

THE CONTINUING QUEST – A STATUS REPORT FROM CANADA’S NUCLEAR WASTE MANAGEMENT ORGANIZATION

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ABSTRACT

In 2002, the Government of Canada passed legislation which required the owners of used nuclear fuel to create an organization to study options and recommend a long-term management approach for used nuclear fuel. The Nuclear Waste Management Organization (NWMO) will submit its report to the Minister of Natural Resources Canada by November 15, 2005.

The NWMO is committed to develop collaboratively with Canadians a management approach for the long-term care of used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible. As such, we have sought the input and advice of the public and experts throughout the process. We have issued two milestone documents *Asking the Right Questions?* (November 2003) and *Understanding the Choices* (August 2004). These documents describe what the NWMO has heard from its research and engagement program, articulates our thinking to date, and invites comment and further direction from Canadians.

This paper outlines what we have learned so far from our discussions with Canadians, presents the preliminary findings of our Assessment Team, and describes our future work to complete the study on long-term management of used nuclear fuel.

INTRODUCTION

For decades, Canadians have benefited from nuclear power. Responsible stewardship requires that we look beyond today in managing the waste that has been produced. Like many countries, Canada is now carefully considering the appropriate approach for managing used nuclear fuel over the long term.

The Government of Canada passed legislation in 2002 [1] that set a decision-making framework. Under the Nuclear Fuel Waste Act, the Government required the owners of this waste to create an organization that would study the options and recommend a long-term management approach. The Nuclear Waste Management Organization (NWMO), the organization created in response to the Act, must study approaches based on three methods: deep geological disposal in the Canadian Shield; centralized storage, above or below ground; and storage at nuclear reactor sites. Other methods or approaches may also be studied. We must submit our study to the Minister of Natural Resources Canada by November 15, 2005.

The NWMO is committed to develop collaboratively with Canadians a management approach for the long-term care of used nuclear fuel that is socially acceptable, technically sound,

environmentally responsible and economically feasible. For the past two years the Nuclear Waste Management Organization (NWMO) has been trying to better understand the choices available to society for the management of used nuclear fuel over the long term. We are profoundly influenced by the time dimension of used fuel management and the nature of the problem dictates that we must look ahead for many thousands of years and reflect on the uncertainty that the future holds. While we cannot possibly know the future perfectly, we also know that inaction is not acceptable. It is reasonable to assume that the future will not be simply more of the present and we must not constrain our thinking to the limits of our current field of vision. The challenge is to move beyond conventional wisdom while embracing a precautionary approach to a long-term solution for used nuclear fuel.

Two assumptions have influenced the NWMO's study plan: the importance of discerning and understanding the values of Canadians and the wisdom of a holistic systems approach to our analysis. Our work program has been firmly rooted in the values that Canadians hold dear. Clearly, the exquisite logic of an analytical process alone may not be convincing. A management approach must resonate with what matters to people in order to give them any degree of confidence about the long term.

In this paper, we will outline what we have learned from Canadians generally as well as from particular individuals with an interest and/or expertise in the management of nuclear waste, present the preliminary findings of our Assessment Team, and describe NWMO's work plan to complete the study.

Understanding Canadian Values

Our study is an engagement process, seeking the input and advice of the public and experts throughout the process. We have commissioned numerous background papers on nuclear waste management and outlined our progress in two milestone study documents on our website (www.nwmo.ca), *Asking the Right Questions?* [2] and *Understanding the Choices* [3]. These documents describe what the NWMO has heard from the public and experts, articulates its thinking to date, and invites comment and further direction from Canadians.

In our first discussion document, we asked Canadians if we were capturing the key questions which should be asked and answered in the analysis and study of potential methods for the long-term management of used nuclear fuel. In our second discussion document, we reported back on the direction we have received from our engagement and research activities to date and presented the results of a preliminary comparative analysis of the options.

From the outset, we recognized the need for the NWMO study to be driven by the values of Canadians. In our first discussion document, we introduced ten key questions that reflected the concerns, priorities, and implicitly the values of Canadians as expressed to us in our early conversations with them. To gain a more in-depth understanding of citizens' values, and to identify these values explicitly, the NWMO initiated three core and parallel activities:

- We launched a National Citizens' Dialogue to better understand citizen values, through a collaborative research project with the Canadian Policy Research Networks (CPRN). This Dialogue brought together 462 unaffiliated Canadians from all walks of life

representative of the public at large. Over the course of the day-long sessions, participants articulated six core values which should direct the long-term management of used nuclear fuel.

- Our initial dialogue with aboriginal peoples has identified the principles inherent in Aboriginal Traditional Knowledge. We need to be responsive to their emphasis on planning within very long time horizons.
- Our NWMO Roundtable on Ethics has created an “Ethical and Social Framework” to help direct our activities as well as the assessment of management approaches. The Roundtable provides a constant reminder of the ethical imperative.

Reflecting on the comments of Canadians, it is apparent that although we share certain values and objectives which should inform the NWMO’s study, there are also tensions. Throughout the dialogue we have heard an emerging sense that the assessment of management approaches will necessarily involve difficult decisions about priorities, and the conditions under which trade-offs among objectives would be appropriate.

This cumulative insight from Canadians on their values and ethical considerations provides a cornerstone for the study as we proceed with the assessment of management approaches.

Reporting Back on the Initial Framework

In response to *Asking the Right Questions?*, the NWMO received important comment and advice. These have come from web-based submissions, public opinion research and face-to-face dialogues and workshops. Overall, people told us that the ten key questions proposed in our first discussion document capture the key issues and considerations that should be addressed.

At the same time, people told us that more study is needed before completing any assessment of management approaches. In particular, they asked us to consider further the following issues:

- A more precise description of the nature of the hazard posed by used nuclear fuel to human health and the environment;
- A more precise account of the nature of the risk posed by transportation of used nuclear fuel;
- Clarification on what “social acceptability” or “public confidence” will entail;
- How the assessment is affected by the volume of used nuclear fuel which ultimately needs to be managed;
- Opportunities to reuse or recycle used nuclear fuel; and
- Opportunities to site a deep disposal repository in geologic media other than that noted in the Nuclear Fuel Waste Act.

Reporting Back on the Technical Methods

In *Asking the Right Questions?* the NWMO identified 14 potential methods for managing used nuclear fuel. For the most part, Canadians agreed that our focus should be on the three methods requiring study under the Nuclear Fuel Waste Act. However, several methods were flagged as appropriate for further study or maintaining a “watching brief”. In this regard, partitioning and

transmutation is of particular interest to Canadians, to explore the possibility of reusing the used nuclear fuel or reducing the hazard it presents.

In *Understanding the Choices* we provided Canadians with fuller descriptions of the approaches on which we have focused our study. To further our dialogue with Canadians, we reported on how the framework to assess the approaches has evolved since our first discussion document and we presented a practical demonstration of this framework through a preliminary assessment of the management approaches.

Early in 2004, the NWMO assembled a multi-disciplinary group of individuals as an Assessment Team to: 1) translate the ten questions presented in the first discussion document into an assessment framework, taking into account the public and expert comment on those questions; and 2) conduct a preliminary assessment of alternative approaches [4].

The NWMO asked the Team to use a methodology that would allow for a holistic assessment – one that would systematically integrate social and ethical dimensions with technical, economic, financial and environmental considerations. Finally, we requested that the Team produce a report that would set out its thinking clearly as they discussed and debated the options. In so doing, they could share transparently with Canadians the range of considerations – including the challenges - encountered in undertaking the assessment.

The work of the Assessment Team has contributed two very important elements to the study. First, it has created a preliminary description of the strengths and limitations of the management approaches, for consideration and dialogue among Canadians. In advancing our understanding of some of the distinguishing features of the options, it provides the context for a substantive discussion with Canadians on how to consider the relative risks, costs and benefits of the alternative management approaches. Secondly, through the broad and integrative approach taken, the work has brought into focus some of the difficult choices and trade-offs which will need to be addressed as part of the assessment of the approaches.

Here we summarize the preliminary findings of the Assessment Team [4]:

At-Reactor Storage

Advantages: No transportation of used nuclear fuel would be required as the used fuel would remain next to where it is generated. Each of these sites already houses nuclear installations, so there is nuclear expertise on site and in the existing communities. These communities are familiar with the presence of nuclear facilities, including storage of used nuclear fuel. Further, the ability to monitor the performance and the flexibility to adapt to changing conditions should be facilitated. The science and technology required are well in hand.

Limitations: The key disadvantage, shared with centralized storage, is the need for continuing administrative controls and operations, including the necessary funding, for the thousands of years the used nuclear fuel remains hazardous. Unlike centralized storage, at-reactor storage means continued management at a number of sites, each of which has, as its primary focus, the production of power, not the long-term management of used nuclear fuel. These reactor sites were selected for their suitability for reactor operation, not for very long-term storage of used

nuclear fuel. The used nuclear fuel will remain hazardous well beyond the almost certain shutdown and ultimate abandonment of the nuclear reactor sites. At-reactor storage would result in very long-term used nuclear fuel management at a number of sites located next to important bodies of water. This raises security, environmental and safety issues and adds significant uncertainty given the potential for changes in institutions and governance and the likelihood of extreme natural and human induced events over such an extended time.

Centralized Storage

Advantages: Centralized storage, either above-ground or shallow below-ground, would allow for the site selection solely on the basis of used nuclear fuel management. If done well, siting can be achieved with community participation. These are both key potential advantages compared to at-reactor storage and apply to the siting of a deep-geological repository as well. Such a site could be either at an already existing nuclear site, if suitable, or at a different site should that prove more advantageous. With the option of shallow below-ground storage, some of the security concerns can likely be abated. As with at-reactor storage, the required science and technology are well in hand.

Limitations: Centralized storage shares with the at-reactor storage option the key disadvantage of requiring effective and continuing administrative controls and operations, including the required funding, for thousands of years. It also would require the identification and development of a site with potentially contentious community involvement. Transportation of the used nuclear fuel to the site would be required with its attendant risks and costs.

Deep Geological Repository

Advantages: The deep geological repository option results in the eventual permanent emplacement of the used nuclear fuel which reduces or may eliminate the necessity for long-term institutional and operational continuity and financial surety. As a consequence, after emplacement and closure, provision of long-term resources and funding are not required, although further actions are not precluded. The site is chosen with specific features as a requisite and, if done well, can be achieved with community participation. The intrinsic geologic, hydrologic and other features of the site, in combination with engineered features such as long-lived waste packages and material buffers, isolate the used nuclear fuel from the accessible environment for the very long time periods that they remain hazardous. Deep emplacement reduces security concerns, both before and after closure.

Limitations: Advance "proof" that such a system works is not scientifically possible because performance is required over thousands of years. Detailed scientific studies, models and codes form the foundation of the assurances of performance provided to regulatory authorities and interested organizations and individuals. Monitoring becomes more difficult as the used nuclear fuel is emplaced deep underground and as the site is backfilled and closed. At this stage adaptability and flexibility are also reduced as retrieval of the used fuel, for example, becomes much more difficult, costly, and hazardous. Siting must pay particular attention to intrinsic geologic features, perhaps limiting options more than for storage alternatives. As with centralized storage, community participation in regard to siting could be contentious and transportation of the used nuclear fuel will be required.

A Responsive Framework

Acknowledging the advice of the public and experts, and the work of the Assessment Team, the NWMO has developed an assessment framework to guide the next phase of our work. This framework will be the foundation of the assessment of the approaches and the launching point for the exploration and design of implementation plans. The framework was developed from the original ten questions in *Asking the Right Questions?* and considered citizen values and ethical principles.

The assessment framework consists of the following eight objectives:

1	Fairness	To ensure fairness (in substance and process) in the distribution of costs, benefits, risks and responsibilities, within this generation and across generations. The selected approach should produce a fair sharing of costs, benefits, risks and responsibilities, now and in the future. In addition, fairness means providing for the participation of interested citizens in key decisions through full and deliberate public engagement through different phases of decision-making and implementation.
2	Public Health and Safety	To ensure public health and safety. Public health ought not to be threatened due to the risk that people might be exposed to radioactive or other hazardous materials. Similarly, the public should be safe from the threat of injuries or deaths due to accidents during used nuclear fuel transportation or other operations associated with the approach.
3	Worker Health and Safety	To ensure worker health and safety. Construction, mining, and other tasks associated with managing used nuclear fuel can be hazardous. The selected approach should not create undue or large risks to the workers who will be employed to implement it.
4	Community Well-being	To ensure community well-being. Implications for the well-being of all communities with a shared interest (including host community, communities in the surrounding region and on the transportation corridor, and those outside of the vicinity who feel affected) should be considered in the selection and implementation of the management system and related infrastructure. A broad range of implications must be considered including those relating to economic activity, environmental disruption and social fabric and culture.
5	Security	To ensure security of facilities, materials and infrastructure. The selected management approach needs to maintain the security of the nuclear materials and associated facilities. For example, over a very long timeframe, the hazardous materials involved ought to be secure from the threat of theft despite possibilities of terrorism or war.
6	Environmental Integrity	To ensure environmental integrity. The selected management approach needs to ensure that environmental integrity over the long term is maintained. Concerns include the possibility of localized or widespread damage to the ecosystem or alteration of environmental characteristics resulting from chronic or unexpected release of radioactive or non-radioactive contaminants. Concerns also include stresses and damage associated with new infrastructure (such as roads and facilities) and operations (e.g., transportation).
7	Economic Viability	To design and implement a management approach that ensures economic viability of the waste management system while simultaneously

		contributing positively to the local economy. Economic viability refers to the need to ensure that adequate economic resources are available to pay the costs of the selected approach, now and in the future. The cost must be reasonable. The selected approach ought to provide high confidence that funding shortfalls will not occur that would threaten the assured continuity of necessary operations.
8	Adaptability	To ensure a capacity to adapt to changing knowledge and conditions over time. The selected management approach should be able to be modified to fit new or unforeseen circumstances. The approach should provide flexibility to future generations to change decisions, and not place burdens or obligations on future generations that will constrain them. The approach should be able to function satisfactorily in the event of unforeseen "surprises".

The dimensions of a preferred management approach are beginning to emerge through our dialogue with Canadians. Canadians want to see the development of a long-term strategy or plan. But they also want action to be taken now on the first steps of that plan. This will be done in a way that ensures that future generations will be able to make decisions that reflect their own values and priorities. The preferred approach must be adaptable, able to incorporate new knowledge as it becomes available. This might best be accomplished by a phased approach that provides for decisions to be taken in steps over time. Finally, the preferred approach will necessarily entail a robust system of governance and measures to ensure that citizens understand the issues, remain informed and have a voice in decision-making.

Continuing Work

Since issuing *Understanding the Choices*, the NWMO has conducted further work on the economic and financial considerations for each approach, and on potential economic regions for implementation of the different approaches. We have also conducted analyses on the types and volumes of waste to be managed, opportunities for recycling, issues related to the hazard associated with used nuclear fuel, transportation implications of the options, and obligations associated with an international nuclear weapons non-proliferation regime. We have also examined the different types of geologic media that might provide feasible options for safely and securely hosting a repository or centralized storage facility. The results from this work and international studies suggest that Canada has a variety of potentially suitable geomedia for a deep repository.

The NWMO has also begun work to develop possible implementation plans for the management approaches. Implementation plans will address, at a minimum, mechanisms for ongoing societal involvement, oversight and monitoring systems, institutional design including human resource capacity, and principles to guide site selection.

Currently we are preparing our draft recommendations to the federal government. We will be sharing our draft recommendations and study report in the next few months, after which we will seek further comment and direction from Canadians before we submit our final report.

CONCLUSION

The NWMO believes that a fair and responsible approach to managing used nuclear fuel can be determined. We have been inspired by the wealth of Canadian scientific and technical expertise and a public prepared to share their perspectives and priorities. We have invited all interested Canadians to continue to contribute comments, to raise issues of concern, and to participate actively and collaboratively in defining a workable strategy.

REFERENCES

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