The Royal Society of Edinburgh

Long-term radioactive waste management

The Royal Society of Edinburgh (RSE) is pleased to respond to the Committee on Radioactive Waste Management (CoRWM) consultation on long-term radioactive waste management. This response has been compiled by the General Secretary, Professor Andrew Miller and the Policy Officer, Dr Marc Rands, with the assistance of a number of Fellows with considerable experience in this area.

The specific questions in the consultation paper are now addressed below:

The issues

What are the most important issues?

The most important issues are to have a decision-making process based on:

(i) scientific and technical assessment of the consequences of each feasible management option, including the possibility of future natural environmental processes, such as earthquakes and climate change.

(ii) a strategy to achieve public acceptability of the chosen management option, including if necessary, visible and economically quantifiable benefits for local communities hosting a waste facility, as is done in Finland.

(iii) a sound quantification of the economics of each management option;

(iv) the minimisation of susceptibility to terrorism for each management option; and;

(v) open and transparent information.

In addition, while there may be a need for more research into some of the options for disposal, especially of high-level waste, existing nuclear waste must be managed now, and interim implementation of surface and shallow burial disposal options must be undertaken as a matter of urgency.

What should be considered when making decisions about a long-term radioactive waste management strategy?

CoRWM need to build in scenarios in the light of UK Energy policy, which may include, or exclude, nuclear power generation. The choice will have a large bearing on volume and type of wastes that will need to be disposed of.

The inventory

How do you think the volume and types of waste in the CoRWM Inventory affect our recommendation of the most suitable option for long term management?

The decision on which waste management option to adopt is one of science, politics and principle and is largely independent of waste volume and type, which are in practice largely variable and convertible. However, all waste streams should be included, including low level wastes. In terms of the classification of separated plutonium and uranium as waste, all active materials will have to be managed, but given their potential to be recycled, their long-term management should be in a recoverable form.

Are there other uncertainties and assumptions that you think we should look at?

It is noted with surprise that knowledge of the UK inventory is deemed to be less than good. This is strange as, for example, the Swiss have one of the best specified and quantified inventories worldwide which was set up for them by a UK company using British staff and expertise. This anomaly in UK needs to be sorted urgently as the entire programme will be based on the inventory.

Have you any other comments on our work so far?

We support the concerns highlighted in the House of Lords Science and Technology Committee 5th Report of Session 2003-04, on Radioactive Waste Management (10 December 2004). The plans need to be much more focused on the science, economics and sociopolitical aspects of the few realistic and feasible options around which there is currently an international consensus. The Committee and list of stake holders need to be modified to contain more independent persons who are knowledgeable and have experience in this field. These persons are in UK universities and research establishments and can be contacted through the Royal Societies of London, Edinburgh, Chemistry, Physics as well as the Government Research Councils. We think the Committee membership is unbalanced at present.

The long-list of options

Have we identified all the relevant options?

The CoRWM paper summarises reviews which have been reported for a number of years, including both alternative "final solution" methods and simple waste conditioning (melting metals). The long list could, however, be better ordered with reference made to feasibility, and the underlying science, economics and sociopolitcs.

Are the options adequately described?

As a preliminary discussion paper on procedure, this CoRWM document is, regrettably, much less informative and useful than might have been hoped. Not only have these options been well known for some time (*Nuclear Power and the Environment*, Royal Commission on Environmental Pollution Sixth Report, 1976; *Management of Nuclear Waste*, House of Lords Select Committee on Science and Technology, 3rd Report, Session 1998-99; *Developing UK policy for the management of radioactive waste*, The Royal Society, April 2002) but other countries with more advanced policies and programmes have already made, quantified and described their decisions and have even accumulated valuable experience and published much on the few more feasible and acceptable options. While it is correct that each country has its own specific needs, resources and opportunities, one might have hoped that, even though the UK has been slow in making its own decisions on long-term waste-management, particularly in view of the magnitude and complexity of its national and international nuclear activities, a paper such as this on national thinking by end-2004 might have been more technically developed with evidence of advanced prioritization and promotion of realistic state-of-the art technology than does this consultation document which essentially starts at the very beginning of thought on the subject.

Have we considered all the relevant aspects of the options in our Options Report?

Storage:

Centralised interim storage facilities have a number of advantages. Such central stores for all waste types would have enhanced security, in being easier to watch than being scattered amongst producers; it would allow high level waste and spent fuel time to be properly cooled before disposal; and could act as a site for reconditioning of old waste forms to save space.

Deep disposal:

Consideration should also be given to offshore as well as onshore locations. Over the past 20 -30 years, a great deal more is now known of offshore geology than of onshore. Knowledge of palaeo-hydrogeology (ancient deep water motion) will also be essential for prediction in deep disposal settings. Consideration of the linked effects of possible heat from waste, inducing groundwater convection, will be important but has not been properly undertaken by any international disposal programme.

Partitioning and Transmutation:

In terms of waste partitioning, significant investment in modelling of the irradiation patterns in reactors (taking into account the historical power curves) could lead to very substantial reduction in the volumes of high level waste and intermediate level waste, but this needs to be done scientifically and systematically if it is to satisfy both the inspectorates and the public. However the alternative is that the volumes of waste in the high activity levels are much larger than they need be because there is not the information available to classify them correctly, with the resulting dramatic increase in the cost of treatment and/or storage.

Transmutation is technically feasible, and is an elegant solution, but is likely to be expensive and is only in the early stages of development. In addition, as it effectively changes the half-life of the long-lived component, it increases the activity of the material by the ratio of the half-lives, resulting in more danger to operators. It would, however, reduce the period that the waste would need to be managed from hundreds of thousands of years, to around a hundred. Note that the spallation process which produces the neutrons to drive the transmutation will itself also produce waste.

Short-listing criteria

On what grounds do you think options should be removed from the long list?

Options should be removed if they do not properly address issues such as: exposure to terrorist attack; possibly changing deep-geological conditions, the need for international discussion and agreement, and the experience of other countries. Additionally, consideration of underground repositories need to be able to take account of any likely impact on hydrogeological regimes and, therefore, the potential risk to potable groundwater supplies.

In addition, while vulnerability to terrorism is clearly an issue with managed storage, there may be concerns over irrecoverable disposal or dispersal, where the waste can not be relatively easily recovered at some future date, should an appropriate technology for disposal be developed.

Are other issues important when assessing options?

The discussion paper does mention the importance of more recent innovations such as the need to minimize vulnerability to terrorism and to include non-anthropocentric risk assessment. However, it underplays the importance of common sense and public acceptability and how fully to incorporate and maximize these. It also almost wholly omits the core science of radwaste disposal impact assessment. For example, it does not deal with predictive assessment modelling: i.e. for each option, there is a basic scientific need to establish feasible nuclide release scenarios and rates, geological migration models and rates, short circuits and critical pathways, environmental appearance and transfer rates, biospheric uptake models for the critical radionuclides, radiological models for resulting exposures to humans and biota, dose/response models, risk factors/models and estimates of likely induction of detriment (deaths/cancers etc). Neither the science of the modelling itself nor the means of predicting the uncertainties in the results of modelling is included. This omission is regrettable as final decisions on and between waste-management options will need to be made on the basis of scientific prediction of the radiological and health effects of each option balanced by considerations of economic cost and sociopolitical appeal.

More explicit investigation of a European communal site should also be undertaken, even if all EU states do not wish to participate. The EU has the possibility of some 15 different national disposal sites, compared to two in the similarly sized USA land area, and some EU countries (e.g. the Czech Republic) have a very restricted choice of subsurface conditions. Therefore, being able to successfully identify a potential disposal site is not guaranteed for all EU countries.

Our plans and your involvement

What do you think of our future plans? Are we going about meeting our objective – to be able to recommend to Government the option or options that are best for the long-term management of solid radioactive waste – in the right way?

The CoRWM process is transparent, but any tangible outcome seems to be post 2007. The problem for now is how to remove much planning blight on generic research, and retain expertise comparable to international peers (*Developing UK policy for the management of radioactive waste*, The Royal Society, April 2002). There is a critical loss of research and technical expertise for deep disposal, for example. In addition, most intermediate level waste is currently not packaged for 10-100 year timescales. This arguably needs to be more urgently addressed now than any future disposal options.

There are also important issues about how nuclear waste repositories should be sited that need to be addressed. For example:

- How many repositories should there be?
- Should international / regional options be considered?
- Should sites be nominated or should there be a call for volunteers?
- If nominated, should site selection be based predominantly on geological or on socio-political factors?

Do you have any other comments?

Could the responsibility for radioactive waste in the UK be consolidated into one organisation? In Japan, where there are several organisations responsible for different wastes, it has led to a large amount of duplication of effort (for example, cementitious low level waste and intermediate level waste have many similar problems such as cement degradation and gas generation) and the danger of 'orphan wastes' where the waste type falls between organisations. In Switzerland, one organisation is responsible for all waste types, including medical, industrial and research waste, and this is much more efficient.

Additional Information

In responding to this consultation, the Society would like to draw attention to the following Royal Society of Edinburgh publications which are of relevance to this subject: *New and Renewable Energy* (May 1999); *Basic Safety Standards Directive Euratom 96/29* (June 1999); *Energy and Natural Environment: A Way To Go* (September 2000); *Fuelling the Future* (March 2001); *Managing Radioactive Waste Safely* (March 2002) and *Modernising the Policy for Decommissioning the UK's Nuclear Facilities* (March 2004). Copies of the above publications and further copies of this response are available from the Policy Officer, Dr Marc Rands (email: evidenceadvice@royalsoced.org.uk) or the RSE Website (www.royalsoced.org.uk).

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