NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

November 2003

NWMO BACKGROUND PAPERS
2. SOCIAL AND ETHICAL DIMENSIONS

CANADA'S USED NUCLEAR FUEL-WHAT TO DO WITH IT!

COMMISSIONED COMMENT

Ian J Duncan DPhil (Oxon), FTSE, FAusIMM, FIEAust

NWMO Background Papers

NWMO has commissioned a series of background papers which present concepts and contextual information about the state of our knowledge on important topics related to the management of radioactive waste. The intent of these background papers is to provide input to defining possible approaches for the long-term management of used nuclear fuel and to contribute to an informed dialogue with the public and other stakeholders. The papers currently available are posted on NWMO's web site. Additional papers may be commissioned.

The topics of the background papers can be classified under the following broad headings:

1. **Guiding Concepts –** describe key concepts which can help guide an informed dialogue with the public and other stakeholders on the topic of radioactive waste management. They include perspectives on risk, security, the precautionary approach, adaptive management, traditional knowledge and sustainable development.
2. **Social and Ethical Dimensions** - provide perspectives on the social and ethical dimensions of radioactive waste management. They include background papers prepared for roundtable discussions.
3. **Health and Safety –** provide information on the status of relevant research, technologies, standards and procedures to reduce radiation and security risk associated with radioactive waste management.
4. **Science and Environment –** provide information on the current status of relevant research on ecosystem processes and environmental management issues. They include descriptions of the current efforts, as well as the status of research into our understanding of the biosphere and geosphere.
5. **Economic Factors** - provide insight into the economic factors and financial requirements for the long-term management of used nuclear fuel.
6. **Technical Methods** - provide general descriptions of the three methods for the long-term management of used nuclear fuel as defined in the NFWA, as well as other possible methods and related system requirements.
7. **Institutions and Governance** - outline the current relevant legal, administrative and institutional requirements that may be applicable to the long-term management of spent nuclear fuel in Canada, including legislation, regulations, guidelines, protocols, directives, policies and procedures of various jurisdictions.

CANADA'S USED NUCLEAR FUEL-*What to do with it!*

Ian J Duncan **DPhil (Oxon), FTSE, FAusIMM, FIEAust**

November 2003

Introduction

The establishment of Nuclear Waste Management Organisation (NWMO) has opened the way for a balanced and informed exchange of information about the disposal of Canada's used nuclear fuel. Through NWMO the public has access to all aspects of used fuel management and disposal, and is able to converse with experts and authorities in this field. People can test their concerns about radiation, health, risk and the environment. Currently, Canada's nuclear generating capacity is 12.1 GWe, equalling about 16% of the total electricity supply. Canada, like all other developed countries, also uses nuclear technology in the fields of medicine, food preparation, sterilisation, science and industry. Each of these applications generates radioactive waste, although by far, the greatest contributor is nuclear power.

Whether Canada continues with its dependency on nuclear power is not an issue here. Large quantities of waste exist as a legacy of power generation and other uses of nuclear technology over the last three decades. Society has had the benefits of that technology but is yet to complete the disposal of its waste. Continued use of nuclear technology will add to the quantity of waste. Those who are opposed to nuclear power often obstruct the disposal of waste as a means of frustrating the industry. Others would point out that the unnecessary obstruction of waste management and disposal could cause a higher health and environmental risk than its appropriate disposal.

Public debate about the management and disposal of used fuel is not unique to Canada. All countries that use nuclear technology face the issue of what to do with its waste. Some countries have made progress and others remain on the starting blocks. Finland is perhaps leading the way, followed by Sweden and the USA.

Finland

Finland has 4 reactors with a total capacity of 2.6 GWe and is currently considering bids for a fifth reactor. Like Canada, they do not reprocess used fuel and plan to have a regime of interim storage followed by deep geological disposal. The geographic setting and degree of cultural complexity is not unlike Canada's.

The company POSIVA OY manages Finland's nuclear waste. This company and its activities are described on www.posiva.fi. Selecting their report *ONKALO Underground Rock Characterisation Facility, OKILUOTO, Eurajoki, Finland* will illustrate the type of underground development that can be expected for a deep geological repository. In May 2001, the Finnish Parliament voted in favour of testing the Okiluoto repository site and Finland now leads the world in such endeavours.

Sweden

Sweden has 11 operating reactors with a total capacity of 9.5 GWe. Sweden, like Canada, does not reprocess used fuel and led the way in the development of steel/copper canisters for interim surface storage and final disposal. SKB manages nuclear waste in Sweden and can be studied on www.skb.se.

Sweden has some similarities to Canada in its space, topography and cultural complexity. Feasibility studies for eight used fuel repository sites were completed in 2001 and site investigations have commenced on two of these (Forsmark and Oskarshamn).

USA

The United States Government has agreed to the characterisation of the Yucca Mountain (Nevada) site for a final disposal repository for non-reprocessed used fuel. This site is well described on www.ymp.gov and www.ocrwm.doe.gov. The geology of Yucca Mountain is not similar to Canada's likely sites, but the democratic processes used to get to this stage included recognition of social and cultural complexity.

United Kingdom

In contrast to Finland, Sweden and USA, UK has failed to get approval for its preferred site for intermediate level waste disposal. The disposal of high level waste arising from the re-processing of used fuel and surplus plutonium is yet to be advanced.

Canada has many natural advantages in finding an agreeable scheme for the management and disposal of these wastes. Canada does not re-process its used fuel and therefore the remnant uranium and plutonium are not liberated, but remain part of the fuel bundle. The waste is solid, not liquid, and the power industry can draw on three decades of experience for used fuel handling, transport and storage. When first extracted from the reactor, used fuel is highly radioactive and therefore generates lots of heat. The radioactivity however decays rapidly to about 2% of its original level in 50 years and less than 1% in the first one hundred years. The radioactivity continues to decay and in 500 years it is about the same level as the original uranium ore.

An acceptable scheme for management and disposal could involve interim surface storage followed by geological disposal. If the geological option is taken, then it is worth reflecting on the likely surface impact on the immense surface area of Canada. If one square kilometre is required to host the surface expression of a repository, then it is equivalent to just 1/10,000,000 (one ten-millionth) of Canada's area. Canada has a great expanse of stable rock types and no doubt some of these will prove to be suitable. Canada's population density of 2.4 people per km^2 also aids the process when compared to say the Finland (14), Sweden (19), USA (23), UK (229) and Japan (313).

Given the time necessary for an acceptable democratic process, Canada could draw from the Scandinavian countries' experiences towards the proper management and disposal of these wastes. Once used fuel disposal is demonstrated in a country with nuclear power, precedents will be established and other countries will surely follow. It will not be the global problem that some imagine.

Throughout the democratic process it is essential to recognise the views of both males and females, because at times they will differ. Females are usually more opposed to risk than are males. Any gathering of opinion must balance the population for gender, age and cultural background. This paper now looks briefly at some of the issues associated with the establishment of a waste disposal repository under the headings of Myths and Reality, Risk and Reward, Trust, Site Selection, Time and Retrievability.

Myths and Realities

Whenever a community considers nuclear technology and the disposal of radioactive waste, many questions arise. Questions such as:

- Does the nuclear industry have a solution to the 'waste problem'?
- Does the transport of waste pose a risk to communities and the environment?
- Is plutonium the most dangerous material in the world?
- Is there a terrorist threat to surface storage of waste?
- Will waste remain hazardous for tens of thousands of years?
- Does manmade radiation differ from natural radiation?
- What is the true cost of waste disposal and how will it be funded?

The World Nuclear Association has developed a set of papers addressing many aspects of waste management and disposal and these can be accessed on www.wna-waste-management.org. Going to 'Myths and Realities' in that series provides an opportunity to examine each of these questions.

In addition to these myths, opponents to nuclear power often use the disposal of its waste as a means to frustrate the energy policy of a country. This line of argument has little logic, as the proper disposal of existing and future waste is by far the best outcome for both health and environment.

Another *red herring* used to sway public opinion is the issue of importing nuclear waste. It is important that Canada remains focused on the management and disposal of its own waste and not allow the debate to be hi-jacked by this spurious issue. Canada has significant quantities of used nuclear fuel and this will increase with the continued use of nuclear power. It therefore seems logical to focus on the proper management and disposal for Canada's own waste, leaving for a separate and future debate, any prospect of a more international role.

Risk and Reward [(1) (2) (3) (5)]

Maria Páez Victor Ph.D., in her paper *Key Social Issues related to Nuclear Waste*, accurately describes risk as "the probability of an event…multiplied by its consequence…". The concept that risk must take into account the impact and probability of an event was identified in the 17^{th} century, and this seems to exemplify our current thought process. If being struck by lightning can be fatal, why do we take the risk of walking in the rain? Is it because we also know that being struck is a very rare event (about one in 10-million for an individual per year.) and therefore we accept that risk, to achieve some other objective – say, to get home from the store?

The mathematical expressions of risk are, regrettably, the first step in separating scientists from the general public. After all, what does it mean if risk is expressed as $15x10^{-6}$? The concept of *comparative risk* has been developed as one other way to consider risk, one that remains scientifically correct but is more comprehensible.

If risks to the community are ranked with the greatest risks on top, it is possible to gain a feeling for the relevance of any particular risk. The ranking of risk and relative probability opens the way for discussions between the public and 'experts'. Table 1 illustrates this point.

Table 1 Average risk of death in the UK from some common causes

Causes	Risk of death per year		
Smoking 10 cigarettes per day	1 in 200	or	$500x10^{-5}$
Natural causes, 40 years old	1 in 700		$140x10^{-5}$
Accidents on the road	1 in 10 000		$10x10^{-5}$
Accidents in the home	1 in 10 000		$10x10^{-5}$
Accidents at work	1 in 50 000		$2x10^{-5}$
Most exposed from nuclear effluents (0.3mSv)	1 in 70 000		$1.4x10^{-5}$
All causes	1 in 80		$1200x10^{-5}$

Source: Living with Radiation (NRPB 1989, p. 24) (4)

This simple ranking illustrates that the risk of death in the UK from smoking 10 cigarettes per day is 350 times more life threatening than the possible effect of nuclear effluent averaged over the community.

So why do people smoke tobacco knowing that it is one of the greatest hazards we face in everyday life? Faced with these data, it could be assumed that those with knowledge of health and risk would be non-smokers, but apparently not. Medical staff who work strenuously to repair, where possible, the damage caused by smoking often go out into the car park for a quick draw! So why do medical practitioners smoke? Is there a belief that it won't happen to them, can they load the dice by only smoking low tar cigarettes, don't they inhale, is there statistical evidence to say that they and their family are less prone to the hazard? Or, if we set aside addiction, is this a matter of getting sufficient comfort from the device such that the perceived risks are equated to or outweighed by the expected benefits?

Those who work in casualty or orthopaedic wards in general hospitals and at the same time travel to and from work by motor cycle have a similar perception of the rewards outweighing the risks. This issue was explored in *The Economist* in an article *Tobacco and Tolerance, Blowing Smoke* (December 20th 1997, p. 71).

> Motorcycling is about 16 times more dangerous than driving a car; but a motorcyclist will tell you that the pleasure of wind in the hair and a powerful engine between the thighs is worth the risk. Smoking, which can both soothe and stimulate, entails just the same sort of risk-for-pleasure trade.

Are these not an illustration of risk and reward at work?

Some communities may develop a *tolerance of risk.* Initially this was interpreted as meaning that they had found, from experience, risks that impact on them are less severe than experts had prescribed. Could tolerability of risk be used as a counter to any over-zealous regulator of risk or sections of the public's inflated concerns about low level radiation? This could be illustrated by the observation that people living near a factory that emits noxious fumes were indicating that they would tolerate emissions at that higher level, irrespective of the regulations and attendant risk. However the field of tolerability is now debated on the grounds that, in the case of apparent tolerability, the respondents may not have been free to act. They may, for example, be employees of the offending factory, have their equity stranded in nearby homes and lack the resources and skills to enable relocation.

A community needs to consider all possible risks that could arise from the development of a waste repository in its area. It will be found that all such risks are manageable and comparatively small. Potentially, increased road traffic might be more hazardous than exposure to radiation.

Having made a risk assessment, the community needs to maintain a direct role in the minimisation of those risks. Any remaining risk can be offset with counterbalancing benefits. A community could negotiate for an improvement in infrastructure, health or education. There will be a large capital inflow into any region hosting a repository. Jobs will be created and there will be demands for accommodation and services. Tourism could be enhanced, as travellers will no doubt want to see the project. Research has shown that the public no longer regards the awarding of benefits as a form of bribery. It is an earned counterpart to offset a potential risk or loss of amenity.

Trust [6]

The public does not trust governments, companies or academics working alone. Research shows that the public has the greatest trust in composite organisations including say government, industry, environmentalists, scientists, doctors and academics. Proponents of nuclear power and waste disposal should keep this in mind. Communities also should base their democratic processes on the knowledge that most people in a community will not follow all of the detail of a proposal, but they would respect the decision of a composite board of men and women who they know and trust.

Site Selection [5] [6]

Potential sites for waste disposal, debated so far in most nuclear countries, have been lost due more to the political process than to technical failure. NAGRA's Wellenberg site in Switzerland is perhaps the most recent site to have been lost by referendum (www.nagra.ch and www.grimsel.com).

Perhaps these site losses have come about due to the effective use of NIMBY (Not In My Back Yard) – a process that developed from the late 1960's. Communities realised that they had a right to be heard, had the resources to mount an action and were becoming increasingly concerned about health and the environment.

It could be argued that a further cause of NIMBY was government and industry practice of Deciding what was best for a community, Announcing it, and then Defending it (DAD). Gradually there was the realisation that a lot of the resistance embodied in NIMBY was more due to the feeling of having been left out of the decision making process, rather than a clear cut rejection of the technical parameters.

Hazardous Waste Siting and Democratic Choice, (ed. Don Munton 1996, Georgetown University Press, Washington, D.C. 20007. ISBN 0-87840-625-5) sets out the thoughts of many scientists working in the field of site selection and social processes. Collectively they make a good case for the site selection process best described as "Voluntary Choice Process". There are many references to successes and failures, some of these in Canada.

It seems clear now that any attempt at site selection by the DAD process will fail. The only way to go forward successfully is to equip all potentially interested communities with information, and access to experts they trust. Finally it will be a form of "Voluntary Choice Process" that succeeds, to the benefit of Canada, the nuclear industry and the volunteering community and its surrounding region.

The social processes for voluntary choice are described in Munton's book (particularly Part 3, Options and Strategies). It therefore does not seem necessary or wise to attempt to design a new social process, as this is not an exact science, is community dependent and could corrupt the overall process. In many respects, it would be wise to let the process evolve, rather than to prejudge it and get it wrong.

The topic of importing foreign waste will always be a sensitive issue. Where site selection has been debated in many countries, the waters have been muddied by the prospect of foreign waste into the debate. It is important that this does not happen here. There are two issues. Firstly, Canada does have responsibility to dispose of its own waste and needs to concentrate on that issue. Resolution of that does not automatically lead to a more international role. Secondly, and separately, if future generations wish to dispose of imported waste, it is a decision for that time, sensitive to all of the then current social, technical and the political processes.

Some argue in favour of several countries agreeing to establish a joint multi-national repository. This makes sense where nuclear programs are small, the country is small or is densely populated. Any implication for Canada requires, like the possibility of importing foreign waste, a separate decision making process. It should not be used to obstruct the Canadian domestic waste disposal process.

Time [(7)]

Public mistrust of any plan that suggests that waste can be securely placed in rock for tens of thousands of year arises from two causes. Firstly there is little trust of government, government departments, or industry acting alone. Perhaps this was illustrated with the work of AECL in the 1970s. Research has now identified another cause of distrust and that is associated with the time required for the isolation of waste – the period needed to allow for change from potentially hazardous to passive.

Most people are uncomfortable with concepts that are very long-lived and could impact adversely on future generations. The disposal of radioactive waste is one such example, where the material must remain separated from the living environment for hundreds, and in some cases, thousands of years.

About 80% of people interviewed have a forward time horizon not longer than 100 years or say, the lives of their grandchildren. This does not fit well with the needs for an engineered separation of thousands of years. Perhaps it is this temporal discomfort that is the main cause of public unrest about actions taken now, but which could be hazardous for thousands of years. (For details of research see reference 7, p 77).

More than half of the people believed that a deep geological repository will fail within 100 years and the waste could once again come into contact with the living environment[7]. Industry and government held the view that geological disposal will meet all requirements for safe long-term waste disposal and the cause of public rejection was probably that people did not have a deep understanding of geology. Or that somehow the public had considered all of the technical parameters, and found them to be less than acceptable – which is unlikely.

It now seems clear that the public does not understand fully all of the technology for waste disposal and therefore the dissemination of information should continue. But even so, there will probably be a rejection of any scheme that needs to last longer than the life of one's grandchildren!

There is a way through this dilemma, and that is to develop a scheme that is reversible. If it is ever decided that the operation of a repository should be stopped and the waste retrieved, then why not build in this requirement from the outset.

Reversibility, Retrievability and Remediability [7]

The waste disposal industry has considered the option of retrievability for a decade or so. The concept appears at least in the publications of the Swedish, Finnish and UK waste companies. Some believe that if the concept of retrievability was adopted then this could lead to added cost and technical complication. Most in the waste industry firmly believe that the currently proposed permanent disposal systems are good enough to meet all contingencies. There is also the possibility that 'retrievability' could imply to the public, a lack of confidence in the system. For example, if the wastes can be retrieved, is this not tantamount to just another form of interim storage. Could the waste be retrieved by 'unauthorised others' and does it not infer that it would be better to leave the wastes on the surface until a truly final disposal system can be developed and accepted by the majority.

The origins of retrievability are probably based on the disposal of used nuclear fuel where, with a change of circumstance, there could be a resource, environment or security reason to recover the material. The added identification of the public's temporal comfort zone being much shorter that the separation period needed, gives weight to a concept that is best described as *permanent/retrievable*. Perhaps this is the form of geological disposal that can earn public acceptance.

Reversibility is a term now being used to describe the option of recovering waste from a repository before it is closed. The possible need to reverse the placement could arise from technical, environmental, health or resource reasons. Reversal prior to closure, whilst unlikely, is technically more simple than retrieval after the repository is closed although it has a cost and once again puts the wastes back onto the surface. However if there is a just cause then surely reversal is a preferred action when compared to retrieval after closure.

Disposal systems incorporate multiple barriers such as the primary form of the waste, metal canister, geological overpack (modified clays), near-field strata (salt, clay, rock) and distance from the biosphere. In most systems there is an in-built redundancy such that if a barrier fails prematurely, other barriers will compensate.

The primary metal canisters are designed with a life of at least 1000 years in the geological repository. Retrieval from a closed repository during that period could be achieved using today's mining methods. A vertical shaft or declining roadway, similar to that used to load the repository would be re-established. Heavy lift equipment would be used underground to capture each canister and convey it to the hoisting apparatus. The canister brought to the surface would then be handled by the same method that was used to deliver it initially. The technologies of that period would then be applied to store, repack or dispose of the waste.

Locating the canisters would not be difficult due to records of the repository, archaeological evidence from the original disposal scheme or detection by each canister's magnetic or radiological signature – bearing in mind that the level of radioactivity will have decayed significantly after the first 50 years or so.

One concept not yet fully explored is the issue of remediation, that is, a form of geo-technical correction if there is a premature failure of the barriers. Industry could be loath to discuss this option as it, like reversibility and retrievability, might infer from the outset that the system could be flawed. It could also infer that if there is a premature failure then a set of 'Band-Aids' hopefully will fix the problem: a poor image. However we should consider, for example, the environmental corrections taking place in and around old uranium mines and processing plants in the Former Soviet Union, particularly in the former East Germany and Czechoslovakia where there has been significant 'remediation'. Mine effluents have been cleaned and are now safely allowed to flow into the river systems, underground acidity is being corrected and surface tailings consolidated and covered with clean material.

Perhaps we should think in terms of what we would do today, faced with a radioactive leak from an underground repository. If such a leak is water born then technologies such as pressure grouting of incoming aquifers to the repository, bypass hydraulics, water quality modification, retrievability of source, down stream environmental and health monitoring could all be applicable. If the contaminants are gas born, then a system of management also needs to be prescribed. Perhaps this could be based upon underground collection manifolds, filtering, conditioning of gases, dilution and release. Any recovered particles should be treated as for any other solid waste. There are geo-technical systems currently available for the remediation of closed coal, salt, uranium and metal mines. The proposed sequestration of carbon dioxide and other gases also illustrates some of the technologies available for remediation.

A commonly held view is that all manmade artefacts will need repair sooner or later, therefore why not prescribe that from the outset. It can be shown that with today's technology, remediation of a premature failure in a repository can be addressed. This would not be dependent upon *new* or *yet to be invented technologies*, but of course there will be a positive evolution in these geo-technical areas. The public probably has more trust in retrievability and remediation if required, than they do for the concept of irreversible and irreparable final disposal? Each generation could then say that at anytime in the future, further deposition can cease and the placed waste can be retrieved if necessary to ensure health and environment.

It falls to scientists and engineers to take these parameters into consideration when designing a viable permanent system for the disposal of radioactive waste, so as to win the confidence of the public. Schemes that are technically valid but cannot engender public confidence will become the deLoreans of this industry: expensive, glitzy, technically smart but unsaleable. The case in favour of a permanent/retrievable scheme is encouraging but needs further social research.

Conclusion

Canada has accumulated a considerable quantity of radioactive waste, from its use of nuclear technology. The formation of Nuclear Waste Management Organisation provides a fresh attempt to advance the socially acceptable final disposal of these wastes. This paper has addressed briefly the topics of Myths and Reality, Risk and Reward, Trust, Site Selection, Time and Retrievability. It addresses the prospect of the development of interim storage followed by a permanent/retrievable geological disposal system.

It is important to stay focused on solving Canada's waste disposal issues and not to be sidetracked by debates about a more international role.

In some countries, progress is being made for the disposal of radioactive wastes at all levels of activity. Canada can take advantage of other national programs, and inherently has abundant land surface, stable geology and a low population density.

NWMO provides the means for a meaningful debate on all elements of nuclear waste disposal. Such a debate should be encouraged as this will lead to a better public understanding of the topic and a reduction of public fear of all things to do with radiation. The evolution of a successful ‘voluntary choice process’ for site selection will overcome many of the traditional problems associated with prior siting attempts. Communities should be encouraged to make their own risk assessments and to negotiate for offsetting benefits.

Most importantly, the organisations involved in waste disposal will need to become more aware of public beliefs, requirements and acceptability. It will then become necessary for them to build a disposal system that meets public demands. A system that allows for interim storage followed by a permanent/retrievable geological disposal could become a widely accepted regime.

REFERENCES

The author has drawn material from his own research and publications, together with other publications referenced. For those interested, each of the following publications is supported by its bibliography.

(1) Parliamentary Office of Science and Technology (November 1997), *Radioactive Waste – Where Next?* London.

(2) The House of Lords, Session 1997-98. Select Committee on Science and Technology, Management of Nuclear Waste: *Written Evidence*, (April 1998). London: The Stationery Office.

(3) The House of Lords, Session 1998-99. Select Committee on Science and Technology, 3rd Report: *Management of Nuclear Waste*, (March 1999). London: The Stationery Office.

(4) National Radiological Protection Board, (1989) *Living With Radiation*. Didcot, Oxon.

(5) Duncan, I. J. 1999a. A Community that Accepts Risk Should be Rewarded. *Decision Risk and Policy* 4 (3): 191-199.

(6) Duncan, I. J. 1999b. Some Aspects of the Relationship between Society and the Disposal of Radioactive Waste. Paper read at The Uranium Institute: Twenty-Fourth Annual Symposium, September 1999, at London.

(7) Duncan, I. J. 2002. Disposal of radioactive waste: a puzzle in four dimensions. Paper read at Radioactive Waste Management 2000, Solutions and Opportunities Conference, October 2000 and re-published in *Nuclear Energy*, 2002, **41**, No. 1, Feb., 75-80. [Report of research conducted in UK, Switzerland and Japan. Canada not included.]

ABOUT THE AUTHOR: Ian J Duncan DPhil (Oxon), FTSE, FAusIMM, FIEAust.

Ian Duncan retired from Australia's mineral resource industry in 1996, after 25 years involvement in exploration, mining and metallurgy. Projects under his management produced copper, uranium, gold and silver. Following that career, he successfully undertook doctoral studies in the School of Geography, University of Oxford. The field studied was *the interface between society and the disposal of radioactive waste*. His research included sociology and technology, and resulted in a more advanced understanding of society's inherent forward time horizons, when considering family and environmental issues.

In addition to Fellowships in scientific and technical associations, he is a member of the World Nuclear Association (previously Uranium Institute), and a co-ordinator in the formation committees of the World Nuclear University. He has been associated with the Uranium Institute for more than 20 years and held executive positions including Chairman. As an extension to his career and studies, he now publishes and consults on nuclear waste disposal, with particular reference to public understanding and acceptance of schemes incorporating geological disposal.