

Comments on statements by McKirdy and Yardley
David Smythe
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All statements below are justified in my MRWS consultation submission. Quotations are in italics.

Bruce McKirdy

Lines 1-5: *The British Geological Survey's study ... of West Cumbria's geology ruled out about 25% of the area as having unsuitable geology, the remaining 75% includes rock types similar to those being investigated in other countries for hosting a geological disposal facility. Therefore, further investigation of the geology of West Cumbria is justified.*

These two sentences are wrong for the following reasons:

1. The BGS screening report did not exclude 25% of the geology because it was “unsuitable”, but because of the risk of future intrusions and/or natural resources. This is irrespective of its suitability or otherwise for a GDF.
2. The statement “*rock types similar to those being investigated in other countries*” is untrue. There is no granulite at the surface (cf. Sweden, Finland), nor plastic clay in a flat unfaulted layer (cf. France, Switzerland, Belgium), nor rocks hundreds of meters above the water table in a desert environment (cf. Yucca Mountain, USA); nor do any of these countries propose a GDF in, or adjacent to, steep terrain such as found in West Cumbria.
3. Therefore the statement that “*further investigation of the geology ... is justified*” does not follow.

Lines 12-16: *NDA has reviewed the applicability of these safety cases to the range of UK wastes and geological environments. This review showed that there is a range of repository concepts which could be adapted to enable safe and secure geological disposal of UK wastes in a number of different geological settings.*

Not true – none of the “*repository concepts*” discussed by the NDA go into the regional geological environment surrounding their concepts. Their understanding and use of the geology as the final barrier in their multi-barrier approach is derisory, as I pointed out in my MRWS consultation submission. The geology input, as applied to West Cumbria where evaporites are not relevant, boils down to the oxymoronic assertion that ‘a suitable host rock will be found’.

Lines 30-34: *... the International Atomic Energy Agency sets safety requirements and gives guidance on geological disposal. It sets a requirement for a multi-barrier system in which the various engineered and natural barriers contribute to the two principal objectives with respect to providing safety - the isolation of the wastes and the containment of the radionuclides associated with the wastes.*

The current MRWS West Cumbria process signally fails to follow the IAEA and other national and international guidelines on how to find suitable geology.

Lines 67-70: *For example, in Sweden groundwater return times are relatively short and the highly-engineered barrier system for spent nuclear fuel comprising a thick-walled copper*

canister surrounded by a bentonite buffer makes a strong contribution to the containment of radionuclides. The rock provides protection of these barriers.

The engineered Swedish 'KBS-3' barrier system relying on 'thick-walled' copper cylinders has been shown to be unsafe on a timescale 1000 times shorter than the one-million year timescale initially predicted. Safety therefore depends on the geology, which is highly complex and faulted. The scale of the Swedish repository is far smaller than that proposed for West Cumbria.

Lines 73-76: In the safety case developed in the UK in the 1990s, the geological barrier provided by the Borrowdale Volcanic group overlain by St Bees sandstone contributed significantly to safety by providing a long travel time somewhere between that expected in Sweden and France.

The modelling supposedly providing the 55,000 year travel time from the BVG repository to the Irish Sea was essentially fiddled, by discounting the flow and guiding effect of the faults cutting both the BVG and the overlying sandstones all the way to the surface. The fiddled result was achieved by applying the same permeability to the finite element model elements representing the fault zones as to the surrounding rock, with the effect that in the fluid flow prediction, the faults are simply not there.

Lines 80-82: However, a definite answer on suitability of a particular location can only be given once the combination of engineered barriers and the surrounding geological environment have been considered together.

This statement betrays a fundamental misunderstanding of the safety case. The 'engineered barriers' and the 'surrounding geological environment' are separate, independent entities. When (and not if) the former fails, the latter takes over, as the final and most important barrier. The final barrier of the natural geology is (by definition) unaffected by the local engineered, or man-made barriers. A good (or bad) man-made barrier is predicted to last, say, m years, and is then superceded by the natural barrier lasting n years. The safety case is of course the sum of the two numbers $m + n$, which should add up to 100,000 years or 1 million years or thereabouts, depending upon what exactly has been placed in the repository. The number m is of course important, in that it comes first, when the radioactivity and heat generation are most intense, but it is of the order of 10 to 1000 years. This leaves 999,000 years (or more) for the natural geology to provide the final barrier for as long as excess radioactivity remains in the waste.

Lines 87 to 99 discuss the Nirex Sellafield investigations, and lines 100-117 discuss the Inspector's conclusions. What Mr McKirdy omits to mention is that the detailed drilling and logging around Longlands Farm merely demonstrated that Nirex did not understand the water flow, even between two boreholes 100 m apart, and that the complex structure was misunderstood. He omits the Inspector's damning conclusion that the site should never have been selected. He concluded: "*this site is not suitable for the proposed repository, and that investigations should now be moved to one of the more promising sites elsewhere.*" [Inspector's report, 8.53] – and by 'elsewhere' he meant one of the other shortlisted sites in the UK, not elsewhere in West Cumbria.

It is noteworthy that there are no criteria set out in advance by which the suitability or otherwise of a site can be measured. The whole tenor of the NDA's approach to West Cumbria is essentially that more and more study and modelling will eventually turn up an acceptable site. If this attitude persists the mistakes of the 1990s will simply be repeated.

Contrary to what Mr McKirdy states in lines 126-129, there is already ample geological information on which to base an informed decision. The BGS analysed the whole of the UK in the 1970s, then repeated the search in the 1980s with more advanced geological concepts, and has evidently revised this search in the early 2000s.

Lines 130-156 are just generalisations about existing survey technology, all of which have in fact already been used in West Cumbria. None of these newer methods solves the fundamental problem of complex, unpredictable, and therefore unsafe, geology.

Bruce Yardley

Lines 53-77 comprise platitudes and generalities concerning what constitutes ideal geology, adding little or nothing to the substance of the debate about West Cumbria.

Lines 78-80: Establishing whether there are large enough blocks of impermeable basement rocks between major fractures to site a repository requires detailed geological investigation, and there has been progress in this for the Sellafield site, but only after the failure of the Nirex appeal.

This statement presumably refers to the Nirex 97 set of documents published in 1997-98, after the inquiry. There has been no real progress; my analysis of the hydrogeological modelling used to build the safety case demonstrates that Nirex continues to fail to understand the complexity of the the rock volume being modelled, and, furthermore, that it is inherently not modellable because of the faults and fractures to which Prof Yardley refers in the previous paragraph.

Lines 81-98 comprise generalised criticism of the research conducted by Prof Haszeldine, but no details are provided. Given the importance of this work in apparently disproving Nirex's safety case, it is astonishing that the nuclear waste disposal industry has not, some 15 years later, tried to refute this research in any detail. My conclusion is that the industry has not done so because it cannot.

Lines 92-96: In the final stages of the Nirex programme, they completed their own investigation of flow in fractured basement rocks, published in reports and as a peer reviewed paper in 2003. This study provided large amounts of information that was not available to Haszeldine and confirmed that many of the assumptions made in the earlier 95 work were not reasonable.

This once again refers to Nirex 97.

Lines 106-109: There is now the technology and software available to construct detailed block diagrams of faulted regions of sedimentary basins and predict where fluid will flow across faults and where it will be retarded. Comparable detailed diagrams are prepared for basement rocks as part of major mining operations.

Prof Yardley is stating the obvious, regarding mapping technology used routinely by the hydrocarbon and mineral mining companies. He is confusing resolution and detail of mapping with understanding of fluid flow in a complex faulted environment. Errors in prediction by an oil or mining company are unimportant, and have merely local and temporary financial consequences. The accuracy of prediction required for nuclear waste disposal is orders of

magnitude greater, because we are dealing with geological timescales, and not just the few years required to find and extract a natural resource.

Lines 117-119: *Many of the geological arguments against the possibility of a safe repository site in west Cumbria are unsupported by published scientific evidence or detailed explanation and have not been subject to peer review.*

Academic peer review is no guarantee of accuracy, although it does serve to exclude idiots and nutcases from publishing in serious academic journals. In fact, most of the extremely detailed published research on the geology of West Cumbria has not been externally peer-reviewed; that does not necessarily mean that it should be ignored. If that were the case, then most of the BGS maps, memoirs and reports, together with about 98% of Nirex material, would have to be rejected. The statement that certain arguments (such as I have made) are “*unsupported by published scientific evidence or detailed explanation*” is evidently false. My explanations, for example, in my MRWS consultation submission of March 2012 run to some 168 pages of text, including diagrams, and backed up by 93 references to the literature. This is true detail. Perhaps what Prof Yardley means is that he has not *read* such detailed evidence.