nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Choosing a Way Forward

The Future Management of Canada's Used Nuclear Fuel

Executive Summary Draft Study Report

Executive

I. THE ISSUE - THE CHALLENGE OF TAKING THE LONG VIEW

For decades Canadians have been using electricity generated by nuclear power reactors. Ontario has 20 reactors at three generating stations. New Brunswick and Québec each have one reactor for electricity generation.

All of the used nuclear fuel from these reactors is safely stored on an interim basis at licensed facilities at the reactor sites. Very small amounts of used fuel are also produced at research facilities throughout Canada. How this used fuel is managed over the long term is the purpose of the NWMO study.

A significant and unique feature of this issue is the time dimension. When used fuel is removed from a nuclear reactor it is highly radioactive and requires proper shielding and careful handling to protect humans and the environment. Although the radioactivity decreases with time, used fuel remains a potential health, safety and security hazard for a very long period, likely tens of thousands of years or longer.

We are contemplating designing and licensing a system for periods longer than recorded history. And our knowledge is not complete. We do not know what technologies may be available to succeeding generations. Nor do we know what use, if any, there may be for the wastes we have generated. We do not know what the capacity of future generations will be to take an active role in managing this waste. And, although we can predict with some confidence, we do not know with certainty how the technologies we put in place today will perform over this very long period of time.

What does responsible action today look like when the potential risk to society spans so long a period? This question is the launching point for the study.

II. THE NWMO'S MANDATE - FINDING A RESPONSIBLE APPROACH

In order to ensure that Canada proceeds with the implementation of a long-term management approach for used nuclear fuel in a timely and appropriate way, the Government of Canada passed the *Nuclear Fuel Waste Act (NFWA)* in 2002. The legislation required nuclear energy corporations to establish the Nuclear Waste Management Organization (NWMO) to study the options available and to recommend a long-term management approach.

The legislation requires the NWMO to study, at a minimum, approaches based on three methods: deep geological disposal in the Canadian Shield; centralized storage, above or below ground; and storage at nuclear reactor sites.

This draft report is the third in a series of discussion documents published by the NWMO as part of its dialogue with Canadians. It is being circulated to review and test our ideas with the interested public, including the many people who have collaborated in the study.

III. WHAT WE DID: OUR COLLABORATION WITH CANADIANS

In fulfilling the requirements of the *NFWA*, the NWMO has taken as its mission "to develop collaboratively with Canadians a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible and economically feasible."

Canadians expect that the best scientific and technical knowledge will be brought to bear in identifying and understanding the ways in which safety can be assured. However, the decision as to whether safety has been assured to a sufficient degree to warrant implementation is a societal one.

We set aside traditional notions of consultation as they too often result in one-way conversations. We have consistently tried to design processes of dialogue to allow NWMO to listen and learn from citizens and genuinely engage those who are interested in this matter. We have tried to be responsive to a variety of views and perspectives. Over the course of the study, thousands have helped in the search for societal direction and common ground.

The NWMO's study process asked Canadians to identify the values and objectives against which a management approach should be assessed. Then we engaged them in dialogues to actually assess the approaches against those values and objectives. We asked Canadians to provide direction on:

- The questions which ought to be asked and answered in the study, and the key issues to be addressed in the assessment of the management approaches;
- The range of technical methods which ought to be considered; and
- The assessment of risks, costs and benefits of each management approach;
- The design of an overarching management structure and implementation plans for each management approach considered in the study.

Sustained engagement with people and communities, whether they welcome, oppose, or seek modifications to our observations and conclusions, has been vital throughout the study.

IV. WHAT WE HEARD: CANADA'S APPROACH NEEDS TO BE SAFE AND FAIR

The question of what constitutes 'responsible action' in the long-term management of used nuclear fuel has been central to the complex and, at times, impassioned discussion we have had with Aboriginal Peoples, the public and knowledge experts.

As required by the *Nuclear Fuel Waste Act*, we have undertaken a comparison of the benefits, risks and costs of each management approach with those of the other approaches. The framework for this comparison emerged from the dialogue with citizens. People told us:

- First and foremost, the approach needs to be safe and secure to people, the environment, communities and workers.
- And, as much as possible, the approach must be fair to both the current generation (and across regions, people and cultures) and to future generations.

Further, people told us that any management approach for Canada should allow us to assume responsibility now for dealing with the waste that has been created while at the same time, preserve the ability of future generations to do what they see as being in their best interests.

V. OUR ASSESSMENT: THE ADVANTAGES AND LIMITATIONS OF THE MANDATED APPROACHES

Our assessments have confirmed that there is reason to be confident that all three technical methods or concepts specified in the *NFWA* are technically credible and could be designed to be safe for the near term. Furthermore, our regulatory regime would demand such "proof of concept" before licensing.

That said, our analysis suggests that:

- Taken individually, no single management approach specified in the *NFWA* perfectly addresses all of the values and objectives which citizens said are important.
- Each of the three approaches has distinct advantages and limitations.

The storage options, Storage at Nuclear Reactor Sites and Centralized Storage, are expected to perform well over the near term (at least within the next 175 years).

However, the existing nuclear reactor sites were not chosen for their suitability as permanent storage locations. Furthermore, communities hosting nuclear reactors have an expectation that the used nuclear fuel will eventually be removed.

The NWMO believes that the risks and uncertainties concerning performance of these storage approaches over the very long term are substantial. A key contributing factor is the extent to which long-term storage relies on strong institutions and active management to ensure safe and effective performance. The NWMO expects that these institutions and the capacity for active management will be strong over the foreseeable future, but uncertain over the very long term. The NWMO believes that the type of responsible and prudent approach Canadians expect dictates that we not rely on strong institutions and active management capacity over tens of thousands of years.

Deep Geological Disposal in the Canadian Shield is judged to perform well in the very long term because of the combination of engineered and natural barriers to isolate the used fuel. However, a key weakness of the approach is its lack of adaptability, which is an important

CONT'D INSIDE >

Summary

CONT'D > objective in the minds of citizens. Over the short term, the approach is judged to be less flexible to responding to changing knowledge or circumstances. There is also some uncertainty about how the system will perform over the very long term because we cannot obtain advanced proof of actual performance over thousands of years. Also, Deep Geological Disposal provides comparatively little opportunity for future generations to influence the way in which the used fuel is managed.

VI. OUR PREFERRED APPROACH: AN ADAPTIVE PHASED MANAGEMENT APPROACH

The insights from our assessments led us to search for an approach that might better meet Canadian objectives than any of the three options taken in isolation.

The Adaptive Phased Management approach has been designed to build upon the advantages of each of the other three approaches studied. Our vision is that Canada will take responsibility for the long-term management of its nuclear fuel waste. Our recommendation proposes a path to achieve that goal through a risk management approach of deliberate stages and periodic decision points.

- It commits this generation of Canadians to take the first steps now to manage the used nuclear fuel we have created;
- It will meet rigorous safety and security standards through its design and process;
- It allows sequential decision-making, providing the flexibility to adapt to experience and societal change;
- It provides genuine choice by taking a financially conservative approach, and by providing for capacity to be transferred from one generation to the next;
- It promotes continuous learning, allowing for improvements in operations and design that would enhance performance and reduce uncertainties;
- It provides a viable, safe and secure long-term storage capability, with the potential for retrievability of waste, which can be exercised until future generations have confidence to close the facility; and
- It is rooted in values and ethics and engages citizens, allowing for societal judgments as to whether there is sufficient certainty to proceed with each following step.

We believe that our approach is both responsive and responsible. It is responsive to what we understand to be the values and expectations of Canadians in providing safe and secure isolation of the waste for the very long term. It has also brought to bear the knowledge, expertise and wisdom of a variety of expert communities to help us understand the choice. We are resolute in our belief that the knowledge we have today is more than adequate to start down this path, yet humble enough to acknowledge that the future will unfold in ways that may redirect the path to our end goal.

VII. ADDITIONAL COMMENT

Our report would be incomplete if we did not refer to the impassioned arguments we heard about energy policy and the future of nuclear power. From the inception of our study, some participants in our dialogues argued that the assessment of management approaches needs to be undertaken in the context of a broader public policy debate about energy. Nuclear energy as a way of generating power, some argue, needs to be fully assessed in comparison with other ways of generating power.

The NWMO has not examined nor is it making a judgment about the appropriate role of nuclear power generation in Canada. We suggest that those future decisions should be the subject of their own assessment and public process. Used fuel exists today and requires management for the long term. Our study process and evaluation of options was intended neither to promote nor penalize Canada's decisions regarding the future of nuclear power.

VIII. THE DIALOGUE CONTINUES

There is no single formula or lens through which to approach this public policy challenge. It demands the wisdom of Aboriginal Elders, the expertise of natural and social scientists and engineers, and the informed interest of citizens. With this draft report, the dialogue must continue. We invite your comment upon our proposals and your participation as we refine our report for final submission.

OUR RECOMMENDATION

Our recommendation for the long-term management of used nuclear fuel in Canada has as its primary objectives safety - the protection of humans and the environment - and fairness to this and future generations.

Therefore we recommend to the Government of Canada Adaptive Phased Management, a risk management approach with the following characteristics:

- Centralized containment and isolation of the used fuel in a deep geologic repository in suitable rock formations, such as the crystalline rock of the Canadian Shield or Ordovician sedimentary rock;
- Flexibility in the pace and manner of implementation through a phased decision-making process, supported by a program of continuous learning, research and development;
- Provision for an interim step in the implementation process in the form of shallow underground storage of used fuel at the central site, prior to final placement in a deep repository;
- Continuous monitoring of the used fuel to support data collection and confirmation of the safety and performance of the repository; and
- Potential for retrievability of the used fuel for an extended period, until such time as a future society makes a determination on the final closure, and the appropriate form and duration of postclosure monitoring.

The Nuclear Waste Management Organization will implement this comprehensive approach, in compliance with the *Nuclear Fuel Waste Act (NFWA)* of 2002, and will:

- Meet or exceed all applicable regulatory standards and requirements for protecting the health, safety and security of humans and the environment;
- Provide financial surety through funding by the nuclear energy corporations (currently Ontario Power Generation Inc., Hydro-Québec and NB Power Nuclear) and Atomic Energy of Canada Limited, according to a financial formula as required by the *NFWA*;
- Seek a willing community to host the central facilities. The site must meet the scientific and technical criteria chosen to ensure that multiple engineered and natural barriers will protect human beings, other life forms and the biosphere. Implementation of the approach will respect the social, cultural and economic aspirations of the affected communities;
- Focus site selection for the facilities on those provinces that are directly involved in the nuclear fuel cycle;
- Sustain the engagement of people and communities thoughout the phased process of decision and implementation; and
- Be responsive to advances in technology, natural and social science research, Traditional Aboriginal Knowledge, and societal values and expectations.

Be Involved

NWMO invites all interested individuals and organizations to get involved. Your views deserve to be heard.

Make a submission or share your comments with other interested Canadians and make your views known by August 31, 2005, at our website, www.nwmo.ca.

Review our public engagement plans, discussion documents, reports and research, which are available on our website at www.nwmo.ca.

Or contact us at:

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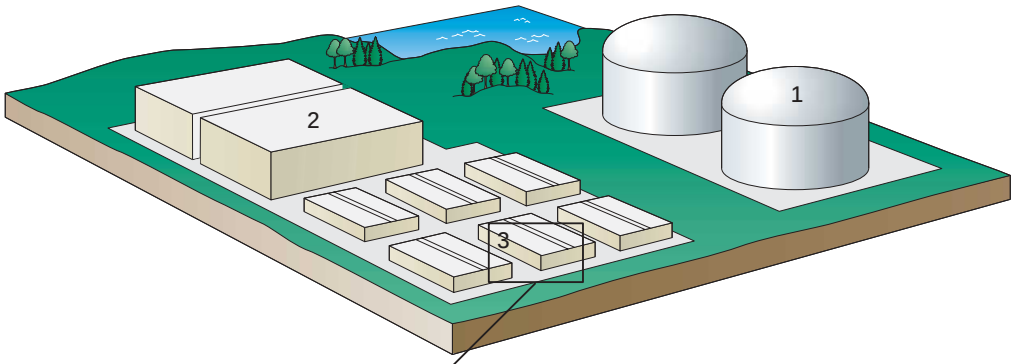
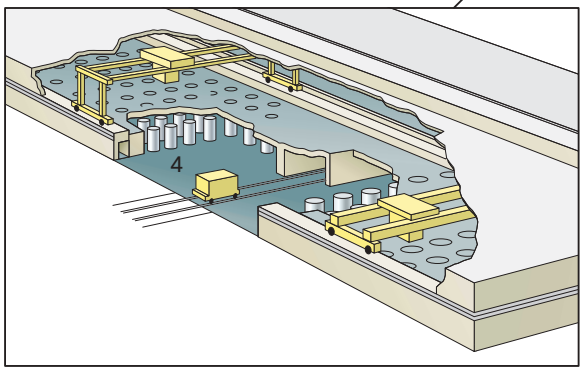
Toronto, Ontario
Canada M4T 1E2
Telephone: 416.934.9814 or toll-free at 1.866.249.6966

Our final report and recommendations must be submitted to the Minister of Natural Resources Canada by November 15, 2005.

Phase 1





LEGEND

1. Nuclear Generating Station
2. Processing Building
3. Storage Buildings
4. Casks in Storage

Adaptive Phased Management Approach - Illustrative Timeline

PHASE 1

Government Decision to proceed with Adaptive Phased Management

Collaboratively develop a siting process and engagement program with people and communities from areas potentially affected, including Aboriginal Peoples.

Incorporate insights from all NWMO work. Consult with regulatory authorities for pre-licensing work.

Implement the Engagement Program, initiating the Siting Process to **select** a preferred site (stakeholder consultations, feasibility studies and site characterization) from candidate sites. Conduct some Design and Safety Assessment activities in parallel.

Conduct further site characterization and design of central facilities. Initiate the licensing process. With public engagement and safety analyses, perform an Environmental Assessment that includes shallow rock cavern storage, the Underground Research Laboratory and deep geologic repository, and apply for Site Preparation Licence.

With Engagement Program, **decide** whether or not to construct centralized storage facility and transport used fuel to the central facility.

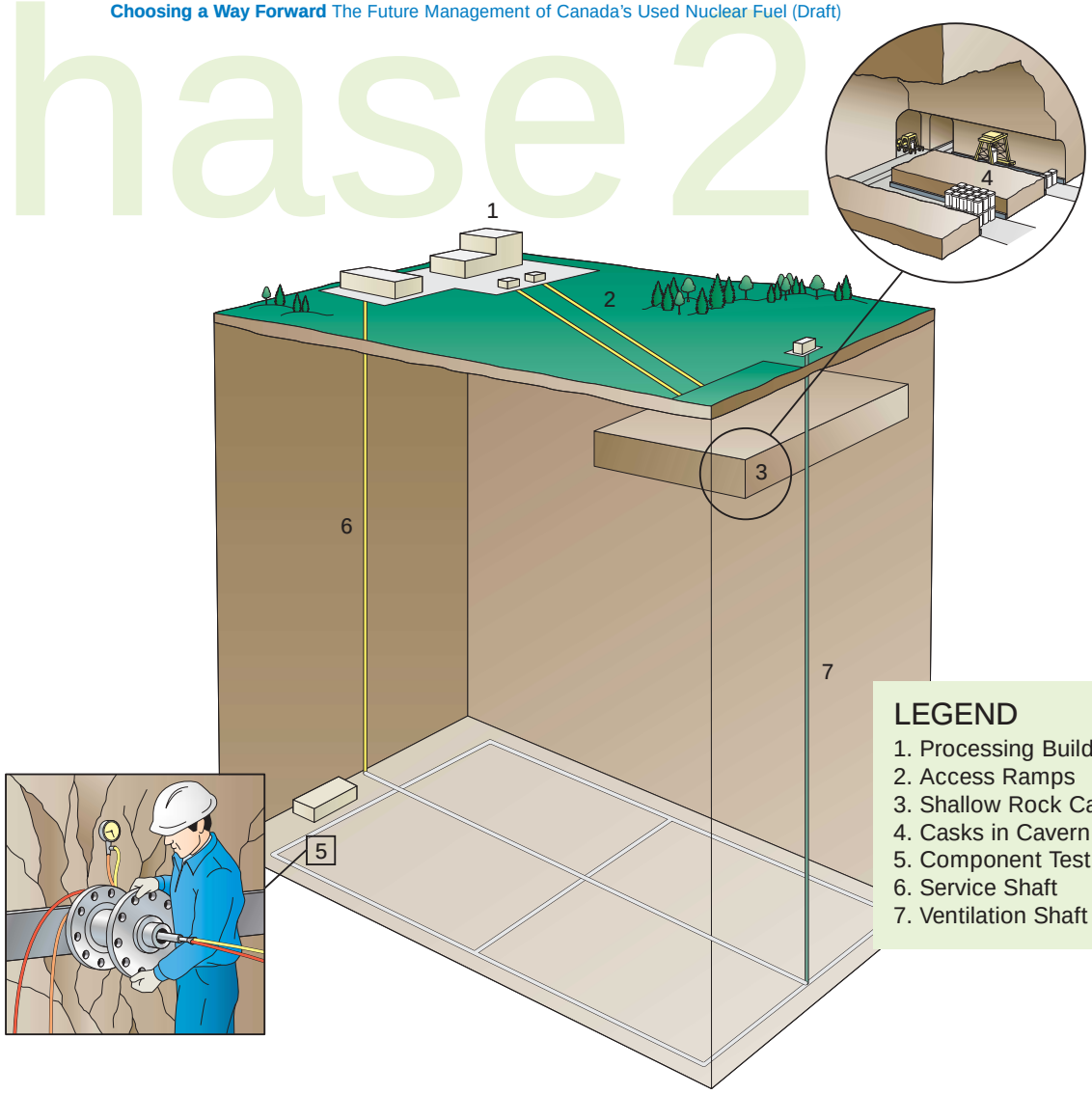
If **no**, maintain used fuel storage at reactor sites. Transport used fuel to central site in Phase 3.

If **yes**, obtain Construction Licence for shallow underground storage.

Obtain Construction Licence for Underground Research Laboratory.

YEAR 1 **YEAR 10** **YEAR 20**

Phase 2



LEGEND

1. Processing Building
2. Access Ramps
3. Shallow Rock Cavern
4. Casks in Cavern
5. Component Test Facility
6. Service Shaft
7. Ventilation Shaft

PHASE 2

If **no**, maintain used fuel storage at reactor sites. Transport used fuel to central site in Phase 3.

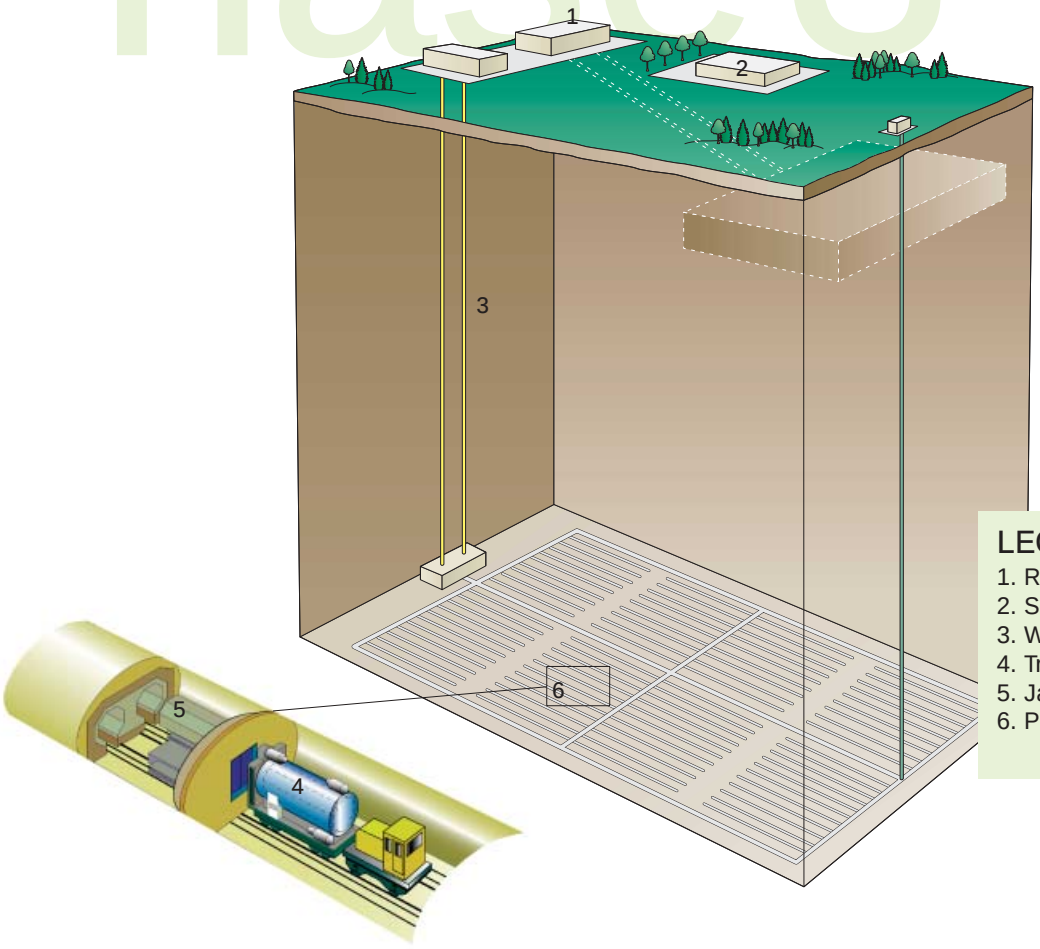
Obtain Operating Licence for shallow rock cavern storage and regulatory approval to transport used fuel. Transport, re-package (as required) and store used fuel in shallow rock caverns.

Operate Underground Research Laboratory to demonstrate technology, support design and licence for deep repository. Confirm the suitability of the site for a deep repository.

Through the Engagement Program, prepare final design and **decide** when to construct the deep repository and ancillary facilities. Obtain Construction Licence for deep repository.

YEAR 30 **YEAR 50**

Phase 3



LEGEND

1. Repackaging Building
2. Sealing Materials Plant
3. Waste Shaft
4. Transport Cask
5. Jacketed Used Fuel Container
6. Placement Rooms

PHASE 3

Obtain Operating Licence for deep geologic repository. Transport used fuel, as required. Package and place used fuel in deep repository and begin extended in-situ monitoring.

Used fuel is now fully placed in repository.

Monitoring will continue until a future society is sufficiently confident that the used fuel will remain contained and isolated.

Decide when to close and decommission deep geologic repository.

Close access tunnels and shafts. Postclosure monitoring may be implemented if desired.

YEAR 60 **YEAR 90** **YEAR 300**