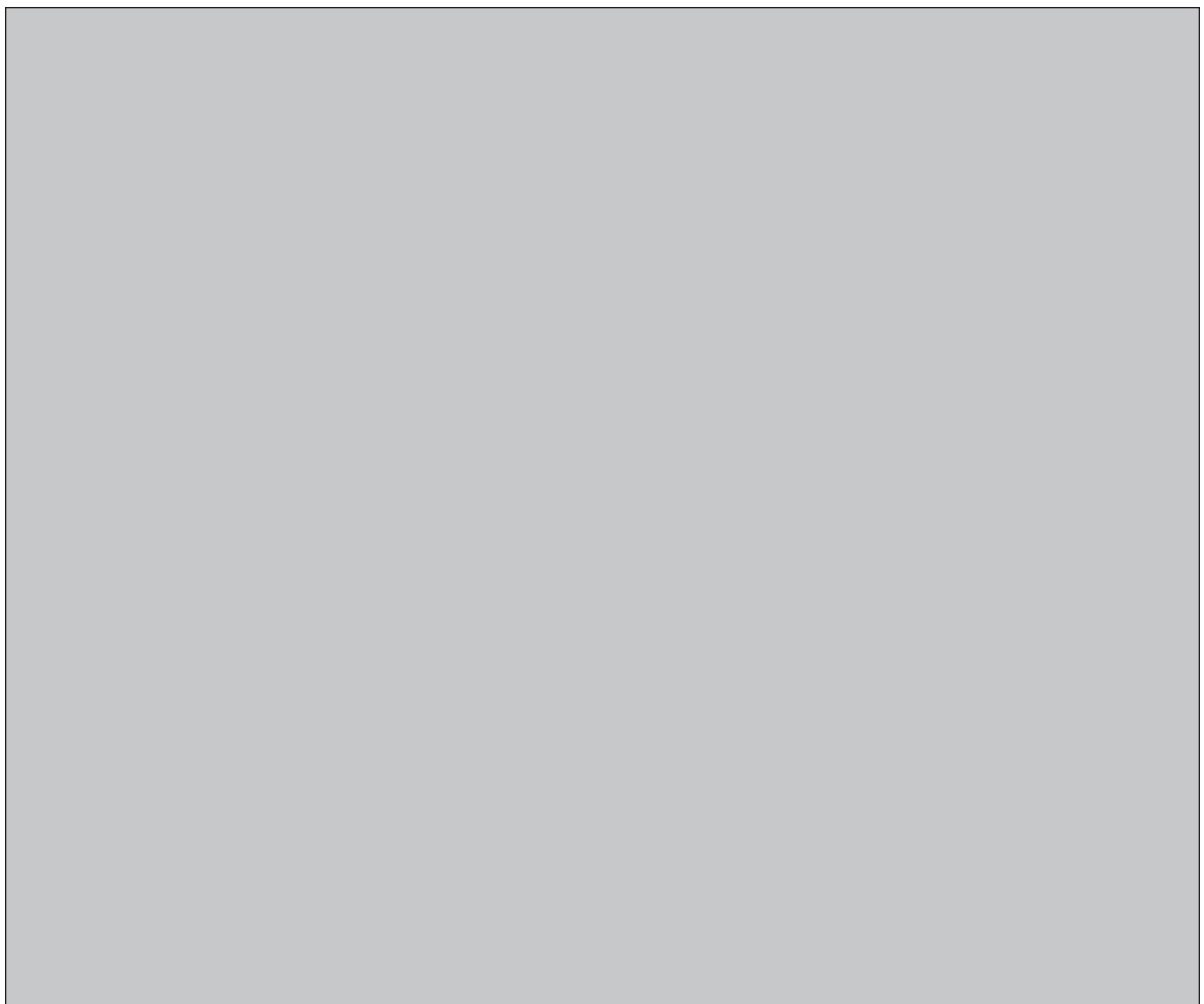


NWMO BACKGROUND PAPERS
2. SOCIAL AND ETHICAL DIMENSIONS

2-4 LONG-TERM MANAGEMENT OF NUCLEAR FUEL WASTE
ISSUES AND CONCERNS RAISED AT NUCLEAR FACILITY SITES 1996 – 2003

F. Chris Haussmann & Peter G. Mueller
Haussmann Consulting



NWMO Background Papers

NWMO has commissioned a series of background papers which present concepts and contextual information about the state of our 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 NWMO's web site. Additional papers may be commissioned.

The topics of the background papers can be classified under the following broad headings:

1. **Guiding Concepts** – describe key concepts which can help guide an informed dialogue with the public and other stakeholders on the topic of radioactive waste management. They include perspectives on risk, security, the precautionary approach, adaptive management, traditional knowledge and sustainable development.
2. **Social and Ethical Dimensions** - provide perspectives on the social and ethical dimensions of radioactive waste management. They include background papers prepared for roundtable discussions.
3. **Health and Safety** – provide information on the status of relevant research, technologies, standards and procedures to reduce radiation and security risk associated with radioactive waste management.
4. **Science and Environment** – provide information on the current status of relevant research on ecosystem processes and environmental management issues. They include descriptions of the current efforts, as well as the status of research into our understanding of the biosphere and geosphere.
5. **Economic Factors** - provide insight into the economic factors and financial requirements for the long-term management of used nuclear fuel.
6. **Technical Methods** - provide general descriptions of the three methods for the long-term management of used nuclear fuel as defined in the NFWA, as well as other possible methods and related system requirements.
7. **Institutions and Governance** - outline the current relevant legal, administrative and institutional requirements that may be applicable to the long-term management of spent nuclear fuel in Canada, including legislation, regulations, guidelines, protocols, directives, policies and procedures of various jurisdictions.

Disclaimer

This report does not necessarily reflect the views or position of the Nuclear Waste Management Organization, its directors, officers, employees and agents (the "NWMO") and unless otherwise specifically stated, is made available to the public by the NWMO for information only. The contents of this report reflect the views of the author(s) who are solely responsible for the text and its conclusions as well as the accuracy of any data used in its creation. The NWMO does not make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information disclosed, or represent that the use of any information would not infringe privately owned rights. Any reference to a specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or preference by NWMO.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	4
2. LONG TERM WASTE MANAGEMENT	7
3. SAFETY, HUMAN HEALTH AND THE ENVIRONMENT.....	10
3.1 SITING.....	10
3.2 INSUFFICIENT DATA.....	10
3.3 RADIATION AND HEALTH	11
3.4 ENVIRONMENTAL MONITORING.....	12
3.5 SAFETY OF INTERIM STORAGE TECHNOLOGIES.....	13
3.6 THE BIOPHYSICAL ENVIRONMENT	14
4. CONFIDENCE IN THE ENVIRONMENTAL ASSESSMENT PROCESS AND TRUST IN NUCLEAR ORGANIZATIONS AND REGULATORS	16
5. ABORIGINAL INTERESTS	19
6. SOCIO-ECONOMIC IMPACTS	21
7. SECURITY IN A POST 9/11 WORLD	23
8. DEREGULATION/PRIVATIZATION.....	24
9. FINANCIAL AND LIABILITY CONSIDERATIONS	25
10. SUMMARY OF KEY OBSERVATIONS AND CONCLUSIONS	26

APPENDIX A: DETAILED ISSUE SUMMARIES BY DOCUMENT REVIEWED

GLOSSARY OF ACRONYMS

EXECUTIVE SUMMARY

The Nuclear Waste Management Organization's (NWMO) mandate is to recommend a long-term approach for managing Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible.

The objective of this study is to support the NWMO mandate by providing the NWMO with an historical perspective on the issues and concerns raised by the public, affected communities and key stakeholders during 17 Environmental Assessment (EA) and planning studies at Canada's nuclear research and power reactor sites, mining and radioactive waste and used fuel management facilities dating back to 1996.

The review covered 67 available reports from which relevant comments, questions and concerns raised during the public consultation process were documented. The raw data gathered from this review are presented in *Appendix A: Detailed Issue Summaries by Document Reviewed*.

Issues were then analyzed and summarized using the following framework:

- Long Term Waste Management;
- Safety, Human Health and the Environment;
- Confidence in the Environmental Assessment Process and Trust in Nuclear Organizations and Regulators;
- Aboriginal Interests;
- Socio-Economic Impacts;
- Security in a Post 9/11 World;
- Deregulation/Privatization; and
- Financial and Liability Considerations.

Our review suggests that the development of long-term waste management approaches for the care of Canada's used nuclear fuel should be informed by at least the following considerations:

- Communities that are currently hosts to interim storage of used fuel the understanding and expectation that:
 - Used fuel will be stored on-site only until an off-site long term used fuel management facility becomes available, and certainly not longer than 50 years (the design life of storage containers);

-
- Only used fuel generated at that location would be accepted for interim storage; and
 - Extensions and expansions of used fuel interim storage facilities will not go on indefinitely.
- Transparency, opportunity for full public engagement and the potential to have real influence on decision-making will be critical factors influencing the social acceptability and sense of public ownership of management approaches. This is particularly important given that some NGOs and members of the public lack trust in nuclear organizations and regulatory agencies. Engagement and review mechanisms to address perceived bias in proponent-based Environmental Assessment studies and the provision of appropriate resources for interveners to participate meaningfully in the engagement process are important factors that can increase confidence in the technical viability of management approaches and acceptance of decision-making outcomes. In this regard, decision-making by a third party, independent and technically informed adjudicating body (e.g. panel) is deemed by many to be the preferred approach.
 - First Nations people want to be acknowledged as a unique stakeholder by virtue of their Aboriginal and Treaty Rights, their traditional relationship to “mother earth” and their spiritual, cultural and social values. Acknowledgement of and respect for their interests and insights can play an important role in shaping ethically, socially and environmentally acceptable approaches to the long-term waste management of Canada’s used nuclear fuel. First Nations people want to be assured that:
 - Their way of life will not be unduly put at risk;
 - They will have adequate resources (financial, human, technical and time) to participate fully, meaningfully and continuously in the consultation, assessment and implementation process from planning to final monitoring; and
 - They will share equitably in the economic benefits.
 - The location of many nuclear facilities close to large population centers and adjacent to watercourses which supply drinking water to those populations, coupled with the events of September 11, 2001 have heightened public awareness with respect to potential terrorist threats against nuclear installations. The public in general and host communities in particular want to be assured that management approaches enhance public safety by taking this new security environment into account and reducing terrorist access to nuclear materials.

-
- Canadians will want to be assured that deregulation and privatization in the electricity sector will not result in the transfer of responsibility for nuclear waste to profit-oriented private sector organizations. To be socially acceptable, management approaches must be based on institutions under public control and scrutiny.
 - Used nuclear fuel will need to be isolated and contained for millennia, during which time the institutional, governance and biophysical environments will change in unpredictable ways. The public and host communities want to be assured that current and future generations will have the technical and financial resources required to implement and sustain the management approach, to provide for long-term monitoring and to fund mitigation, should it be required.
 - Management approaches need to ensure that the economic viability of a host community is maintained and enhanced, that property and business values are protected and that the residents of the host community benefit in an equitable way from the economic opportunities generated by the management approach.
 - To be acceptable to host communities and the wider public, management approaches must be based on state-of-the-art technologies and best practices designed to safeguard human health and environmental integrity now and in the long term. At the same time, innovation must be balanced with evidence that the technologies adopted are proven, reliable and durable. Flexibility to incorporate new advances in technology, whether for materials recycling, containment or monitoring is seen as a valued feature in facility design.
 - Public anxiety about their health or radionuclides in the air, drinking water and the food chain may not be calmed by technical and scientific studies or risk analyses suggesting negligible impact on the ecosystem and human populations. The explicit inclusion in the management approach of monitoring regimes designed and implemented around public and local involvement can play an important role in enhancing confidence in safety projections and ensuring public trust in ongoing system performance. In the event that periodic reassessments of the management approach are undertaken, public involvement in ongoing monitoring regimes will increase trust in the data used to arrive at conclusions.

1. INTRODUCTION

The Nuclear Waste Management Organization's (NWMO) mandate is to recommend a long-term approach for managing Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible. The NWMO has developed an extensive study plan to achieve this mandate. Using a variety of techniques and venues, the NWMO is engaging a range of individual Canadians, communities of interest and key stakeholders to better understand their views and needs.

The objective of this study is to provide the NWMO with an historical perspective on the issues and concerns raised by the public, affected communities and key stakeholders during 17 Environmental Assessment (EA) and planning studies at Canada's nuclear research and power reactor sites, mining and radioactive waste management and used fuel storage facilities dating back to 1996.

The following studies were reviewed:

TITLE/DESCRIPTION	LOCATION	EA START	DECISION DATE	EA TYPE
Port Hope Area Initiative: Port Hope Long-Term Low-Level Radioactive Waste Management Project	Port Hope	Nov 21, 2001		Screening
Port Hope Area Initiative: Port Granby Long-Term Low-Level Radioactive Waste Management Project	Port Granby	Nov 21, 2001		Screening
Pickering NGS Used Fuel Dry Storage Facility	Pickering	Aug 28, 1998	May 11, 1999	Screening
Pickering Waste Management Facility Phase II	Pickering	Jul 4, 2002		Screening
Bruce Used Fuel Dry Storage Facility	Kincardine	Jul 29, 1996	Apr 15, 1999	Comprehensive
Construction and operation of Darlington used fuel dry storage facility	Darlington	Sep 18, 2001		Screening
Modifications to Gentilly 2 SRWMF - Modifications and construction of additional storage structures	Bécancour	Nov 29, 2002		Screening
Modifications to Point Lepreau SRWMF	Point Lepreau	Apr 3, 2001		Screening
Bruce Radioactive Waste Operations Site 2 – Additional storage for low and intermediate level waste	Kincardine	Feb 24, 2000	May 30, 2001	Screening
Pickering A Return to Service	Pickering	Jul 30, 1999	Feb 16, 2001	Screening
Restart of Bruce A Units 3&4	Kincardine	Sep 11, 2001	Jan 6, 2003	Screening

TITLE/DESCRIPTION	LOCATION	EA START	DECISION DATE	EA TYPE
Decommissioning of AECL's Whiteshell Laboratories	Whiteshell	June 2, 1999	Apr 2, 2002	Comprehensive
Waste Treatment Centre Upgrade Project to provide for a five-fold increase in treatment capacity for low level radioactive liquid waste	Chalk River	Oct 2, 1997	Aug 5, 1998	Comprehensive
Re-Opening of Waste Management Area "G"	Chalk River	Jul 16, 1998	Jul 6, 2000	Screening
Construction and operation of waste sorting and handling and waste management area "H" for above-ground and bulk storage for low-level radioactive waste	Chalk River	Jan 12, 1999	Nov 1, 1999	Screening
Construction and operation of ITER Facility	Clarington	Apr 4, 2001		Screening
Joint Federal - Provincial Panel on Uranium Mining Developments in Northern Saskatchewan		Aug 1991	Nov 1997	Panel

Most of the 67 documents reviewed relate to nuclear reactor facilities – either the reactors themselves or related nuclear waste and used fuel storage facilities. The three exceptions are the reports of the Saskatchewan uranium mining projects, the Iter project and the Port Hope Area Initiative environmental assessments of long-term low-level radioactive waste management facilities. The latter are of primary relevance to the NWMO mandate, and the only projects that deal with long-term (as opposed to interim) storage of radioactive waste.

The following tasks were undertaken to achieve the study's objective:

- Available documentation pertaining to each study was identified and sourced.
- Reports from each study were reviewed and the relevant comments, questions and concerns raised during the public consultation process were documented for every available report. Where comments were highly site or project specific, these were excluded from the summary documentation. These raw data and a summary list of studies reviewed are presented in *Appendix A: Detailed Issue Summaries by Document Reviewed*.
- Issues raised by participants were then analyzed and summarized using an eight-category issues framework. This framework emerged from our review of the raw data, where it became evident that these themes were frequently repeated in the comments recorded by report authors:

1. Long Term Waste Management;
2. Safety, Human Health and the Environment;
3. Confidence in the Environmental Assessment Process and Trust in Nuclear Organizations and Regulators;
4. Aboriginal Interests;
5. Socio-Economic Impacts;
6. Security in a Post 9/11 World;
7. Deregulation/Privatization; and
8. Financial and Liability Considerations.

Item 1 on the list captures issues unique to the nature of long-term storage as well as those that relate to the relationship between interim and long-term storage of used fuel. Items 2 and 5 are typical components of EA studies and the comments found there usually address concerns about inadequacies in the descriptions of these components of the environment or the related effects assessments presented in the EA reports. Items 7 and 9 relate to the long-term financial and institutional stewardship demands of radioactive waste. The nature of items 3, 4 and 6 is self-evident.

- Finally, some observations were made with respect to NWMO's mandate and its development of long-term waste management approaches for the care of Canada's used nuclear fuel.

This report captures a wide range of issues raised by participants that relate directly or indirectly to the long term management of used fuel; however, no attempt was made to determine the accuracy of the comments recorded, their relative significance and level of support for any one comment, question or concern relative to the others. Indeed, some comments are directly contradictory to others, reflecting the diversity of opinions resident in any community. Nor was it possible to determine the frequency of mention of specific comments from the reports reviewed.

It should be noted that the EA and similar planning processes are designed to elicit issues and concerns from the public so that they may be addressed in the EA Report and project design and implementation. Hence, many of the issues identified will have been so addressed by the project proponents. This report makes no attempt to evaluate how successful these proponent responses were, nor how acceptable they were to the affected public and stakeholders.

2. LONG TERM WASTE MANAGEMENT

Concerns, comments and questions regarding the long-term management of nuclear wastes arose during most of the EAs reviewed, and without exception when used fuel interim storage and long-term low-level radioactive waste management were involved. Comments tended to focus on:

- The ability to ensure proper management of waste facilities for hundreds or even thousands of years into the future, perpetual care and funding;
- Considerations unique to long-term facilities, such as global climate change and other effects of the environment on facilities with required lifetimes in the hundreds and thousands of years;
- The length of time used fuel or other nuclear waste will be stored on-site at interim facilities;
- The stigma associated with radioactive waste facilities and effects on community image;
- Community oversight of the planning and long-term monitoring of the facilities with access to independent expertise;
- Lack of knowledge of long-term effects of low-level radiation on people, and the need to study past effects as well as future effects;
- Risks associated with transportation of radioactive waste to long-term facilities;
- Proximity of facilities to population centres and water resources;
- The concept that waste stored for the long term should be retrievable in order to take advantage of future technologies that may find a use for the waste; and
- Concern that interim might become long-term by default because it is thought that no progress is being made on permanent disposal.

This latter concern was also related to a lack of trust in the proponent nuclear operators and regulators and the planning process. Some commenters asked why they should believe statements committing to interim storage only, when they have witnessed the extension of municipal waste facilities beyond previously committed closure dates. A perception of less-than-transparent disclosure by nuclear operators on issues such as unplanned radioactive releases (accidents or incidents) and health effects of radiation adds to their skepticism.

Concerns about the lack of a long-term solution for the management of used fuel and opposition to long-term storage on-site were frequently voiced. Clearly, there is an expectation that used fuel will be stored on-site only until a longer-term, off-site used fuel management facility becomes available. Participants were emphatic that approval of a proposed interim facility should not be interpreted as approval for long-term storage at that location and that there should not be endless extensions and expansions of interim storage facilities.

Explicit support for interim used fuel storage facilities appears to have come primarily from municipal and regional governments and was in some cases conditional on the proposed facility being used:

- Only as an interim measure until permanent storage is identified; and
- To store only radioactive waste generated at that location.

Other key concerns and comments voiced regarding long-term waste management included the following:

- Proposed interim storage facilities were sometimes viewed as reinforcing the perception of the community as a possible host to an expanded facility in the future, especially in the event that permanent disposal facilities do not become available. Many of the host communities expressed concerns about used fuel or radioactive waste coming to their community from other locations or jurisdictions and that their community had already become or was becoming a dumping ground for nuclear waste.
- Permanent storage of used fuel on site was generally viewed as not acceptable. Some suggested that interim storage proposals should be assessed in the light of long-term storage, that interim storage proposals be put on hold until long-term disposal decisions are made and that there should be contingency plans in the event that used fuel “burial” is delayed or rejected.
- Questions frequently asked included: If this facility is for interim storage, what happens after this period? Is there a long-term strategy for the management of used fuel? What will be the cost of long-term disposal; is funding available to move used fuel to permanent disposal; and who will pay? Will there be sufficient technical and financial resources in the future to manage the waste?

- Some concerns were raised regarding the 50-year life expectancy of interim storage technologies such as used fuel Dry Storage Containers (DSCs). Concerns centered on the future transportability of DSCs to off-site storage, especially if a national repository for permanent safekeeping of used fuel is not available when DSCs reach the end of their service life. Skepticism about the inherent transportability of DSCs (during or after their service life) and perceived risks regarding the potential need to repackage used fuel in the future added to the concern that interim might become long-term.
- Some participants wondered about the physical integrity of DSCs if they were dropped during transportation off-site.
- Comments concerning the reprocessing of used fuel were not common and when made took the form of either wondering whether reprocessing was a possible solution to the interim and long-term storage problem or expressing worry that reprocessing might indeed be part of the agenda for used fuel.
- Some wondered whether geological disposal of used fuel in northern Ontario or on the Canadian Shield was a long-term solution.
- How do other countries deal with their used fuel in the short and long term?

3. SAFETY, HUMAN HEALTH AND THE ENVIRONMENT

Issues around the safety of nuclear waste management facilities and the potential impacts on human health and the environment were closely linked, arose during all of the EAs reviewed for this study, and represented the single largest area of concern and anxiety for participants in the EAs studied.

On an optimistic note, public attitude research for the Port Hope Area Initiative found that confidence in the ability to safely manage radioactive waste in the long term increased with increasing awareness and knowledge of the projects.

While concerns were often site specific, a number of common and over-arching themes were also evident, including the following:

3.1 Siting

The wisdom of siting interim waste facilities and storing used fuel close to large population centers and adjacent to lakes and rivers was frequently challenged. It was noted, for example, that the Great Lakes are a nearly closed ecosystem from which millions of people draw their drinking water, not to mention their economic importance for commercial, tourism and recreational activities.

On the other hand, some residents near the Port Granby LLRW (AECL) facility prefer leaving the waste in place near the Lake Ontario shoreline to avoid disturbing the community and risking dispersion of contaminants through the air in the course of excavation.

The desire to minimize risks of transportation of radioactive waste is another concern that relates to site location.

Some participants asked whether there would be compensation in the event that water quality was negatively affected by the presence of storage facilities.

3.2 Insufficient Data

A general concern was expressed by some participants that databases of previous conditions are inadequate, that information to make reasonable predictions about the overall likelihood and significance of effects is insufficient and that there are gaps in critical information that preclude reasonable assessment conclusions. Examples cited include:

- Insufficient baseline data concerning radioactivity levels and effects, making it difficult to detect incremental changes, ascribe them to a specific action or determine cumulative effects;
- Inadequate meteorological data to predict dispersion of released material;

-
- Inadequate groundwater flow pattern information and methods to determine sources of groundwater contamination;
 - Shortcomings in present monitoring of long-term effects, notably health effects; and
 - Cumulative Effects Assessments do not include effects from significant abnormal events.

3.3 *Radiation and Health*

Participants frequently raised concerns about a perceived local increase in the number of serious illnesses such as cancer and birth defects and wondered whether these increases were the result of existing nuclear facilities in their communities. Some participants worried that proposed facilities would further increase cancer rates in the local community and expressed particular concern about health impacts on children.

Participants asked:

- Whether there are studies on health problems for people living near nuclear facilities and what they show? It was suggested that the health of residents should be studied and monitored, and that historic health effects of existing nuclear facilities as well as predicted future effects of proposed facilities should be studied;
- How increased radiation levels from proposed waste management facilities will compare with existing levels and what impact these exposures will have on workers and the public;
- How levels and exposures are monitored; and
- What are the chronic effects of increased radiation levels.

Participants indicated that they found dosage numbers confusing and not meaningful to lay people:

- What is the definition of “acceptable” or “negligible”?
- Who determines this?
- What are the consequences of chronic exposure to low-level radiation?

Responses by project proponents to questions from the public were sometimes seen as revealing a “don’t worry” attitude.

It was suggested that given (perceived) past underestimation of the risks associated with radionuclides, it is uncertain whether new risk estimates accurately assess the real risk to human health.

Concerns about the cumulative human health effects of tritium and other radionuclides in the environment (air, crops, vegetation, fish, animals and especially water) around nuclear facilities were frequently voiced. It was suggested that the health effects of chronic exposure to low levels of radiation are unknown and that standards for limits should consider that children are more susceptible than adults. Before concluding that there are no adverse health effects, it was suggested that critical dose assessments should be recalculated using the most sensitive receptors and conservative assumptions.

It was suggested that cumulative effects do not get adequate attention. For example, Cumulative Effects Assessments fail to consider spatial and temporal overlap of radiation doses. People may have overlap of exposure if they work at a nuclear facility and also eat fish from the lake.

Some public participants criticized the EA process for not recognizing the effects of perceived risk in the general population and the resulting feelings of dread, stress and insecurity that can affect the health and quality of life of community residents.

Assumptions and methodology to formulate critical group dose calculations were sometimes questioned, and the suggestion made that background radiation levels are overestimated to minimize the significance of future radiation from the project.

Some people voiced concern about continuing uncertainty in the assessment of radiological risks and the selection of appropriate, conservative standards for dose limits.

It was suggested that regulatory requirements are not always sufficient to protect the environment or human health, that we should look to best practices and standards worldwide, and that the “as low as reasonably achievable” (ALARA) principle should apply.

3.4 Environmental Monitoring

Environmental monitoring regimes, both on and off-site, play a vital role in maintaining public confidence in the safety of waste management facilities. The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan made the following important observations with respect to environmental monitoring:

People are not reassured by risk analyses and modeling predicting that their fears are groundless. They demand proof that contaminants are being successfully contained and not damaging the surrounding ecosystems. This can only be achieved with monitoring programs that are carefully designed and implemented with the involvement of local people.

Even if the monitoring program were carefully designed and executed, its results might fail to convince the people of the region of its validity. Local participation in the monitoring protocols is essential. Without local participation, distrust of the monitoring data is likely to result in a continued misunderstanding of the state of the environment. Residents must be involved, especially in the implementation of the program, before they will trust the results.

Other issues voiced by participants included the following:

- The frequency of monitoring (radiation, groundwater, surface waters, air, vegetation).
- Regular reporting of monitoring information to neighboring communities would help alleviate concerns.
- Independent monitoring with periodic audits would give people more confidence.
- The monitoring system must remain in the public sector with local community oversight.
- The monitoring system should be able to be upgraded as new technology becomes available.
- People asked about the radiological environmental monitoring program, for example the lack of specifics about indicator species and other accepted scientific practices.
- Adopt the highest international standards where they exceed Canadian standards.

3.5 Safety of Interim Storage Technologies

The most commonly asked questions and comments with respect to the safety of interim storage technologies and facilities included the following:

- How much radiation escapes from DSCs? Will the concrete used in DSCs deteriorate through aging or radiation over the 50-year life of DSCs, thereby releasing radiation? What happens after the end of the 50-year design life or if a DSC is dropped or damaged or found to be leaking? Will DSCs

themselves require disposal as radioactive waste at the end of their design life?

- How will safety be affected in the event of natural disasters such as earthquakes, floods or fires or if a plane crashes into the facility?
- How will safety be ensured for the public and workers during used fuel transfers from wet storage to DSCs and during transportation to the interim storage facility? It was suggested that the facility should be as close as possible to the fuel bays (i.e., to minimize transportation distances).
- Emergency preparedness plans in the event of an accident should be provided and better publicized. How will local residents be informed if there were a problem or emergency?
- Is the technology used elsewhere? Are there other facilities like this and what has their experience been?
- A few participants suggested that independent testing and certification of DSCs should be undertaken and that the entire system should be reviewed from fuel bay to storage pad.

During the EA for the proposed decommissioning of AECL's Whiteshell Laboratories, important safety concerns were raised as a result of the proposed 60-year decommissioning time frame, a time frame necessitated by the assumption that a national long-term waste site would not be available before 2050. It was suggested that such a lengthy time frame would not only defer costs to future generations but also reduce community and worker safety because personnel with hands-on knowledge of facility operations and the location and nature of wastes and contaminated areas would be lost.

3.6 *The Biophysical Environment*

Concerns about the environmental impacts of waste management facilities arose during all of the reports reviewed. The most commonly asked questions and comments included the following:

- People want to know that it is safe to drink the water, to fish, to trap, to hunt and to harvest plants, both now and in the future. This requires collecting baseline data to determine the state of the terrestrial and aquatic environment before the proposed project.
- It was sometimes suggested that baseline environmental data, assumptions and studies of habitats, biota and water were incomplete.
- Concerns were expressed about drinking water quality and contamination of the food chain due to emissions and leaks. How will surface and ground water

be affected? Is there any safe level for the release and spills of radioactive materials to watercourses? What are the potential pathways of storm water to the lake and how will this be managed? What are the downwind effects of atmospheric releases?

- It was suggested that migratory species and wildlife that move in and out of Waste Management areas should be included in environmental assessments.
- Concerns about radiation levels in the environment (air, crops, vegetation, fish, animals and especially water) around nuclear facilities were frequently voiced, as were concerns about the cumulative effects of radionuclides.

Some participants perceived deficiencies in assessing environmental impacts, making it difficult to establish post-construction effects and needed remediation to protect flora and fauna. For example:

- The approach to determining the significance of environmental effects is deficient. There is no reference to current standards or the carrying capacity for impacted aquatic resources and their tolerance levels.
- There is no attempt to assess the possible additive effects of each predicted effect or to establish the threshold beyond which an effect is likely to have significant adverse consequences on the environment.

Other comments included:

- How will the proponent go about implementing appropriate mitigation or compensation for environmental impacts that cannot be avoided?
- In the long term, there should be no adverse environmental effects beyond the facility fence line.
- Given the long timeframes involved, consideration must be given to the effects of global climate change and the effects of this on the proposed facilities and the host environment.

4. CONFIDENCE IN THE ENVIRONMENTAL ASSESSMENT PROCESS AND TRUST IN NUCLEAR ORGANIZATIONS AND REGULATORS

Concerns and comments regarding the Environmental Assessment planning and review process arose during a number of the nuclear waste management EAs reviewed, including those involving used fuel interim storage. Concerns tended to focus on factors such as:

- The appropriateness of the chosen EA track (Screening, Comprehensive, Panel) with preference expressed for a full panel review;
- Perceived bias in studies conducted by project proponents;
- Perceived pro-nuclear stance by the CNSC;
- The inadequacy of time frames and resources to review reports and participate in meaningful consultation; and
- The desire to have an adequately resourced local citizen group watching over the process on behalf of the community, and a team of independent experts to peer review the studies.

These concerns suggest that confidence in the review and approvals process as well as trust in some of the key nuclear organizations and regulators involved is not universally shared.

Key concerns and comments included the following:

- Many participants stated that the public comment period was too short for effective public input and that there is too much information to review in a short period of time. Flexibility and consultation with stakeholders in establishing comment periods that reflect the volume and complexity of material to be reviewed are suggested.
- How is the effectiveness of outreach measured? Establish benchmarks to determine if the community and stakeholders have been fully informed.
- Proponents' concept of community consultations is to ignore them and move on with their plan as originally conceived. The plans are clearly driven by fiscal not safety, economic or public morality considerations.
- The proponent has decided, using corporate criteria unrelated to factors of economic and technical feasibility, health, safety or environmental protection, that there is no acceptable alternative to be discussed.
- Frequently, people do not trust the proponent's capacity to self-assess. An unbiased party should conduct environmental Assessments. Delegating part of the EA to the proponent is a potential conflict of interest. An independent

panel with full public hearings is required to provide the necessary arm's length assessment.

- The screening track is insufficient. A full and transparent public review is needed, with public hearings and intervener funding. We want public hearings by an independent, impartial panel.
- Some participants suggested that the Scope of Assessment was too narrow, that information presented is biased and that, in light of previous rulings, they lack confidence in the CNSC.
- One NGO suggested that it does not have confidence in the CNSC as an agency capable of carrying out an independent and objective assessment of the environmental implications of the proposed project. It is too closely associated with the nuclear industry and with the government ministry that supports and promotes nuclear power.
- The same NGO also expressed a lack of confidence in the public consultation process because these consultations are delegated in large measure to the proponent.
- One comment suggested that the government would seek out the cheapest solution, not the best or most appropriate.

Comments by some participants around other issues such as safety, health and environmental impacts may provide insight regarding some of the factors affecting the level of trust in nuclear organizations. For example:

- Communications with the public on incidents/accidents is slow and “secretive” with some denial.
- Responses to questions reveal a “don’t worry” attitude.
- Dosage numbers are very confusing and not meaningful to lay people. What is the definition of “acceptable”, “minor leak”, and “negligible”? Who determines this?
- Proponents rarely refer to human consequences of chronic exposure to low-level radiation, for example cancer or genetic damage.
- Assumptions and methodology to formulate critical group dosage calculations are suspect. Background radiation levels are overestimated to permit underestimation of the significance of incremental future radiation from the project.

-
- Given past underestimation of the risks associated with radionuclides, it is uncertain whether new risk estimates accurately assess the real risk to human health.
 - There is a strong trend in the EA to dismiss any cumulative effects.
 - The proponent is controlling the access to information about the condition of the facilities and the quantities, types and disposition of radionuclides, making it impossible to undertake independent safety assessments.
 - Future trust and assurances are more difficult because of a past lack of information disclosure. Open, honest discussion with full disclosure of information will enhance credibility and trust.

The findings reported in public attitude research indicate a direct correlation between familiarity with nuclear organizations and confidence ratings of their performance in protecting the environment and human health.

5. ABORIGINAL INTERESTS

First Nations issues and concerns around traditional resources and activities, land use, culture and heritage played a role in a number of the projects reviewed, including those involving used fuel interim storage. These and other Aboriginal issues were particularly well articulated by the Union of New Brunswick Indians (UNBI) during the Environmental Assessment for proposed Modifications to the Point Lepreau Solid Radioactive Waste Management Facility.¹

Key comments from the UNBI submission include the following and reflect many of the concerns voiced by First Nations at other projects reviewed as part of this study:

- Aboriginal and Treaty rights make First Nations a unique stakeholder in the province, one whose rights and interests should take precedence over the rights of other stakeholders.
- The UNBI expressed concern that facility construction and operation will have adverse cultural and social impacts on Aboriginal and Treaty rights, burial sites and artifacts, significant sites such as ancient portages, villages and meeting places, deer wintering grounds, areas used for collecting traditional plants for edible and medicinal purposes and areas used for harvesting wood products, fishing, hunting and trapping.
- The EA and consultation process did not:
 - Enable First Nations peoples to participate in the planning process in a manner suitable to their culture and status in the Canadian framework.
 - Fund First Nations to undertake studies using experts and independent advisors of their choice.
 - Permit adequate time to review documents or engage in meaningful consultations.

¹ Overall, there were relatively few comments identified as issuing from Aboriginal peoples, and none identifiable as Métis or Inuit comments.

The UNBI made a number of recommendations designed to address their concerns, including the following:

- Ensure that First Nations have adequate resources (financial, human, technical and time) to participate in the EA and consultation process.²
- Ensure that guidelines are jointly developed by the CNSC, NBP, and First Nations and put in place to ensure that proponents of major projects adequately assess concerns of First Nations peoples.
- Ensure that First Nations have meaningful and continuous involvement in the assessment process from the planning stage to final monitoring.
- Allow for alternate First Nations environmental assessment regimes using “traditional knowledge”.
- Ensure that First Nations peoples receive training for jobs in the trades, security and monitoring in order that they receive a share of the economic benefits from the project.
- Establish appropriate training programs in the environmental sciences for First Nations youths, possibly with an emphasis on merging traditional knowledge with today’s science.

During the Bruce Used Fuel Dry Storage Facility EA, Aboriginal groups indicated opposition to the transportation of radioactive waste across First Nations territory and to the concept of geological nuclear waste disposal in the Canadian Shield.

² With respect to time, it must be noted that First Nations may require a considerably longer time period to review material and develop their positions and comments. In the Bruce A Restart EA, one First Nation did not participate until late in the process, at which time it was not possible to accommodate their input to use a different indicator species for aquatic effects assessment. Their concern was accommodated by modifying the follow-up monitoring program to include the indicator proposed. (Personal communications, Dr. Duncan Moffett, Golder Associates).

6. SOCIO-ECONOMIC IMPACTS

Concerns and questions regarding the socio-economic impacts of nuclear waste management facilities arose during a number of the EAs reviewed, including several involving interim storage of used fuel. Comments centered primarily on the direct economic impacts of proposed projects (particularly in smaller or more remote communities), on the need for an appropriate balance between the benefits of proposed projects and the perceived risks inherent in accepting them, and on the potential for projects to alter the image and reputation of host communities.

It may be instructive to consider what participants in the two Port Hope Area Initiative projects (the only projects reviewed that focus specifically on long-term radioactive waste management) identified as socio-economic characteristics they consider appropriate for a long-term facility:

- No cost burden to the local communities;
- Cost should never compromise safety, health protection or environmental integrity;
- Dedicated, long-term funding for construction, operation and maintenance, management and monitoring, including a contingency fund in case of accident or malfunction;
- Funding to defray municipal infrastructure needs associated with the project; and
- Independent financial and performance audits available to the host communities.

Most projects reviewed included comments pertaining to socio-economic considerations. The most frequently asked questions and comments regarding socio-economic impacts were as follows:

- The wind blows in this direction and the water flows in this direction, from your facility, so we get all the bad stuff, but there are no jobs for our people at the facility. We don't get anything out of it. That is our real concern.
- There needs to be a balance between the hazards of accepting waste at the site and benefits for the community, e.g., jobs.
- What will the impact be on the local economy and on employment? How many and what types of new jobs will be created?
- Will there be any work for local contractors and manufacturers?
- Will property values be negatively affected?

Questions and comments around community image reflected the anxiety of participants that their communities would increasingly be stigmatized and viewed as a dumping ground for nuclear waste, rather than simply a host for nuclear-related activities such as power generation or research:

- What will be the impact on the area's recreation resources and tourism industries and interest on the part of people and businesses to move to the area?
- Will waste be brought in from outside? Will the area become a dumpsite for all of Canada's or North America's nuclear waste? We are concerned about public perceptions and that the community will be viewed as a nuclear waste site.

7. SECURITY IN A POST 9/11 WORLD

Questions and concerns about the security of waste management facilities arose during a number of the EAs reviewed, including those involving used fuel interim storage. The security issue clearly assumed additional poignancy after the September 11th attacks, given the strategic location and economic significance of many nuclear facilities. The most commonly asked questions and comments were:

- In a post 9/11 world, what is being done to enhance the security of Dry Storage Facilities to deal with potential threats of sabotage, the theft of used fuel and terrorist attacks from the land, air and water?
- Should Dry Storage buildings have concrete domes or be placed underground?
- What security measures are in place when transporting used fuel from wet to dry storage?
- How will the community be warned or protected in the event of a sabotage or terrorist threat? An emergency plan should be in place for these facilities as well as for nuclear reactors.
- Can used fuel be used to create an atomic bomb?
- Waste management facilities require professional 24/7 security.

8. DEREGULATION/PRIVATIZATION

Concerns about the potential impact of deregulation and privatization in the electricity sector were voiced during a number of the nuclear waste management EAs reviewed, including several involving interim storage of used fuel.

Reorganization of the electricity sector and perceived doubts regarding the viability of the nuclear industry were sometimes cited as part of a new set of uncertainties (along with September 11th, the legal acceptance of the rights and interests of Aboriginal peoples and the perceived failure of deep geological burial of high-level waste) that needed to be taken into account when considering used fuel storage proposals.

Participants were concerned that responsibility for nuclear waste might reside with private organizations as a result of the changes and uncertainties at play in the electricity sector.

Comments included the following:

- What will be the effect of privatization on safety and public involvement in approvals?
- There should be no shortcuts of economy over safety, especially with privatization.
- If the site is sold, what will the impact be on the waste management facility? Is the waste site part of the sale? Is there a chance that waste will come here from other sites belonging to the new company?

9. FINANCIAL AND LIABILITY CONSIDERATIONS

Although financial issues do not appear to have been a major concern during many of the nuclear waste management EAs reviewed, important questions did arise, including the following:

- Who is going to pay for waste management facilities - the public or the companies involved?
- Will there be insurance for property losses in case of an accident?
- Is the liability insurance under the Nuclear Liability Act adequate given current housing and business values?
- Will there be sufficient technical and financial resources in the future to manage the wastes?
- What happens to monitoring if the government decides to reduce funding? What guarantees are there that resources will be available for long-term monitoring, and mitigation or compensation if required?
- Will proponents be able to acquire the necessary resources for decommissioning?
- What assurances do the public have that proponents won't take shortcuts?
- Whatever decommissioning plan is finally accepted, there must be guaranteed funding in place to carry it out.
- Stop passing the buck on financial liability. All future commitments for decommissioning should be presented and guaranteed jointly by the proponent and the federal government.
- The Joint Federal-Provincial Panel on Uranium Mining Developments in Northern Saskatchewan noted certain wastes, such as uranium mine tailings, will require containment for millennia, during which time many aspects of both the biophysical and institutional environments will be altered. The Panel therefore recommended the establishment of a contingency fund to provide for the ongoing costs of long-term monitoring and mitigation, should it be required.

10. SUMMARY OF KEY OBSERVATIONS AND CONCLUSIONS

Issues and concerns voiced by participants during the EAs reviewed for this study may assist in providing guidance with respect to the NWMO's mandate, its sustainable development framework and the conditions for acceptability of long-term waste management approaches for the care of Canada's used nuclear fuel. This section is an attempt to review the comments and concerns expressed as reported in the foregoing, and draw some relevant implications for the NWMO mandate and proposed management framework.

Our review suggests that the development of management approaches should be informed by at least the following considerations:

- Communities that are currently hosts to interim storage of used fuel have the understanding and expectation that:
 - Used fuel will be stored on-site only until an off-site long term used fuel management facility becomes available;
 - Only used fuel generated at that location would be accepted for interim storage; and
 - Extensions and expansions of used fuel interim storage facilities will not go on indefinitely.
- Transparency, opportunity for full public engagement and the potential to have real influence on decision-making will be critical factors influencing the social acceptability and sense of public ownership of management approaches. This is particularly important given that some NGOs and members of the public lack trust in nuclear organizations and regulatory agencies. Engagement and review mechanisms to address perceived bias in proponent-based Environmental Assessment studies and the provision of appropriate resources for interveners to participate meaningfully in the engagement process will also be important factors in increasing confidence in the technical viability of management approaches and acceptance of decision-making outcomes. In this regard, decision-making by a third party, independent and technically informed adjudicating body (e.g. panel) is deemed by many to be the preferred approach.
- First Nations people want to be acknowledged as a unique stakeholder by virtue of their Aboriginal and Treaty Rights, their traditional relationship to "mother earth" and their spiritual, cultural and social values. Acknowledgement of and respect for their interests and insights can play an important role in shaping ethically, socially and environmentally acceptable approaches to the long-term waste management of Canada's used nuclear fuel. First Nations people want to be assured that:

-
- Their way of life will not be unduly put at risk;
 - They will have adequate resources (financial, human, technical and time) to participate fully, meaningfully and continuously in the consultation, assessment and implementation process from planning to final monitoring; and
 - They will share equitably in the economic benefits.
- The location of many nuclear facilities close to large population centers and adjacent to watercourses which supply drinking water to those populations, coupled with the events of September 11, 2001 have heightened public awareness with respect to potential terrorist threats against nuclear installations. The public in general and host communities in particular want to be assured that management approaches enhance public safety by taking this new security environment into account and reducing terrorist access to nuclear materials.
 - Canadians will want to be assured that deregulation and privatization in the electricity sector will not result in the transfer of responsibility for nuclear waste to profit-oriented private sector organizations. To be socially acceptable, management approaches must be based on institutions under public control and scrutiny.
 - Used nuclear fuel will need to be isolated and contained for millennia, during which time institutional and governance environments will change in unpredictable ways. The public and host communities want to be assured that current and future generations will have the technical and financial resources required to implement and sustain the management approach, to provide for long-term monitoring and to fund mitigation, should it be required.
 - Management approaches need to ensure that the economic viability of a host community is maintained and enhanced, that property and business values are protected and that the residents of the host community benefit in an equitable way from the economic opportunities generated by the management approach.
 - To be acceptable to host communities and the wider public, management approaches must be based on state-of-the-art technologies and best practices designed to safeguard human health and environmental integrity now and in the long term. At the same time, innovation must be balanced with evidence that the technologies adopted are proven, reliable and durable. Flexibility to incorporate new advances in technology, whether for materials recycling, containment or monitoring is seen as a valued feature in facility design.

- Public anxiety about their health or radionuclides in the air, drinking water and the food chain may not be calmed by technical and scientific studies or risk analyses suggesting negligible impact on the ecosystem and human populations. The explicit inclusion in the management approach of monitoring regimes designed and implemented around public and local involvement can play an important role in enhancing confidence in safety projections and ensuring public trust in ongoing system performance. In the event that periodic reassessments of the management approach are undertaken, public involvement in ongoing monitoring regimes will increase trust in the data used to arrive at conclusions.