Financial Implications of Used Fuel Volume Variation in Long Term Management – 2008 Update

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ABSTRACT

Title: **Financial Implications of Used Fuel Volume Variation in Long Term Management – 2008 Update**
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Abstract
The Nuclear Waste Management Organization submitted its final study report recommending Adaptive Phased Management (APM) in November 2005. For economic comparison purposes, NWMO study report contained cost estimates based on the assumption that 3.6 million fuel bundles would be produced. The 3.6 million fuel bundle volume was derived from a projection of continued use of existing reactors.

Since the Nuclear Waste Management Organization (NWMO) submitted its final study in 2005, there have been a number of additional proposals to refurbish reactors and proposals for building new reactors. These new proposals could significantly extend the life of the nuclear program in Canada. The amount of used nuclear fuel which could be potentially produced in Canada could conceivably reach eight million used CANDU fuel bundles if all planned refurbishments occur and all planned new reactors were built to a CANDU design.

This report provides an assessment of the cost of building and operating a deep geological repository (DGR) to accommodate 7.2 million bundles.

This assessment shows that a deep geological repository for 7.2 million fuel bundles would result in an average cost per fuel bundle of $3,400 compared to $4,140 for a repository for 3.6 million fuel bundles (both expressed in 2008 constant $).

NWMO recognizes its responsibility to provide the long-term management of Canada's used nuclear fuel – that which exists today and that which may be produced in the future. NWMO is committed to reviewing and adapting its implementation plans in light of changing energy policy that may have implications for the financial costing and other implications for implementation. As decisions are taken in Canada which affect the volumes or types of used fuel requiring long term management by NWMO, NWMO will update its plans and the program cost estimates, and make public the implications for program implementation.

The NFWA requires that each annual report issued by NWMO will include updated cost information and set out the amounts of the deposits to trust funds required to be paid during the next fiscal year by each of the waste owners.

A detailed program cost re-estimation is planned for completion in 2011.

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1. INTRODUCTION

The Nuclear Waste Management Organization (NWMO) studied a number of approaches for long-term management of Canada's used nuclear fuel and submitted its final study report and recommendation for Adaptive Phased Management (APM) in November 2005[1]. The recommendation was accepted by the Government of Canada in June 2007.

The Nuclear Fuel Waste Act (NFWA) specifically assigns the responsibility for financing the long-term management of used fuel to the companies that are the major owners of used nuclear fuel. The NFWA requires that these corporations establish trust funds for this purpose and make annual payments to the trust funds to address the long–term financial contributions required to implement Adaptive Phased Management.

In accordance with the Nuclear Fuel Waste Act (2002), the NWMO will be responsible for the long-term management of the used fuel produced in Canada. NWMO has an ongoing responsibility for ensuring that the cost estimates of the long-term management program are updated, and for proposing a funding formula to support financing of all aspects of the long-term management approach. As NWMO updates the program cost estimates, member corporation contributions to their respective trust funds will be adjusted periodically. These adjustments will reflect updated projections of overall costs of the management approach and the number of fuel bundles to be produced by each owner of used nuclear fuel.

As part of its responsibility for providing financial surety for program delivery, NWMO will continue to assess external developments that may impact on the amount of used fuel to be managed in Canada and potential implications for future costs.

This paper reports on some of this tracking of developments that may have implications for future program costs. Several scenarios for implementing APM were costed in the study leading to the recommendation to government. The highest cost scenario, in present value terms, was a Deep Geological Repository (DGR) which would be operational starting in approximately 2035. The cost of the facility was based on a 2003 cost estimate for DGR developed by CTECH [2] and an associated Used Fuel Transportation System (UFTS) cost estimate developed by COGEMA [3]. These estimates were developed for a projected Canadian inventory of 3.6 million used CANDU fuel bundles.

Since the NWMO Final Study was issued in 2005, there have been a number of planned and proposed nuclear reactor refurbishments and new nuclear build initiatives in Canada. Reactor refurbishment activities could extend the projected end of existing CANDU reactor operation in Canada from the previously assumed shut down date of 2034 to about 2055. Nuclear new-build activities could introduce a broad range of nuclear reactor designs and fuel types including fuel enriched with uranium-235. New nuclear build would also extend the projected end of nuclear reactor operation in Canada to 2085 or beyond. Depending on planning assumptions used, the new build/life extension projected volume will be in the range of 2.8 to 8.3 million used fuel bundles.

2. ASSESSMENT OF COST IMPACT OF EXPANDED REPOSITORY

The current cost estimate for a Deep Geological Repository (DGR) for used fuel is based on a cost estimate developed in 2003 by CTECH. The estimate assumed a repository sized to accommodate 3.6 million used fuel bundles. In future scenarios where reactors are refurbished and new reactors are constructed, the total number of used fuel bundles will far exceed 3.6 million.

To provide an indication of the financial impact of future scenarios where existing reactors are refurbished and new reactors are built, NWMO has completed an assessment of the cost of a DGR for 7.2 million fuel bundles. To carry out this assessment the NWMO worked in conjunction with experts in the nuclear estimating field. The assessment utilized the CTECH estimate for 3.6 million bundles to derive estimates for each cost element for a repository of double the size assuming the facility would operate for 60 years as opposed to the 30 year operating life assumed for the original cost estimate for 3.6 million fuel bundles.

The revised estimate assumed that the capability to receive fuel at the DGR would remain constant at approximately 120,000 bundles per year and, as such, it would not be necessary to increase the size of unloading facilities and packaging plant. Major DGR equipment and facilities such as the Used Fuel Packaging Plant (UFPP) were assumed to be replaced after 30 years of operation, at the same cost (escalated) as the original equipment. This corresponds to the original design life of the facility for 3.6 million fuel bundles and the midpoint of the 60-year operating life of a facility for 7.2 million fuel bundles. Other costs such as containers and lateral excavation in the repository were doubled to reflect a facility twice the size. Selected systems such as underground access and ventilation shafts were assumed to be capable of operating for 60 years without additional modification or cost. Monitoring and maintenance activity costs were doubled to reflect a doubling of operating life.

The results of the revised cost estimate are summarized below. The present value calculations are based on the assumption that the first 3.6 million fuel bundles are transferred to the repository between 2035 and 2064 and the second 3.6 million fuel bundles are transferred between 2065 and 2095.

This assessment indicates the cost of a facility for 7.2 million fuel bundles is approximately 67% more than that for a 3.6 million fuel bundle facility in constant dollars and 37% in present value dollars due to timing of placement of additional bundles. On a per bundle basis, the average cost decreases from $4,140 (2008 constant $) to $3,400 (2008 constant $) when the facility is expanded to accommodate 7.2 million fuel bundles.

Used Fuel Repository Cost Estimates[1]

Cost Estimates	Total Cost	
	2008 constant $	Jan 1 2008 PV$
3.6 million bundles	$14.9B	$6.0B
7.2 million bundles	$24.5B	$8.2B

The approximation of the costs allows the NWMO to determine incremental rates for used fuel above the maximum number of bundles assumed in the individual estimates. These incremental rates will allow the cost estimate to be scaled forward from the approximate 3.6 million used fuel bundle cost estimate for other scenarios until the detailed re-estimate is complete in 2011.

3. FUNDING FORMULA

NWMO developed a funding formula that addresses the future financial costs of implementing the Adaptive Phased Management approach. The funding formula assumed that the current fleet of reactors could produce a range of used fuel volumes dependent on the extent of refurbishment. The proposed funding formula was submitted to the Minister of Natural Resources for approval in NWMO's 2007 Annual Report (www.nwmo.ca).

Should there be new reactors and/or new used fuel owners, it would necessitate review and potential revision to the funding formula. The funding formula would need to take account of any new owners of used fuel that may emerge with the building of new nuclear power reactors. The formula would reflect the sharing of fixed costs, variable costs and investments already made by the current waste owners, amongst other considerations. Future revisions to the funding formula will be done in a fair and equitable manner, balancing the interests of current and new waste owners, and based on funding principles which form the basis of the funding formula submitted to the Minister in the 2007 Annual Report.

[1] Interim cost estimates for a deep geological repository for Canada's used nuclear fuel pending a full update to the conceptual design and cost estimate which is expected to be completed in 2011.

4. GOING FORWARD

NWMO recognizes its responsibility to provide the long-term management of Canada's used nuclear fuel – that which exists today and that which may be produced in the future. NWMO is committed to reviewing and adapting its implementation plans in light of changing energy policy that may have implications for the financial costing and other implications for implementation. As decisions are taken in Canada which affect the volumes or types of used fuel requiring long term management by NWMO, NWMO will update its plans and the program cost estimates, and make public the implications for program implementation.

The NFWA requires that each annual report issued by NWMO will include updated cost information and set out the amounts of the deposits to trust funds required to be paid during the next fiscal year by each of the waste owners.

A detailed program cost re-estimation is planned for completion in 2011.

REFERENCES

[1] Choosing a Path Forward – The Future of Canada's Used Nuclear Fuel – Final Study, Nuclear Waste Management Organization Report, November 2005.

[2] Cost Estimate for a Deep Geologic Repository for Used Nuclear Fuel. CTECH Report, 1106/MD18085/REP/02, September 2003.

[3] Cost Estimate for Transportation of Used Fuel to a Centralized Facility, COGEMA Logistics Report, 500276-B-010, September 2003.

[4] Nuclear Fuel Waste Projections in Canada – 2008 Update, Nuclear Waste Management Organization Report, NWMO TR-2008-18, December 2008.