

# **CANADA'S APPROACH TO THE MANAGEMENT OF USED NUCLEAR FUEL: THE ROLE OF THE ADVISORY COUNCIL TO THE NUCLEAR WASTE MANAGEMENT ORGANISATION**

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## **1. Introduction**

In fulfilling its mandate and presenting to the government of Canada in 2005 November its final study on the future management of Canada's used nuclear fuel [1], the Nuclear Waste Management Organisation (NWMO) received and acted upon advice from its Advisory Council. The Council was established in 2002 by the act of parliament that also established the NWMO, and its members were endorsed by the board of directors of the NWMO. That board is made up of representatives of the three Canadian utilities with nuclear fuel liabilities – Ontario Power Generation (OPG), New Brunswick Power Nuclear (NBPN) and Hydro Québec (HQ). The other Canadian organisation owning quantities of used nuclear fuel, Atomic Energy of Canada Limited (AECL), chose not to participate on the NWMO board.

The Council comprises nine individuals with a range of perspectives, knowledge and experience that includes environmental law, public policy, physical and biological science, Aboriginal affairs, citizen engagement and nuclear engineering. Not surprisingly, the group holds diverse opinions on energy utilisation and some members are particularly divided on the deployment of nuclear power. Nevertheless, in spite of the tensions that such diversity can generate, members have met their responsibilities and conducted their business effectively, debating and discussing the Council's agenda in an atmosphere of professionalism and mutual respect.

This paper recounts the activities of the Council in coming to agreement on its continuing advice to the NWMO and in reaching consensus on its general support for the concept of Adaptive Phased Management (APM) for Canada's used nuclear fuel [2].

## **2. The NWMO study**

The NWMO was mandated to follow a set of minimum conditions [2] while studying at least the following three management approaches: storage at nuclear reactor sites; centralised storage, either above or below ground; and, deep geological disposal. The last approach, only directed specifically at disposal in granite in the Canadian Shield region, had earlier been the subject of an extensive R&D program carried out by AECL in the 1980s [3]; however, after a series of public hearings across Canada in the 1990s, a government-appointed Environmental Assessment Panel had concluded that, although the concept was technically safe, it had not been demonstrated to have public acceptance [4]. Other approaches that were considered briefly by the NWMO but rejected because of insufficient proof-of-concept or contravention of international agreements included: dilution and dispersion; disposal at sea; disposal in ice sheets; disposal in space or in geological subduction zones; and, sub-seabed emplacement. The task of the NWMO was to recommend to government one approach for managing Canada's used nuclear fuel.

The three-year study that culminated in the final report and recommendation to government was conducted in four phases:

- discerning public expectations;
- exploring fundamental issues;
- evaluating the management approaches;

- finalising the Study Report.

The Seaborn Panel [4] had made it clear that public acceptance of any management approach would involve extensive engagement with Canadians. The four phases of the study were therefore structured as a “dialogue” with citizens. As illustrated in Figure 1, many techniques were applied in the dialogue, which was designed as an intensive, iterative process. Aboriginal groups, expert panels, special interest groups, etc., were involved throughout. The dialogue became particularly intensive during the final phase, when the recommendation was first aired in public via a Draft of the Final Study Report.

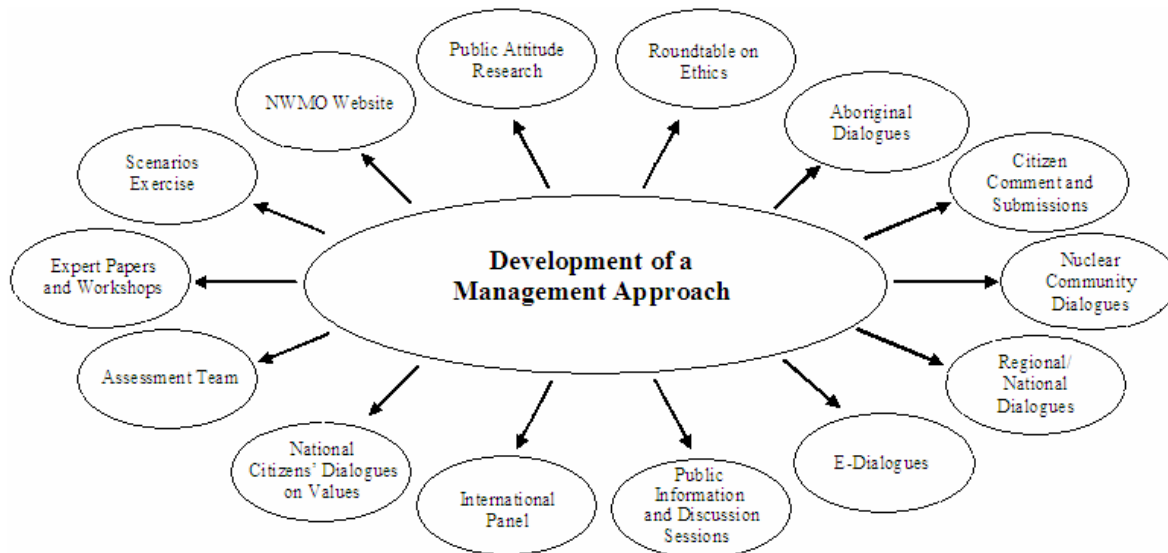


Figure 1 The NWMO’s engagement activities (from [1])

The study culminated in the recommendation for Adaptive Phased Management, which consists of a technical method and a management system. The technical method is based on final containment and isolation of the used fuel in a deep geological repository at a central site. Crystalline rock of the Canadian Shield or Ordovician sedimentary rock are identified as potentially suitable media. The concept has provision for an optional step during implementation in the form of shallow underground storage at the central site prior to final emplacement. The management system involves phased and adaptive decision-making, continuous monitoring, provision for retrieval and ongoing citizen engagement.

### 3. The Advisory Council approach

The legislation required the Council to provide independent commentary on the outcome of the NWMO study. The Council’s approach was to take an active rôle by providing advice and consultation throughout, thereby influencing strongly the form and direction of the study programs. As the NWMO’s work moves into the next phase when the government has responded to the recommendations, the Council will continue to provide advice and commentary throughout the siting and implementation process.

In carrying out its affairs, the Council meets regularly and conducts joint meetings with NWMO management, when it receives briefings on NWMO activities. Over the three-year study period it has spoken to government officials, outreach experts, etc., and has received deputations from both industry and anti-nuclear groups. From time to time it has sent representatives to overseas facilities to view

international practices as well as to Canadian sites to become familiar with the domestic status. Individual members have attended the NWMO public engagement activities as observers. A particular focus of the NWMO study, as stipulated in the legislation, was engagement of Aboriginal groups, so the Council formed a subcommittee expressly to audit this activity and itself to speak to Aboriginal representatives.

As it fulfilled its legislated obligations, the Council offered written comments and observations on the work and study of the NWMO. These are published in the Council's Final Report, alongside the NWMO's Final Study Report [1]. They first addressed the *comprehensiveness* of the NWMO study, asking whether all the reasonable alternative approaches to a management system for used nuclear fuel had been considered and whether the three required options had been thoroughly covered.

They addressed the *fairness and balance* of the study, asking whether the analysis had given appropriate weight to all relevant evidence, neglecting none of significance, and whether it had given adequate consideration to diverse points of view while recognising the interests of minority positions. Was there evidence of bias or partiality in the analysis or recommendations, and was the final recommendation logical?

They addressed the *integrity* of the study, asking whether there had been sufficient opportunity for public engagement, especially as regards Aboriginal people, concerned stakeholders and affected communities. Were sources of expertise and specialised experience sought out and utilised effectively? Were "state of the art" processes of public consultation, ethical reflection, socio-economic analysis, technical and scientific study, financial forecasting and impact assessment employed? Was international comparative experience adequately considered?

Finally, the Council comments addressed the *transparency* of the study, asking whether the NWMO's plans and timetable had been made clear and information made available promptly, allowing adequate time for full public participation. Were technical data and complex scientific concepts honestly simplified to develop public understanding?

The Council has also been concerned with these principles as they apply to its own approach. It has paid particular attention to its independence and its arm's-length decision-making. Accordingly, its activities are recorded on the NWMO website [5]. In particular, a Tracking Matrix, in which items such as Council's requests to the NWMO and the corresponding responses are logged, has been posted.

The spectrum of opinion across the Council on the use of nuclear energy led to tensions over the amount of used fuel that the study should consider. Pro-nuclear councillors wanted to ensure that the NWMO recommendations did not preclude continuing the nuclear option while anti-nuclear councillors were worried that a door to expansion might be opened. In the end, the Council agreed on the following policy statement: "The Advisory Council would be critical of an NWMO recommendation of any management approach that makes provision for more nuclear waste than the present generating plants are expected to create, unless it were linked to a clear statement about the need for broad public discussion of Canadian energy policy prior to a decision about future nuclear energy development. The potential rôle of nuclear energy in addressing Canada's future electricity requirements needs to be placed within a much larger policy framework that examines the costs, benefits and hazards of all available forms of electrical energy supply, and that framework needs to make provision for comprehensive, informed public participation."

#### **4. Discussion**

The Council is unanimous in its opinion that the engagement activities of the NWMO constituted an extraordinary process, employing innovative techniques that were a significant advance on traditional methods of outreach. In particular, it acknowledges that a good balance was struck between specialist input and public engagement – a particularly difficult task that underpinned the entire study. The process

admirably addressed the deficiency in the previous AECL study that had been pointed out by the Seaborn Panel [4], namely, that there had been insufficient public consultation. Nevertheless, it was recognised that in spite of these exemplary efforts the vast majority of Canadians could not be engaged because they are not sufficiently interested in nuclear waste issues.

Of the many topics that were discussed and debated during the three years that the Council followed the NWMO's engagement activities, a few may be singled out for comment here. For example, the National Citizens' Dialogues on Values, which had individual councillors in attendance as observers, were structured one-day meetings held across Canada in which groups of people chosen at random (but excluded if they had obvious bias) were led through the various issues by a facilitator. The objective was to understand the major concerns of the public at large and to consider the management of used nuclear fuel in that context. To the Council observers, it quickly became clear that the technical concepts behind the issues and their ramifications are much too complex to be grasped by the uninitiated in a short briefing. It proved particularly difficult for councillors with pertinent technical backgrounds to remain as silent observers when scientific misconceptions were perpetuated during the proceedings. Participants and observers alike saw the need for a greater understanding of the technical and financial issues in order to come to an informed opinion. In spite of such reservations about the ability of the sessions to provide technical information, however, the Council saw the value to the NWMO for gauging public attitudes in general and for bringing key values of Canadians to the surface.

One notable outcome of the engagement activities was the observation that many people think that there should be provision for retrieving the used fuel, or for possibly changing the management policy, at least for a period before final disposal. This stemmed partly from the feeling that over the next few decades science will develop a technology to "neutralise" the radioactivity. Many believed also that the used fuel is actually a resource and will become useful in the future as conventional nuclear fuel becomes scarce. Others expressed irritation in the belief that the industry had not addressed the waste problem until now. Most, however, were of the opinion that there is a need for a national discussion on energy policy, in which nuclear waste is considered alongside the wastes from other energy sources and the pros and cons of all methods of power generation are debated.

The question of whether the used fuel is a waste or a resource prompted much discussion at the Council and prompted an internal paper by one of its members [6]. The paper points out that the generation of CANDU reactors up to the present has been fuelled with natural uranium, its fissile content of 0.7% U-235 providing burnups of about 7.5 GWd/te. Used CANDU fuel therefore contains a limited quantity of fissile material. It amounts to, on average, 0.23% U-235 and 0.27% fissile plutonium (Pu-239 and Pu-241). As a potential fuel source, it would be in competition with the much more abundant spent fuel from LWRs around the world, which was initially enriched to 3% or so U-235 and has achieved burnups of about 35 GWd/te. The remaining fissile content of used LWR fuel averages 0.91% U-235 and 0.67% fissile Pu. For used CANDU fuel to be attractive as a fuel source, therefore, the economics of reprocessing or the politics of energy utilisation (e.g. involving considerations of national self-sufficiency) have to change. Nor is the utilisation of separated U-238 from used CANDU fuel as a fertile feed for breeder reactors likely to be attractive with current economics because of the competition from depleted uranium (already amounting to about 2.5 Mte world-wide) accumulated during international enrichment activities. Moreover, employing fast breeder reactors in Canada would involve a major policy and technology change.

Economic and political systems do change and technologies do develop, however. In fact, if nuclear power continues in Canada, the next generation of CANDU reactors will itself employ slightly enriched uranium. A longer-term scenario could involve the utilisation of separated plutonium as start-up fuel for advanced thorium-fuelled reactors, since the CANDU design is well suited to the thorium cycle. Decisions to move to these technologies will have implications for the design of the used fuel repository because the composition and amount of the used fuel will change. Such issues were not considered in the NWMO study, which dealt with existing facilities. Although it is recognised that a major advantage of the NWMO's concept of APM is that it can accommodate technical and policy changes over the next several decades before the planned final disposal, the Council has pointed out that significant changes in the type or amount of used fuel to be managed should trigger a review of the NWMO study.

The NWMO's engagement with Aboriginal peoples, as mandated by the government legislation, is an area of particular focus for the Council. Its subcommittee on Aboriginal Engagement has been active throughout the study, reviewing the NWMO's plans and advising on their implementation. The concern is to ensure that the contributions of Aboriginal groups and the expertise that resides in traditional Aboriginal knowledge are reflected in the NWMO's work. The Council noted that the Aboriginal engagement activities were slow to get started; this caused particular concern because of the complex and lengthy procedures that such activities traditionally entail. As the study continued, however, the engagement process improved and the Council became satisfied that the NWMO was laying a solid foundation for a continuing constructive relationship. A significant milestone was passed in 2005 August, shortly before the final Study report was compiled, when the Council subcommittee provided advice on the organisation of an Elders' Forum that brought together elders and youth from Aboriginal groups across Canada. For ongoing engagement with Aboriginal peoples, as repository siting becomes the major issue, the Council has identified a need for greater clarification of the fiduciary obligations of the Federal Government.

While many dialogues and engagement activities were pursued by the NWMO (see Figure 1), it was clear to the Council that the final recommendation was strongly influenced by the conclusions of the Assessment Team, a group of international experts on energy issues, public policy planning and scenario assessment. During the better part of a year, during which several intensive sessions were held, the Team employed a structured methodology to compare the possible management options. Each option was tested against eight objectives ranging from environmental integrity to economic viability. The methodology entailed identifying and mapping on an "influence diagram" the factors that may affect the capacity of the option to reach each objective. The assessment considered the near term, defined as the next seven generations (approximately 175 years), and the long term (beyond 175 years).

The Council was suitably impressed with the thoroughness of the assessment methodology, though it did perceive the possibility that bias could inadvertently enter the process. It accordingly recommended that any future employment of the exercise be replicated with independent teams. The NWMO responded in its commissioning of other approaches; for example, subsequent work by a private consulting company effectively endorsed the outcome of the Assessment.

The NWMO's recommendation of APM was endorsed by the Council, which considered the assessment process to be thorough and to have covered all the key considerations. It was noted, however, that the concept of emplacement in Ordovician sedimentary rock was introduced late into the exercise without the full rigour that was applied to the concept of crystalline rock of the Canadian Shield region. Both concepts cannot therefore be considered equal alternatives; sedimentary rock needs more study.

## **5. Conclusions**

The overall finding of the Council was that Adaptive Phased Management should be implemented with all the considerations of diligence and integrity described by the NWMO in its Final Report [1], allowing enough time and resources for each step to be undertaken properly.

Prominent among the Council's ancillary comments on future activities, particularly the siting exercise, that will follow the Canadian government's response to the NWMO's recommendations were:

- intensive engagement activities should continue – particularly with communities of interest, including potential "willing hosts" for the repository;
- the criteria for defining the Board of Directors should be declared and the Board should adopt appropriate standards of transparency in its deliberations;
- increasing emphasis should be placed on reaching out to young people;
- a strong educational program should be provided to deepen public understanding and facilitate informed decision-making;
- Aboriginal staff should be hired into the NWMO and an Aboriginal advisory committee established;

- engagement of Aboriginal elders should continue;
- possible future management scenarios, involving different quantities of used fuel, for example, should be costed in more detail and should include considerations of NWMO's liability.

Finally, the Council articulated its concerns about energy issues in general with the statements:

- "The federal government should work with the provincial and territorial governments to facilitate a national policy discussion about future energy supplies in Canada"
- and;
- "There should be no expansion or reduction of nuclear power generation at the provincial or territorial levels without public policy discussion about future energy supplies within those jurisdictions."

## 6. Acknowledgements

This paper is a brief summary of the combined efforts of the nine individuals of the Advisory Council during the three-year review of the NWMO's study. Their contributions are gratefully acknowledged. The authors also thank Canada's Nuclear Waste Management Organisation for its continuing support, cooperation and responsiveness to Council advice.

## 7. References

- [1] NWMO, "Choosing a way forward: the future management of Canada's used nuclear fuel", *Final Study Report of the Nuclear Waste Management Organisation*, Toronto, Canada. 2005 November.
- [2] Shaver, K., "Long-term management of Canada's spent nuclear fuel: the Nuclear Waste Management Organisation's recommendation to government", 15<sup>th</sup> Pacific Basin Nuclear Conference, Sydney, Australia. 2006 October 15-20.
- [3] Atomic Energy of Canada Limited, "Environmental impact statement on the concept for disposal of Canada's nuclear fuel waste", *Atomic Energy of Canada Limited Report, AECL-10711, COG-93-1*. Chalk River, Ontario, Canada. 1994.
- [4] Seaborn, B., "Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel", *Submitted to the Government of Canada*, Ottawa, Canada. 1998 February.
- [5] NWMO website: [www.nwmo.ca](http://www.nwmo.ca)
- [6] Rozon, D., "CANDU spent fuel: a waste or a resource?" *Private communication to NWMO Advisory Council*. 2005 August.