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18 June 2012

Mr R Bennett
c/o West Cumbrian MRWS Partnership
Copeland Borough Council
The Copeland Centre
Catherine Street
WHITEHAVEN
Cumbria
CA28 7SJ

Dear Mr Bennett

ACTION 5: GEOLOGICAL DOCUMENT REVIEW OF CONSULTATION SUBMISSIONS

As requested, I have undertaken a review of the following three documents;

- Smythe, D.K.: Response to West Cumbria MRWS Consultation: Why a deep nuclear waste repository should not be sited in Cumbria
- Haszeldene, R.S.: Response to West Cumbria MRWS Consultation: Geological Disposal of radioactive waste in West Cumbria
- Notes of MRWS Steering Group including discussion with the Lead Inspector and Technical Assessor from the Nirex Inquiry

The purpose of this review was to provide comment on whether these documents change my previously held opinions regarding the level and type of geological information that is available for West Cumbria with respect to the current Stage 2 of the MRWS process; principally whether these documents indicate sufficient geological data already exists to preclude going any further in the MRWS process and whether or not there is a realistic prospect of a potentially suitable site being located within West Cumbria.

Since my last documented response on the geological consultation process, Professor Smythe has provided additional data, and his personal opinions/interpretation of these data, in a series of published documents and public lectures. I understand he has compiled all this additional information into the submission document identified above. I have also participated in a number of the public consultation meetings and have received a wide variety of questions/opinions/interpretations/feedback on the geological information available on West Cumbria as it pertains to Stage 2 of the MRWS Process. I have tried to

synthesise this information into this letter report. Professor Haszeldene has presented his opinions regarding the geological, and in particular the hydrogeological, issues with respect to the prospective disposal of radioactive waste in west Cumbria. Lastly, Mr Colin Knipe (Technical Assessor at the Nirex Inquiry), together with Mr Chris McDonald (Lead Inspector for the Nirex Inquiry), have summarised the issues that led to their rejection of the Nirex application for a Rock Characterisation Facility (RCF) at Longlands Farm, and the implications of these to the current MRWS process. Where necessary, I have drawn on the minuted records of this meeting; in particular the issue of sufficient geological data already being available to reject the entire West Cumbria region and on the possibility for ultimately finding a potentially suitable rock volume in West Cumbria in which to locate a GDF. In this letter, through necessity, I can only provide a summary of the issues considered in my response. I have, however, tried to identify the most salient features of any discussions presented, and to address them. I have not tried to present a detailed, step-by-step response to every issue raised.

Having read the latest submissions, I remain of the opinion that there are at least two potential rock volumes in West Cumbria that meet the current international guidelines for a potentially suitable Geological Disposal Facility (GDF). These are the low permeability sedimentary rocks associated with the Mercia Mudstone Group (MMG), and the granitic rocks forming part of the Lake District Batholith.

It has been argued that the MMG of the Solway Plain and Solway Basin are unsuitable, on geological grounds, as they are faulted/fractured (leading to elevated zones of hydraulic conductivity), have inappropriate hydraulic conductivities (based on measurements made predominantly in the West Midlands), indicate a geochemically unsuitable (oxidising) environment, and have already been sufficiently explored by the oil industry over the past 30 years (for the specific purpose of identifying hydrocarbon deposits) to be already sufficiently well understood to be ruled out without further evaluation as a potential GDF host rock.

Whilst I do not share the opinions/interpretation of Professor Smythe regarding much of the geological information he has collated on West Cumbria as it pertains to the MRWS process, I acknowledge that additional, and relevant, data has been put forward. However, I do not share his opinion that these data should be taken at this stage to rule out the MMG. There has been no systematic deskstudy undertaken of the MMG for the purpose of evaluating its potential as a GDF under the current MRWS process. Until this has been undertaken, and subjected to adequate review, the MMG should not be dismissed as a potential GDF host rock. There appears to be a general consensus that the British Geological Survey (BGS) are best placed to undertake such a review, as they have access to oil industry and other data outside the public domain and remain an impartial source of geological assessment of issues of national/international importance. Figure 2.1.1 (b) in Smythe's submission identifies the area including the MMG as "areas of potentially suitable sedimentary rocks" following Dr Chapman's 1986 review. Whilst an assessment may have been made at the time to remove this area from the search for potentially suitable sites, additional data have since been acquired that may, or may not, change that view. These data need to be assessed. Professor Smythe appears to have misunderstood my comments that "a proper evaluation of the available data has not yet been undertaken". In my opinion, and that of Mr Colin Knipe, only the BGS is capable of making this assessment, and until the BGS undertake and publish such a review the area must remain potentially suitable. The BGS have published a report indicating that large faults in the

MMG strata of the Cheshire Basin “where present, (the faults) are impermeable and do not form pathways for fluid migration” (Evans and Hough, 2009). I am of the scientific opinion that until suitable, quality, hydraulic conductivity data are available for the MMG in the West Cumbria region, it should not be ruled out on the basis of data drawn from another region (as is argued by Professor Smythe using data drawn from the West Midlands). It is not an appeal to ignorance made to muddy the waters (as claimed by Prof Smythe) that I make this request, it is based on my experience that although the rocks in a particular area may be lithostratigraphically similar, it cannot be stated without investigation and measurement, that it shares the same or similar hydrogeological properties and characteristics. It may certainly be hypothesised that this is the case, but the very nature of a scientific hypothesis is that it should be tested by scientific research and then either accepted or rejected.

It is primarily on this basis that I suggest that the MMG cannot be rejected at this stage of the MRWS Partnership process as a potential GDF host rock. I also agree with Mr Knipe’s comments that, whilst not currently ruled out, the prospect of finding sufficient volume of suitable rock in the MMG is not promising, it **CANNOT AT THIS STAGE BE ENTIRELY RULED OUT**.

Regarding the Lake District Batholith, and specifically the Eskdale Granite, faulting/fracturing (with the potential for elevated hydraulic conductivities) and elevated topography have been identified as the main geological reasons why this rock body should not be considered as a potential GDF sites in West Cumbria. As a result of the acknowledged lack of exposure, a detailed assessment of the fracture patterns and faulting in the Eskdale Granite is currently not available. The impact of faults/fractures on the potential for a GDF have so far NOT been included in any BGS Screening exercise carried out for the West Cumbria region. It is quite possible that the fracture/faulting density of the Eskdale Granite will identify it as unsuitable for a potential GDF, but once again this study has not yet been undertaken as part of the MRWS Partnership process. The evidence presented to date does NOT demonstrate that a fracture/fault pattern is present that would wholly preclude its inclusion as a potential GDF host rock.

The topography of the Lake District has been cited as a reason why the entire area is unsuitable for a potential GDF by both Professors Smythe and Haszeldene. The fact that parts of West Cumbria have elevated topography is undisputed, although the Solway Plain should be considered to fall outside the area of elevated topography. Elevated topography will only manifest itself in the form of high hydraulic gradients that will increase groundwater flowrates (and thus potentially speed up the discharge rate of any radionuclides from a potential GDF site) if the rock itself naturally permits groundwater flow. Many granites, for example, exhibit dead-end pore porosities so the elevated topography can produce a potentially high hydraulic gradient, but in reality groundwater flow may be significantly inhibited as the void spaces in the rock are not interconnected and thus water entering the rock is trapped by the dead-end pores. Thus whilst elevated topography in a potential GDF region should be considered undesirable, this only significantly affects the rocks in a region through which groundwater will flow. It is insufficient to identify a region as having elevated topography and thus drawing the conclusion that it is unsuitable as a potential GDF. In fact, in areas of mixed high and low permeability rocks, it is quite possible (excluding many other significant geological factors), that groundwater will flow “in preference” through the higher permeability units and thus, in effect, increase the relative lack of groundwater flow through the lower

permeability units. Parts of the MMG in the UK, for example, are known to contain highly soluble halite (rock salt) deposits that have remained in place for over 200 million years, despite being overlain and underlain by Secondary A aquifer units in areas within, or adjacent to, regions of elevated topography. If groundwater simply moved through all geological units irrespective of their hydraulic properties, these deposits could not have remained in place over millions of years.

In conclusion, I do not believe that the data presented in the three identified documents indicate that sufficient geological data **already exist** to preclude going any further in the MRWS process. There remain two potentially suitable rock volumes in West Cumbria, for which insufficient data and no published authoritative reviews are currently available, that have the potential to be suitable GDF host rocks. Neither of these two rock volumes should be regarded at this stage as being particularly promising, in terms of their potential to eventually be identified as a suitable GDF host rock, but until available data have been reviewed by a suitably impartial authoritative body, they cannot be ruled out AT THIS STAGE from the MRWS Partnership process.

Yours sincerely
On behalf of FWS Consultants Ltd



Dr J P L DEARLOVE
PRINCIPAL CONSULTANT



DR F W SMITH
DIRECTOR

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- 6 The opinions expressed in this report regarding any contamination are based on simple statistical analysis and comparison with available guidance values. No liability can be accepted for the retrospective effects of any changes or amendments to these values.