RADIOACTIVE WASTE - Where next ?

- *Sources of radioactive waste*
- *Current and future management options*

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This is a summary of a 100-page report available from the PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (extension 2840).

The failure of Nirex to obtain planning permission for an underground rock laboratory to research the suitability of the proposed Sellafield deep disposal site has stopped dead in its tracks, the search for a long-term disposal route for intermediate level radioactive waste. Parliamentary interest in this is rising and the House of Lords Science andTechnology Committee will shortly start an Inquiry.

POST has reviewed the reasons for Nirex's reversal and where it leaves policy for the future management of radioactive wastes. This note summarises the full report[1] and findings.

BACKGROUND

Radioactive wastes (RW) arise primarily from:

- materials which have become contaminated in nuclear power stations and nuclear manufacture;
- waste from reprocessing nuclear fuel;
- decommissioning nuclear facilities;
- use of radioactive materials in university research, medicine and industry.

The full report quantifies these arisings and explains the basis of the classification system into Very Low Level Waste (VLLW), Low Level Wastes (LLW), Intermediate Level Waste (ILW) and High Level Waste (HLW). Some 66,100m^3 of ILW is now in storage and a further 6,000m^3 are arising each year. From the middle of next century, some 10,000m^3 per annum of LLW will also need to be managed once facilities at the current near-surface disposal site at Drigg are full. Around this time, a long-term strategy for the relatively small quantity of HLW (~2,000 m^3in all) will need to be developed.

The decision to develop a long-term solution for the disposal of solid radioactive waste followed the 1976 report by the Royal Commission on Environmental Pollution (RCEP) which recommended that a national disposal facility should be built and operated by a 'Nuclear Waste Disposal Corporation' accountable to the Secretary of State for the Environment. Subsequently, the Nuclear Industry Radioactive Waste Management Executive (now UK Nirex Ltd) was set up and, after several years of site evaluation, Nirex decided to evaluate the suitability of Sellafield as the site of a deep repository for ILW. After initial investigations, Nirex proposed excavating an underground rock laboratory (the 'Rock Characterisation Facility' -RCF) to investigate the geology and groundwater regimes in the vicinity of the proposed repository. The company's planning application for the RCF was refused by Cumbria County Council and this was upheld against Nirex's appeal by the Secretary of State (SoS) in March 1997, after a full planning inquiry. Nirex decided not to challenge the SoS's decision.

The present situation is therefore that only wastes with low-level activity can be disposed of (at the Drigg facility near Sellafield). Other RW remains in storage pending a final management strategy (mostly at BNFL at Sellafield, but also at nuclear power stations, UKAEA and MoD sites). It had been intended that the largest part of this (wastes with intermediate level activity) would progressively be transferred to a deep repository operated by Nirex from about 2015 onwards, but existing and future waste arisings will now need to remain in store for many more years, pending the development of a new long-term management strategy for these wastes.

The full report reviews the international framework within which policy has developed, the UK system for RW management and regulation, and the various regulatory and advisory bodies involved. Key players are:

- DETR and Government set the overall national policy framework;
- Nirex is responsible for the operational aspects of storing and disposing of ILW waste (including selection and evaluation of sites);
- The Radioactive Waste Management Advisory Committee (RWMAC) provides the Government with scientific advice; other expert groups include the Nuclear Safety Advisory Committee (NuSAC) and the National Radiological Protection Board (NRPB);
- The Environment Agency and the Health and Safety Executive (HSE) are the regulators on environmental and safety aspects;
- Local authorities assess proposals under the planning rules.

Key events in the last 15 years are described in the full report and include:

- after opposition to the idea of near-surface disposal, a decision to only consider a deep repository for ILW (and future LLW) was taken (1986).

1. The full report "Radioactive Waste - Where Next?" (100pp) is available from POST, 7, Millbank, London SW1P 3JA; free to Parliamentarians; external sales £14 (contact Parliamentary Bookshop on 0171-219-3890).

- a 'paper-based' geological evaluation led to a shortlist of 12 sites assessed as capable of hosting a repository in the late 1980s, but public opposition prevented any field investigations from being carried out;
- selection in 1989 of Sellafield as the preferred site on which to base full evaluations of a safety case;
- intensive scientific, geological and hydrogeological studies and development of models of the site characteristics and water movements etc.
- review of science programme by the Royal Society in 1994;
- decision to pursue a research laboratory underground to develop the data needed (1995);
- refusal of planning permission for the RCF;
- planning inquiry (1995-1996) and dismissal of Nirex's appeal (1997);
- acceptance that the Sellafield proposal would go no further until there had been a full review of policy and new approaches decided.

The primary regulatory requirements and the detailed processes involved in preparing a safety case for a repository are explored in the full report, but a central design target is to demonstrate that the risk (of death or hereditary genetic defect) encountered by any member of the public during the thousands or even millions of years components of the waste may remain radioactive, will **not exceed one in a million per year**. This risk level is approximately one hundredth of the average risk encountered by people at present due to natural background radiation (from sunshine etc.). In an attempt to meet such a target, the repository would employ a philosophy of multiple barriers (**Figure 1**):-

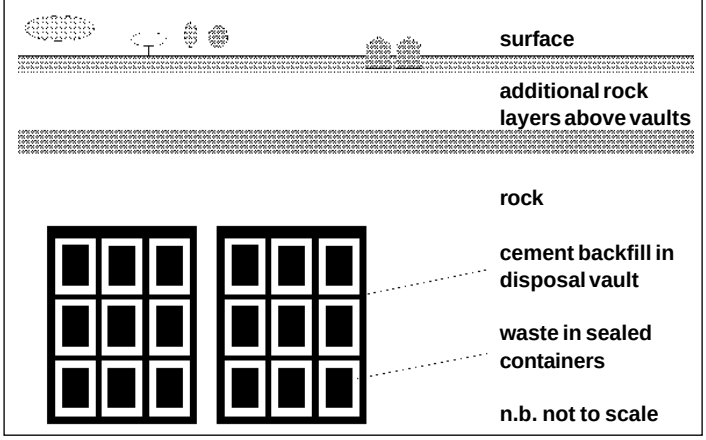
- the waste containers themselves;
- filling the surrounding caverns (and access shafts) with a grout to capture or impede any radionuclides dissolving from the containers;
- geological containment in the surrounding rocks;
- dispersal of any radionuclides penetrating the above in groundwater away from potable sources.

The full report describes how the scientific investigations were used to develop models to predict the amounts of radioactivity reaching the surface over very long periods and the risk to future residents.

WHAT WENT WRONG?

Different groups derive different lessons from the outcome. A key point of contention is whether the planning inquiry should have considered only the impact of the RCF as an experimental facility (in which no radioactive materials would be placed), or attempted to form an independent judgment of the likely suitability of the site for a safe deep RW depository. Although it was not the inquiry's job to assess the suitability of the final repository, much discussion centred on precisely this

FIGURE 1 MULTIPLE BARRIERS IN A DEEP REPOSITORY



point, and many areas of technical disagreement emerged between Nirex and expert witnesses for environmental groups and the Council. There was particular disagreement over the site's geology and its impacts on groundwater flow, over the strategy for containing radionuclides and over what scenarios should be assumed for changes in the region's environment over the next million years.

Overall, challenges to Nirex's confidence in the ultimate suitability of the site were accepted by the Inspector, who concluded that Nirex did not understand the hydrogeological system well enough, did not fully comprehend the *"extreme complexity"* of the area and overestimated its knowledge and understanding. On the timing of the application, the Inspector concluded (and the SoS agreed) that more scientific and technical work was required before a RCF could proceed, regarding the application for the RCF as "*seriously premature*". He also noted that to excavate the RCF prematurely could compromise the interpretation of other scientific work underway to understand the site.

As pointed out in the full report, the result raises several questions. If the application was seen as premature - when would it have been well-timed? Secondly, how does one deal with the 'catch-22' situation where an RCF is needed to collect data, but is opposed because the act of observation may affect the subject being observed? **Asking planning inquiries to rule on such technical issues** (some of which are at the leading edge of advancing knowledge) **may be problematic** in itself.

Another key area of disagreement concerned the procedures for site selection. Nirex thought it was operating with Government support to evaluate Sellafield alone, after attempts during the 1980s had failed to produce a practical alternative. The Inspector, on the other hand, saw the general requirements for environmental statements as requiring Nirex to justify its selection of the Sellafield site against alternatives at the planning inquiry, **despite this not being mandatory in the relevant UK law**. This interpretation raises very substantial issues because it is a very contentious and expen-

sive process to evaluate alternative sites[2]. **Further guidance and clarification will be needed to define how far the investigation of alternative sites needs to proceed, since the cost and time implications could be very great**.

The Nirex experience has brought into sharp relief one of the inherent quandaries of the current approval system - how to merge interests which range from the local to international. Because of the sensitivity of the issues surrounding radioactive waste, **current systems find it difficult to provide an adequate forum within which the tensions between national and local interests** can be resolved. As pointed out by RWMAC, the local planning inquiry was the proper forum for addressing the land-use and planning issues raised by the proposed RCF, but was not the regulatory forum for deciding on the safety or otherwise of a repository itself. In the event however, the planning inquiry became the *de facto* forum for deliberating the rights and wrongs of the general principles behind the underground disposal of radioactive waste, and also whether the site itself would be ultimately suitable for the repository - all under the full adversarial approach of the English legal system.

The full report asks *"could we start again under the existing system?"* and concludes that there are no technical reasons why a suitable site should not be found in the UK (potentially suitable candidate strata may be found under almost half the country). While the current system remains so adversarial however, the scope for almost indefinite argument over the many uncertainties incapable of objective resolution **almost guarantees failure to reach a conclusion in the long run**.

WAYS FORWARD

Overall, there is a broad view that a fundamental reassessment of the way forward is needed, with a much greater emphasis on public acceptability and participation in decision-making, transparency and accountability. The key may be to develop a consensus on the fundamental aspects of the strategy desired and the process involved and then to develop the detail in an open and interactive manner. In this respect, the full report asks what **lessons might be learnt from overseas experience**?

Underground repositories are the preferred long-term option for radioactive waste in most other countries examined, so there is nothing exceptional in the UK's approach. Examples of operational or planned facilities in all 3 main candidate rock types exist: clays, crystalline rocks and salt. While some countries had encountered similar levels of public opposition to those in the UK, others had not and might provide models for achieving consensus (see full report). Perhaps the most interesting findings come from the studies of natural contamination, where a major release of radionuclides some millions of years ago (in Africa) appears to have resulted in very little movement in geological strata which at first sight would not appear to offer good containment prospects. This raises the possibility that there are processes operating at the large scale which may be more effective at capturing radionuclides than might be predicted on the basis of the results of laboratory and small-scale tests.

Currently, it is clear that storage will have to remain the primary means of dealing with ILW for at least the next 20-30 years. Indeed, upgrading storage to accommodate wastes over longer periods than this is already underway at some sites. The longer term options can be broadly grouped into two[3]:

- make very long-term provision for storage, putting off for many years the decision whether or not to dispose of wastes finally underground;
- renew the currently suspended search for a permanent disposal in a repository, in the expectation that one could be developed in a timescale to take over from current (or easily upgraded) storage facilities.

These options each have their supporters and critics. The storage option is seen as offering continued access and monitoring and is less reliant on complex and uncertain mathematical models for its safety assessment, and is supported by environmental groups. At the same time its costs in the short term could be much less than a repository and thus attractive to industry. On the other hand, storage is not the final, permanent route favoured as long ago as 1976 by the RCEP, and a lack of a satisfactory long-term disposal route is difficult to mesh with the basic principles of sustainable development (through burdening future generations with the responsibility of dealing with risks caused by the current generation). For these reasons, many in the industry, RWMAC and others argue that the principle of disposal in a repository **should be re-affirmed by Government** and a new process to identify and develop a site should be constructed and implemented.

The inevitable delay of several decades before a final repository would be available could make the option of '**store and decay**' worth evaluating for short-lived ILW. Here short-lived ILW (i.e. around 25% of the current ILW arisings), would be stored for 2-300 years allowing the radioactivity to decay to levels low enough for the wastes to be regarded as LLW, and disposed of at near-surface sites equivalent to Drigg. Because the delays will also cause the timescales for ILW and HLW to

2. Indeed all attempts to evaluate alternatives during the previous decade had foundered on public opposition to the very first proposals to investigate any site's geological suitability, except for the 'nuclear' areas of Dounreay and Sellafield.

3. Other options have either been foreclosed (e.g. sea disposal) or are technically infeasible (e.g. destruction)

overlap, it would be envisaged that **the same storage or deep repository site could provide an appropriate strategy for both remaining ILW and HLW.**

Current (inherited) policy following from the 1995 White Paper is to develop a new approach for repository site selection when the *"next opportunity arises"*. The present hiatus is widely seen as such as opportunity, and therefore that new procedures will have to be developed before any search for a new site can start. In the debate over the 'new procedure', there are a number of lessons from Nirex's experience that can be applied.

With the benefit of hindsight, some of the departures from the 1976 RCEP recommendations may have contributed to the failure to meet the original repository targets. The fact that RWMAC has no members drawn from environmental organisations and no role in sponsoring and directing scientific research on waste management, may have made it more difficult for the question to be debated in a spirit of consensus and for the scientific data to be seen as independent and trustworthy. Equally, the fact that Nirex did not come within the remit of the DoE, the close alliance in the public eye of Nirex to its owners, together with an historical lack of openness, also fuelled challenges over the objectivity of the scientific case.

Most now accept however, that reorganising the system for radioactive waste management needs to be more fundamental than changing committee structures and is likely to require:-

- A fully independent organisation (a Commission), answerable to Government and Parliament, and funded by a levy on the nuclear industry, with responsibility to develop waste management strategies and choose a site for the necessary facilities (subject to regulatory controls and consents).
- A radioactive waste management organisation, operating under contract to the nuclear industry and the Government, which would have the task of designing, building, financing and operating the appropriate facility at the site chosen and according to the approved design.

Recent events underline the importance of the principles underlying the role of the Commission, viz:

- Independence of the nuclear industry.
- Responsiveness to the concerns of stakeholders in all decisions (from basic management options to final facility siting).
- Openness all its scientific work and decision-making to peer review.
- Addressing throughout the public sensitivity to the issue by education and consultation.

Other ideas are addressed in the full report. But, while future arrangements are discussed, a key aspect is to **ensure that the expertise, experience and intellectual property built up by Nirex are not lost,** especially in the areas of waste handling and packaging, repository design and post-closure performance assessment. Some on-going activities are specific to the Sellafield site itself, and there are at least two schools of thought as to their future. One is that Sellafield may yet prove to be an entirely acceptable site in any future process, and that to allow its future consideration, research on its geology and hydrogeology needs to be maintained. An alternative view is that the apparent complexity of the geology makes Sellafield a 'dead duck' for presentational reasons alone and that it should be ruled out of any future process, and only sites which meet the 'ideal' criteria[4] for a deep repository considered. In this event, the area could become a research site investigating deep groundwater flow in fractured rock, and generic geophysical research and methods.

IN CONCLUSION

The refusal of the planning appeal by the last Government brought to an abrupt halt a process started as long ago as 1976 and which has involved investments of approaching £500M over the intervening years - now with little to show for it. While site characteristics and the way in which Nirex was perceived to operate no doubt contributed to the particular problems, the experience throws up serious questions over the mechanism for determining the appropriate approach to what would have to be a unique and national facility. There are grounds for believing that the inherent scientific uncertainties are such that, in the present adversarial system, there will never be a means of resolving disputes objectively and that **failure is almost guaranteed**.

Consequently, there have been calls for the decision-making process to be made more transparent and widened to include a broad range of contributions from interested and affected parties, and to develop a more consensual approach. One possible approach is to establish an independent, widely constituted radioactive waste management forum which would consult widely and decide on the most appropriate management solutions and siting for the facilities.

Such ideas will be pursued by the House of Lords Science and Technology Committee in its recently announced inquiry into the management of nuclear waste.

4. The ideal criteria are stable and readily understood geological strata, long groundwater return times, very slow water movement and simple, predictable behaviour over long periods of time.