nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Planning Transportation for Adaptive Phased Management

DISCUSSION DOCUMENT

September 2016

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NWMO Values

Integrity
We will conduct ourselves with openness, honesty and respect for all persons and organizations with whom we deal.

Excellence
We will pursue the best knowledge, understanding and innovative thinking in our analysis, engagement processes and decision-making.

Engagement
We will seek the participation of all communities of interest and be responsive to a diversity of views and perspectives. We will communicate and consult actively, promoting thoughtful reflection and facilitating a constructive dialogue.

Accountability
We will be fully responsible for the wise, prudent and efficient management of resources, and be accountable for all our actions.

Transparency
We will be open and transparent in our process, communications and decision-making, so that the approach is clear to all Canadians.

An Invitation

The Task Ahead

Within the next 30 years, Canada's used nuclear fuel will start to be moved from licensed interim storage locations to a deep geological repository for safe and secure, long-term containment and isolation. We are now beginning to put in place a plan for this transportation. We invite you to become involved and help guide decision-making on this important task.

Our Shared Responsibility

We draw the energy we need to sustain life from many sources – from the plants and animals around us, from the sun, water, and wind, and from resources found in the earth such as coal, oil, and gas. Over the last 50 years, we have drawn power on a large scale from a common element in the Earth's crust – uranium. Small amounts of it can be found almost everywhere in rocks, soils, rivers, and oceans.

Uranium mined from within rocks is fabricated into ceramic pellets that are bundled and used as fuel in nuclear power plants. For example, it has been a significant source of Ontario's electricity for several decades and is currently responsible for more than 50 per cent of Ontario's power. One of the legacies of this electricity production is used nuclear fuel, which is a compact, solid material that needs to be contained and isolated from people and the environment, essentially indefinitely.

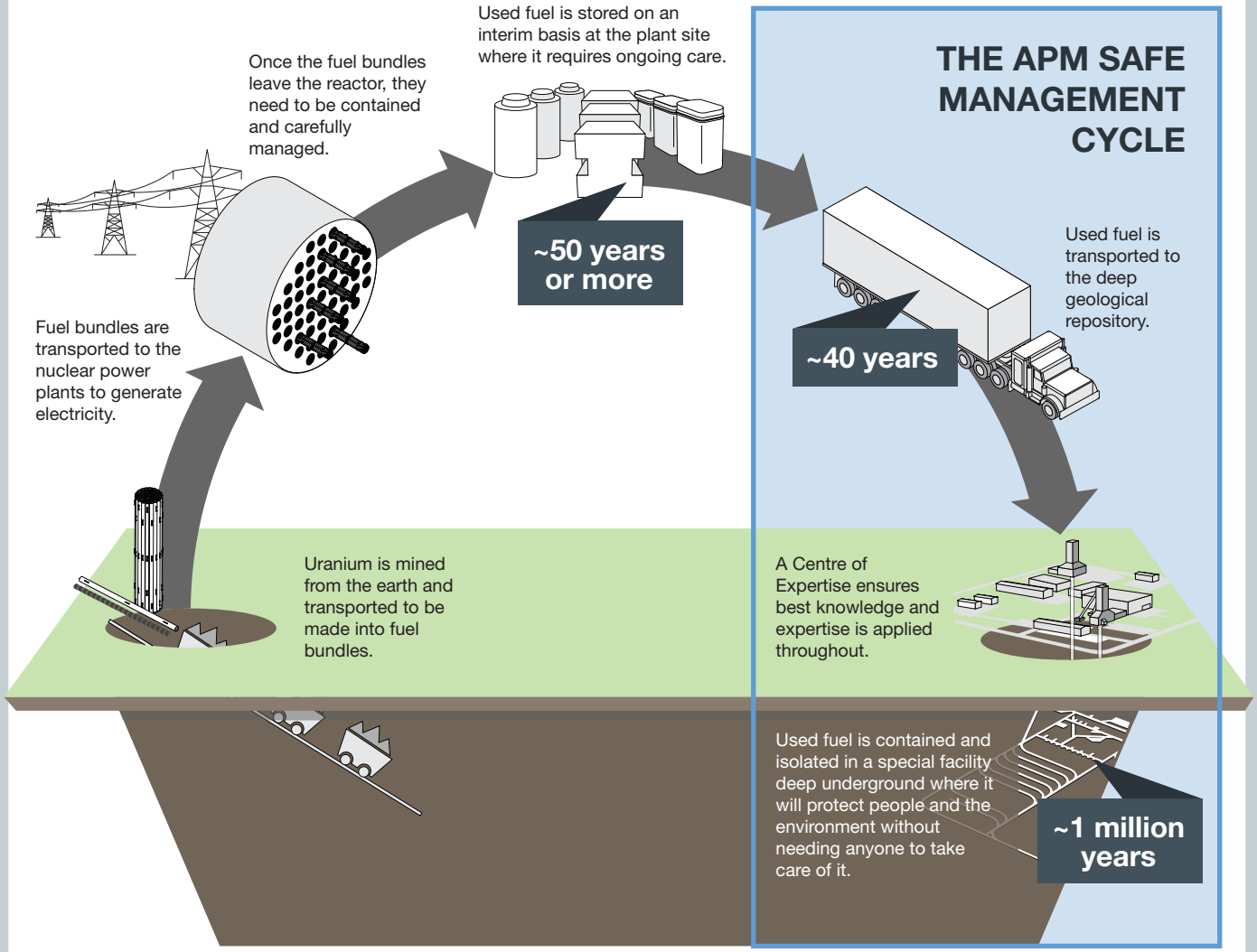
Canada, like many other countries around the world, has a plan for the safe, long-term management of used nuclear fuel in a specially designed deep geological repository. Located approximately 500 metres underground in a safe and stable rock formation, used nuclear fuel can be kept separate from people and the environment without needing anyone to actively take care of it. This plan uses the best science and learnings from nature and natural systems. It is recognized internationally as the best approach.

Canada's plan is known as Adaptive Phased Management (APM). It involves taking the waste, which is currently stored at or near nuclear generating stations and research facilities, to a deep geological repository for long-term management. Transporting used nuclear fuel from where it is currently stored to the deep geological repository is an important component of this safe, long-term management plan.

Canada's plan was developed in dialogue with a broad cross-section of Canadians. The starting point for this plan is that this generation is taking responsibility for the management of the waste it has created and is not leaving it as a burden to future generations.

Canada's plan for the long-term management of used nuclear fuel requires us all to work together to implement each component. Planning for transportation of the used nuclear fuel, an important component of APM, requires the involvement of a broad range of citizens and technical specialists. Together, we can ensure APM transportation plans incorporate the best knowledge and expertise, and are guided by the values and priorities of Canadians to protect future generations, people, plants, and animals.

We have time to develop this transportation plan together and consider it carefully, as APM transportation is not expected to begin before 2040. To prepare for this important phase of work, we are beginning to identify the framework that should guide this planning, and the information we will need from technical and other knowledge specialists to make decisions in the future.



The APM Safe Management Cycle

APM involves approximately 40 years of safe transportation as part of a plan to contain and isolate used nuclear fuel for hundreds of thousands of years.

The APM transportation plan will need to lay out clear objectives, the issues that will need to be addressed, the factors to consider in making decisions, and the means we will use to ensure the plan includes best knowledge and experience, as well as the values and priorities of citizens. We invite you to be involved and help guide decision-making on this important task.

This document is organized in three sections:

Taking the next step in implementing Canada's plan

To begin the conversation, we review where we are in implementing APM, Canada's plan for the long-term management of used nuclear fuel. Transportation of used nuclear fuel is an important component of this plan.

Discussion

To get the conversation started, we suggest beginning with the following five questions. We can add to these questions along the way as we reflect and discuss together.

1. **Basic requirements of any plan –** Requirements have already been identified by regulatory bodies. Best practice and experience also suggest some requirements. These basic requirements will need to be addressed in any plan and provide a starting point for discussion.

   Question 1: What basic requirements or factors should form the starting foundation for the APM transportation plan?

2. **Principles, objectives and key questions –** Safety is paramount. This principle is overarching to all APM activities. Other important principles, objectives and key questions for guiding decision-making may also emerge from discussion.

   Question 2: Which objectives, principles and key questions should guide development of an APM transportation plan?

3. **Ensuring we are inclusive –** Early conversations suggest that it will be important to be inclusive in designing and implementing the transportation plan. APM suggests the best knowledge and expertise should be taken into account, and a broad and inclusive approach to understanding citizen values and priorities be used to guide design and implementation. Some commitments are already in place, and discussion may suggest other opportunities.

   Question 3: How can we ensure the design and implementation of the APM transportation plan is sufficiently inclusive to ensure good decisions are made?

4. **Technical research, technology development and demonstration –** The APM transportation plan will need to be informed and supported by a robust program of technical research, technology development and demonstration. Reflection on the information we will need to support decision-making may identify opportunities to expand the program.

   Question 4: What information will we need from technical specialists to develop the plan and support decision-making?

5. **Modes and routes –** In the future, decisions will need to be made about modes, such as road and rail, and routes in developing the plan. Early discussion will help identify some initial considerations to prepare for these future decisions.

   Question 5: What factors should be considered in future decisions about modes and routes?

Next steps in developing a planning framework

In this section, we summarize the discussion questions and outline next steps to involve you in the conversation.

Helpful resources to support this conversation include the NWMO brochures *Safe and Secure Transportation of Canada's Used Nuclear Fuel*, and *Safe and Secure Transportation of Canada's Used Nuclear Fuel – Questions and Answers*. The NWMO website (www.nwmo.ca) also includes a broad range of information that may be of interest. We look forward to working with you on developing the APM transportation plan and hearing what you have to say.

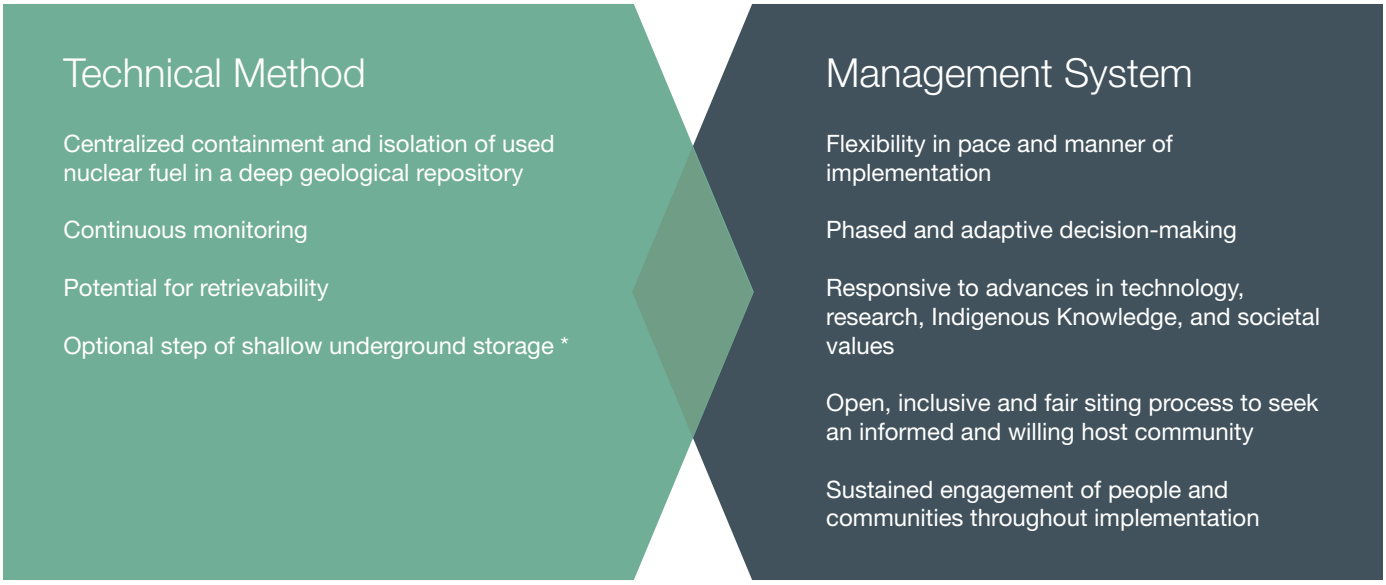
Taking the Next Step in Implementing Canada's Plan

We are taking the next step to implement Adaptive Phased Management (APM), Canada's plan for the safe, long-term management of our country's used nuclear fuel. This next step involves planning to transport used nuclear fuel from licensed facilities where it is currently stored on an interim basis to a deep geological repository where it will be contained and isolated from people and the environment for hundreds of thousands of years.

Canada's Plan

APM moves towards a goal that Canadians themselves identified: safe, secure, long-term containment and isolation of used nuclear fuel produced in Canada, with flexibility for future generations to make their own decisions, and adapt to experience and societal changes.

Canada's plan involves placing our country's used nuclear fuel in a deep geological repository in a suitable rock formation using a multiple-barrier system. A fundamental tenet of Canada's plan is incorporating learning and knowledge at each step to guide a process of phased decision-making. APM is designed to be flexible, and respond to new learning, societal priorities, and evolving public policy.



*** Temporary shallow storage at the deep geological repository is optional and not currently included in the NWMO's implementation plan.**

The development of the long-term management facility for Canada's used nuclear fuel is a national infrastructure project. The facility is to be sited in an area with an informed, willing host. The process for identifying the site reflects the ideas, experience and best advice of a broad cross-section of Canadians who participated in dialogues conducted over a two-year period.

Selecting a Site

Since 2010, the NWMO has been working collaboratively with interested communities to identify a single site where Canada's used nuclear fuel can be safely and securely contained and isolated over the long term. The initiative to begin to explore the suitability of areas has come from communities that expressed interest in learning more about the project. Their expressions of interest began a process of technical studies that identified potentially suitable study areas within and around those communities. Engagement and outreach are now broadening to include First Nation and Métis communities, and neighbouring municipalities in learning more about the project and becoming involved in decision-making.

Twenty-two communities initially came forward to learn about the project and explore the potential to host it in their area. A series of increasingly more detailed studies to assess potential to meet the project's robust technical safety and social requirements have informed a gradual narrowing-down process. Preliminary assessment studies are now focused in areas around nine of these communities.

Communities that are currently in the site selection process and requested Preliminary Assessments

- Blind River, ON
- Central Huron, ON
- Elliot Lake, ON
- Hornepayne, ON
- Huron-Kinloss, ON
- Ignace, ON
- Manitouwadge, ON
- South Bruce, ON
- White River, ON

APM Transportation

Transportation of used nuclear fuel is an important element of the APM Project. Used nuclear fuel is currently safely stored in facilities licensed by the Canadian Nuclear Safety Commission (CNSC) at or near sites where it is produced. Placing all Canada's used nuclear fuel in a single central location will require transportation from these interim storage facilities to the deep geological repository.

Canada's used nuclear fuel is a stable solid material. Transportation will involve emplacing these solid used fuel bundles in a transportation package that is specially designed to protect people and the environment during transportation, including in accident conditions. These transportation packages will be transported by road or rail, depending on the location chosen in the future for the deep geological repository.

Transportation of radioactive material is a well-established practice. There is a strong international track record in transporting used nuclear fuel safely.

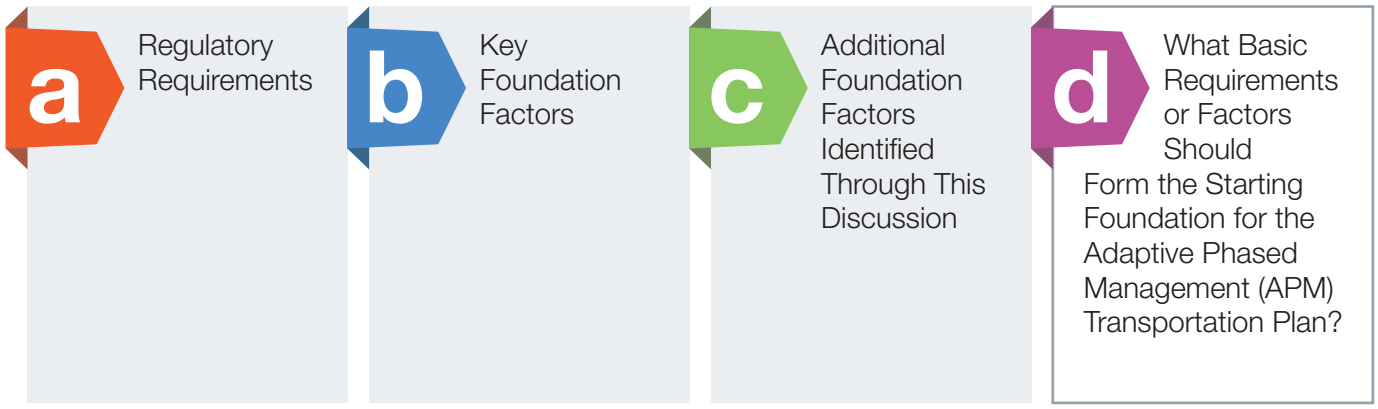
Transportation of used fuel, as will be required by APM transportation, is subject to robust regulation and oversight. The NWMO will need to demonstrate to regulatory authorities and citizens the safety and security of any transportation system before transport of used nuclear fuel to the repository can begin. APM transportation will have to meet the stringent requirements of the CNSC and Transport Canada regulations prior to obtaining the certificate for the design of the package and a licence to transport. Once a licence is issued, it will be the subject of ongoing compliance monitoring.

APM Transportation Timelines

We have time to carefully plan this phase of work. A preferred site for the repository might be identified as early as 2023. Detailed characterization of that site would then be required over several years. Once that is complete, the site would become the subject of independent regulatory review before we could proceed to construct the repository at the site. APM transportation is expected to take about 40 years to complete. It is not expected to begin before 2040.

Discussion

1. Basic Requirements of Any Plan



Collectively, we have already begun the process of establishing the plan's basic requirements, with the regulatory requirements already identified. These requirements, as understood today, are outlined in this section. They provide a starting point for discussion or starting foundation for the plan.

a Regulatory Requirements

Transportation is subject to robust regulation and oversight. Stringent regulatory requirements must be met before used nuclear fuel is transported.

Transportation of used nuclear fuel is regulated by the Canadian Nuclear Safety Commission (CNSC) and Transport Canada. Used nuclear fuel shipments will need to meet the International Atomic Energy Agency's (IAEA) requirements to ensure they are safe and secure. Transportation operations will need to meet federal, provincial, and local safety legal requirements, and will be inspected for compliance. The NWMO will need to demonstrate to regulatory authorities the safety and security of a transportation system before the shipments of used fuel can begin.

The CNSC regulates the transport of radioactive material through the 2015 *Packaging and Transport of Nuclear Substances Regulations* (*PTNSR*). The *PTNSR* are derived from the standards published by the IAEA. The *PTNSR* include a series of safety-based regulatory requirements covering the entire journey of a shipment, from the time it is initially packaged to arrival at its destination. Canadian regulatory requirements for transportation security are aligned with international standards and good practices.

Prior to transporting used fuel in Canada, the CNSC's comprehensive regulatory framework requires a certificate for the transport package and a licence to transport. The CNSC evaluates applications to ensure that safety and security measures are technically and scientifically sound, that all requirements are met, and that the appropriate safety and security provisions are in place to protect people and the environment.

Transport Canada's *Transportation of Dangerous Goods Regulations* establish requirements for worker and driver training, emergency planning, safety marks, and documentation.

Provincial governments/regulators/ministries are responsible for enforcing provincial statutes and inspection. First responders would respond to a transportation incident involving radioactive material and draw on additional NWMO, provincial or federal resources as required.

For more information about the activities involved in regulatory control of packaging and transport of used nuclear fuel, see the NWMO brochure *Safe and Secure Transportation of Canada's Used Nuclear Fuel*.

b Key Foundation Factors

Best international practice and experience suggest that many factors will be an important foundation for any plan. Four of these factors are identified below as a starting point for discussion.

- **Transportation package:** Packages used to transport used nuclear fuel from interim storage facilities to the repository must be certified by the CNSC. Radiation levels from the package must remain below regulatory limits at all times, including during a transport accident. Packages must pass a series of performance tests as specified in regulations, thereby demonstrating robustness ensuring that radioactive material is not released during transportation.
- **Radiological safety:** Packages used to transport used nuclear fuel must meet radiation level requirements prescribed by the CNSC's *PTNSR*. Regulatory requirements for the package ensure the public and workers are safe. In the event of an accident, the package must prevent a radiological release that exceeds regulatory limits. The CNSC's *Radiation Protection Regulations* have set an annual radiation dose limit for members of the public to limit exposure from nuclear-related activities.
- **Emergency response:** An Emergency Response Plan will need to be developed to ensure workers and first responders are trained before shipments can begin. The plan will need to ensure that all transportation equipment, packages, and activities for road and rail shipments meet regulatory requirements. The NWMO will need to work with local response agencies to co-ordinate planning and preparedness activities.
- **Security:** Security provisions during transportation will need to ensure CNSC regulatory requirements are met.

Indigenous Knowledge may provide additional perspectives and requirements that need to be understood and addressed from a holistic approach and in connection with the land. We are seeking insight from Indigenous Knowledge related to each of the questions suggested in this document.

An example of the holistic approach, and the breadth of knowledge and insight that could be brought to APM transportation planning is reflected in the mission statement adopted by the NWMO Council of Elders and Youth: "The Council of Elders and Youth will provide advice to the NWMO that will help protect and preserve all creation: air, land, fire, water, plants, medicines, animals, and humankind – guided by the seven universal teachings of love, trust, sharing, honesty, humility, respect, and wisdom."

C Other Factors

Building on a foundation of regulatory requirements, and best international practice and experience, discussion may identify other key factors that should be included in the foundation of this plan.

DID YOU KNOW?

To be certified, a Used Fuel Transportation Package needs to pass a number of tests.

Required tests: The certificate for the package design is based on it meeting tests that demonstrate its ability to withstand accident conditions without releasing its contents. This includes:

Free-Drop Test

The package is dropped from nine metres (30 feet) onto a flat, unyielding surface (such as a steel-reinforced concrete pad), striking the surface in the orientation that will result in the most damage to the package.

Thermal Test

The same package used in the drop and puncture tests is then subjected to a fully engulfing petroleum fire. The fire temperature must reach 800 degrees Celsius (1,475 degrees Fahrenheit) for 30 minutes.

Puncture Test

After the drop test, the same package is subjected to a one-metre (40-inch) free drop onto a 15-centimetre (six-inch) diameter steel bar at least 20 centimetres (eight inches) long.

Immersion Test

Using either computer analysis or physical testing methods, the package is subjected to external pressure that is the same as if it were immersed under 15 metres (50 feet) of water for at least eight hours to test for leakage. The package is also subjected to an enhanced water immersion test at 200 metres (650 feet) for one hour to ensure it will not buckle or collapse under extreme external pressure for an extended period of time.

What-if scenarios: The NWMO's technology development and demonstration program includes expanding the testing of the package to address a broad range of 'what-if' scenarios.

Other testing: Additional demonstration trials have been conducted over the years with Used Fuel Transportation Packages by other countries. This includes testing the package to successfully withstand being rammed by a train travelling at 160 kilometres per hour, and exploding a propane-filled railcar next to a nuclear waste transportation cask. In all tests, the transportation packages survived the demonstration intact without releasing its contents.

DID YOU KNOW?

There is a long track record in safely transporting used nuclear fuel.

Since the 1970s, Canada has transported approximately five used fuel shipments annually from nuclear generating stations to Atomic Energy of Canada Limited's Chalk River Laboratories, now called the Canadian Nuclear Laboratories.

Used nuclear fuel shipments are common in other countries, such as the United Kingdom, France, Germany, Sweden, and the United States. Over the past 50 years, worldwide there have been more than 20,000 shipments of used fuel. Great Britain and France average 550 shipments per year, mainly by rail. In the United States, used nuclear fuel shipments take place mainly by road and total approximately 3,000 shipments to date. In Sweden, approximately 40 trips by water are made between the reactor and the central storage facility each year.

There have been no serious injuries, health impacts, fatalities, or environmental consequences attributable to the radiological nature of used nuclear fuel shipments since the establishment of the IAEA transport regulations more than 50 years ago.

d

Discussion Question

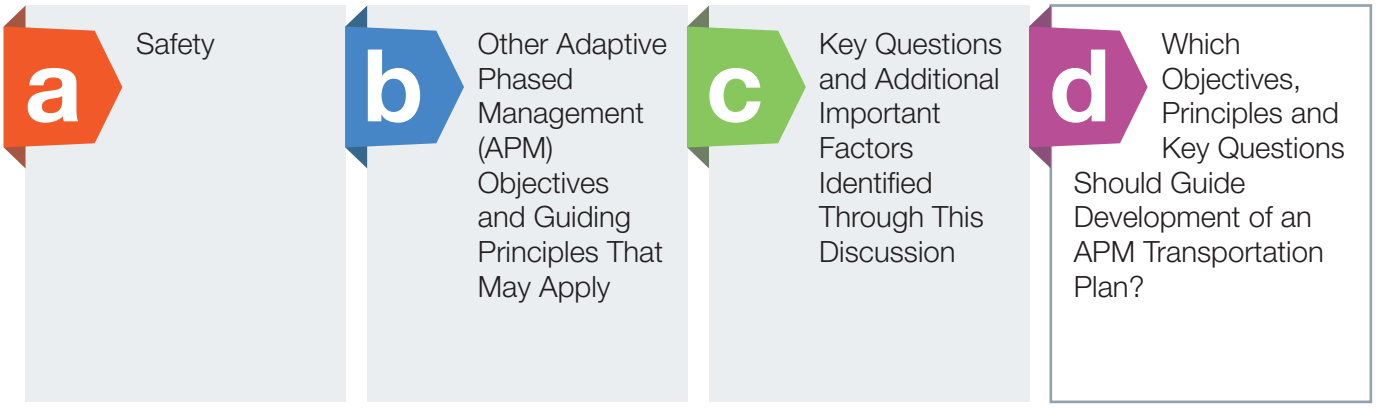
In this section, we have outlined requirements and factors that could form the foundation on which to begin to build a transportation plan. Building on this understanding, are there other factors or requirements that need to be included in the foundation for the plan?

What Basic Requirements or Factors Should Form the Starting Foundation for the APM Transportation Plan?

We might consider:

- What basic requirements should be explored?
- What Canadian and international experience should be reviewed?

2. Principles, Objectives and Key Questions



In considering objectives for APM transportation, safety is paramount and needs to be the first consideration. This principle is overarching in all APM activities. There may also be other important principles and objectives for guiding APM transportation that should be included in the plan.

This section outlines what we have heard about objectives, and guiding principles citizens have set for APM. Some of these may apply to APM transportation and are outlined here as a possible starting point for discussion. This is a list we could refine, add to or even replace based on discussion. Identifying key questions that need to be addressed may also help focus the plan.

a Safety

APM has a number of objectives, goals and guiding principles that have informed work to date. Safety is the first consideration. Any transportation plan will need to address technical factors that will acknowledge precaution and ensure protection for present and future generations – people, land, air, water, plants, and animals. Safety must not be compromised by other considerations.

b Other APM Objectives and Guiding Principles That May Apply

APM has a number of objectives, goals and guiding principles that have informed implementation of Canada's plan to date. The NWMO has also identified five fundamental values (integrity, excellence, engagement, accountability, and transparency) and an Ethical and Social Framework that inform all its work.

Building upon this framework, the following objectives and principles were identified in dialogue with Canadians during the development of APM. Some of these may apply to APM transportation, and more may be needed.

» Objectives

A set of objectives were identified through dialogue with Canadians to develop APM, Canada's approach for the long-term management of used nuclear fuel. Some of these may apply to APM transportation.

Protect public health and safety from the risk of exposure to radioactive or other hazardous materials, and from the threat of injuries or deaths due to accidents;

Protect workers from and minimize hazards associated with managing used nuclear fuel;

Ensure fairness in the distribution of costs, benefits, risks, and responsibilities;

Ensure the well-being of all communities with a shared interest;

Ensure the security of facilities, materials and infrastructure;

Ensure that environmental integrity is maintained over the long term;

Ensure economic viability of the used nuclear fuel management system; and

Ensure a capacity to adapt to changing knowledge and conditions over time.

Guiding Principles

In conversations with citizens, it was clear that the site selection process needs to be grounded in a set of principles that reflects the values, concerns and priorities of Canadians. Some of these may apply to APM transportation.

Focus on safety. Safety, security, and protection of people and the environment are central. The plan must address scientific and technical factors that will acknowledge precaution and ensure protection of people and the environment.

Meet or exceed regulatory requirements. The plan must meet, and if possible, exceed all applicable regulatory standards and requirements for protecting the health, safety, and security of humans and the environment, and respect Canada's international commitments on the peaceful use of nuclear energy.

Aboriginal rights, treaties and land claims. The plan must respect Aboriginal rights and treaties, and take into account that there may be unresolved claims between Aboriginal peoples and the Crown.

Inclusiveness. The plan must respond to and address, where appropriate, the views of those who are most likely to be affected by the plan. Questions and concerns must be heard, acknowledged and taken into account in decision-making on the plan.

Informing the process. The plan must be informed by the best relevant available knowledge, including science, social science, Indigenous Knowledge, and ethics. Consistent with the NWMO's commitment to transparency in its work, the information that is collected and used to develop the plan must be published on the NWMO website for public review and scrutiny, and be the subject of third-party review.

Ongoing engagement of governments. The NWMO must involve all potentially affected provincial governments in the development and review of the plan.

c Key Questions and Other Considerations

In potential siting areas, dialogue has begun. The safe and secure transportation of used nuclear fuel is an ongoing area of interest in conversation about the long-term management of used nuclear fuel.

Interest in understanding how used nuclear fuel can be transported safely and securely is leading to active discussion interwoven throughout the broad dialogue about the project. Through this dialogue, communities, interested individuals and groups have begun the process of exploring the basis for confidence in safety of transporting used nuclear fuel. (To learn more about what we are hearing, review the report *Transportation Themes 2014-2015: What We Heard About Transportation Planning From Working With Communities* on the NWMO website.)

Over the course of this dialogue, a basic set of questions is emerging. These questions may be helpful in focusing development of the plan.

- How will Used Fuel Transportation Packages ensure safety of people, plants, animals, land, and water along the route?
- How will we prepare for emergencies, and what will security measures look like?
- What is the risk to workers, the public, and the environment during transport and during the unlikely event of a breach of containment? How can this risk be minimized?
- What accident scenarios are being considered, and do they cover what is needed?
- What oversight, checks and balances are in place?

d Discussion Question

In this section, we have outlined objectives, guiding principles and key questions that could provide a framework for transportation planning.

Safety is paramount. This principle is overarching in all APM activities. There may be other important principles and objectives for guiding the transportation plan for APM. Identifying some key questions will also help focus the development of the plan.

Which Objectives, Principles and Key Questions Should Guide Development of an APM Transportation Plan?

We might consider:

- Which, if any, of the objectives and principles identified in dialogue with Canadians during the development of APM should apply to transportation?
- Are there other objectives and guiding principles that should be considered?
- What are the questions and concerns that need to be addressed in developing the plan?

3. Ensuring We Are Inclusive

Early conversations suggest that it will be important to be inclusive when designing and implementing the plan in order to ensure that good decisions are made. Collectively, we have already begun the process of identifying some key parties that need to be involved. For instance, Canadian law has established an essential starting point with approval required from regulatory authorities for many aspects of the plan. Independently, APM requires that best knowledge and expertise are taken into account. It also requires a broad and inclusive approach to understanding citizen values and priorities be used to guide activities. How can we ensure the design and implementation of the APM transportation plan includes the best knowledge and expertise, as well as citizen values and priorities?

a Regulatory Involvement

As a starting point, in order for transportation to proceed, the involvement of a number of organizations has been identified as required. This involvement is laid out in Canadian legal and/or regulatory requirements.

Safety needs to be confirmed by independent Canadian regulators against regulations established by the Government of Canada. These regulations are informed by international standards and recommendations, from organizations such as the International Commission on Radiological Protection and the International Atomic Energy Agency. APM transportation cannot proceed without the approval of the Canadian Nuclear Safety Commission (CNSC).

The CNSC and Transport Canada regulations cover the certification of the package design, the licence to transport, security planning, training requirements for the shipper and transporter, emergency response planning, and communication procedures. These requirements are in addition to the normal commercial vehicle and rail operating and safety regulations, and are similar to those used internationally.

b Commitments in Canada's Plan

APM requires that best knowledge and expertise are taken into account, and a broad and inclusive approach to understanding citizen values and priorities be used to help guide activities.

For APM transportation, this suggests it will be important to involve:

- A broad range of academic experts and consultants in Canada and from around the world as part of a robust research, technology development and testing program.

It also suggests that an understanding of citizen values and priorities be used to help guide the design and implementation of the APM transportation plan. This could include understanding the values and priorities of a variety of communities, individuals, and groups, and ensuring that their questions and concerns are understood and addressed. This could include:

- Interested community, First Nation and Métis communities, and surrounding communities at or near the repository site;
- Surrounding communities, First Nation and Métis communities, regions, and other jurisdictional levels potentially affected by the project and the transportation of used fuel, to help identify and assess health, environmental, social, economic, and cultural effects of the project;
- Indigenous Knowledge holders, to ensure that Indigenous Knowledge is interwoven throughout all APM decisions; and
- Interested individuals and organizations.

In considering how to ensure the plan is inclusive, the commitments made for implementing Canada's plan for used nuclear fuel may apply to APM transportation in whole or in part. They form a starting point for discussion.

c Other Considerations

Building on a foundation of responsiveness to regulatory requirements, and mirroring the commitments made in APM, early conversations suggest it will be important to be inclusive of the values and priorities of a wide variety of individuals and groups in the design and implementation of the plan in order to ensure good decisions are made. Discussion may identify other considerations in ensuring the APM transportation plan is sufficiently inclusive to ensure good decisions are made.

d Discussion Question

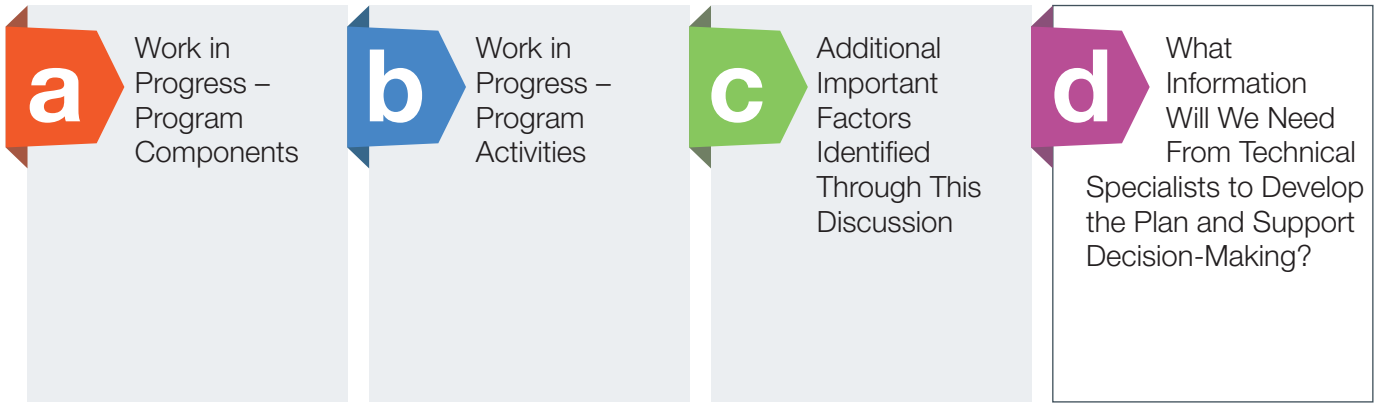
Early conversations suggest it will be important to include the best knowledge and experience, as well as the values and priorities of a wide variety of individuals and groups in the design and implementation of the plan.

How Can We Ensure the Design and Implementation of the APM Transportation Plan Is Sufficiently Inclusive to Ensure Good Decisions Are Made?

We might consider:

- Who needs to be involved in sharing values, priorities, questions, and concerns?
- What other factors need to be considered in ensuring the design and implementation of the plan is inclusive?

4. Technical Research, Technology Development and Demonstration



Planning for the safe transportation of used nuclear fuel requires involvement of a broad range of citizens and technical specialists, including Indigenous Knowledge holders. In planning for safety, and in anticipation of what may be required to address the questions and concerns that citizens and regulators will need addressed, some work is already underway to lay the foundation for transportation planning.

The NWMO's Research, Design and Development program is designed to ensure the best knowledge and expertise is available to inform Adaptive Phased Management (APM) transportation planning. The program is designed to be comprehensive; however, there may be additional questions to consider as the program advances. Now is a good time to review and add to the program to better support future decision-making.

a Work in Progress – Program Components

The APM transportation plan is expected to include many components. Research, technology development and demonstration activities will help shape each of these components.

Key components reflecting regulation and best practice identified to date include:

- A robust, tested and certified transportation package;
- A plan to meet commercial vehicle and railroad safety and security requirements;
- A Transportation Security Plan;
- An Emergency Response Plan;
- A plan for periodic reviews;
- A program for hiring high-quality and well-trained workers and vehicle operators;
- A plan for training and joint exercises with provincial and community emergency responders; and
- Procedures for safe and secure operations.

Through discussion, we might wish to consider additional components.

DID YOU KNOW?

Measuring Public Exposure

The NWMO has completed initial studies to measure the potential radiological dose to members of the public and transportation workers during the transport of a Used Fuel Transportation Package. These studies concluded that the dose to workers and the public during normal transport would be well below both the Canadian Nuclear Safety Commission (CNSC) regulatory limit and natural background radiation Canadians are exposed to on a daily basis. To read more, see www.nwmo.ca.

b Work in Progress – Program Activities

There are a number of activities the NWMO has committed to completing to support development of a plan for transporting used nuclear fuel. Through discussion, we might identify other important work areas to be added. These activities include:

- Identifying and technically assessing road and rail modes of transport and mode combinations;
- Studying and developing approaches to handling used nuclear fuel during transport, including logistics for transporting used nuclear fuel by road and rail from interim storage facilities to the siting regions;
- Assessing a set of bounding transportation accident scenarios as part of a transportation risk assessment;
- Identifying and technically assessing packaging options to ensure protection of the public and the environment during normal operations, as well as during accident conditions;
- Studying risk and approaches to controlling exposure to the public and workers;
- Identifying and designing the necessary transportation equipment and facilities;
- Outlining an approach for emergency response;
- Outlining an approach to shipment security;
- Constructing and testing all equipment required for loading, transporting and unloading used nuclear fuel transportation packages, including truck trailers and/or railcars;
- Developing updated package designs for transportation packages, with consideration of 'beyond-design-basis' scenarios;
- Reviewing and reporting on experience and best practices with transportation of hazardous materials, including transportation of nuclear waste in Canada and internationally, to identify lessons that can be applied to APM transportation;
- Completing public and worker dose assessments; and
- Securing and maintaining CNSC design certificates for road and/or rail transport packages.

c Other Important Factors

The NWMO's Research, Design and Development program is designed to ensure the best knowledge and expertise is available to inform APM transportation planning. The program is designed to be comprehensive; however, there may be additional questions to consider. Through review and reflection on the program, discussion may identify opportunities to add to it to better support future decision-making.

d Discussion Question

The APM transportation plan will need to be informed and supported by a robust program of research, technology development and demonstration. In planning for safety, and in anticipation of what may be required to address citizens' and regulators' questions and concerns, some work is already underway to lay the foundation for transportation planning.

The technical work program has been developed to facilitate a discussion about transportation safety, to test and demonstrate safety, and to build broad confidence before APM transportation can begin.

There may be additional questions this program could address. Now is a good time to review and add to the program to better support future decision-making.

What Information Will We Need From Technical Specialists to Develop the Plan and Support Decision-Making?

We might consider:

- What information and technology demonstration do we need from technical specialists to ensure we make good decisions?
- What research, technology development and demonstration activities should be considered?
- How can technical specialists best support development and implementation of the plan?

5. Modes and Routes

a Considerations Suggested by Early Citizen Discussions

b Considerations Suggested by Best Practice and Experience

c Additional Important Factors Identified Through This Discussion

d What Factors Should Be Considered in Future Decisions About Modes and Routes?

Any transportation plan for used nuclear fuel will need to provide a framework for making decisions about the method we will use (modes) and the transportation pathway we will use (routes). We may need to consider using a combination of modes, such as road and rail, depending on the location chosen for a repository. The way we use these modes as part of a transportation system, along with associated logistics, will be important, and should be designed with public preferences and sensitivities in mind.

The technical suitability of potential siting areas for the repository is still being studied. These studies will take many more years to complete, so it is too early for detailed planning. It is not too early, however, to begin to identify factors that could be considered in the future to make decisions about modes and routes to the repository location.

a Considerations Suggested by Early Citizen Discussions

Modes

The decision on the preferred mode for the transportation of used nuclear fuel will need to factor in the location of the site that is ultimately selected to host the repository. While we are several years away from identifying a preferred site, we could begin to identify factors that will be important to consider when we are ready to select modes.

In 2014, the NWMO engaged Environics Research to conduct focus groups with a cross-section of citizens. During these sessions, participants identified a number of factors to consider in transportation planning related to modes. These factors are briefly described here as a starting point for discussion. When considering each mode of transportation, participants identified the following as important considerations:

- The number of times used nuclear fuel would be handled during the process, especially if multiple modes were used;
- The extent of contact of used fuel with the general public;
- Ease of access to the used nuclear fuel and package if an accident were to happen;
- The ability to minimize risk; and
- International experience and track record with transport by each mode.

b

Considerations Suggested by Best Practice and Experience

Routes

The NWMO has begun to reflect on the potential to identify or develop alternative transportation routes for the safe and secure transportation of used nuclear fuel from locations where it is currently stored to each of the areas under study for the deep geological repository. After review of Canadian and international best practice and experience, the NWMO identified a list of considerations for both road and rail transport to use in early assessments of each area. These considerations provide a starting point for discussion.

Transporting by Road

1. Is there a continuous public road system connecting the interim storage facilities to the community? Is this road system capable of supporting an average of two heavy trucks per day for the duration of the transportation program?
2. Are there design, operating or structural deficiencies that would limit the use of a segment of the roadway system by heavy trucks (e.g., weight limits for bridges, or narrow lanes)? If so, is there a transportation improvement program in place to address those deficiencies?
3. Are there two or more serviceable routes providing access from the interim storage facilities to the community? If not, is a second route planned?
4. Are there travel limitations regarding use of the roadway by heavy trucks due to reoccurring weather or seasonal conditions?
5. Are there emergency response resources for those roadways that provide access from the Canadian national roadways to the community? What are their capacities?

Transporting by Rail

1. Is there a continuous rail system connecting the interim storage facilities to the community? Is this system capable of supporting an average of one multi-car train per week for the duration of a long-term shipping program?
2. Are there design, operating or structural deficiencies that would limit the use of a segment of the railway system by heavy trains (e.g., weight limits for bridges, track condition, sharp curves, or steep grades)? If so, is there a plan in place to address these deficiencies?
3. Are there two or more serviceable routes providing access from the interim storage facilities to the community? If not, is one planned?
4. Are there travel limitations regarding use of heavy cars on the railway due to reoccurring weather or seasonal conditions?

Photo courtesy of World Nuclear Transport Institute

DID YOU KNOW?

Early studies suggest potential for safe transportation to each of the study areas.

Early assessments have been completed for all areas currently involved in the site selection process. These assessments focused on the question, "Can a transportation route be identified or developed for the safe and secure transportation of used nuclear fuel to the site from the locations at which it is stored?"

These assessments considered the factors listed in this section and included two major components: a description of regulatory oversight, including how the requirements are being met by the current program; and a desktop analysis of transportation logistics assuming available transport infrastructure.

The assessments found there is strong potential to meet these requirements for each of the areas. These findings are based on a preliminary review of existing roadways and railways. It assumed that the necessary connecting road, railway, and intermodal infrastructure would be constructed, thereby providing access from existing transportation infrastructure to the repository. It also assumed that improvements, if required, to the transportation and intermodal infrastructure would be reviewed in the next phase of more detailed studies.

These early assessments showed there is a robust technical safety case for the safe and secure transport of used nuclear fuel to each of these areas. Engagement of surrounding communities and those on potential transportation routes as a large group with a shared interest would be required to help build understanding, and address questions and concerns. Dialogue is also needed with federal, provincial, and local authorities in later phases as modes, routes, and operational details related to a future transportation system are considered.

c Other Important Factors

Any transportation plan for used nuclear fuel will need to provide a framework for making decisions about the method we will use (modes) and the transportation pathway we will use (routes). The factors identified to date and described above provide a starting point for discussion. Even at this early stage, we may be able to identify additional factors that could be considered to make decisions about modes and routes to the repository location in the future.

d Discussion Question

In the future, decisions will need to be made about modes and routes in developing the Adaptive Phased Management transportation plan. Since the technical suitability of potential siting areas for the repository is still being studied, it is too early for detailed planning. It is not too early, however, to begin to identify the factors that could be considered in the future in decisions about modes and routes to the repository location.

What Factors Should Be Considered in Future Decisions About Modes and Routes?

We might consider:

- How can we best prepare to make future decisions about modes of transportation? What factors should be considered and tests used?
- How can we best prepare to make future decisions about transportation routes? What factors should be considered and tests used?

Next Steps in Developing a Planning Framework

Canada's plan for the long-term management of used nuclear fuel, known as Adaptive Phased Management (APM), emerged from a dialogue with Canadians. The starting point for this plan is that this generation is taking responsibility for the management of the waste it has created and is not leaving it as a burden to future generations.

Canada's plan requires us all to work together to implement it. Planning for APM transportation requires the involvement of a broad range of citizens and knowledge specialists, including specialists in Indigenous Knowledge. Together, we can ensure APM transportation plans are implemented safely, and guided by the values, priorities, and sensitivities of Canadians.

We have time to develop this plan together and consider it carefully, as APM transportation will not begin before 2040. To prepare for this important phase of work, we are starting to identify the framework that should guide this planning and the information we will need from technical and other specialists to make decisions in the future.

The APM transportation plan will need to lay out clear objectives, the issues that will need to be addressed, the factors to consider in making decisions, and the means we will use to ensure the plan includes best knowledge and experience, as well as the values and priorities of citizens.

To get the conversation started, the NWMO suggests we begin with the following five questions. We can add to these questions along the way as we reflect and discuss together.

Question 1: What basic requirements or factors should form the starting foundation for the APM transportation plan?

Question 2: Which objectives, principles and key questions should guide development of an APM transportation plan?

Question 3: How can we ensure the design and implementation of the APM transportation plan is sufficiently inclusive to ensure good decisions are made?

Question 4: What information will we need from technical specialists to develop the plan and support decision-making?

Question 5: What factors should be considered in future decisions about modes and routes?

Join us at an open house or workshop in your area, visit NWMO specialists at an NWMO community office, fill out a comment form, or visit the NWMO website to learn more about this topic and upcoming events and to share your perspective.

We look forward to working with you on developing the APM transportation plan.

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

For more information, please contact:

Nuclear Waste Management Organization
22 St. Clair Avenue East, Sixth Floor
Toronto, Ontario M4T 2S3, Canada
Tel.: 416.934.9814 Toll Free: 1.866.249.6966
Email: contactus@nwmo.ca
Website: www.nwmo.ca