Nuclear Free Local Authorities

RADIOACTIVE WASTE POLICY

Briefing on the Government Review

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Deep Geological Disposal: Known Unknowns[†]

> *"There are known knowns; there are things we know we know. We also know there are known unknowns."* [1]
> *Donald Rumsfeld, United States, Department of Defence, February 12, 2002*

1. Introduction

There are no proven examples that we can point to where nuclear waste has been disposed of in the past to gain reassurance that it could be done safely over the long term. Instead what we have is a huge volume of paperwork that supposedly presents a scientific case for disposal. However, in 1997 the nuclear waste disposal company Nirex was refused permission to begin excavation works for it's proposed nuclear waste disposal programme at Sellafield. This decision was taken following a Public Inquiry where the Inspector identified technical and scientific problems that were so great he was unable to give permission.[1] Nirex's response was to cut it's research staff.[2]

Ten years later the Government is revisiting deep geological disposal upon the recommendation of the Committee on Radioactive Waste Management (CoRWM). CoRWM's recommendation was subject to an 'intensified' research and development programme but this particular qualification to their recommendation appears lost in the new drive for a 'solution' to the radioactive waste dilemma.

2. Uncertainty

The essence of the 'science' of deep disposal is to supposedly demonstrate that a fatal cancer risk to human beings from radioactivity leaking out of a repository over thousands of years into the future will not exceed 'one in a million'. To make this calculation:

- the concentration of radioactivity in the inevitable leaks must be added up;
- the rate that the leaks enter the water supply system must be worked out.

[†] This paper was prepared by Dr Rachel Western, formerly of Friends of the Earth and UK Nirex Ltd.

[1] CORWM Final Report, July 2006, Chapter One, paragraph 17
[2] Independent, 28 March 1997, Nicolas Schoon, '*Nirex retreats from lab appeal*'

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Concentration

In the wastes there are many, many different radioactive chemicals – too many for the industry's computers to cope with. This needn't be a problem, however the different chemicals can have wildly different properties, which makes the risk calculations very unreliable. As an analogy, the chemical element carbon is found in sugar and in diamonds. Carbon in sugar dissolves, carbon in diamonds doesn't – so, clearly in order to be able to say how much carbon will dissolve, you would need to know what chemical form the carbon was in. However, in the context of nuclear waste disposal, this vital information is essentially unknown.

To give an idea of how serious this problem is, the regulatory targets are based on a 'one in a million' goal – but as the carbon example shows the carbon in sugar is essentially infinitely more soluble than the carbon in a diamond. Therefore without using the correct chemical information there is no way that a useful answer can be given about whether disposal would meet the 'one in a million' test. Specific examples reported by Nirex include variability of 10,000 where organics are present[3] or even 200 million due to inappropriate assumptions about uranium.[4]

The concentration is not just dependent on how much of the waste dissolves in the groundwater. The nuclear industry argue that much of what dissolves is subsequently taken up onto the rock surfaces in a process called 'sorption'. But here again there are huge potential variations in the extent to which this could happen depending on the particular chemical situation. This problem is exacerbated by the way that the nuclear industry gather the sorption data. Sorption is a slow process and so to gather data within a practical research time period, the rock is crushed to speed up the 'sorption' process. However this exposes different types of rock surfaces – surfaces that are raw, with a greater capacity to take up contaminants. The use of this data has the potential to lead to underestimation of the risk factor. Although the industry have started to make slight adjustments to their data to allow for this, it is very questionable whether the adjustment is adequate.

An example of the shakiness of the nuclear industry's calculations is the phenomenon of Rock Matrix Diffusion. Here it is speculated that the radioactivity gets taken up by tiny spaces inside the bulk of the rock Although Nirex admitted that the available data was '*ambiguous,*'[5] the calculations that they made in the 1990s still assumed that 100% of the rock mass was accessible to take up radioactivity by this mechanism.[6]

In addition to these problems, there is the fact that much of the data needed for the calculation is simply not available. To get round this the nuclear industry use 'data elicitation by expert judgement'. This, of course, is simply expert 'guess-work' with an elaborate name. As such, very little reliance can be placed upon it.

[3] Cross (1989) NSS/R151 '*Modelling the Behaviour of Organic Degradation Products*' p(ii)
[4] Cross (1991) NSS/R252, '*Modelling of Redox Front and Uranium Movement in a Uranium Mine at Pocos de Caldas, Brazil*' p10
[5] '*Potential Areas of Future Geosphere Research*' (February 2006, Report Number 494794) page 32
[6] '*Potential Areas of Future Geosphere Research*' (February 2006, Report Number 494794) page 33

Pathway

The pathway from the underground cavern to the water supply system at the surface can also be very complex. The Nuclear Energy Agency of the OECD has commented:

> "*The structural complexity of natural systems remains a significant source of uncertainty, … in the modelling of the performance of deep repository systems.*"[7]

This problem is magnified by the fact that in order to create the underground cavern an entry shaft needs to be dug. Around this the rock is damaged and this damaged zone represents an express route for the transfer of radioactivity from deep underground to the surface. Nirex itself comments that this presents a key uncertainty.[8]

Over the forthcoming summer the Government hope to persuade different regions to volunteer to be investigated for the development of a nuclear waste repository in their area. CORWM have stated:

> "*This is a highly technical and specialised task that is difficult to explain to the lay person. The uncertainties over the geology could have implications for the implementation programme.*"[9]

This complexity means that the volunteer initiative could be very tenuous. How can a local authority or community volunteer for a project with so many uncertainties?

Overview of the '*Scientific*' Approach

In their final July 2006 report, CORWM commented on the limited availability of scientists from the environmental movement.[10] They recommended (Recommendation 4):

> "*There should be a commitment to an intensified programme of research and development into the long-term safety of geological disposal aimed at reducing uncertainties at generic and site-specific levels*"[11]

The wording of this recommendation displays both a misunderstanding of the scientific method and an institutional bias towards a particular outcome of the research. Given the current level of uncertainty outlined above, a genuine scientific programme would be concerned with evaluating whether a disposal programme can be implemented safely – not 'reducing uncertainties'. The nature of the scientific method determines that the outcome of an investigation cannot be prejudged.

The bias of the nuclear industry's approach to the supposed calculation of the safety of disposal may be seen in the following quote from the Nuclear Energy Agency of the OECD report "*Post-Closure Safety Case for Geological Repositories*" (2004):

> "*If the evidence, arguments and analyses do not give the developer sufficient confidence to support a positive decision, then the assessment may need to be revised*"[12]

- with only the extreme case of moving to another site.

[7] OECD NEA "GEOTRAP Radionuclide Migration in Geologic Heterogeneous Media" (2002)
[8] '*Potential Areas of Future Geosphere Research*' (February 2006, Report Number 494794) page 13
[9] CORWM, Final Report, July 2006, Chapter 18, paragraph 23
[10] CORWM, Final Report, July 2006, Chapter 8, paragraph 16
[11] CORWM, Final Report, July 2006, Recommendations
[12] OECD NEA (2004) Section 5.3 – N.B. Authors included representatives from the UK nuclear industry