Out of their depth? Uncertainties in nuclear waste management

Rachel Western argues that the nuclear industry and the UK government are not properly considering the scientific evidence in their rush to 'solve' the problem of radioactive waste.

Early concerns

In the early days of the nuclear industry, the long term question of what would eventually be done with the fiercely carcinogenic by-products – the radioactive wastes – was not given much thought.

All that changed in 1976, when a report from the Royal Commission on Environmental Pollution (known as the 'Flowers Report') raised the alarm. It stated that: "*...it would be morally wrong to commit future generations to the consequences of fission power on a massive scale unless it has been demonstrated beyond reasonable doubt that at least one method exists for the safe isolation of these wastes for the indefinite future*" [emphasis added].[1]

However, within a couple of years the nuclear industry were confidently asserting that a deep-burial approach ('geological disposal') could be adopted, which would ensure that the wastes would be kept out of harm's way. It was thought that a series of barriers (such as the waste containers and the overlying rock) would provide a 'belt and braces' approach to safety.[2]

But when an initial review was carried out in 1985-86 the significance of the 'gas issue' was identified[3] – the issue being that, due to the eventual corrosion of the steel involved in the repository, a very large amount of hydrogen gas would be produced. This factor demanded that a gas release pathway had to be included in order to avoid over-pressurisation.

Thus the deep burial strategy that was proposed had an intrinsic design flaw: while at the same time as trying to hold in the wastes, there needed to be a route for the gas to escape. Hence the initial benchmark of 'isolation' had to be abandoned. The supposition was that it would be possible to predict accurately the levels of contamination of the water that would seep from the burial facility back towards people at the surface. This is meant to show in advance that disposal would not be too risky – since if a burial facility leaked too much there would be little that could be done about it.

In 1991, the nuclear industry tested their capacity to make such predictions by carrying out experiments at a uranium mine in Brazil (the 'Pocos de Caldas' Mine)[4]. The uranium contamination level that was predicted was 1.4×10^{-11} milligrams per litre (mg/l). However, the contamination level that was actually measured was considerably higher: 3×10^{-3} mg/l. This meant the nuclear industry had under-estimated the contamination level by a factor of *200 million*.[5]

Although such a large error range may seem extraordinary, it should be realised that the estimation of the solubility of a chemical element – without having accurate information on its chemical surroundings (particularly what else it is bonded to) – is liable to lead to wildly mistaken predictions.

In the mid-1990s the nuclear industry planned to start excavation work near Sellafield where they wished eventually to bury their radioactive waste. The plan was very controversial and so was subject to a public inquiry (which lasted from September 1995 to February 1996). During this inquiry the research on deep burial underwent extensive scrutiny.[6] Overall, the inquiry inspector concluded that the nuclear industry should not be given the go-ahead to begin their planned programme "in [their] current state of inadequate knowledge."[7] Hence the burial plans were shelved.

The new drive for deep burial

Eleven years later, following work by a new advisory body, the Committee on Radioactive Waste Management, the government decided to push ahead with deep burial. Critically, this body did not examine the scientific reasons for the earlier rejection of disposal. The Department for Environment, Food and Rural Affairs (DEFRA) consequently published a white paper on the subject, stating that "*there is already sufficient research work available to be confident that geological disposal is technically achievable.*"[8]

In parallel with the launch of the white paper, the Nuclear Decommissioning Authority (NDA) – the body responsible for implementing radioactive waste disposal – published their Proposed Research and Development Strategy for consultation.[9] This document is also upbeat on the rigour of existing research, stating: "*There has been an extensive research programme over a number of years measuring the solubility of important radionuclides in the high pH and reducing environment of the geological disposal facility.*"[10]

However, a quick flick to the reference list of this document indicates that each of the three reports that this quote refers to pre-dates the 1995-96 inquiry – and its call for "considerably more" research.

So it appears that both the government and the nuclear industry are going try to ignore the inconvenient conclusions from the mid-1990s.

If a wrong decision were to be made about nuclear waste burial it could result in severe blight in the future and the possibility of an enormous bill for remediation (if remediation were actually to be possible). Yet, as is well-known, the nuclear industry is planning a new generation of power stations, backed by the government, while a huge legacy of existing waste remains to be dealt with. We should be heeding the advice of the Flowers Report and not going ahead with a new major nuclear programme before a method for the "safe isolation of the resultant wastes" has been established.

Action

As mentioned above, the NDA are undertaking a consultation on their research programme – with a deadline of 30 November 2008. I am looking for people with expertise in any of the areas below to help challenge the NDA's arguments. In most cases, this will involve tracking the literature from the 1990s to the present and establishing which research areas remain to be addressed. Expertise sought: chemistry, geology, hydrogeology, engineering, and statistics.

Dr Rachel Western has a background in nuclear waste science and policy. She has worked for the nuclear waste agency, Nirex, and Friends of the Earth <rachelejwestern@googlemail.com>.

References

1. Royal Commission on Environmental Pollution (1976). Nuclear power and the environment. Sixth report. ISBN 0101661800. Quoted at: http://www.no2nuclearpower.org.uk/reports/waste_disposal.php
2. p.30 of: Roberts LEJ (1979). Radioactive Waste – Policy and Perspectives. United Kingdom Atomic Energy Authority.
3. p.113 of: Cooper MJ, Hodgkinson (ed) (1987). The Nirex Safety Assessment Research Programme: Annual Report for 1986/87. NSS/R101 Nirex.
4. Cross JE, Gabriel DS, Haworth A, Neretnicks I, Sharland SM, Tweed CJ (1991). Modelling of Redox Front and Uranium Movement in a Uranium Mine at Pocos de Caldas Brazil. NSS/R/252, Nirex.
5. pp.9-10 and 19 of: Cross et al (1991) – op cit.
6. See, for example: http://www.foe.co.uk/archive/nirex/prflist.html
7. p.277, para 8.56 of: McDonald (1997).
8. p.30 of: DEFRA (2008). Managing Radioactive Waste Safely: A Framework for Implementing Geological Disposal. June. http://www.defra.gov.uk/environment/radioactivity/mrws/index.htm
9. NDA Radioactive Waste Management Directorate (2008). Proposed Research and Development Strategy. May. http://www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=20962
10. p.43 of: NDA (2008) – op cit.