Nuclear Waste Management Organization

Independent Peer Review of NWMO Discussion Document 2, "Understanding the Choices"

Prepared for Canadian Association of Nuclear Host Communities

> SL-008414 December 2004





55 East Monroe Street Chicago, IL 60603-5780 USA Nuclear Waste Management Organization

Independent Peer Review of NWMO Discussion Document 2, "Understanding the Choices"

Prepared by

Sean F. Hager Principal Consultant and **Project Manager**

Reviewed by

Timothy P. Krause Senior Environmental Specialist

Approved by

2-13-2004

Sean F. Hagen Principal Consultant and Project Manager

> SL-008414 December 2004



Acres-S&L

55 East Monroe Street Chicago, IL 60603-5780 USA

LEGAL NOTICE

This report was prepared by Acres–Sargent & Lundy, hereafter referred to as ASL, expressly for the Canadian Association of Nuclear Host Communities. Neither ASL nor any person acting on their behalf (a) makes any warranty, express or implied, with respect to the use of any information or methods disclosed in this report or (b) assumes any liability with respect to the use of any information or methods disclosed in this report.

COPYRIGHT NOTICE

This document contains information that is proprietary to Sargent & Lundy LLC (S&L). It shall not be reproduced in whole or in part or released to any third party without the prior written consent of S&L. Copyright S&L 2004; all rights reserved.



Independent Peer Review of NWMO Discussion Document 2, "Understanding The Choices"

CONTENTS

Sect	Section Page		
1.	INTRODUCTION		1-1
2.	EXEC	CUTIVE SUMMARY	
2.1	Ove	rview	2-1
2.2	Res	ults	2-1
22	Kar	Issues and Recommendations	2.4
2.5	Key		
3.	MET	IODOLOGY	
4.	DETA	ILED EVALUATION RESULTS	4-1
4.1	Ove	erview of Discussion Document 2 / Understanding the Choices	
4.2	Ass	essment Framework	
	4.2.1	General Discussion	
	4.2.2	Comprehensiveness and Balance	
	4.2.3	Engagement	
	4.2.4	Timing	
	4.2.5	"Keeping an Eye on the Waste"	4-7
	4.2.6	Retrievability	
4.3	Ma	nagement Approaches	
	4.3.1	General Discussion	
	4.3.2	Strengths and Weaknesses	
	4.3.3	Impact on Current Host Communities	
4.4	Imp	lementation Plan	4-14
	4.4.1	General Discussion	



CONTENTS (cont.)

Sec	tion	<u>Page</u>
	4.4.2 Specific Needs for Implementation Plans	4-16
	4.4.3 Phased Approach	4-18
5.	BACKGROUND INFORMATION	5-1
Ар	pendixes	
Α	Correspondence and Contract Information	
	A.1 Request for Proposal	
	A.2 Proposal	
	A.3 Meeting Minutes – Teleconference of November 22, 2004	
	A.4 Authorization	
	A.5 Contact Information	
В	NWMO Fact Sheets	
	The Nuclear Waste Management Organization	
	Nuclear Fuel Waste in Canada	
	How Nuclear Fuel Waste is Managed in Canada	
	The Canadian Nuclear Regulatory Framework	
	Health Effects of Radiation and Radioactivity	
	Centralized Extended Storage	
	Deep Geological Repository	
	Nuclear Site Extended Storage	
	The NWMO Study Process	
С	NWMO Web Site Map	
D	Reference Table	
E	List of NWMO Background Papers	
F	Discussion Document 2, Executive Summary	
G	Joint Waste Owner Conceptual Designs - Overview Documentation	



LIST OF TABLES

Table	Page
Table 2-1 — Issue and Recommendation Summary	2-4
Table 4-1 — Key Activity Durations of the Main Management Approaches	
Table 4-2 — Summary of Management Approaches Considered by the NWMO	4-10
Table 4-3 — Key Strengths and Weaknesses of the Main Management Approaches	4-11
Table 4-4 — Anticipated Environmental Assessments for the Main Management Approaches	4-17
Table 5-1 — Used Fuel Bundles at Canadian Nuclear Facilities as of December 31, 2001	



ACRONYMS AND ABBREVIATIONS

Term	Definition or Clarification
AECL	Atomic Energy of Canada Limited
ASL	Acres-Sargent & Lundy
CANDU	Canada Deuterium Uranium
CANHC	Canadian Association of Nuclear Host Communities
CEAA	Canadian Environmental Assessment Act
CNSC	Canadian Nuclear Safety Commission
CRL	Chalk River Laboratories
DGR	Deep geological repository (facility)
EA	Environmental Assessment
NFWA	Nuclear Fuel Waste Act
NPV	Net present value
NWMO	Nuclear Waste Management Organization
RFP	Request for proposal
SAR	Safety analysis report



1. INTRODUCTION

Acres-Sargent & Lundy (ASL) was engaged by the Canadian Association of Nuclear Host Communities (CANHC) to assist in its evaluation of Canada's Nuclear Waste Management Organization (NWMO) process for the future management of Canada's used nuclear fuel. Specifically, CANHC requested ASL's assistance by reviewing NWMO's Discussion Document 2: "Understanding the Choices: The Future Management of Canada's Used Nuclear Fuel." This report summarizes our review of Discussion Document 2 for CANHC.

The purpose of Discussion Document 2 is to share the NWMO's recent work and thoughts about the long-term management of used nuclear fuel in Canada. The document provides information "important for a public dialogue about the relative merits of the different waste management approaches." Our review will address the following questions asked by the NWMO in the discussion document as a means to seek continued public involvement:

- Is the assessment framework comprehensive and balanced? Are there gaps, and if so, what should be added to the assessment framework?
- What are our thoughts on the strengths and weaknesses of each management approach: deep geological disposal, centralized storage, and reactor site storage?
- Are there specific elements that we believe must be built into an implementation plan? What are our thoughts on what a phased approach must include?

These questions were supplemented by questions asked by CANHC during the performance of our review.

This Independent Peer Review is organized into several sections. Section 2 of this report provides a summary of the results of our review and includes a table of the key issues we identified and the corresponding recommendations we developed. Section 3 discusses the methodology and approach we used to perform our review. Section 4 provides a detailed discussion of the key issues and questions related to Discussion Document 2. Section 5 includes background information related to CANHC, the NWMO, and the overall study that the NWMO is to develop its recommended management approach.

In addition, several appendixes are included to provide references and general information related to our independent peer review. Appendix A contains correspondence and administrative information related to our engagement to perform the independent peer review, including CANHC's Request for Proposal, ASL's proposal, minutes from the interview/kick-off teleconference, CANHC's authorizing ASL to perform the



1-2 SL-008414 Final

review, and contact information for ASL's key personnel. Appendix B includes several NWMO fact sheets that provide more background information about Canadian used nuclear fuel issues. To facilitate accessing NWMO information on the Internet related to Discussion Document 2 and our review, Appendix C includes a copy of the site map for NWMO's web site and Appendix D includes a table of web links. Appendix E provides a listing of the background papers developed by NWMO related to their study. In order to provide a comprehensive overview of Discussion Document 2, Appendix F includes Discussion Document 2's Executive Summary. Appendix G includes summaries developed by the Joint Waste Owner's to provide an overview of the three main management approaches.

Last page of Section 1.



2. EXECUTIVE SUMMARY

2.1 OVERVIEW

The NWMO was established under the Nuclear Fuel Waste Act (NFWA) to investigate approaches for managing Canada's used nuclear fuel. The Nuclear Fuel Waste Act requires the NWMO to recommend a preferred management approach to the Government of Canada by November 15, 2005. The NWMO will then implement the approach chosen by the Government. In order to provide an overview of used nuclear fuel and related issues in Canada, Appendix B contains nine fact sheets developed by the NWMO that address topics such as the NWMO organization, what is "used nuclear fuel," the Canadian nuclear regulatory framework, and the NWMO study process, among others. As noted in the NWMO's Fact Sheet 9, "The NWMO Study Process," the NWMO has committed to "develop collaboratively with Canadians a management approach that is socially acceptable, technically sound, environmentally responsible, and economically feasible."

The NFWA requires that the following three main management approaches must be studied: deep geological disposal, storage at nuclear reactor sites, and centralized storage. Other methods may also be considered. To undertake the study, the NWMO has "adopted an iterative study process, undertaken in phases to allow information, analyses, and thinking to be considered in a staged manner." Discussion Document 2 was developed and issued as part of this iterative and open process to summarize the progress so far and the next steps the NWMO is taking to arrive at its recommended management approach.

ASL performed a broad review of Discussion Document 2 with the overall objective of identifying questions that are not currently being asked by either the NWMO or others reviewing the NWMO's process. The intent of the review was to identify key issues and areas that we recommend CANHC focus on as NWMO continues in their process.

2.2 RESULTS

Discussion Document 2 is a high level document that contains a broad summary of the NWMO's activities since Discussion Document 1 was issued. As a summary document, it contains a significant number of references to other NWMO documents that address the topics and issues related to developing the recommendation for which management approach the Canadian government should use. These references are generally located on the NWMO web site. Appendix C provides the current site map of NWMO's web site for



reference. Appendix D contains a reference table developed by ASL in its review of Discussion Document 2 that lists the web sites referenced in the document along with the related files posted on the web.

The current assessment framework is derived from the original ten questions discussed in NWMO's Discussion Document 1, "Asking the Right Questions," and consists of eight objective and associated guiding principles and influences. The framework was developed by a multi-disciplinary Assessment Team assembled by the NWMO to develop a comparative analysis of alternate approaches. The NWMO's Assessment Team based their work on the ten questions posed in Discussion Document 1 and on the NWMO's engagement with Canadians and ongoing research and analysis activities.

The eight objectives of the NWMO's current assessment framework are as follows:

- Fairness
- Public Health and Safety
- Worker Health and Safety
- Community Well-Being
- Security
- Environmental Integrity
- Economic Viability
- Adaptability

Based on the updated framework, the NWMO Assessment Team performed a comparative analysis of the three main management approaches by systematically comparing the approaches against the objectives using a multiattribute utility analysis. The NWMO Assessment Team's report was issued in June 2004 and forms a significant basis for the information presented in Discussion Document 2.

The NWMO has performed significant engagement activities and actively solicited a wide range of input on its work. The NWMO's engagement activities were designed to establish an informed dialogue with a wide range of stakeholders, ranging from the Canadian public at large to governments, business interests, and interested individuals.

The NWMO has developed conceptual designs, cost estimates, transportation requirements, and preliminary project timelines for each of the main management approaches; these can be accessed on NWMO's web site as



2-3 SL-008414 Final

noted in Appendix D. The conceptual designs and cost estimates are intended to provide sufficient detail to confirm the engineering feasibility of the management approaches to support the current phase of the NWMO's study, which is appropriate. The NWMO has arranged for independent reviews of these technical evaluations. The NWMO noted in Discussion Document 2 that these third-party reviews concluded that the designs are reasonable and feasible, that the cost estimates have been prepared in accordance with appropriate estimating methodology, and that the technical information as a whole is suitable for the options review and directional decision-making requirements of the NWMO.

Based on the conceptual designs and cost estimates, the Assessment Team analyzed each of the three main management approaches within the current assessment framework. The resulting relative strengths and weaknesses of each approach is summarized in Figure E-1 (starting on page 7) in Discussion Document 2's Executive Summary (provided in Appendix F of this report to facilitate reference). The relative strengths and weaknesses are discussed in more detail in Section 4.3.2 below.

The Assessment Team's report notes that the overall management of spent fuel in Canada is politically complicated. Under the Canadian constitution, energy policies and land management that involve the production of spent fuel are responsibilities of the provincial governments, while management of radioactive materials is the responsibility of the federal government. Discussion Document 2 notes that the NWMO will be focusing on implementation plans as their study moves forward and that implementation is a critical part of making a recommendation. The NWMO notes that the development of implementation plans will include, at a minimum, consideration of the following elements:

- Oversight and monitoring systems
- Ongoing societal involvement
- Institutional design, including human resource capacity
- Ownership and liability
- Dispute management
- Principles to guide site selection; and
- Education and information programs.

The NFWA states that the selected management approach will be implemented by the NWMO "subject to all of the necessary regulatory approvals." Discussion Document 2 contains implementation timelines for each of the

Sargene & Lundy Acres-S&L

three main management approaches. Siting and approval for each of the approaches is a critical element of each of the timelines. The NWMO has started to assess the regulatory framework within which the selected approach will be implemented.

2.3 KEY ISSUES AND RECOMMENDATIONS

ASL identified several issues and corresponding recommendations during its independent peer review as summarized in the table below. The detailed results and discussion of these issues is presented in Section 4.

Issue	Recommendation			
Assessment Framework				
Although the Assessment Team's report provides alternate weightings of the different overall objectives, it does not provide the weightings for the specific influence variables associated with each objective. As a result, ASL cannot determine how balanced the assessment framework is.				
The Assessment Team report notes that a practical strategy for implementing an overall management approach must take the political climate into account, and that this factor is outside the scope of the Team's assessment.	The NWMO should provide explanations of how political climate, contingency planning, fatal flaws, and relative importance of the objectives and specific influence variables were considered, so that it is possible in future work to confirm and evaluate the overall balance of the assessment framework.			
The Assessment Team notes that "The assessment suggests it will be necessary to ensure that contingency plans are known and available should they be required, at least for the period in which active management of the waste is needed to ensure safety."				
The Assessment Team's report presents the results of their analysis in the form of composite scores, and does not seem to consider fatal flaws (that is, an issue or problem that would exclude a particular option from further consideration).				
The NWMO has not systematically engaged with groups that focus and represent public opinion, such as nuclear awareness groups or environmental groups. These groups may have specific agendas that may be counter to the NWMO's ultimate objective to implement a management approach once the Canadian government makes a decision based on the NWMO's recommendation.	The NWMO should specifically solicit input from groups that focus and represent public opinion. In addition, or alternatively, the NWMO should develop an assessment of the positions of these groups, the influence they may exert on the process, the impact this influence could have on the recommended management approach, and what can be done to gain their input or otherwise address their positions.			

Table 2-1 — Issue and Recommendation Summary



Issue	Recommendation	
There is a conflict between the desire of some stakeholders to "keep an eye on the waste" versus the scientific community's general preference for deep geological disposal. For example, a reactor site storage (or, to a more limited extent, centralized storage) keeps the issue and societal costs of nuclear waste more visible, and so provides an impetus for reducing the generation of this type of waste. A comparison was made to trash along the side of a road: if disposed in a landfill and out of sight, there is less of a constant reminder of the overall costs associated with	The NWMO study should ensure (1) that the conflicting desires of some stakeholders to keep the issue of used fuel visible versus the scientific community's general preference for deep geological disposal are given proper weight, (2) that the technical details of the selected management approach address this issue, and (3) that broader social values and motives (such as keeping used fuel disposal highly visible in order to highlight the issue) are considered.	
creating the trash. This perspective would not necessarily be addressed by a technically focused comparative analysis and could significantly affect the current host communities due to its bias towards reactor site storage.	As part of the engagement process, the NWMO should consider establishing focus groups to identify specific concerns that people may have with "keeping an eye on the waste" (i.e., technical or social) to support fully addressing this issue.	
The used nuclear fuel is retrievable in the two storage approaches, but by design is not retrievable in the deep geological disposal approach after the site is decommissioned. Discussion Document 2 does not fully address this issue, nor is it fully addressed in the Assessment Team's report, "Assessing the Choices."	The NWMO should more fully address the issue of retrievability as it develops more detailed comparative analyses.	
Management Approaches		
Any changes to the weighting of the different objectives and corresponding factors used in the ongoing comparative assessment process will affect the relative strengths and weaknesses.	Potential changes in the relative strengths and weaknesses should be reviewed as the comparative analysis process continues.	
The site selection process for deep geological disposal does not include as a limitation the challenges associated with establishing the geological suitability of potential sites. This issue is an ongoing concern in the United States with the Yucca Mountain project.	Consideration should be given to the effect associated with confirming the technical suitability of potential sites (such as schedule delays and cost impacts).	
There appears to be a discrepancy in the advantages and limitations relative to the objective for Adaptability. For example, Adaptability was noted as being a weakness of deep geological disposal. However, the deep geological disposal approach had the same or higher performance value score compared to the other approaches in the analysis of Adaptability.	This discrepancy should be clarified or otherwise resolved as the comparative analysis process continues.	



Issue	Recommendation	
The relative strengths and weaknesses of the different management approaches as discussed in Discussion Document 2 do not provide an indication of how they might be affected by potential technical changes.	The sensitivity analyses conducted as part of the NWMO's ongoing comparative analysis process should consider changes in key technical assumptions. (It should be noted that the Assessment Team's sensitivity analysis addresses broader changes in future conditions; this recommendation is intended to apply at more of a technical design level.)	
Social effects on communities and siting issues are not mentioned in the limitations for reactor site storage even though the current host communities were not selected based on their suitability for extended storage. The analysis notes technical limitations for at-reactor storage (such as proximity to large bodies of water), but does not note any social disadvantages.	The ongoing comparative analysis should specifically assess the overall impact of the selected management approach on the current host communities to ensure that they are afforded the same considerations	
Discussion Document 2 does not discretely analyze the impacts of the separate management approaches on the current host communities.	communities.	
The strengths and weaknesses noted by the NWMO in Discussion Document 2 do not mention or appear to account for a comparative assessment of the risks related to the different approaches. The comparative risks include both technical risks (such as the impact of postulated accidents) and financial risks (such as changes in the assumed discount rates used in the financial models).	Relative technical and financial risks should be identified and considered during the ongoing detailed comparative assessments that the NWMO is currently performing.	
Implementation Plan		
Background paper 7-8 notes that any proposal to postpone a decision on a preferred long-term option would itself have significant implications and may be deemed worthy of a review panel. The NWMO should ensure the implementation plans develop separate management appro comprehensive and specific p schedules that define which p		
Many of the problems and delays in the implementation of major projects with significant environmental implications stem from the failure to correctly identify all the required permits and permit application requirements associated with a given project.	it takes to apply for and obtain them, and who has to make the application. Possible conflicts or uncertainties regarding the lega jurisdiction of different government agencies should be identified.	



Issue	Recommendation
Problems and delays can also stem from determined opposition from one or more stakeholders (such as environmental groups or elected officials) when the EA and applications are reviewed. It should be noted that technical issues (engineering, conceptual designs, etc.) or costs are frequently not the critical parameters that determine a project's success or failure.	ASL's earlier recommendation about the need to engage groups that focus and represent public opinion should be pursued in recognition that they may provide valuable information for the NWMO's implementation plans in terms of identifying potential opposition, assessing the primary concerns of potential opponents, and developing mitigation measures to address these concerns.
The assessment performed by the Assessment Team is not specific with respect to the choice of economic region for a centralized storage facility or geologic repository. The NWMO's ongoing efforts will focus on developing characteristics that would be appropriate in choosing specific economic regions for deep geological disposal and centralized storage approaches.	In addition to supporting site selection, the NWMO should ensure that site-specific issues and considerations are identified and addressed within the associated implementation plans.
As the implementation plans are developed, the resulting details could affect the comparative assessments of the different management approaches performed up to that point.	The NWMO should ensure that the comparative assessments are updated and re-evaluated as required to be consistent with the planned implementation details.
Although a phased approach is reasonable and has significant advantages, in ASL's experience, it has the potential of negatively affecting the overall effective implementation of a project.	The NWMO should ensure that the overall project implementation plans include key project milestones where "go – no go" decisions are made, as well as points where designs are finalized, or "frozen," to enable the project to proceed with minimal potential for design changes. To be able to capitalize on new technical or other advances, the design parameters associated with the selected management approach should be developed and selected to maximize overall system flexibility.

Last page of Section 2.



3. METHODOLOGY

ASL's independent review was performed by a core team of consultants that have significant spent fuel disposal experience, as well as experience in assessing the impacts of new nuclear facilities and associated development and permitting requirements. Immediately before project authorization, a combination interview/ kick-off meeting was held between ASL and the CANHC Steering Committee to review ASL's qualifications and to confirm the planned approach for the independent evaluation.

ASL performed a broad review of Discussion Document 2 with the overall objective of identifying questions that are not currently being asked by either the NWMO or others reviewing the NWMO's process. The intent of the review was to identify key issues and areas that we recommend CANHC focus on as the NWMO continues in their process.

During the project interview/kick-off teleconference, ASL and CANHC discussed several questions and comments that provide further depth to the issues and supplement the questions included in Discussion Document 2. ASL utilized these questions during its review of the document to provided focus on the key issues relative to the current host communities. These questions and issues are summarized below:

- Assessment Framework
 - Is the assessment framework comprehensive and balanced?
 - Are there gaps, and if so, what should be added to the assessment framework?
 - How can the NWMO reconcile the apparent preference of Canadians to "keep an eye on the waste" and the apparent preference of the scientific community for deep geological disposal?
 - Do the various management approaches adequately address the possibility that the waste could be retrieved?
- Management Approaches
 - What are our thoughts on the strengths and weaknesses of each management approach: deep geological disposal, centralized storage, and reactor site storage?
 - Focus on the impact on the existing site communities.
- Implementation Plan
 - Are there specific elements that we believe must be built into an implementation plan?
 - What are our thoughts on what a phased approach must include?



- If the NWMO recommends an approach that involves relocating the waste, the ability of that approach to be implemented must be addressed, given social and political realities. Otherwise, onsite storage will become, by default, the selected management approach.
- Whether or not a phased approach to implementation is adopted, the waste will remain at the existing sites for a number of years. Therefore, the interest of the existing host communities must be considered when developing an implementation plan.

In addition to considering these questions and comments, ASL reviewed the NWMO's process, including its assessment framework, management approaches, and implementation plan, in consideration of the types of environmental screening and permitting processes used for other major projects.

ASL did not review each of the documents referenced in Discussion Document 2 as part of our independent peer review, as this depth of review is beyond the scope of our independent peer review. However, we reviewed certain documents in some detail and did review the types and subjects of documents relative to the context of Discussion Document 2 and the questions and comments used to guide our review. For example, our review of the list of background papers developed by the NWMO regarding certain topics, such as Guiding Concepts, provides an indication of how thoroughly the NWMO has addressed that particular topic. Selected reference documents were reviewed in more detail as appropriate to address the key questions and comments used to guide the independent peer review.

Last page of Section 3.



4. DETAILED EVALUATION RESULTS

4.1 OVERVIEW OF DISCUSSION DOCUMENT 2 / UNDERSTANDING THE CHOICES

Discussion Document 2 contains the following elements:

- Part 1 / Foundations of the Assessment Chapter 1 / Introduction Chapter 2 / Understanding Canadian Values Chapter 3 / Reporting Back
- Part 2 / A Preliminary Comparative Assessment Chapter 4 / Choosing and Describing An Assessment Approach Chapter 5 / An Assessment
- Part 3 / Towards a Management Approach Chapter 6 / A Responsive Framework Chapter 7 / NWMO's Work Continues Chapter 8 / Engaging Canadians
- Appendices

Appendix 1 / Profile of the NWMO Appendix 2 / Engagement Activities Appendix 3 / NWMO Background Research Appendix 4 / Screening Rationale for Methods of Limited Interest Appendix 5 / Glossary

Building on Discussion Document 1, Part 1 of Discussion Document 2 reports on the NWMO's further exploration of the values and priorities of Canadians and presents insights from the dialogues convened in Discussion Document 1, "Asking the Right Questions." Part 2 provides a fuller description of the approaches that the NWMO will now focus on for the study. Part 3 "takes stock" of what the NWMO has learned to date and identifies a path forward for the next phase of the NWMO's study. The Executive Summary of Discussion Document 2 is included in Appendix F of this report to provide a more detailed summary of the document. In addition, as noted earlier, ASL developed the Reference Table in Appendix D that lists the web sites referenced in Discussion Document 2 along with the related files posted on the web. This table summarizes the information that the NWMO has developed so far in its study and provides an indication of how they have addressed the issues and questions raised so far in the process. The web links noted in Appendix D are listed in



the order they are referenced in Discussion Document 2 (it should be noted that some web sites are referenced multiple times, and so are repeated in the reference table to denoted the references made in each section of "Understanding the Choices").

4.2 ASSESSMENT FRAMEWORK

4.2.1 General Discussion

The current assessment framework is derived from the original ten questions discussed in the NWMO's Discussion Document 1, "Asking the Right Questions." To help with the comparative analysis of alternate approaches, the NWMO put together a multi-disciplinary Assessment Team and asked them to develop an assessment framework based on the ten questions posed in Discussion Document 1. The NWMO Assessment Team issued its report in June 2004.

Based on the NWMO's engagement with Canadians and its research and analysis activities, the Assessment Team converted the original ten questions into eight objectives and associated guiding principles and influences, which comprise the assessment framework. The discussion in Part 2 of Discussion Document 2 is based on the Assessment Team's report. The original ten questions are summarized below:

- 1. Does the management approach have a foundation of rules, incentives, programs, and capacities that ensure all operational consequences will be addressed for many years to come?
- 2. Does the management approach provide for deliberate and full public engagement through different phases of the implementation?
- 3. Have aboriginal perspectives and insights informed the direction and influenced the development of the management approach?
- 4. Is the process for selecting, assessing, and implementing the management approach one that is fair and equitable to our generation and future generations?
- 5. When considered together, do the different components of the assessment suggest that the management approach will contribute to an overall improvement in human and ecosystem well-being over the long-term?
- 6. Does the management approach ensure that people's health, safety, and well-being are maintained (or improved) now and over the long-term?
- 7. Does the management approach contribute adequately to human security? Will it result in reduced access to nuclear materials by terrorists or other unauthorized agents?
- 8. Does the management approach ensure the long-term integrity of the environment?



- 9. Is the economic viability of the management approach assured and will the economy of the community (and future communities) be maintained or improved as a result?
- 10. Is the technical adequacy of the management approach assured and are design, construction and implementation of the method(s) used by it based on the best available technical and scientific insight?

The current objectives developed by the Assessment Team are summarized below:

- **Fairness.** Capacity to ensure fairness in the distribution of costs, benefits, and risks: process and substance.
- **Public Health and Safety.** Capacity to ensure public health and safety.
- Worker Health and Safety. Capacity to ensure worker health and safety
- Community Well-being. Capacity to ensure community well-being
- Security. Capacity to ensure security of materials, facilities, and infrastructure
- Environmental Integrity. Capacity to ensure environmental integrity
- Economic Viability. Capacity to ensure economic viability
- Adaptability. Capacity to adapt to changing conditions over time.

The relationship between the original ten questions and the eight objectives of the current assessment framework is shown in Figure 4-5 of Discussion Document 2, "Elements of the Objectives Hierarchy Plotted Against the Original Ten Questions."

4.2.2 Comprehensiveness and Balance

The process used to derive the current framework, as described in Discussion Document 2, is considered to be reasonable and appropriate and is supported by the documents referenced in the discussion document.

Although ASL believes that the assessment framework is generally comprehensive, we identified potential gaps in the assessment framework as it is described and used in Discussion Document 2. One potential gap relates to the potential political climates that may exist during the decision and implementation phases of the management approaches. The Assessment Team report notes that a practical strategy for implementing an overall management approach must take the political climate into account, and that this factor is outside the scope of the Team's assessment. If the political climate does not support making a decision or implementing a decision, then, by default, the used fuel will likely remain at the current sites. It was not clear from our review of



Discussion Document 2 and the NWMO's background papers whether this factor and related strategies are assessed by the NWMO.

Another potential gap in the assessment framework that was noted in the Assessment Team's report is related to contingency planning. The Assessment Team notes that "The assessment suggests it will be necessary to ensure . . . that contingency plans are known and available should they be required, at least for the period in which active management of the waste is needed to ensure safety." Again, it was not clear from our review of Discussion Document 2 and the NWMO's background papers whether this factor and related strategies are assessed by the NWMO.

In addition to these gaps, it is not clear how the relative importance or priorities of the eight objectives will be addressed when assessing the different management approaches. In Figure 4-5 of Discussion Document 2, the original ten questions and eight current objectives are characterized as all having equal importance (i.e., the order in which they are listed does not imply a prioritization of concerns). In the Assessment Team's report, however, the Assessment Team notes that it used different weights to explore trade-offs between the different objectives based on competing values and preferences identified during the NWMO's engagement activities. As noted in Section 5.2 of the Assessment Team's report, these competing values include the following:

- Security vs. Accessibility
- Remote location vs. Minimal handling and transportation of waste
- Assume responsibility today vs. Provide flexibility for future generations
- Making a decision vs. Managing uncertainty

The Assessment Team's report presents the results of their analysis in the form of composite scores and does not seem to consider fatal flaws (that is, an issue or problem that would exclude a particular option from further consideration). For example, the composite scores of the onsite storage options relative to the objectives of Pubic Health and Safety and the objective for Security, beyond 175 years, both include a performance value score of zero in their ranges. This indicates that at least some on the Assessment Team may have considered these options to untenable; however, without a consideration of fatal flaws, this would only have the affect of broadening the range of scores as opposed to initiating a more significant assessment of these options.

The Assessment Team indicated that changing the weighting used in the assessment as part of their methodology provides a sensitivity analysis that indicates whether different levels of importance for different



issues impact the ranking of the management approaches. In ASL's opinion, this type of sensitivity analysis is important and necessary to fully evaluate the different approaches and confirm that the assessment framework is balanced. The Assessment Team report indicates the magnitude of the relative weights used in its assessment of the overall objectives, but not for the specific influence variables associated with each objective.

In summary, ASL believes that the assessment framework is generally comprehensive but cannot determine how balanced it is. The NWMO should provide explanations of how political climate, contingency planning, fatal flaws, and relative importance of the objectives and specific influence variables were considered, so that it is possible in future work to determine whether the assessment framework is balanced. The NWMO should also explore the potential effect of fatal flaws.

4.2.3 Engagement

The NWMO has openly described its methods and framework and has actively solicited a wide range of input on its work. The NWMO's engagement activities were designed to establish an informed dialogue with the following communities of interest (reference the NWMO's Engagement Plan, dated June 10, 2003):

- Canadian public at large
- Governments (federal, provincial, local/municipal, aboriginal)
- Residents and representatives from communities with current storage sites
- Communities that might be affected in future (through storage or transportation)
- Non-profit and non-governmental organizations from civil society (health, social sciences, energy, environment, faith, professional societies, culture, education, development, civil rights, labor, etc.)
- Business interests
- Nuclear energy corporations
- Individuals who have any interest in nuclear waste management and/or who have an area of relevant expertise
- The NWMO

Based on the references cited in Discussion Document 2, the NWMO has achieved a wide range of engagement in accordance with its plan. A recent e-dialogue coordinated by Royal Roads University (reference Group #1 on November 29, 2004), however, identified a potential gap in the communities engaged by the NWMO. The engagement activities have not been designed to, nor have they achieved, consultation with groups that focus



and represent public opinion, such as nuclear awareness groups or environmental groups. This perspective is confirmed by our review of the engagement documents posted on the web by the NWMO, which do not appear to include input from these types of groups.

These groups may have specific agendas that may be counter to the NWMO's ultimate objective to implement a management approach once the Canadian government makes a decision based on the NWMO's recommendation. Accordingly, ASL believes that the NWMO should specifically solicit the input from these types of groups. In addition, or alternatively, the NWMO should develop an assessment of the positions of these groups, the influence they may exert on the process, the impact this influence could have on the recommended management approach, and what can be done to gain their input or otherwise address their positions.

4.2.4 Timing

Based on the progress made by the NWMO to date, as measured against the timeline established by the NWMO to complete the study, the three-year duration allotted by the NFWA is technically sufficient to develop a recommended management approach. Figure 8-1 in Discussion Document 2, "NWMO Study: A Process of Interactive Engagement," summarizes the NWMO process and timeline. It should be noted that this process and timeline are consistent with the NWMO's Engagement Plan, issued in June 2003, and the document "NWMO Approach to Development of Analytical Framework," issued in July 2003.

Discussion Document 2 includes the estimated duration for implementing each of the three primary management approaches, as noted below:

Management Approach	Estimated Duration for Siting & Approvals	Estimated Duration for Design and Construction	
Reactor site extended storage	5 years	5 years	
Centralized storage	10 years	10 years	
Deep geological repository	10 to 15 years	10 to 15 years	

 Table 4-1 — Key Activity Durations of the Main Management Approaches

The existing industry experience with the three main management approaches support the three-year time allowed for the NWMO to develop a recommended approach and for the estimated duration of the design and construction phases. The Joint Waste Owner Overview Documentation (see Appendix G) indicates that Atomic



4-7 SL-008414 Final

Energy of Canada Limited (AECL) and Ontario Power Generation began to investigate various options for dry storage in the 1970s and that AECL has more than 25 years of experience with dry storage systems. This paper also notes that centralized extended storage systems are already operational in 12 countries and used over a wide range of circumstances from providing common temporary storage for used fuel from a few reactors to providing a fully centralized management system for used fuel at the national level. While uncertainties exist related to the long-term performance of deep geological repositories, many countries support the concept, including Sweden, Italy, Spain, Japan, China, and the United States, among others. The design concept for deep geological repository for used CANDU fuel was developed by AECL during the period 1978–1996 as part of the Canadian Nuclear Fuel Waste Management Program.

It should be noted that the actual time required to gain social acceptance of the recommended approach and corresponding implementation and overall schedule for the selected management approach will be determined at least in part by the political climate, adding importance to the need for the NWMO to assess the impact of potential political climates as discussed earlier.

4.2.5 "Keeping an Eye on the Waste"

CANHC requested ASL to assess how the NWMO can reconcile the apparent preference of Canadians to "keep an eye of the waste" and the apparent preference of the scientific community for deep geological disposal. In our opinion, this can be achieved within the assessment framework that the NWMO has established and by utilizing the multi-attribute utility analysis that the Assessment Team adopted. As the name of this analytical method implies, this type of analysis takes several factors into account related to each objective. For example, the influence diagrams shown in Chapter 5 of Discussion Document 2 show the factors included in the Assessment Team's analyses. Accordingly, factors related to "keeping an eye on the waste" can be incorporated into ongoing assessments of the different options. For example, the objectives of Fairness, Community Well-Being, Security, and Adaptability may all be influenced to a certain extent by this factor.

The NWMO is taking steps to evaluate the need to assess the issue of monitoring the waste. For example, the NWMO has assessed monitoring waste in Background Paper 3-5, issued in November 2004. This paper noted that the selected used nuclear fuel management system, whether a deep geological repository or an extended storage system, will require monitoring. The purpose of the paper was to develop a risk-based monitoring framework for used fuel management approaches. This was carried out in two steps:



- First, the various management methods were reviewed to estimate potential risks at each stage of their development.
- Second, the results of the review were used to develop, at a conceptual level, a monitoring framework that focuses on the main areas of potential risk.

The paper identified several gaps in the risk estimates and its documentation, but indicated that none of them affect the paper's overall conclusions. The paper recommends that the gaps need to be addressed as part of the implementation of the approach selected by the Canadian government.

Another aspect of "keeping an eye on the waste" was identified during the e-dialogues coordinated by Royal Roads University (reference Group #3 on November 29, 2004). In essence, a comment was made that a reactor site storage (or, to a more limited extent, centralized storage) kept the issue and societal costs of nuclear waste more visible, and so provides an impetus for reducing the generation of this type of waste. The comparison was made to trash along the side of a road: if disposed in a landfill and out of sight, there is less of a constant reminder of the overall costs associated with creating the trash. This perspective would not necessarily be addressed by a technically focused comparative analysis of the potential management approaches, and so highlights the value of the multi-attribute utility analysis used by the NWMO. This perspective could significantly affect the current host communities due to its bias towards reactor site storage, and so should be addressed as the NWMO moves closer towards making a recommendation.

In summary, the NWMO is evaluating monitoring requirements and is using appropriate analytical tools that can reconcile requirements with competing objectives. Moving forward, it will be important for CANHC to review the final phases of the NWMO study to ensure that these factors are given proper weight (as discussed earlier in this review), that the technical details of the selected management approach address this issue, and that broader social values and motives (such as keeping used fuel disposal highly visible) are considered. As part of the engagement process, the NWMO should consider establishing focus groups to identify specific concerns that people may have with "keeping an eye on the waste" (i.e., technical or social) and to support fully addressing this issue.

4.2.6 Retrievability

The three primary management approaches required to be considered are summarized in Appendix G, which is a copy of the Joint Waste Owners Conceptual Designs Overview paper as posted on the NWMO's web site. Of the three approaches, Reactor Site Extended Storage and Centralized Extended Storage include assumptions



4-9 SL-008414 Final

that the waste will be repackaged. Accordingly, for these two approaches, the NWMO has addressed the possibility that the waste could be retrieved. The third approach, the deep geological repository concept, does not explicitly identify the assumption that the waste will either be repackaged or retrieved. The base assumption for deep geological disposal, instead, is that the facility will be decommissioned after a certain period of operations and monitoring. This approach requires that the used fuel containers be retrievable during the preclosure phase, but it does not address retrievability after the facility has been decommissioned. The design concept includes backfilling around the spent fuel disposal containers, which would hinder the ability to retrieve the spent fuel if required.

In summary, the used nuclear fuel is retrievable in the two storage approaches, but by design is not retrievable in the disposal approach after the site is decommissioned (closed). Discussion Document 2 does not fully address this issue, nor is it fully addressed in "Assessing the Choices." For example, retrievability is a factor in the "Adaptability" influence diagram, but the performance value scores for the deep geological disposal approach are approximately the same as for the other approaches. ASL believes that the NWMO should more fully address this issue as it develops more detailed comparative analyses.

4.3 MANAGEMENT APPROACHES

4.3.1 General Discussion

The table below summarizes the management approaches that the NWMO has identified and considered to date:



Methods Requiring Review (Mandated by NFWA)	Methods Receiving International Attention	Methods of Limited Interest
Deep Geological Disposal in the	Reprocessing, Partitioning, and	Direct Injection
Canadian Shield	Iransmutation	Rock Melting
Storage at Reactor Sites	Storage or Disposal at an International Repository	Sub-Seabed Disposal
Centralized Storage Above or Below Ground	Emplacement in Deep Boreholes	Disposal at Sea
		Disposal in Ice Sheets
		Disposal in Subduction Zones
		Disposal in Space
		Dilution and Dispersion

Table 4-2 — Summa	ry of Management	Approaches	Considered by	y the NWMO
-------------------	------------------	------------	---------------	------------

Source: Table 3-1, Potential Technical Methods, in Discussion Document 2

Appendix G of this review paper contains overview documents prepared by the Joint Waste Owners for the NWMO that describe the management methods in more detail; they are included to facilitate the reader's reference. The NWMO has developed conceptual designs, cost estimates, transportation requirements, and preliminary project timelines for each of the main management approaches, which can be accessed on the NWMO's web site, as noted in Appendix C. The conceptual designs and cost estimates are intended to provide sufficient detail to confirm the engineering feasibility of the management approaches to support the current phase of the NWMO's study, which is appropriate. The timelines shown for each of the approaches in Discussion Document 2 allow for detailed design and construction of the selected facilities.

The NWMO has arranged for independent reviews of these technical evaluations. Overall, the NWMO noted in Discussion Document 2 that these third-party reviews concluded that the designs are reasonable and feasible, that the cost estimates have been prepared in accordance with appropriate estimating methodology, and that the technical information as a whole is suitable for the options review and directional decision-making requirements of the NWMO.

The methods receiving international attention were presented for comment in the NWMO's Discussion Document 1. In "Understanding the Choices," the NWMO reports that "For the most part, Canadians indicated that these methods should not receive detailed study at this point, although it would be appropriate to maintain a "watching-brief" on these methods." The Assessment Team's report, "Assessing the Choices," provides the



specific reasons that these methods were screened out (see Section 3.2.2). However, the Assessment team noted that "Canada may wish to maintain some interest in each of these options by undertaking research and/or tracking related international developments."

The methods of limited interested are described in Discussion Document 2's Appendix 4. The NWMO is not actively pursuing these methods further based on the screening rationale presented in Appendix 4.

4.3.2 Strengths and Weaknesses

The Assessment Team analyzed each of the three main management approaches within the current assessment framework. The resulting relative strengths and weaknesses of each approach is summarized in Figure E-1in Discussion Document 2's Executive Summary (provided in Appendix F of this report to facilitate reference). The following table summarizes the advantages and limitations that the NWMO has identified for each of the main management approaches:

Management Approach	Key Advantages	Key Limitations
At-Reactor Storage	No transportation of spent nuclear fuel is required There is nuclear expertise at the existing sites and communities	There will be need for continuing administrative controls and operations, including necessary funding, for thousands of years
	The ability to monitor performance and flexibility to adapt to changing conditions should be facilitated	The reactor sites were selected for their suitability for reactor operation, not fuel storage (for example, their proximity to large bodies of water is needed for reactor operations, but is not needed
	developed	and may be a liability for fuel storage)
Centralized Storage	Site selection could be made solely on the basis of used nuclear fuel management If done well, siting can be achieved	There will be need for continuing administrative controls and operations, including necessary funding, for thousands of years
	with community participation	Site selection would result in potentially contentious community involvement
	abated	Transportation of spent nuclear fuel is
	Required technologies are already developed	

Table 4-3 — Key Strengths and Weaknesses of the Main Management Approaches



Management Approach	Key Advantages	Key Limitations
Deep Geological Repository	The eventual permanent emplacement of used nuclear fuel would reduce or eliminate the necessity for long-term institutional and operational continuity and financial surety. Site selection could be made solely on the basis of used nuclear fuel management If done well, siting can be achieved with community participation Security concerns could be abated	Advance "proof' that the system would work is not scientifically possible because performance is required over thousands of years* Monitoring is more difficult as compared to the other options as the site is backfilled and closed. Adaptability and flexibility are reduced because retrieval of the used fuel becomes more difficult. Site selection would result in potentially contentious community involvement
		Transportation of spent nuclear fuel is required

^{*} Although the systems do not have proof, the Assessment team, in its report "Assessing the Options," notes that the conceptual design developed on behalf of the Joint Waste Owners for a deep geological repository facility (DGR) provides sufficient detail to confirm the engineering feasibility of a DGR and to allow preparation of a conceptual cost estimate for its implementation.

The weighting of the different objectives and corresponding factors used in the ongoing comparative assessment process will affect the relative strengths and weaknesses. Accordingly, it will be important to review potential changes in the relative strengths and weaknesses as the comparative analysis process continues.

The site selection process for deep geological disposal does not note limitations associated with establishing the geological suitability of potential sites. Based on the experience in the United States with the Yucca Mountain project, consideration should be given to the effect associated with confirming the technical suitability of potential sites (such as schedule delays and cost impacts).

There appears to be a discrepancy in the advantages and limitations relative to the objective for Adaptability. The ability to monitor performance and flexibility to adapt to changing conditions was noted as being a relative advantage for at-reactor storage, but was not mentioned for centralized storage. We believe these same factors should be listed as an advantage for centralized storage. In addition, Adaptability was noted as being a limitation for deep geological disposal, which is consistent with its technical details. However, the deep geological disposal approach had the same or higher performance value score compared to the other approaches



in the analysis of Adaptability. This discrepancy should be clarified or otherwise resolved as the comparative analysis process continues.

The relative strengths and weaknesses of the different management approaches as discussed in Discussion Document 2 do not provide an indication of how they might be affected by potential technical changes. Although the Assessment Team's report lists basic assumptions used for conceptual designs, there is no sensitivity analysis of what would happen if there were significant changes in cost or design parameters as these assumptions are validated during the detailed design stage for the selected approach. For example, what would be the effect of a change in the volume of spent nuclear fuel requiring disposal because reactor operating life is extended or shortened? Does the design or costs significantly change? It may be an advantage if one of the approaches was shown to be less sensitive to potential design changes.

One of the limitations (weaknesses) noted for centralized storage and deep geological storage is the effect on communities and siting issues; however, these are not mentioned in the limitations for reactor site storage even though the current host communities were not selected for extended storage. The analysis notes technical limitations for at-reactor storage (such as proximity to large bodies of water), but does not note any social disadvantages. This issue also does not seem to be addressed by any of the NWMO's background papers (especially in reference to the papers regarding Social and Ethical Dimensions).

The strengths and weaknesses noted by the NWMO in Discussion Document 2 do not mention or appear to account for a comparative assessment of the risks related to the different approaches. The comparative risks include both technical risks (such as the impact of postulated accidents) and financial risks (such as changes in the assumed discount rates used in the financial models). Similar to the potential advantage (or disadvantage) for an approach to accommodate changes in the technical assumptions (discussed above), an approach may have a relative strength (or weakness) if it can accommodate these types of risks better (or worse) than the other approaches. This issue should be considered during the ongoing detailed comparative assessments that the NWMO is currently performing.

4.3.3 Impact on Current Host Communities

The assessment framework considers the impact of the management approaches on new host communities; however, Discussion Document 2 does not discretely analyze the impact of the separate management approaches on the current host communities. The NWMO's list of background papers as shown in Appendix E

also does not include a paper on the impact on current host communities. Accordingly, the overall impact of the selected management approach on the current host communities has to be assessed by evaluating how the current host communities fit into the definitions of the new communities that will be affected by the selected management approach. Specifically, in the report "Assessing the Options," the Assessment Team notes that:

It is vital to consider what would lead a community to agree to having a used nuclear fuel facility with in its boundaries. . . . The siting policy may also include benefits to a host community to compensate that community for taking on the burden associated with used nuclear fuel while a much wider population shares the benefits.

Considering that the current host communities are listed as a strength associated with the reactor site extended storage approach, the benefits to the wider population may even be magnified if the current host communities evolve into becoming the ongoing used nuclear fuel storage communities. It would seem appropriate to ensure that the current host communities are afforded the same considerations and potential benefits as new host communities within the ongoing assessment process. This would be especially appropriate if a decision relative to which management approach to use is not made, or if the decision cannot be implemented, so that the current host communities become the storage communities by default.

4.4 IMPLEMENTATION PLAN

4.4.1 General Discussion

The NFWA states that the selected management approach will be implemented by the NWMO "subject to all of the necessary regulatory approvals." Discussion Document 2 notes that the NWMO will be focusing on implementation plans as their study moves forward and that implementation is a critical part of making a recommendation. As stated in Discussion Document 2:

The NWMO is persuaded of the critical importance of mapping out specific plans for implementing any course of action. The manner in which any approach is implemented will affect the effectiveness and the extent to which it is responsive to societal needs and concerns.

We believe that *how* any approach is implemented will be every bit as important as *which* approach is selected.

The NWMO notes that the development of implementation plans will include, at a minimum, consideration of the following elements:

- Oversight and monitoring systems
- Ongoing societal involvement



- Institutional design, including human resource capacity
- Ownership and liability
- Dispute management
- Principles to guide site selection; and
- Education and information programs.

In Discussion Document 2, a preliminary implementation plan is addressed for each primary management approach as summarized below (the costs estimates are also noted for reference):

Reactor Site Extended Storage — Siting and Approvals 5 years Design and Construction 5 years - Operations 35 to 40 years Monitoring Ongoing Building Refurbishments and Repackaging 10 year duration, done every 300 years Costs: Total to be Spent (2002 \$) \$17.6 - \$25.7 billion / 300-year cycle Costs: NPV of total to be spent (2004 \$) \$2.3 – \$4.4 billion / 300-year cycle Centralized Storage — Siting and Approvals 10 years Design and Construction 10 years Transportation and Operations 25 to 40 years Monitoring Ongoing Building Refurbishments and Repackaging Variable duration, done every 300 years - Costs: Total to be Spent (2002 \$) \$15.7 - \$20.0 billion/ 300-year cycle — Costs: NPV of total to be spent (2004 \$) \$3.1 – \$3.8 billion / 300-year cycle Deep Geological Disposal — Siting and Approvals 10 to 15 years Design and Construction 10 to 15 years Transportation and Operations 25 to 40 years Monitoring 70 years (maximum assumed for costs) Decommissioning 25 years Costs: Total to be Spent (2002 \$) \$16.2 billion Costs: NPV of total to be spent (2004 \$) \$6.2 billion



These timelines were assessed in more detail in the Assessment Team's report based on the conceptual design papers developed by the NWMO.

4.4.2 Specific Needs for Implementation Plans

Siting and approvals is a significant phase of each of the management approaches. As noted above, the NFWA requires that the selected approach be implemented in accordance with all the necessary regulatory approvals. The Assessment Team's report notes that the overall management of spent fuel in Canada is politically complicated. Under the Canadian constitution, energy policies and land management that involve the production of spent fuel are responsibilities of the provincial governments, while management of radioactive materials is the responsibility of the federal government.

The NWMO has started to assess the regulatory framework within which the selected approach will be implemented. The NWMO documents related to this issue include Fact Sheet 4, "The Canadian Regulatory Framework," background paper 7-8, "Review of the Canadian Environmental Assessment Act (CEAA) Process in Relation to Nuclear Waste Management," and background paper 7-9, "Review of the CNSC Licensing Process in Relation to Spent Fuel Management."

Background paper 7-8 discusses the four basic types of environmental assessments in the CEAA and their associated level of detail summarized as follows:

- Screening. Minimum level of EA required, although some screenings can be reasonably detailed.
- Comprehensive Study. Next level, requires more detail.
- **Review panel.** More formal EA involving experts appointed by Minister of Environment.
- **Mediation.** Infrequently used voluntary process of EA negotiation in which an independent mediator (usually appointed by Minister of Environment) helps interested parties resolve their issues.

The following table summarizes which types of environmental assessments are anticipated to be applicable for the separate management approaches as discussed in background paper 7-8 (reference pages 5 and 6).



Management Approach	Anticipated Required Type of Environmental Assessment	Implications for the NWMO
Deep Geological Disposal	Review panel	Would theoretically start as a comprehensive study.
Centralized Storage	Review panel	Would theoretically start as comprehensive study, but extensive transportation requirements would likely dictate the need for a review panel.
Reactor Site Extended Storage	Screening or comprehensive study	A screening would be required if the proposed project were to fall within the boundaries of the currently licensed facility.
		If the project were to include areas outside the existing boundaries of the nuclear facility, a "comprehensive study" would be required.
		"Any proposal, however, to postpone a decision on a preferred long-term option would itself have significant implications and may be deemed worthy of a review panel."

Table 4-4 — Anticipated Environmental Assessments for the Main Management Approaches

In ASL's opinion, many of the problems and delays in project implementation stem from the failure to correctly identify all the required permits and permit application requirements associated with a given project. Accordingly, the NWMO should ensure that the implementation plans developed for the separate management approaches include comprehensive and specific permitting schedules that define which permits are required, when they are required, how long it takes to apply for and obtain them, and who has to make the application. Possible conflicts or uncertainties regarding the legal jurisdiction of different government agencies should be identified.

Problems and delays can also stem from determined opposition from one or more stakeholders (such as environmental groups or elected officials) when the EA and applications are reviewed. Getting stakeholders involved early in the project sometimes can eliminate determined opposition by allowing key concerns to be addressed in the basic project design.

ASL's earlier comments about the need to engage groups that focus and represent public opinion should be pursued in recognition that they may provide valuable information for the NWMO's implementation plans in terms of identifying potential opposition, assessing the primary concerns of potential opponents, and developing mitigation measures to address these concerns. It should be noted that technical issues (engineering, conceptual



designs, etc.) are frequently not the critical parameters that determine a project's success or failure. Cost is also not necessarily the critical parameter; as noted in "Assessing the Options" (Section 3.6.9), "The least expensive method is not necessarily the wisest choice if it does not meet other public policy objectives and cannot be successfully sited."

"Assessing the Options" (Section 3.6.10) notes that the Assessment Team's analysis covers only general considerations regarding how communities respond to the issue of site selection and recognizes that different communities may have very different attitudes. The assessment performed by the Assessment Team is not specific with respect to choice of economic region for a centralized storage facility or geologic repository. Discussion Document 2 recognizes this and notes that the NWMO's ongoing efforts will focus on developing characteristics that would be appropriate in choosing specific economic regions for deep geological disposal and centralized storage approaches. In addition to supporting site selection, the NWMO should ensure that site-specific issues and considerations are identified and addressed within the associated implementation plans.

As the implementation plans are developed, the resulting details could affect the comparative assessments of the different management approaches performed up to that point. Accordingly, the NWMO should ensure that the comparative assessments are updated and re-evaluated as required to be consistent with the planned implementation details.

4.4.3 Phased Approach

Discussion Document 2 indicates that taking a staged approach is important based on the dialogues conducted to date. A staged approach is seen as building adaptability into the selected management approach, regardless of which one is chosen. Staging provides for reviews and adjustments, and supports continuous learning and the ability to incorporate new technical developments (such as improvements in design and operational requirements). A phased approach to implementing one of the main management approaches would also enable monitoring of emerging options that have been screened out to date, such as partitioning and transmutation.

Although a phased approach is reasonable and has significant advantages, in ASL's experience, it also has the potential of negatively affecting the overall effective implementation of a project. For example, a phased approach includes the potential for cost overruns and schedule delays resulting from changes in the design of key components in an attempt to incorporate ongoing technical developments. There is also potential for the project scope to increase, which could increase the project's overall schedule and cost, based on additional



4-19 SL-008414 Final

analyses to evaluate new alternatives (occasionally referred to as "analysis paralysis"). To avoid this during the staged approach, the NWMO should ensure that the overall project implementation plans include key project milestones where "go – no go" decisions are made, as well as points where designs are finalized, or "frozen," to enable the project to proceed with minimal potential for design changes. To be able to capitalize on new technical or other advances, the design parameters associated with the selected management approach should be developed and selected to maximize overall system flexibility. For example, instead of designing a centralized storage facility for the entire planned inventory of used nuclear fuel during the initial phase of the project (as shown in the Discussion Document 2 timelines), it may be beneficial to perform the design in phases. Hypothetically, the initial phase could account for 50% of the planned inventory, while the remaining 50% is designed after the facility is operational (several years later). The design for the second 50% would then be able to incorporate the latest information and technology available at that time with minimal impact on the implementation timeline for the first 50%.

Last page of Section 4.



5. BACKGROUND INFORMATION

The Canadian Association of Nuclear Host Communities (CANHC) consists of those communities in Canada that are hosts to nuclear generating stations or other nuclear facilities, as follows:

- The Municipality of Kincardine, Ontario (Bruce Nuclear Generating Station)
- The City of Pickering, Ontario (Pickering Nuclear Generating Station)
- The Municipality of Clarington, Ontario (Darlington Nuclear Generating Station)
- The City of Becancour, Quebec (Gentilly 2 Nuclear Generating Station)
- The Town of Deep River, Ontario (AECL Chalk River Laboratories)
- The Town of Pinawa, Manitoba (AECL Whiteshell Laboratories).

CANHC has noted that, as Canada's nuclear host communities, they will be substantially affected by the NWMO's process and the recommended management approach, regardless of which approach is recommended. Accordingly, CANHC requested ASL to perform this independent peer review of Discussion Document 2.

The NWMO was established under the Nuclear Fuel Waste Act (NFWA) to investigate approaches for managing Canada's used nuclear fuel. Used nuclear fuel is a by-product of the generation of electricity in a nuclear power plant. If not managed properly, used nuclear fuel is hazardous to people and the environment for a very long time. Currently, nuclear power plants are operating in Ontario, Quebec and New Brunswick.

The following table summarizes the location and quantities of used fuel bundles in Canada as of December 31, 2001 (reference: NWMO Fact Sheet 2, "Nuclear Fuel Waste in Canada"):

Nuclear Facility	Province	Number in Reactor	Number in Wet Storage	Number in Dry Storage	Total
Point Lepreau	New Brunswick	4,560	40,814	48,600	93,974
Gentilly 2	Quebec	4,560	32,525	48,000	85,085
Bruce A	Ontario	0	354,567	0	354,567
Bruce B	Ontario	24,960	337,637	0	362,597
Pickering	Ontario	36,990	400,534	79,266	516,790

Table 5-1 — Used Fuel Bundles at Canadian Nuclear Facilities as of December 31, 2001



Nuclear Facility	Province	Number in Reactor	Number in Wet Storage	Number in Dry Storage	Total
Darlington	Ontario	24,960	191,522	0	216,482
Douglas Point	Ontario	0	0	22,256	22,256
AECL – Gentilly 1	Quebec	0	0	3,213	3,213
AECL – WSL	Manitoba	0	0	360	360
AECL – CRL	Ontario	0	0	4,853	4,853
Total		96,030	1,357,599	206,548	1,660,177

The NFWA requires electricity generating companies which produce used nuclear fuel to-

- Establish a waste management organization to provide recommendations to the Government of Canada on the long-term management of used nuclear fuel and
- Establish segregated trust funds to finance the long-term management of the used fuel.

The NFWA requires the waste management organization to-

- Establish an Advisory Council whose comments on the waste management organization's study and reports will be made public and
- Within three years of the legislation coming into force, submit to the Minister of Natural Resources proposed approaches for the management of used nuclear fuel, along with comments of the Advisory Council, and a recommended approach.

The legislation authorizes the Government of Canada to decide on the approach. The government's choice will then be implemented by the Nuclear Waste Management Organization, subject to all of the necessary regulatory approvals. The Nuclear Fuel Waste Act is the most recent milestone in a 25-year program to identify and implement a long-term management approach for used nuclear fuel in Canada. The legislation represents, in part, the Government of Canada's response to the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel, which was chaired by Mr. Blair Seaborn and which reported in March 1998. The law entered into force on November 15, 2002.

The NWMO's process to determine a recommended management approach includes the release of the following documents:

• **Discussion Document 1 – Asking the Right Questions** (November 2003) initiated the dialogue with Canadians about the long-term management of used nuclear fuel.



- **Discussion Document 2 Understanding the Choices** (September 2004) provides an initial assessment of the three management options being considered.
- Draft Study Report Choosing a Way Forward (Early 2005) will provide a more detailed assessment of management options, will propose implementation strategies, and provide draft recommendations.
- Final Study Report Choosing a Way Forward (November 2005) will provide the final assessment of the management options and recommend an approach for the long term management of Canada's used nuclear fuel.

In addition to these papers, the NWMO has developed and posted many other documents as part of their current work to arrive at a recommended approach (see the web links included in Appendix D). These additional documents include a series of background papers that present concepts and contextual information about the state of 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 the NWMO's web site. The NWMO background papers are listed and briefly summarized in Appendix 3 of Discussion Document 2. Appendix E of this report provides a listing of the title of these papers for reference and as an indication of the depth the NWMO has addressed particular topics.

Last page of Section 5.