quantities from microbial attack on sulphate ions in the wastes and groundwater."* Comparison with 8B above, shows a fundamental dilemma. Large quantities of methane and carbon dioxide require leakage from an engineered repository, whereas to limit copper corrosion hydrogen requires to be contained. Microbes will process the waste to produce sulphates, which the engineer disposal aspires to convert into sulphides, which will promote copper canister dissolution. In addition, an Environment Agency report from 2008, summarizing the state of knowledge on gas generation and leakage from a GDF, states that "a small proportion of the generated gas will be radioactive, mainly as a result of the incorporation of tritium and carbon-14 that will be present within the waste". This 2008 review acknowledges that substantial detailed work has been undertaken by directs and the NDA, but also that many significant and fundamental issues remain to be resolved. In particular, the 2008 review states *"Gas migration through the geosphere has been shown to depend on fine details of the geology and hydrogeology of the overlying strata. During site screening and selection the need to demonstrate that the geosphere will retard or disperse gases will need to be considered more than perhaps in the past.".* Problems of gas generation and migration are still a key priority for NDA research today.

Consequently it appears that although research on gas generation a migration from GDF has been undertaken for more than 20 years, the intractable problem still persists. It is now even more clear that a dilemma exists, with irreconcilable factors pointing in opposite directions, either for release of large gas quantities, or for retention of gas. It remains completely unclear how, or if, engineered containment of a multilayer backfill in the GDF could retain different quantities of hydrogen gas generation from different parts of the GDF, whilst also releasing radioactive methane rapidly enough to preclude fracturing of the engineered containment and ingress of groundwater, which can not be remediated after closure. The role of surrounding geology can again be crucially beneficial, to enable retention of gases, or provide geochemical reactions to absorb and eliminate gas leakage. This dilemma is extremely hard to resolve in an engineering fractured hard-rock GDF, but as shown in Switzerland or France, is much easier to resolve and reconcile in a GDF constructed within sediments and rocks which have the appropriate physical permeability characteristics and are geochemically suitable for retention. Relying solely on engineered containment

is not credible.

9. Surface storage

Throughout UK radioactive waste disposal history, there has been a lack of clear road mapping from cradle to grave stop consequently the decisions taken on reactor type and operation, decisions on once through fuel cycle versus reprocessing, and decisions on encapsulation and storage are not joined up. This is still manifested by omissions within this consultation.

At Sellafield is large quantity of existing waste, and future arisings are predicted for disposal in a GDF. Much of the legacy waste is still not adequately contained, with notorious outstanding issues as far back as the 1950s. Even with favourable and unhindered site identification and evaluation process for a new GDF, then waste will not be emplaced in a GDF until many tens of years from now. Although slow progress is being made, this legacy waste problem requires that storage on the surface at Sellafield or elsewhere in the UK, is much more seriously addressed than it is being now. Many of these storage facilities are imperfect and provide a much greater risk to workers and the public and environment than a planned GDF ever will.

The explicit inclusion of spent fuel and ILW from newbuild 16 GW of reactors is a welcome clarity. Which is not to say that it is agreeable to a potential local community. Irrespective of that, the design of new build reactors implies that waste arising is will be intensely radioactive for a period of many decades and hundreds of years after use. Surface facilities to allow cooling through time decay of radioactivity, will be essential. That is part of the waste disposal process and somewhere in the GDF proposition this needs to be recognized that surface facilities will be needed for hundreds of years, somewhere.

Surface facilities need not, of course, be co-located with a GDF. It is very clear that radioactive materials, including high-level waste, have been transported around the UK for many decades, and will continue to do so from existing, and potential new-build, reactors. The NDA clearly state on their website that no incidents have occurred since 1965, therefore transportation must be regarded as proven safe and secure. Looking forward in time through a potential programme of new-build and operation, the proposed types of reactors are calculated by CORWM II to produce very hot wastes, with more radioactivity than is currently held in west Cumbria. This radioactive material, smaller in volume but more potentially hazardous in its characteristics, will need transporting to west Cumbria, or elsewhere. Consequently, there is no over-riding requirement to locate a GDF in west Cumbria “close to over 70% of existing wastes”.

An additional fundamental point exists, that UK policy on radioactive waste disposal has never really interacted with the design and operation of nuclear-power reactors and the fuel and waste reprocessing cycle which generates waste. Having ignored, or refused to classify, spent fuel and plutonium as waste

since the mid-1950s, it now seems possible that the UK may be about to form plans for disposal of these materials. That could be somewhat ironic, because of emerging propositions for different nuclear reactor designs, and even breeder reactor designs, which could utilise this spent fuel and plutonium as fuel sources. It is possible that instead of being a waste, these materials could form the basis of low carbon energy production for many hundreds of years into the future, utilising material which is already held in the UK. Planning for co-disposal of these materials greatly complicates the design of a GDF, and is not undertaken elsewhere on such a scale. In Switzerland, separate GDF are planned for spent fuel and ILW, because of the different packaging and chemistry required, together with the very different heat production during burial. There has been no clear technical explanation of why the UK seeks co-disposal of both ILW and spent fuel, other than the supposition that a willing community will be prepared to accept any inventory. A contrary opinion suggests that it may be more wise to plan for reactors specified to de-weaponise the plutonium, and to store plutonium and spent fuel in the shallow subsurface, in anticipation of its re-use as fuel.

10. Jobs

There is much controversy about the employment benefits of a GDF. In some respects this is no different to any other large construction project. During the first scoping phases and surface evaluations through to deepen phase of drilling and practically all the jobs will be skilled contractors from outside the area selected. In the second phase of actual construction which may last tens of years, the jobs will be a mix inside the areas selected with the majority of skilled machinery operators from with the area. In the third phase of GDF operation it is clear from information published by other countries, that only tends of jobs will be created, potentially at 200. This is not a West Cumbria employment bonanza.

Similar effects are noted in the potential for employment from shale gas investigations, where the AMEC SEA report for DECC in 19 Dec 2013 states that a maximum 17% of the jobs will be local. The process outlined for GDF consultation does not seem to make this clear.

11. Alternative geological sites

There has been a truly remarkable lack of success by UK government in seeking alternative sites for GDF. A few attempts have been made, but have been thwarted before reaching any public statement, or have been thwarted by rapid mobilisation of an opposition locally. The problem of negative public perception for GDF is clearly unique and extreme.

A well entrenched public view can be changed and even overturned by long-term campaign of information and persuasion and trustworthy actions by government. The present resurgence of nuclear new-build could be regarded as one example. The determined Government campaign in favour of unconventional gas exploration in England may be another. For government to gain trust, leading

to acceptance, of radioactive waste disposal is likely to require a campaign of many years. That is, partly, what the volunteerism process is supposed to be about.

Experience from other nations shows that public agreement to accept GDF is often successful where there is a coincidence of a nuclear facility at the present day land surface, combined with suitable subsurface geology. Using the Nirex national screening of the 1980s, it is clear that there are several such candidate regions in the UK
http://www.geos.ed.ac.uk/homes/rsh/possible_UK_radwaste_sites.html ;

1) Caithness 2) Anglesey 3) Hartlepool (evaporite mines) 4) Norfolk (empty military space at Stanford, not nuclear site) 5) SE Kent 6) And, possibly, east of Oldbury. The point is not that such candidate regions exist, but there has been no attempts by government either gain additional geological information in these regions, and no sustained campaign by government to provide geological and nuclear education to the surrounding publics. West Cumbria has, since the 1970s, been persistently perceived by UK Government as a winnable political option irrespective of its geological suitability – which amounts to pre-determination.

A predetermination attitude appears to exist in present-day government, with comments by Minister Fallon on 10 Dec 2013 to the House of Lords Science and Technology Committee.
"…. *it is not right a county council should have a veto over a project..."* and later *" ... an overarching local authority should not have the right to veto...";*

a wider county has no real interest in the siting of a GDF"; and *"the immediate local community should dominate".*

" that the consultation has already ended" and later…. *"that consultation has now closed";* At that time consultation had *NOT* then ended or closed. These statements by the Minister provide a very negative impression that DECC is making an authentic consultation. These comments re-enforce the established perception that Government is not being straightforward in its dealings with radioactive waste, and do nothing to assist in searching for alternative sites.

As commented above in this consultation reply, the proposed reconstruction of MRWS volunteerism and decision-making to empower local or Borough councils, and exclude parish councils and county councils, is exactly designed to enable one or two West Cumbria local authorities to make decisions which are convenient to Westminster government in favour of siting a GDF in their locations.

Searching for alternative geological regions also suffers from a problem that some of the best combinations of geology with surface acceptance, may well lie beneath regions which are very sparsely populated. One example of that is Stanford in East Anglia, where the population seems to be fewer than 10. How do such sites "volunteer" ?

A second and broader example, are sites beneath the coastal or nearshore zone of the UK. On both the East Coast and West Coast are geological circumstances which are potentially extremely suitable. These are layers of evaporite salt minerals, which slope offshore to contain groundwater flow downwards and away from the land surface. These result from the drying out of geologically ancient seas. These bedded layers are impermeable to water flow, and their continued existence to the present day testifies to a lack of penetration by deep groundwater circulation.

On the east coast, excavating and maintaining tunnel networks in these layers is entirely feasible, as shown by the Boulby potash mine in East Yorkshire, with a depth of 1300 metres. In the very earliest days of search for radioactive waste disposal in the UK the Billingham evaporate minds were considered, but rejected after public opposition. These remain a geologically very suitable location.

On the west coast, it is under-appreciated that immediately offshore of Sellafield are thick layers of bedded salt in the Triassic Rossal, Mythop, and Preesall Halites. These extend down to 1100 m below seabed, and provide a perfect upper seal against groundwater movement, even through forthcoming glaciations. Gas generation and migration away from a GDF can occur laterally and downwards through permeable sandstone sediments, percolating into the wider deep sedimentary basin and not moving towards the surface. Access could be by construction of a tunnel some 25-40km in length direct from the Sellafield site. That completely eliminates any transportation and security problems. The main obstacle is potentially legal rather than technical, being criteria set out in the OSPAR conventions

10. Summary and conclusions

1.Do you agree that a test of public support should be taken before the representative authority loses the Right of Withdrawal?

Everyone must have complete confidence in the process. There must be a high level of engagement, openness and complete transparency.

Decision making within the process should **involve** as broad a group as is democratically practical.

There must be enshrined the legitimate and democratic **Right of Withdrawal** by potential host communities, parish councils,

district councils and the county council (or unitary authority).

2.*Do you agree with the proposed amendments to decision-making within the MRWS siting process? If not how would you modify the proposed phased approach or alternatively, what different approach would you propose?*

The proposed new arrangements outlined in the consultation paper show a complete lack of independent advice and no genuinely impartial supervision of any of the processes.

We strongly disagree with the changes in arrangements that allow District Councils to act as the Representative Authority. We also disagree with the suggestion that the Leader of the Representative Authority should chair the Steering Group.

3.*Do you agree with this approach to revising roles in the siting process set out in the White Paper? If not, what alternative approach would you propose and why?*

The proposals will allow for a body, most likely to be a Borough or District Council, to express an interest. This body will then be responsible for steering the project and finally, as Representative Authority (RA), it will decide upon a right of withdrawal. These powers should not be held by one body.

A GDF project will cross many service boundaries, highways, minerals, planning, safety and waste disposal. By limiting the County Council to a consultant role it seems that DECC wishes to remove obstacles to the outcome that they want. DECC are not creating a process properly based on voluntarism.

It is vital that any further siting process must include a clear and unambiguous definition of a Host Community.

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?*

Selection of the suitable geology for ***geological*** disposal of nuclear waste must be the number one priority. DECC has chosen in this review to mislead, misrepresent and distort the facts in order to engineer the outcome it wants.

A national screening process for sites with suitable geology is possible. The data already exists that could be examined and compiled into a national report within a matter of months.

It must be emphasised repeatedly that the long term safety of a GDF depends almost entirely on the geology in which it is placed.

5.*Do you agree with this proposed approach to planning for the geological disposal facility?*

The 'representative authority' role should not be delegated to a district council. A County Council must have a participative role rather than merely a consultative one.

There will be conflict of interest if the final decision about a GDF application is adjudicated by the Secretary of State for ENERGY. This is not acceptable.

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?*

DECC appears to be ignoring the government's Committee on Radioactive Waste Management (CoRWM) recommendations

by including waste from a new build programme in the revised Baseline Inventory.

Why set up an advisory committee if you choose to ignore inconvenient conclusions?

7.Do you endorse the proposed approach to community benefits associated with a GDF. If not what alternative approach would you propose and why?

It would be totally wrong to suggest to a community that its economic future and well-being depended on an agreement to host a GDF.

Community benefits could be paid from the 'focusing phase'. A volunteer community could come forward at that stage and benefits could be paid to that community. If the geology were then found to be unsuitable government retrieval of these benefits would be hugely disadvantageous to both the community and the representative authority.

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?

It is important to prevent a community feeling that it is under pressure to accept a GDF to bring it out of economic hardship. Any socio-economic information presented to a community should be factual, unbiased and delivered by an independent body.

There should be clear separation of the environmental issues from the economic issues. With regard to environmental issues, it would appear to be illogical and entirely counter-productive to

attempt to put a GDF where it could adversely affect any nationally and internationally protected areas (National Parks, Areas of Outstanding Natural Beauty, World Heritage Sites, Special Areas of Conservation, Ramsar Sites, Special Protection Areas).