

RECENT DEVELOPMENTS IN NUCLEAR WASTE MANAGEMENT IN CANADA

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ABSTRACT

This paper provides an overview and update on nuclear waste management activities in the nuclear utility sector in Canada. A recent development that will significantly affect future activities is the December 1998 Government of Canada response to the March 1998 Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel. This response establishes current federal government policy for the long-term management of nuclear fuel waste.

The essence of the Government of Canada response is that it expects the producers and owners of nuclear fuel waste in Canada to establish: (i) a waste management organization, incorporated as a separate legal entity, with a mandate to manage and coordinate the full range of activities relating to the long-term management of nuclear fuel waste, including disposal; and, (ii) a fund to fully finance all activities and operations of the waste management organization including the costs for developing and comparing waste management options, for designing and siting the preferred approach for the long-term management of nuclear fuel waste, including disposal, and for implementation of the preferred approach and ultimately for decommissioning waste management facilities.

Following the conduct of an options study, the waste management organization will report to the Government of Canada setting out its preferred approach for the long-term management of nuclear fuel wastes, and future steps. The Government of Canada will determine whether it accepts the report and the preferred approach proposed by the waste management organization, and the future steps.

In response to the government policy announcement, Ontario Hydro has taken the lead, working closely with Hydro Québec and New Brunswick Power, in investigating how best to establish a separate waste management organization and segregated fund(s).

INTRODUCTION

This paper provides an update on nuclear waste management activities in the nuclear utility sector in Canada. The paper concentrates on recent developments related to the long-term management of wastes and on activities expected to occur in the near future. A recent development that receives particular focus is the December 1998 Canadian government response¹ to the March 1998 Report of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel². This response establishes current federal government policy

for the long-term management of nuclear fuel waste. An overview of the broader nuclear waste management situation in the utility sector in Canada is presented to provide overall perspective. This paper does not discuss the status of nuclear waste management activities associated with the operation or decommissioning of nuclear research facilities and demonstration power reactors, or historical contaminated soil wastes. These activities are the responsibility of the federal government.

NUCLEAR POWER PROGRAM IN CANADA

There are twenty-two commercial nuclear power reactors in Canada: twenty in the province of Ontario, owned by Ontario Hydro; one in the province of Québec, owned by Hydro Québec; and one in the province of New Brunswick, owned by New Brunswick Power. All three utilities are owned by their provincial governments. As of February 1, 1999, Ontario Hydro has twelve reactors in operation, seven in operational lay-up (i.e., under extended shutdown) mode and one in decommissioning laid-up mode. An element of Ontario Hydro's nuclear recovery plan is to bring all laid-up units back into service in the 2000-2009 timeframe, should economic conditions warrant. Decisions related to the return of Ontario Hydro's laid-up reactors to operation will be made over the next few years. The reactors in Québec and New Brunswick are both operational.

WASTE INVENTORIES AND PROJECTIONS

Current and projected inventories of used nuclear fuel, and reactor operational low- and intermediate-level wastes are given in the table below.

Table I: Current Waste Inventories and Projections

Utility	Used Fuel		Intermediate-level Waste		Low-level Waste	
	Current (bundles)	Projected (bundles)	Current (m ³)	Projected (m ³)	Current (m ³)	Projected (m ³)
Ontario Hydro	1,133,000 (22,000 Mg U)	3,306,000 (64,000 Mg U)	2,600	9,000	41,000	100,000
Hydro Québec	67,000 (1285 Mg U)	138,000 (2650 Mg U)	200	400	500	900
New Brunswick Power	85,000 (1650 Mg U)	150,000 (2900 Mg U)	125	230	1300	2400

In the above table, intermediate-level wastes are those that contain long-lived radionuclides, such as ion-exchange resins and fuel channel wastes, and are expected to require deep geologic disposal. Intermediate-level waste volumes are stored volumes, not allowing for volume expansion that may be associated with conditioning prior to disposal. Low-level volumes are disposal volumes, including packaging.

The above table does not include low- and intermediate-level wastes arising from reactor decommissioning. Disposal volumes associated with these wastes are expected to be in the range of 140,000 m³.

Current initiatives to minimize waste arisings by source minimization, decontamination and recycling processes are likely to reduce the projected volumes.

POLICY AND LEGISLATIVE FRAMEWORK

In July 1996 the federal Minister of Natural Resources announced a Policy Framework for Radioactive Waste³. This policy framework consists of a set of principles governing the institutional and financial arrangements for disposal of radioactive waste by producers and owners. These principles are:

- The federal government will ensure that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, and cost-effective and integrated manner.
- The federal government has the responsibility to develop policy, to regulate, and to oversee producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans.
- The waste producers and owners are responsible, in accordance with the principle of 'polluter pays', for the funding, organization, management and operation of disposal and other facilities required for their waste. This recognizes that arrangements may be different for nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings.

Regulation of nuclear matters in Canada is a federal responsibility. The current *Atomic Energy Control Act* is expected to be replaced by the *Nuclear Safety and Control Act* (NSCA) by mid-1999, as soon as new Regulations are finalized. Canada does not have any nuclear-waste-specific legislation at this time. The NSCA will provide the framework under which licences for site preparation, construction, operation, decommissioning and abandonment of nuclear waste facilities are obtained. The NSCA also replaces the Atomic Energy Control Board with an expanded Canadian Nuclear Safety Commission (CNSC) and empowers it to require financial guarantees from licence holders for the decommissioning of nuclear facilities and for the long-term management of nuclear waste.

In addition to the NSCA and Regulations, the CNSC will provide further direction in the form of Regulatory Guidance Documents. Two such documents pertinent to nuclear waste were issued for public review in late 1998: C-206, *Financial Guarantees Guide for the Decommissioning of Licensed Activities*; and C-219, *Decommissioning Planning Guide for Licensed Activities*. Consultative document C-206 is particularly important in that it defines the extent and form of the financial guarantees required to be established to fund future reactor decommissioning and waste management activities, including disposal.

It is also expected that in late 1999 the CNSC will issue new guidance documents related to safety requirements and site characterization requirements for waste disposal facilities.

Applications to build a nuclear facility also trigger the *Canadian Environmental Assessment Act*. It is under this Act, and possibly provincial environmental legislation as well, that an

environmental assessment for a nuclear waste facility would be prepared, reviewed and approved.

MANAGEMENT OF USED NUCLEAR FUEL

Used Fuel Storage

Used fuel, on leaving a reactor, is stored in water-filled pools at each station. When the water-filled pools are nearing their capacity, older fuel is transferred from the water-filled pools to dry storage facilities.

A used fuel dry storage facility has been in operation at Ontario Hydro's Pickering Waste Management Facility since 1995. The dry storage containers in use were developed by Ontario Hydro and are concrete-filled, steel-shelled vessels each containing 384 fuel bundles. An application to construct a dry storage facility at the Bruce Waste Management Facility has been submitted to the Atomic Energy Control Board and the proposed project is currently undergoing environmental assessment under the Canadian Environmental Assessment Act. The planned in-service date for this facility is 2002. A similar dry storage facility is planned for in-service at the Darlington site in 2005. Currently 30,000 fuel bundles (600 Mg U) are in dry storage at Pickering.

New Brunswick Power has had a dry storage facility at its Pt. Lepreau reactor in operation since 1992. Used fuel is transferred to concrete, steel-lined dry storage containers, each containing 540 fuel bundles. Currently 39,000 fuel bundles (750 Mg U) are in dry storage.

Hydro Québec also has a used fuel dry storage facility at its Gentilly-2 reactor. In this case, used fuel is stored dry in an above-ground concrete vault. Additional vault modules are added when required. Currently 30,000 fuel bundles (570 Mg U) are in dry storage.

Historical Review of Disposal Concept Development

In 1978 the Governments of Canada and Ontario established the Nuclear Fuel Waste Management Program to assure the safe and permanent disposal of nuclear fuel waste. Responsibility for research and development on disposal in a deep underground repository in intrusive igneous rock was allocated to Atomic Energy of Canada Limited (AECL). Responsibility for studies on interim storage and transportation of used fuel was allocated to Ontario Hydro. In 1981, in response to public reaction related to AECL site investigation studies, the Governments of Canada and Ontario announced that no disposal site selection activities could be undertaken until after the repository concept had been accepted. A federal environmental assessment (EA) Panel was established in 1989 to determine the acceptability of the concept. The EA Panel was comprised of eight members and was chaired by Blair Seaborn. It was supported by a fifteen-member Scientific Review Group.

AECL's development activities included the construction of an underground research laboratory near its Whiteshell Laboratories site in the province of Manitoba, and the broad-based development of disposal technology. In 1994 it submitted a comprehensive Environmental

Impact Statement based on the concept of placing nuclear fuel waste in corrosion-resistant containers at a depth of between 500 – 1000 metres in plutonic rock of the Canadian Shield⁴.

In 1996 Ontario Hydro assumed the full responsibility for program direction and funding for used fuel disposal technology development.

Report of the Disposal Concept EA Panel

Following the submission of the Environmental Impact Statement by AECL, a process of review occurred, including public hearings, and the EA Panel submitted its report to the federal government in March 1998.

The Panel's key conclusions were:

- Broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel wastes;
- Safety is a key part, but only one part, of acceptability. Safety must be viewed from two complementary perspectives: technical and social;
- From a technical perspective, safety of the AECL concept has been on balance adequately demonstrated for a conceptual stage of development, but from a social perspective, it has not;
- As it stands, the AECL concept for deep geological disposal has not been demonstrated to have broad public support. The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear fuel wastes.

The Panel's key recommendations were:

- A policy statement on managing nuclear fuel wastes should be issued;
- An Aboriginal participation process should be initiated;
- A nuclear fuel waste management agency should be created;
- A public review of AECB regulatory documents using a more effective consultation process should be conducted;
- A comprehensive public participation plan should be developed;
- An ethical and social assessment framework should be developed;
- Options for managing nuclear fuel wastes should be developed and compared.

The recommendations to the federal government were advisory and the process in Canada is then for the government to respond to each of the Panel's recommendations.

Government Response to the EA Panel Report

In December 1998 the federal government issued its response to the EA Panel Report. The essence of the response is that for nuclear fuel waste, the Government of Canada expects that:

- The producers and owners of nuclear fuel waste in Canada will establish a waste management organization, incorporated as a separate legal entity, with a mandate to manage and coordinate the full range of activities relating to the long-term management, including disposal, of nuclear fuel waste. The waste management organization will:
 - have a Board of Directors, representative of producers and owners of nuclear fuel waste;
 - have an advisory council; and

- be comprehensive, i.e., allow for the participation of all producers and owners of nuclear fuel waste.
- The producers and owners of nuclear fuel waste in Canada will establish a fund to fully finance all activities and operations of the waste management organization including the costs for developing and comparing waste management options, for designing and siting the preferred approach for the long-term management, including disposal, of nuclear fuel waste, for implementation, and ultimately for decommissioning waste management facilities.
- The waste management organization will report to the Government of Canada setting out its preferred approach for the long-term management, including disposal, of nuclear fuel waste, with justification, as well as:
 - a comprehensive public participation plan;
 - an ethical and social assessment framework;
 - an Aboriginal participation process;
 - practical long-term waste management options for Canada, including the following: a modified AECL concept for deep geological disposal; storage at reactor sites; and centralized storage, either above or below ground;
 - a comparison of risks, costs and benefits of the options along with proposed siting territories; and
 - future steps.

The Government of Canada will determine whether it accepts the report and the preferred approach proposed by the waste management organization, and future steps.

As part of its deliberations in arriving at the response to the EA Panel Report, the federal government also addressed its role, as outlined in the 1996 Policy Framework for Radioactive Waste, for providing oversight to ensure that appropriate long-term solutions to nuclear fuel waste management are developed, funded and implemented. The response to the EA Panel Report identified three objectives of the proposed federal oversight mechanism. These were to ensure that:

- a dedicated fund be established for the long-term management, including disposal, of nuclear fuel waste;
- a reporting relationship be established between the federal government and the waste management organization; and that
- a federal review and approval mechanism be established to provide oversight and access to the fund.

The federal government identified new legislation as the most effective means to ensure that these objectives would be met. However, it is undertaking a consultative process within the federal government, waste producers and owners, the provinces and other stakeholders to seek views on how best to meet the oversight objectives. The government response indicates that the Minister of Natural Resources will return to Cabinet prior to December 1999 with the preferred option to ensure that the federal oversight objectives are met.

Nuclear Utility Position and Initiatives with Respect to Government Policy Announcement

The nuclear utilities welcomed the government response as the conclusion of the process that began in 1978, and as an important starting point for future activities related to meeting their

continuing responsibility of managing used nuclear fuel, and other nuclear wastes, in an environmentally, socially and financially responsible manner. The EA Panel Report had introduced uncertainty as to who would have responsibility to provide long-term solutions for nuclear fuel waste, but the government response clearly assigned the waste producers and owners this responsibility, consistent with their 1996 Policy Framework. The nuclear utilities are supportive of the government direction to establish both a separate waste management organization and a segregated fund(s) to pay for long-term nuclear fuel waste management liabilities.

In response to the government policy announcement, Ontario Hydro has taken the lead, working closely with the other nuclear utilities, in investigating how best to establish a separate waste management organization. In December 1998 it formed an internal Steering Committee to provide high-level direction related to the establishment of a new waste management organization. Key issues to be addressed in the formation of the waste management organization are the scope of responsibilities of the organization, relationships among waste owners, governance issues and relationship to the segregated fund(s). As part of resolving the scope of responsibilities issue, the pros and cons of whether the organization should also have responsibility for the long-term management of low- and intermediate-level wastes, or for the operation of waste storage facilities, is being addressed. A comprehensive process of stakeholder consultations is now underway to seek input on issues related to the establishment of the new waste management organization. It is expected that the new waste management organization will be operational in late 1999.

Ontario Hydro is also taking steps to set up a segregated fund to cover nuclear waste and reactor decommissioning liabilities. It is expected that some of the key issues surrounding the formation of the fund will be addressed as part of the separation of Ontario Hydro into three independent corporate entities, which will occur on April 1, 1999, in response to provincial legislation enacted in 1998.

One of the first functions of the waste management organization will be to develop plans to conduct the options study for the long-term management of used nuclear fuel, as required by the December 1998 federal government policy announcement. As a minimum, the options that need to be considered are a modified AECL concept for deep geological disposal (i.e., modified to take into account the Panel's recommendations for improved postclosure monitoring and retrieval capability); continued storage at reactor sites; and centralized storage, either above or below ground.

MANAGEMENT OF LOW- AND INTERMEDIATE-LEVEL WASTES

Low- and Intermediate-Level Waste Processing and Storage

In the case of Ontario Hydro, a centralized waste processing and storage facility for reactor operational low- and intermediate-level waste is located at its Bruce Nuclear Power Development site. The Bruce Waste Management Facility includes a radioactive waste incinerator, box compactor and various in-ground and above-ground storage facilities. Near-term expansion plans include the construction of a new incinerator and additional storage facilities. Fuel channel

wastes from the retubing of Pickering reactors 1-4 are stored at the Pickering Waste Management Facility.

In Québec and New Brunswick, reactor operational nuclear wastes are stored at each reactor site.

Status of Disposal Development

All low- and intermediate-level nuclear wastes in Canada are in storage. There are no disposal facilities in operation or construction.

In the case of Ontario Hydro, the current reference plan is to have a low-level waste disposal facility in operation in 2015. In 1998 a wide range of alternative disposal concepts were reviewed and four were identified as the most promising. These four are: a covered above grade concrete vault, a shallow concrete vault, a deep concrete vault, and a rock cavern vault. Conceptual designs were developed for each and life-cycle cost estimates were prepared for a disposal facility based on each of the conceptual designs. Siting activities for a low-level nuclear waste disposal facility for reactor operational waste have not started. Ontario Hydro's current reference plan for intermediate-level waste disposal is for it to be co-located with a used fuel disposal facility.

SUMMARY

The most significant recent development in the nuclear waste management area in Canada has been the December 1998 response of the federal government to the recommendations of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel. This response established government policy for the long-term management of used nuclear fuel. The nuclear utilities are taking action to implement this policy while maintaining their responsibility to manage all of their nuclear wastes in an environmentally, socially and financially responsible manner.

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