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Deep Disposal in the UK and the Nirex Programme

Remarks by Michael Folger, Chief Executive, UK Nirex Ltd.

Introduction

Sir Richard and I welcome the opportunity to meet you and give an update on progress with the UK deep disposal programme.

In June 1994 the Board visited our site at Sellafield, which is on the coast of North-West England, and had discussions with some of our colleagues

[Slide 1 - aerial view of Longlands Farm, with BNFL Sellafield Works visible]

Much has happened since then, as reflected in the background materials which I hope you will have received in advance.

I will keep my remarks today brief, to allow time for questions. Both Sir Richard and I will be glad to follow up any points raised informally through the week. We are particularly looking forward to joining you on Friday at Yucca Mountain to see progress underground with the ESF. We saw its very early stages when OCRWM kindly arranged a visit for us in March 1994.

UK policy on radwaste disposal

National policy on radwaste disposal was reaffirmed by the British Government in a "White Paper", published last 4 July.

Financial and philosophical arguments about the timing of disposal were reviewed in detail. The clear conclusion was that construction of a deep repository should proceed *"as soon as reasonably practicable"* once a suitable site has been found. Nirex's programme to identify such a site was given full backing. The precise timetable for

availability of the repository was explicitly recognised as dependent on the scientific requirements for establishing a sound safety case. There was recognition, too, of the time needed to secure planning permission - "zoning approval" in US parlance - for each phase of the programme and for regulatory approvals. Earlier policy statements, by contrast, had implied a need for expedition in the whole process, though each step was subject to normal planning and regulatory procedures.

Note that the priority for deep disposal in the UK - and the focus of Nirex's current responsibilities - is intermediate-level wastes which arise from reprocessing of fuel. (These have more than 4 Gbq/te of alpha or 12 Gbq/te of beta/gamma activity but little heat output - roughly equivalent to "TRU" wastes in US terms.)

[Slide 2: cross-section of ILW swarf in 500 litre drum].

We are presently planning for 200 to 275 thousand m^3 of these wastes to be disposed of over a 50-year period to 2060. Much of the material derives from reprocessing of Magnox fuel - metallic uranium clad in a magnesium alloy. It is of a mixed character, relatively bulky and less stable chemically than vitrified high level waste or oxide fuel.

High level waste from reprocessing is currently being converted to solid form, after which most of it will be held by BNFL at Sellafield, in a passively safe surface store, to cool down for at least 50 years. The 1995 White Paper announced that government would initiate research work to define a long term national strategy for these wastes, and for any spent fuel which operators eventually offer for direct disposal. The strategy is envisaged as leading to disposal in an underground repository, assumed to be separate from the Nirex repository for intermediate level waste.

Nirex programme

Against this helpful policy background, we have made excellent progress with our investigations at Sellafield. At a cost of some US $ 300 million up to the Spring of

1995 [£187 million of Sellafield - specific spending to 31 March 1995], a programme comprising more than 20 deep boreholes and other studies has enabled us to prepare a first-cut, risk-based, safety assessment for the crucial groundwater pathway. It shows good performance for a range of future climate states. Probabilistic modelling on conservative judgments gives results within our demanding regulatory target, which is a 10^{-6} ceiling on the annual risk to a representative member of the critical group at any time in the future. This result is robust to a number of variant cases covering alternative treatments of specific features of the Sellafield site. The potential host formation there is volcanic rock, water-saturated, lying beneath a sandstone aquifer in which groundwater flows are in an offshore direction.

[Slide 3: geological cross-section]

The evidence is of sluggish flow of saline water in the volcanic rock, with more rapid flows of relatively fresh water in the sandstone. For disposal of reprocessing waste, our concept provides for packaging the wastes in stainless steel drums set within a cementitious backfill, which is expected to hold pH above 10.5 for around a million years. Short-lived fission products are taken care of by the packaging and the actinides by suppression of their solubility. The radionuclides defining safety performance then become mobile long-lived species like Cl-36 and I-129 and, over the very long term, the U-238 daughter Ra-226.

For such a system, the key hydrogeological parameters at Sellafield have become pretty clear. They are the annual flow through the repository nearfield - which is looking like a hundred or so m^3 through a repository volume of hundreds of thousands of m^3 - and the dilution of any such flows entering the overlying sandstone - calculated as a factor of around 1000.

The flow volume through the repository is important because it needs to be sufficiently low to ensure that chemical conditioning by the backfill - resulting in low solubility and high sorption for key radionuclides - is not prematurely exhausted. Flow through the repository also determines the spreading time of the source term -

the time taken for release of radionuclides in water from the nearfield into the geosphere. Together with spreading in time during transit through the geosphere, that determines the effective dilution of residual radionuclides released from the repository and hence the associated radiological risk.

For a naturally evolving repository at Sellafield, the base-case modelling taking account of uncertainties gives realisations generally the right side of the 10^{-6} contour in terms of individual risk.

[Slide 4: based on Figure 8.8 of Volume 3 of Nirex '95]

Our modelling shows an early peak in individual risk after a few tens of thousands of years - due to Cl 36 - and a longer term peak due to Ra 226.

[Slide 5: based on Figure 6.13 of Volume 3 of Nirex '95].

An important focus of ongoing work is tightening estimates of volume flow and dilution and validating models, to increase our confidence in the "natural discharge" projections. Separately, the impact of intrusion by wells, drilled for drinking water, is being addressed. Encouragingly, even the current deterministic modelling of that case, with conservative assumptions about the nature of the wells and associated population patterns and lifestyles, gives a risk outcome well within 10^{-5}.

RCF and the planning inquiry

Our next step is to build confidence in our evaluation of Sellafield, so that we have a firm basis to decide whether to select it as the repository site or whether to look elsewhere. Selection of Sellafield would imply submitting a planning application for repository development and triggering regulatory procedures with the UK Environment Agency and the Health and Safety Executive.

Confidence-building will come from the Rock Characterisation Facility. This is a site-specific underground rock laboratory, to be developed in three phases over 10 years at a planned depth of 650 to 900 metres below sea level. In broad concept it is akin to the ESF, but obviously its focus is on testing rock characteristics and hydrogeological behaviour in a saturated rock environment rather than a geological setting lying above the water table, as at Yucca Mountain.

[Slide 6: RCF 3 phases].

The first RCF phase is sinking the two shafts through a close array of monitoring boreholes. It is expected to give invaluable data, from observations and tests in the shafts and from the associated large-scale drawdown experiment, for model validation. Our current assumption is that the data from that four year phase will enable us to judge whether to propose Sellafield as the repository site. On that basis, a repository could be in operation at Sellafield by 2012. But we may need to take longer.

To our regret, in December 1994 our request for planning permission for the RCF, as an exploratory and research facility, was refused by the local planning authority, Cumbria County Council. This was despite significant local support for the RCF from the general public. We are now three months into a four month planning inquiry, conducted by a government inspector under standard zoning laws - our Town and Country Planning Act 1990. That statute does however have considerable flexibility. The Secretary of State for the Environment gave published guidance to his appointed inspector which has allowed a thorough debate of relevant issues, including the potential safety performance of a repository at the site.

Nirex has been able to set out its emerging safety assessment, taking account of the encouraging scientific results I have explained. We have also reported the strong support for the RCF approach from the Royal Society and the Radioactive Waste Management Advisory Committee. Witnesses appearing for the objecting parties - including ERM witnesses for the County Council and various academics for

Greenpeace and Friends of the Earth - have been able to set out their counter views about the promise of the site. In many cases, these have not been set in a coherent probabilistic safety assessment framework. Public perception of our science case is, we judge, emerging strengthened from the inquiry process. We did not seek the inquiry and the cost is huge, but it is proving to be a good opportunity to expose some of the poor science ranged against us and to raise public awareness of the high quality of the work underlying our preliminary safety assessments.

By and large, sensationalism has been avoided through the inquiry process. Principal evidence has to be submitted in advance in writing and so wild claims, about earthquake risk for example, are subject to searching cross-examination and to rebuttal evidence.

Non-technical issues

Aside from the supposed unsuitability of the Sellafield site, a primary focus of some objectors - particularly the County Council - has been the basis of Nirex decisions in 1989 to investigate first sites at Dounreay (Scotland) and Sellafield, from amongst a short-list of 12 sites; and, in 1991, to focus on Sellafield. In evidence the Company has been quite open about the basis for its decisions - the expected ability of the candidate sites to meet the tight 10^{-6} safety target and the importance of a degree of local understanding and support for nuclear activities in carrying forward its programme at any particular location. Nirex has also reaffirmed the importance and relevance of cost considerations as a matter to be given due weight in site choice, provided safety requirements are met by the chosen site.

Parties objecting to the RCF initially alleged that in its approach to site selection Nirex had not followed applicable IAEA guidelines on site selection. But the Company has offered clear evidence that it has acted consistently with the guidelines. More generally, by revealing summary information about the 12 candidate sites across 30 different attributes we have further demonstrated our commitment to openness.

Expert judgment

The role of expert judgment in probabilistic risk assessment has been mentioned by various parties to the inquiry.

Objectors have naturally sought to emphasise the "fuzziness" of some of the judgments used in setting probability distribution functions for site parameters - data uncertainty - and in modelling behaviour over hundreds of thousands of years - model uncertainty. But my impression is that - particularly as so many of the objectors' witnesses are geologists and acquainted with the ultimate necessity for expert judgment - the issue has not created huge interest. The fact that Nirex procedures embody systematic peer review of safety-critical judgments has been brought out well.

I provided as a background document for today a 1992 report by Professor Watson of Cambridge University, prepared for Her Majesty's Inspectorate of Pollution - forerunners of our Environment Agency. It gives a fair account of the UK debate on expert judgment. It references the 1990 Sandia work for the NRC and I would draw your attention to Section 6.2 in particular. The Nirex Report [S/94/002] of 1994 on Information Management in post-closure performance assessment gives a good summary of Nirex practice. This recognises the importance of a carefully disciplined and structured approach to elicitation.

Before finishing I should just mention that we have had interesting debate in the UK through 1995 on two other areas which I have not time to develop in detail:

> first, the appropriate regulatory guidance about what an acceptable safety case for deep disposal should encompass. The 10^{-6} risk target and assessment of performance against it in expected value terms has been confirmed as important. But the impossibility of relying on probabilistic risk calculations alone has rightly been recognised in the draft guidance we have sent to you.

We detect some convergence between UK thinking and the National Research Council recommendations for Yucca Mountain;

second, whether a more prescriptive approach should be taken in future to UK practice on site selection. A government-appointed study group report in 1995 recommended consideration of quantitative hydrogeological indices for use in ranking prospective sites on a desk-study basis. Cost and other socio-economic factors would not be considered until a later stage. Final site selection by government, rather than the repository developer, was also recommended, with announcement of the locations of a multiplicity of possible sites being followed by extensive public consultation on each, overseen by a new "Commission". In the White Paper, the Government did not retrofit such an approach to the Nirex programme. But it indicated that aspects of the study group's thinking should be borne in mind for the future in the selection of a site for deep disposal of high level waste and spent fuel.

Thank you for your attention. Time at last for your questions.

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