

Moving forward together

Planning framework for
the transportation of used
nuclear fuel

December 2021



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1. The task ahead

For more than 50 years, we have drawn power on a large scale from nuclear energy. One of the byproducts of this electricity production is used nuclear fuel, a solid material that is hazardous and needs to be contained and isolated from people and the environment, essentially indefinitely.

Used nuclear fuel is currently managed in licensed storage facilities, many of which are located at nuclear power plant sites. This storage is interim and requires active care to maintain. The concrete and steel containers that currently contain the used nuclear fuel need to be replaced every 50 to 100 years, and the buildings in which these sit need to be continuously monitored and maintained.

Canada has a plan that puts in place a long-term management approach that will safely and securely contain and isolate used nuclear fuel in a passive manner – a manner that does not require future generations to take care of a waste they did not produce or benefit from. Canadians and Indigenous peoples (First Nations, Métis and Inuit) have said it is unfair to put the responsibility for taking care of this waste on to future generations when we have the knowledge, capacity and resources to safely and securely put in place a long-term management plan today. Additionally, our dialogue with Indigenous peoples has told us that we can and should look to Indigenous Knowledge and the seven grandfather teachings as we consider how to plan for the future.

Transportation is an essential step in the implementation of Canada's plan. The used fuel must be transported from where it is currently stored today, on an interim basis, to a centralized location. While the transportation of used nuclear fuel occurs on a small scale in Canada today, the transportation of all Canada's used nuclear fuel will be a significant undertaking – one that we want Canadians and Indigenous peoples to provide input to and help us plan.

Many decisions about transportation will be technical in nature and must adhere to a strict set of regulatory requirements. That said, the Nuclear Waste Management Organization (NWMO) is committed to involving people in this process. In particular, Indigenous peoples, first responders and municipalities that have questions, concerns and an interest in helping to shape transportation plans. Indigenous voices have historically not been heard on these issues. We believe that, in particular, those voices can help guide the development of this plan, providing insights into the application of Indigenous Knowledge and how the NWMO could engage with rights holders whose traditional territory used fuel may pass through. We will also look to our Reconciliation Policy to help shape this work.

This document is based on discussions with Indigenous peoples, municipalities, first responders, citizens and civil society organizations. It describes a framework for transportation planning that is emerging, as well as a proposed implementation approach. It will be updated every three years to reflect what we are hearing from our ongoing dialogue.

Canada's plan

Canada's plan, known as Adaptive Phased Management (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 refine the approach, 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, including Indigenous and Traditional Knowledge, at each step to guide a process of phased decision-making. APM is designed to be flexible and responsive to new learning, societal priorities and evolving public policy.

Developing the long-term management facility for Canada's used nuclear fuel is a national environmental infrastructure project. The facility will be sited in an area with informed and willing hosts. Canada's plan was developed through discussions with a broad cross-section of people nationwide.

Site selection

Since 2010, the NWMO has been working collaboratively with interested communities to identify a single site where Canada's used nuclear fuel can be contained and isolated over the long term.

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 detailed studies to assess potential to meet the project's rigorous technical, safety and social requirements have informed a gradual narrowing down process.

Current work focuses on two remaining siting areas that have strong potential to meet the requirements of the project. We are advancing detailed technical and social studies, and continuing dialogue with First Nation, Métis and municipal communities in these areas to support learning about the project and a process of shared decision-making.

We expect to select a single, preferred site in 2023.

Partnership

We are implementing the site selection process using a partnership approach. Engagement, dialogue and collaboration help ensure that any community and area that is selected to host this facility is both informed about the project and willing to host it.

Ultimately, the preferred repository site will be one that can safely and securely contain and isolate used nuclear fuel for the time period required. Our approach to partnership is grounded in Reconciliation – where municipalities and Indigenous communities have mutual respect for each other. The project will only proceed in an area with informed and willing hosts, where the municipality, First Nation and Métis communities, and others in the area are working together to implement it.

Transportation

Transportation of used nuclear fuel is an important component of APM. 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 location will require transportation from these interim storage facilities to the deep geological repository.

Transportation will involve placing 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 and/or rail, depending on the location chosen for the deep geological repository.

Transportation of radioactive material is a well-established practice with a strong track record of safety. Transportation of used nuclear fuel is subject to stringent regulation and oversight. The NWMO will need to demonstrate to regulatory authorities the safety and security of any transportation system before transportation to the repository can begin. We have also committed to demonstrating social safety to the public because the transportation of used fuel bundles will go through many traditional territories, municipalities and communities.

APM transportation is expected to begin in the 2040s and take about 50 years to complete.

A few facts at a glance

- Used nuclear fuel is a byproduct created when nuclear power plants generate electricity. It remains radioactive for a long period of time, and must be contained and isolated from people and the environment, essentially indefinitely. Used CANDU nuclear fuel (the fuel used by Canadian reactors) is not a liquid or a gas – it is a solid. It is not flammable, fissile or explosive.
- As of June 30, 2021, Canada had approximately 3.1 million used fuel bundles in temporary storage. If Canada's existing reactors operate to the end of their planned lives, including planned refurbishment, the inventory of used fuel that will need to be shipped to the repository could be about 5.5 million bundles.
- Canada's plan was developed for managing only Canada's used nuclear fuel. No used fuel from outside Canada will be placed in the APM repository.
- There is a great deal of experience in the safe movement of used nuclear fuel and other radioactive material both in Canada and around the world. In over 50 years, there have been more than 20,000 shipments worldwide of used nuclear fuel using road, rail and water transport without serious injuries, health impacts, fatalities or environmental consequences attributable to the radiological nature of the shipments.
- When the repository begins operation many years from now, used nuclear fuel will be delivered to the repository site at a rate that allows it to be placed in the repository as it is received.
- The transportation program may involve use of roadways, railways, or a combination depending on the site selected to host the repository.
- The transportation program is expected to extend over approximately 50 years or more, based on current anticipated volumes from nuclear facilities. If an all-road approach were taken, this might involve about 620 truck shipments each year, approximately one to two shipments per day. If an all-rail approach were taken, this might involve about 60 train shipments each year, approximately one shipment every six days.

2. A shared vision

Planning and implementing the transportation program is an important component of APM, one that requires a shared vision. During the past several years, the NWMO has been leading a dialogue with interested individuals, organizations, and municipal, First Nation and Métis communities to develop a framework to support this planning. A shared vision has emerged from these conversations.

The NWMO has been part of thousands of conversations as part of the process of learning about and reflecting on the transportation of used nuclear fuel and requirements of any socially acceptable APM transportation plan. People have often begun conversations by expressing fear, concern and opposition to even engaging in the discussion. We often heard, “No one asked my permission to create this waste in the first place,” “Dump it in your own backyard!” and “You are talking about a mobile Chernobyl.” As we acknowledge and begin to address these concerns, we see a shared vision forming that requires a deep respect for all people and the land we all share.

We have heard people reflect on our shared responsibility as a society for managing the used fuel we have created. When people begin to learn about our technical capacity to safely transport this material, and the fact that it exists today and has been around for about 70 years, often they move beyond their initial fear to then considering and addressing this challenge.

There are many aspects of a planning framework where, together, we appear to have strong agreement. There are other aspects on which we do not all agree, and these will need to be explored as transportation planning progresses. However, our many areas of agreement form a strong foundation to begin planning and continue those discussions.



3. The framework

The planning framework depicted below is built around objectives, principles and criteria shared by a broad cross-section of Canadians and Indigenous peoples through dialogues over the course of 2018-21. These areas of common ground are the starting point for the framework.

Underlying this discussion, we heard a strong commitment to the importance of successfully implementing Canada's plan, including the transportation program, and acknowledgment that hard work will be needed to engage broadly and find a way to work together. People shared their thoughts about the challenges they see ahead, which will require us to work together over the coming years to develop ways to address them. A strong framework of objectives, principles and priorities will help guide this collective work as we advance planning.



a. Basic requirements: What needs to be considered in transportation planning?

The plan is focused on several key areas that reflect the perspectives of Canadians and Indigenous peoples as shared through dialogue and form the foundation for the plan.

Safety is first and foremost on this list and must consider the public, workers and the environment.

Beyond ensuring safety, preventing, or if not possible minimizing, impact on the environment, including protecting water as the foundation for all life, is a requirement.

Planning for, and addressing, threats to security and potential emergency scenarios, and adopting best practices for training, monitoring, tracking, and auditing is a requirement.

Ensuring that the program is both adaptable and sustainable given the long duration of the transportation program is a requirement.

Communication is also a requirement as people have a basic 'right to know' about Canada's plan and the transportation program. Proactive communication is required to build awareness and confidence in the program. This communication will need to be balanced by an understanding that some details must be kept confidential for security reasons.

Engaging communities affected by the program is also a requirement, especially concerning the planning and construction of new infrastructure and facilities associated with the program.

In the spirit of Reconciliation given historical wrongs in Canada's history and a desire to build more positive relationships going forward, special consideration needs to be given to including and involving First Nation and Métis communities that may be affected by the program.



Safety is the primary consideration

Safety needs to be the first consideration. We need to consider the public, workers and the environment.

Protecting the environment

We need to ensure that the plan prevents, and where not possible, minimizes and mitigates impact on the land that is our shared responsibility. The protection of water is important as it is the life source upon which every person, plant and animal relies.

Emergency response planning

There needs to be advance planning and preparation for potential emergency scenarios, both through technical study and putting in place a program to support first responders along the route.

Drawing on international lessons learned

We need to ensure that Canada's transportation plan for moving used nuclear fuel is informed by the best available knowledge and expertise.

Monitoring, tracking and auditing

Keeping track of the used nuclear fuel at all times throughout the transportation program is essential. This includes keeping track of containers, evaluating and auditing procedures and processes, and holding people accountable.

Communication, education and engagement

People, particularly those living in communities along the route, have a 'right to know' about the project. It is important to proactively provide easily understandable information, and address questions and concerns in order to proceed.

Considering infrastructure

Collaboration with transportation system owners is anticipated to address safety and service gaps along primary and alternative transportation routes.

Respectful relationship with First Nation and Métis communities

Respecting Indigenous peoples' relationship to the land and working to acknowledging the knowledge that can be shared through respectful dialogue with First Nation and Métis communities.

Security

We need to plan for and address possible threats.

Ensuring that the plan is adaptive

Considering the transportation program will extend over several decades, the plan needs to be able to accommodate changes in science and technology.

Training

Because used nuclear fuel is very hazardous, the highest standards must be met in areas such as employee qualifications, security screening, training, and certification.

Ensuring program sustainability

Given the long-term nature of this project, a solid financial and political foundation will be important for the sustainability of the program required to complete it.

b. Objectives and principles

The objectives and guiding principles for planning are designed to reflect the perspectives of Canadians and Indigenous peoples that emerged through dialogue. These objectives and principles build on the basic requirements.

Planning objectives

Protect the public and workers: Eliminate or mitigate hazards associated with the transportation of used nuclear fuel. Safety and security form the umbrella under which all other objectives and principles must be considered. Safety includes protection of the public, workers and the environment from potential hazards associated with managing and transporting used nuclear fuel.

Security: Ensure the security of facilities, materials and infrastructure. Security is intimately related to safety but must be considered separately. The risk of malicious threat must be considered, factored into planning, and addressed in order to ensure public confidence. The plan must ensure the security of facilities, materials, infrastructure, workers, and the public, including consideration of cybersecurity, while transporting used nuclear fuel.

Protect the environment: Ensure that the environment is protected. We need to understand our potential impact on the environment and put in place plans to mitigate it. This includes risks to the environment through “spills,” greenhouse gas emissions (carbon footprint associated with transporting the fuel) and other impacts (e.g., from improvements to transportation infrastructure). Events such as forest fires, snowstorms and tornadoes that could impact transportation also need to be considered. Protecting water is very important.

Relationship with First Nation and Métis communities: Build respectful relationships with Indigenous peoples. Working positively and respectfully with First Nation and Métis communities, and understanding their unique perspectives, values and priorities is considered of utmost importance. The plan must also respect the constitutional rights of Indigenous peoples, reflect treaties, and consider that there may be unresolved claims between Indigenous peoples and the Government of Canada.

Project finances: Ensure economic sustainability of the project, without compromising safety, security and the environment. There must be financial surety in place in order to be confident that the full transportation program will be completed, and over time, safety will not be compromised because of lack of funds. This includes a secure source of funding, and confidence there is sufficient funding to avoid the need to increase electricity rates and/or taxes in the future to cover costs.

Guiding principles

Safety: Safety should be the overarching principle guiding all APM planning and activities. Safety, security, and protection of people and the environment are central and must not be compromised by other considerations.

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

Transparency and trust building: Information used to make decisions about transportation planning must be readily available to the public. The NWMO must be transparent in its approach to its work, including its interaction with the public (e.g., in communicating potential risks). Transparency is understood to be key to gaining public trust, and therefore, advancing the program. Information used to make decisions about transportation planning must be made public and readily available (e.g., transportation package certification, selection of transportation mode).

Balancing adaptability and continuity: The transportation plan needs to be flexible to continuously incorporate new learning, while maintaining continuity throughout changes in government. The planning framework must ensure that the transportation plan is flexible enough to continuously incorporate the latest and best science and technology, and provide continuity throughout the project; particularly with respect to project finances and changes in government. The program must be able to respond to changes in the regulatory framework, technology or infrastructure.

Evidence-informed decision-making: The plan must be informed by the best relevant available knowledge. This includes science, social science, local knowledge, Indigenous and Traditional Knowledge, and ethics. Knowledge holders in these areas need to be part of decision-making and involved in the process.

Incorporating Indigenous and Traditional Knowledge: Ensuring the insight from Indigenous science, Traditional Knowledge and ways of life is interwoven throughout is important for a strong plan. This includes knowledge about the land and ecology. It includes knowledge about developing and maintaining effective and meaningful relationships. Finally, it includes looking to the seven grandfather teachings for guidance as we plan for the future.

Responsible project management: The plan must be managed in a fiscally responsible way so that the cost of the project does not become a burden to current ratepayers or future generations. This will also provide confidence that future safety will not be compromised for cost considerations.

Informing and engaging: People, particularly those living in communities along the route, have a 'right to know' about the project and feel confident in its safety. It is important to proactively provide easily understandable information, and address questions and concerns, in order to proceed. Information needs to be provided at multiple levels of detail, from short descriptions that are easily understood by a lay audience to detailed technical reports for those who wish to review the findings in more depth.

c. Ensuring safety

The approach to safety is necessarily a holistic one that considers the public, workers and the environment (e.g., delicate ecosystems, animals, plants, water, and air). One Indigenous participant captured this sentiment in saying that he doesn't make a distinction between nature and people. So if one is hurt, all are hurt; we are all part of nature. This understanding of the need to 'look at the whole' was echoed in various ways by many people across the many discussions and appears to be a fundamental underpinning and point of agreement.

The holistic approach takes into account both radiation and non-radiation related impacts. For instance, measures need to be taken to protect people and the environment from the release of radioactive materials, and also from other impacts associated with the transportation program such as greenhouse gas emissions. The potential for injury from conventional traffic accidents, which may be influenced by the poor state of some roads, must also be taken into account. Similarly, the risk of public inconvenience must be considered, for instance the potential for used nuclear fuel transportation to impact the flow of traffic, to slow traffic or contribute to traffic congestion, detours, wear and tear of roadways, and road closures.

Science, including Indigenous science, and evidence-based decision-making in the development needs to play a prominent role in planning. Technical specialists have a role to play in helping to build awareness and understanding of the program and broad public confidence in safety and readiness to proceed.

Three key streams of work are important to establishing safety:

- » Ensuring a strong scientific and technical foundation for the plan to ensure best knowledge and expertise informs the plan;
- » Ensuring a comprehensive testing program; and
- » Ensuring a strong program of regulatory oversight and review, being able to meet or exceed regulatory requirements, and having a strong emergency response program in place.

This needs to include work to address the sensitivities and concerns of First Nation, Métis and municipal communities with respect to the science behind the plan. In the case of container testing, this needs to include consideration of the lived experience of people with direct knowledge and experience with the transportation routes.

Being assured there is stringent container testing will be particularly important. This includes an understanding of the testing already conducted to date, as well as using the Canadian used fuel transportation package in a series of new and contemporary testing. This needs to explicitly address transportation logistics during standard and extreme weather events (e.g., snowstorms, forest fires, tornadoes) and factor these into assessment and planning.

Ensure strong scientific and technical foundation for the plan

A strong scientific and technical program needs to address regulatory requirements and reflect best practices. The technical program needs to provide:

- A 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 regular 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.

Program activities must include:

- Identifying and technically assessing road and rail modes of transport and mode combinations;
- Developing approaches to handling used nuclear fuel during transport, including logistics for transporting used nuclear fuel from interim storage facilities to the siting regions;
- Assessing risks associated with a range of transportation accident scenarios;
- Identifying and technically assessing transportation package options to ensure protection of the public and the environment during normal operations, as well as accident conditions;
- Studying risk and approaches to controlling exposure to the public and workers;
- Outlining an approach for emergency response and 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 package designs for transportation packages, considering scenarios based on local knowledge and/or experience;
- Reviewing and reporting on experience and best practices with transportation of hazardous materials; internationally, to identify lessons that can be applied;
- Completing public and worker dose assessments associated with various package designs and scenarios for licensing review, as well as develop a program of ongoing monitoring and testing once transport of used nuclear fuel begins; and
- Securing and maintaining CNSC design certificates for road and/or rail transport packages.

Comprehensive testing program

Comprehensive testing of the container, and broadly sharing the results of this testing, is important for public confidence in safety. The testing program must address a range of scenarios.

Used nuclear fuel transportation packages must be designed and tested to ensure protection of the public during normal operations, as well as during accident conditions. Testing must be conducted to ensure the package can survive all plausible accident scenarios without releasing its contents. It builds confidence that these tests are conducted in sequence to simulate stresses that would cause the most damage to the package and total cumulative effects. As planned and as required by regulatory authorities, tests need to include the following:

- 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.
- 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.
- 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.
- 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) to test its ability to withstand extreme external pressures.

Beyond these tests, a broad range of accident scenarios must be considered, scenarios that mirror the lived experience of people who regularly travel these routes. These scenarios include:

- Train derailments in remote areas with limited access;
- Road or rail accidents resulting in the transportation container falling from a bridge over nine metres, similar to bridges in the area;
- Accidents resulting in the transportation container falling down a steep rock-face into a water source;
- Accidents where the entire vehicle rolls down a steep rock-face;
- Accidents involving fires burning at higher than 800 degrees Celsius or for a longer duration, for instance in a remote location in the midst of a forest fire;
- Road accidents involving a head-on collision with another truck carrying dangerous goods;
- Accidents resulting in the transportation package being under water for longer than eight hours, for instance in a remote location with retrieval challenges; and
- Train derailment with other dangerous goods in the vicinity, such as the Lac Mégantic and Mississauga train derailment disasters.

Meet or exceed regulatory requirements for safety and emergency response

Meeting, if not exceeding, stringent regulatory requirements is important for public confidence in safety. There is a responsibility to build broad awareness of these requirements, as well as shared work that demonstrates the APM transportation program's ability to meet or exceed them. This includes the three areas detailed below, as understood by the NWMO.

Safety: Packages used to transport used nuclear fuel from interim storage facilities to the repository need to be certified by the CNSC. Radiation levels from the package need to remain below regulatory limits at all times, including during transportation accidents. In order to confirm that the transportation package will do its job, packages must pass a series of performance tests specified in the regulations to demonstrate their ability to restrict loss of contents and to provide adequate shielding.

The safety of the transportation vehicle must also be demonstrated. Transport Canada, the entity that regulates the transport of dangerous goods, has a number of checks and balances to ensure that transporters adhere to a strict set of standards that a) are meant to prevent accidents (e.g., driver training requirements); and b) provide clear direction on how to manage accident scenarios (e.g., emergency planning requirements).

Security: Security provisions during transportation need to meet CNSC regulatory requirements, including the development and implementation of a transportation security plan. Components of a security plan are expected to include:

- A complete description of the material being transported;
- Threat assessment to identify any credible threats;
- Description of mode of transportation;
- Proposed security measures (e.g., escorts or continuous tracking);
- Communication arrangements between the NWMO and the carrier along the route;
- Response arrangements between the NWMO and any policy/response forces;
- Primary and alternatives routes; and
- Provisions for stopover during transport.

Emergency response: Emergency response planning requirements will need to be met, ensuring workers and first responders are trained before shipments can begin. The NWMO will need to work with local response agencies to co-ordinate planning and preparedness activities before transportation can begin.

Although existing supports are available (e.g., Canadian Transport Emergency Centre) and training covers incidents involving dangerous goods, including radioactive material, access to training can be budget-dependent. The NWMO needs to work with first responders along transportation routes to understand specific information and training requirements, and ensure that all parties have appropriate information, resources, training, and a clear understanding of roles and responsibilities in the event of an accident.

d. Protecting the environment

Ensuring that the plan protects the environment and mitigates any impact where they cannot be eliminated is important. This includes consideration of both radiation-related and more conventional impacts on the environment.

The release of radioactive material into the environment needs to be eliminated, and where not possible, mitigated and minimized. People are concerned about potential for an accident or act of terror to cause used nuclear fuel to enter the soil, water and/or contaminate the air. The plan should include measures to prevent environmental damage, as well as ensure that specialized resources and response mechanisms are in place to mitigate and repair damage to the environment should an incident occur.

The plan needs to also take into account and minimize more conventional impacts over the course of day-to-day transportation operations. Specifically, greenhouse gas emissions from trucks or trains and disturbance to sensitive areas from road or rail work that may be needed to support the transportation program.

The transportation plan must not only ensure safety by meeting or exceeding regulatory requirements, but it should also go beyond this through specifically minimizing impact of the transportation program on the environment. Seeking opportunities to incorporate green technology in day-to-day operations of the transportation program was an example mentioned by many.

The protection of water is important. Expressed in different ways by different people, the importance of water was pinnacle, as it is the life source or life blood of the earth upon which every person, plant and animal relies. People talked about the importance of larger water bodies and also streams and rivers as connectors.



Protecting the environment

We heard that the program must include:

Measures to prevent environmental damage from radiation contamination:

- These measures need to prevent or minimize used nuclear fuel escaping from the cask into the environment, including acts of terrorism and sabotage.

Measures to prevent environmental damage from non-radiological impacts:

- Greenhouse gas emissions from the vehicles used;
- Impacts that improvements to infrastructure (e.g., widening roads, building segment of dedicated rail lines, reinforcing bridges) may have on the local environment, especially around fragile habitats; and
- Impacts of conventional accidents on the environment (e.g., diesel spills).

Resources and response mechanisms to mitigate and repair damage should an incident occur:

- Emergency response plans are in place; and
- Local first responders are trained and equipped for accident scenarios.

Use of green technologies:

- Incorporating green technology as it becomes available.

We heard the following considerations are also important to take into account:

- Impact of environmental conditions along a route on safety, such as forest fires, snowstorms and tornadoes;
- Use of off-sets to make up for negative impacts on the environment (e.g., planting trees, rehabilitating habitat);
- Implementing a system of environmental monitoring of radiation and of impacts of transportation on the environment (e.g., wildlife, sensitive habitats); and
- Impacts related to the manufacturing of transportation equipment.

e. Relationship with the land

While environmental protection is key to the work that the NWMO is doing, there is much that we can learn from the land and people's relationship with the land. Through the NWMO's Reconciliation work and the conversations we have had with Canadians and Indigenous peoples, we recognize that we must listen to the important teachings given to us. In doing this, we can build trust and find ways to work together.

We are the land. The land is us. From discussions with First Nations, Métis and municipal leaders, including camp owners, hunters, harvesters, and fishers, we heard that transportation corridors are important thoroughfares used by both people and animals. Transportation corridors also pass over and connect many water bodies. We were also told that this connection to the land extends over generations, past, present and future. People are adamant that these water bodies and the land around them be protected from any harm to protect not only this generation, but also past and future generations. It will be important for the NWMO to consider these connections and look to people and ceremony for guidance on this program.

Fundamentally, it will be important for transportation planning to integrate the principles described in the NWMO's Indigenous Knowledge Policy. For example:

- » The NWMO will continue to honour spirit and ceremony as a core value within Indigenous Knowledge;
- » The NWMO acknowledges that Indigenous peoples are holders of Indigenous Knowledge, and recognizes that Indigenous Knowledge is essential and integral to decision-making processes; and
- » The NWMO understands that Indigenous Knowledge, together with western science, is part of good decision-making when built on a foundation of trust and sharing of information in a respectful manner.

Respecting the land

Our conversations with people have helped us to begin to outline what respect for the land could look like:

- Water connects all of us and the past and future generations. Water must be protected, respected and looked-to to avoid mistakes of the past (e.g., contamination of water supply from industrial activities);
- Developing a culture-centred approach to engagement will allow the NWMO to seek insight from rights holders, keepers and guardians to understand the stories of the land and how to best respect and protect it;
- The NWMO should look to ceremony to incorporate the teachings of past, present and future generations into our transportation planning;
- Consider the seven grandfather teachings as we plan for transportation together to answer the question, "How does this initiative support Mino-Bimaadiziwin ('the good life' in Ojibway)?", which was asked of the NWMO at one of our engagement sessions.

f. Being inclusive

It is important to be inclusive when designing and implementing the plan. This is important to ensuring good decisions are made. We heard this is needed to ensure the project proceeds, and that people have an opportunity to learn about transporting this material about which there are natural fears and concerns.

There is an important role for government, an important role for experts, and an important role for critics to ensure the best knowledge and expertise are applied and the plan is safe. However, safety is not in itself sufficient. People said Canadians and Indigenous peoples need to be aware and informed, and prepared to see the program implemented. They need to learn about used nuclear fuel and the ability to transport it safely. They need to become informed, be able to ask questions and have their questions addressed. Many people should be involved in this conversation, including Indigenous peoples, communities along transportation routes, communities that currently host nuclear facilities, first responders, government officials, scientists, and technical experts.

The rights of Indigenous peoples need to be respected. Beyond that, there is a special duty owed by Canadians, given past history and historical wrongs to Indigenous peoples, and this means they need a special role in planning for this type of program. This will need to be worked out over time with the First Nation and Métis communities involved. Indigenous dialogue participants talked about formal rights and Crown duty to consult and consent. We also heard from Indigenous participants about the need to focus on a culture-centred approach to engagement that focuses on rights holders, keepers and guardians in our implementation process. Through this process, there is the potential for the program to develop new ways and new relationships built on mutual respect, and seeking opportunities for collaboration, shared planning and co-creation. We have also heard that now that Bill C15 has passed, the NWMO must consider how the United Nations Declaration on the Rights of Indigenous Peoples will apply to our work.

Raising awareness, building understanding and addressing questions and concerns that people will inevitably raise appeared to be considered essential by most who engaged in the dialogue.

Building respectful relationships with communities, both municipal and Indigenous, and informing and engaging people are among the key objectives identified for the plan. Being inclusive in developing and implementing the transportation plan is important, and there was much discussion about how best to achieve this. It is important that through the conversation, people grappled with what can be practically achieved, and what is workable and justified given the need to advance Canada's plan.

After much consideration and discussion among individuals and groups in a variety of engagement and dialogue settings over the past several years, a set of principles emerged to guide our path forward. We accept that the way forward will be challenging, but with patience and time, we can and will move forward together.

Inclusivity principles and activities

Over the course of discussions, people laid out a set of principles to guide first steps:

- **Awareness and understanding:** Canadians should have some measure of awareness and understanding about the transportation plan. Building awareness and informing people is a primary goal of the plan, and conversely, people have a responsibility to participate in this learning;
- **Focus on potentially affected communities:** People who are more directly affected by the transportation program should have greater opportunity to understand the plan and to be heard. Informing people and communities along the route, including nuclear host communities, should be a primary focus;
- **Special role for leaders and first responders:** Relevant government officials, municipal leaders, first responders, and scientific and technical experts should be involved. This will help to ensure good decisions are made;
- **Right to be informed:** People have a right to be informed about the plan. Good information and a desire to be informed are important for good decision-making; and
- **Special role for Indigenous communities:** Indigenous communities need to play a role in the development of the plan. They are rights holders, keepers and guardians of the land. Given the history of continuing and past wrongs as a country, it is imperative that positive and respectful relationships be built to advance the project.

People have also outlined some key activities as a starting point

Informing people: Engaging with communities along the routes is a high priority. The objective of this engagement should be to inform residents by providing information, answering questions and addressing concerns. 'People have a right to know.' This is seen as an important NWMO responsibility.

Assuaging fear: The NWMO needs to proactively alleviate fear about the transportation of used nuclear fuel before this fear becomes entrenched. We heard that over time, there is an expectation that community engagement should be able to reassure most community residents, and the broader public, about the project and the soundness of the transportation plan. It is a responsibility of the NWMO to inform people to move them out of a state of fear.

Building relationships: Building relationships, and establishing mutual trust and respect, are important. Building relationships with First Nation and Métis communities and organizations is important to ensure Indigenous values and priorities, questions and concerns, and insight from Indigenous and Traditional Knowledge inform the plan.

g. Selecting 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. While we have not yet identified a preferred site, dialogue to date has identified factors that the public expects will be considered when we are ready for detailed decision-making.

In selecting modes and routes, first and foremost, safety and security must be the primary consideration. The pros and cons of various modes and routes must be thoroughly analyzed, and the best possible decision be made based on science, with a primary focus on safety and security. Considerations reflecting best practice and experience in Canada and internationally must be used. Local knowledge and lived experience related to specific roads and routes of people living in the area and travelling those routes must also be considered.

Many factors will need to be considered, and we heard we should look to transportation specialists to advise on how best to achieve or balance individual objectives when they may conflict.

Considerations for the selection of modes and routes

People expect best practice and experience to be taken into account in the selection of modes and routes in order to ensure safety and security. In exploring choices between modes and between routes, it will be important for them to see that factors such as the following are being considered, some of which mirror the lived experience of people who regularly travel routes in the area:

- Application of Indigenous science and local knowledge;
- Risk of accident (e.g., based on historical accident and operational data);
- Risk of security breach (e.g., relative ease of access);
- Adequacy of transportation infrastructure (e.g., quality of roads and tracks) with some indicating that much of their transportation infrastructure needs maintenance and modernization;
- Potential environmental impacts (e.g., on wildlife and surrounding terrain);
- Weather and the ability to adapt to seasonal changes (e.g., snow, ice, rain, and floods);
- Further understanding of Indigenous and local knowledge and application to transportation program (e.g., along potential transportation corridors);
- Ease of containment and access by first responders in the event of an incident;
- Analysis of the relative merits of opting for bigger loads and fewer trips versus smaller loads and more numerous trips;
- The frequency and nature of handling and transfers (particularly for worker exposure); and
- Adaptability of modes to future innovations in transportation (e.g., autonomous automobiles).

There will need to be some balancing or trade-offs between objectives. In doing so, there will need to be no compromise in safety. Transportation routes would and should be selected by experts based on a consideration of trade-offs, and pros and cons, including:

- Proximity to population centres and schools;
- Proximity to sensitive environmental areas;
- Proximity to water bodies;
- Response time for first responders/emergency response;
- Potential need to improve existing or build new infrastructure (e.g., extension of rail track);
- Conditions of the route during winter and inclement weather (e.g., days of rain and snowfall);
- Potential for traffic congestion and potential impact on commuters;
- Assessment of political and social acceptance;
- Trade-off between a longer route that goes through less densely populated areas versus a shorter route that goes through more densely populated areas; and
- The need to vary routes for security reasons.

h. The framework

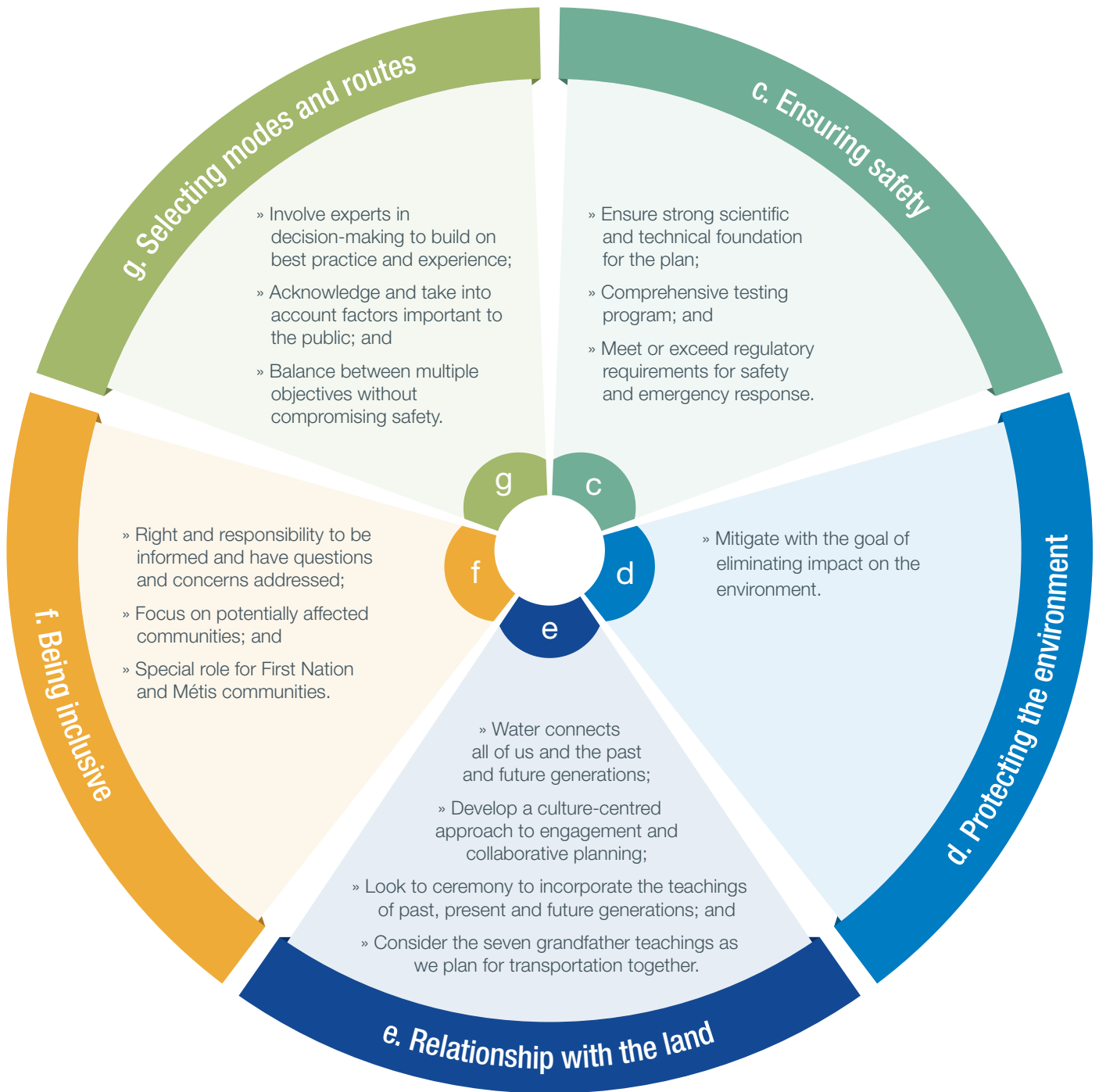
A framework of public expectations, principles and priorities for the APM used fuel transportation plan is emerging from these discussions and is outlined below at a high level.

a. Basic requirements

- » Safety as the primary consideration;
- » Protecting the environment;
- » Security;
- » Emergency response planning;
- » Drawing on international lessons;
- » Ensuring that the plan is adaptive;
- » Training;
- » Monitoring, tracking and auditing;
- » Communication, education and engagement;
- » Building respectful relations with First Nation and Métis communities; and
- » Ensuring program sustainability.

b. Objectives and principles

- » Ensuring transparency;
- » Balancing adaptability and continuity;
- » A focus on evidence – informed decision-making;
- » Incorporating Indigenous and Traditional Knowledge;
- » Ensuring responsible project management;
- » A focus on informing and engaging; and
- » Attention to project finances.



4. Proposed approach to implementing the framework

We understand we need to take an approach that embeds the framework in decision-making throughout planning and implementation of the transportation program. The approach needs to be flexible and adaptive, and it needs to continue to involve people at key milestones along the way.



In this section, we propose key elements of a potential transportation plan, or management system, for discussion. It includes:

- » A plan for working together through engagement, collaboration and shared decision-making;
- » A readiness checklist, to be used by the NWMO and the public together, to regularly assess preparations to initiate the transportation program; and
- » A road map of key milestones and steps, including collaboration and shared decision-making, putting in place a strong scientific and technical foundation for the program, and meeting or exceeding regulatory requirements.

a. Collaboration and shared decision-making

We understand from what we heard that there is a need to involve people in decision-making all along the way, to ensure the program continues to reflect the principles and objectives important to the public. Here, we outline milestones for continuing to shape and advance the plan together.

Key milestones

1. Refine the draft framework and milestones (2020-21): Dialogue and engagement to review and refine the draft framework and reflect on the proposed management system.

2. Review an initial conceptual plan (2022-23): Dialogue and engagement to review an early sample transportation plan. This plan would be general in nature, as the repository site will not yet have been selected, but could be used to further explore expectations.

3. Review and refine site-specific transportation plan (2023 until initiation of transportation): Dialogue and engagement to review an early sample site-specific transportation plan. This plan would need to continue to be refined over the years leading up to the initiation of the transportation program, but could be a basis for further exploring expectations. This might involve:

- The NWMO working with people and organizations in the initial development of the plan, such as transportation specialists (e.g., Canadian and international scientists and engineers), federal and provincial government ministries and agencies (e.g., CNSC, Transport Canada, Public Safety Canada, and provincial ministries of transportation), and Canada's nuclear power generators.
- Including First Nation and Métis communities along potential routes, as well as Indigenous organizations, in planning and helping the NWMO understand how to consider traditional knowledge and culture-centred engagement in transportation planning.
- Addressing the questions and concerns of interested communities, individuals and groups as part of the transportation planning process, including first responders along potential routes, first responder associations/organizations, municipalities and municipal associations as a group with a shared interest, and other interested individuals and groups. Communities that currently host interim storage facilities will also need to be involved in planning how used fuel is moved through their community.

4. Build awareness and communicate about plans as they are refined (2023 until initiation of transportation): Dialogue and engagement to build awareness and understanding of the APM Project and transportation plan, and confidence in safety. We heard this is a critical component of any plan, and it will take time and effort to accomplish this. This may include activities such as face-to-face discussion and facilitating a dedicated virtual space for learning about the plan, asking questions, hearing from transportation specialists, and addressing frequently asked questions and concerns on an ongoing basis.

5. Monitoring and adapting (2023 onwards): Ongoing review of evolving best practices, new and emerging technologies and standards, and reflection on the need to refine and adapt the program. Monitoring will include ongoing review of experience in implementing the transportation program once it begins, including impacts and mitigations, to support reflection and adaptation of the program during implementation.

We understand from what we heard that evidence-based decision-making is an important part of this process. We understand we need to continue to learn and build on best practices and evolving international and Canadian expertise, science and technical developments as we implement the program. We understand that transparency, auditing and reporting are key.

Here, we outline components of a potential program for reporting and continuous improvement to working together to shape and advance the plan.

Ongoing reporting and continuous improvement

We heard that ongoing reporting and continuous learning is important for the program to be able to adapt over time as needed. Ongoing reporting and continuous learning might include the following:

- 1. Monitoring and reporting on evolving best practice:** Beginning in 2023 and on a triennial basis, the NWMO publishes a report with updates on best practice, new and emerging technologies and evolving state of the art, evolving standards, and how it is adapting the program in the spirit of continuous improvement.
- 2. Monitoring and reporting on ongoing impacts and mitigations:** Once used fuel transportation begins, the NWMO monitors and regularly reports on public and environmental impacts, reportable events, and action taken in a manner that is understandable and accessible to the public. People have specifically identified that they are interested in being informed about the number of shipments and incidents in as real-time as possible.
- 3. Monitoring and reporting on project finances:** Beginning in 2023 and on a triennial basis, the NWMO publishes a report of the status of finances for the transportation program, including the project's cost and sources of funding.
- 4. Regular reporting on outcomes of engagement programs:** The NWMO currently publishes an annual *What we heard* report. The NWMO will continue to publish this document, which will describe engagement activities, questions raised, responses to those questions, and updates on the implementation of this framework.



b. Putting in place a readiness checklist

We understand there are a broad range of factors that need to be addressed before the NWMO and the public together will be ready to begin transporting used nuclear fuel as part of APM. Here, we outline our understanding of the factors and outcomes needed, in the form of a readiness checklist.

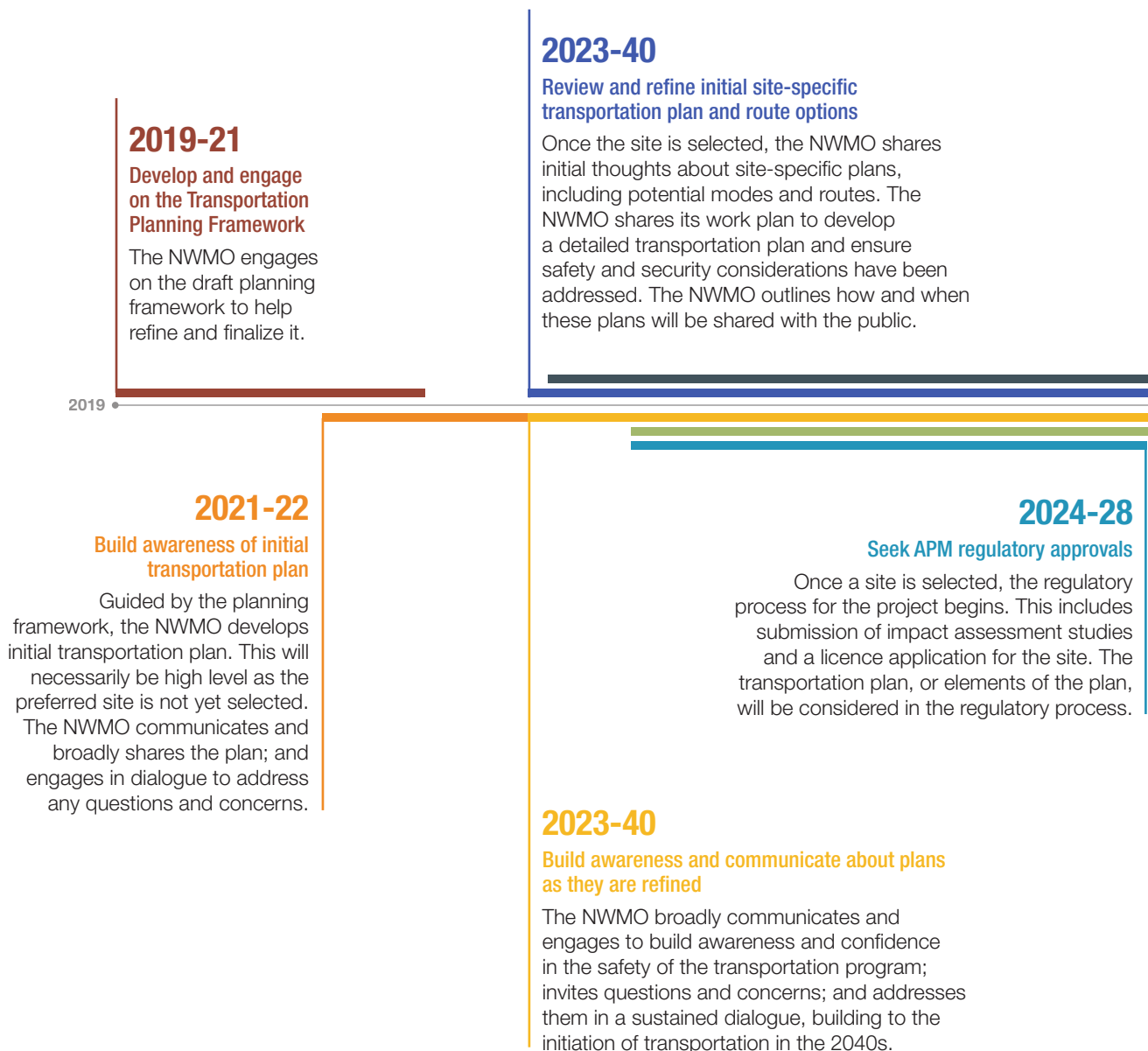
Using this checklist, we would regularly track and report on our progress in putting these necessary conditions in place. In this way, we would collectively gauge program readiness to begin with transport of the first used fuel bundle from interim storage facilities to the deep geological repository. Some of these activities will require involvement of specific parties (e.g., government, first responders). As we plan for transportation together over the next 20 years, we will further define roles and responsibilities associated with this checklist.

Readiness checklist

- A site-specific transportation plan;
- A broad-based awareness and education program for the general public and communities along the transportation route to meet the needs of different population segments (e.g., youth, elders);
- An ongoing engagement and dialogue with First Nation and Métis communities along the transportation route;
- Questions received about transportation are acknowledged, addressed and shared broadly;
- Awareness and training program for first responders along the transportation route;
- A tested and certified transportation package;
- Accident scenarios specific to transportation routes, including those that align with the lived experience of people in the area, have been covered by transportation package testing, and safety has been demonstrated;
- A transportation security plan that takes into account threats of sabotage and terrorism;
- An emergency response plan that explicitly describes resources available along the route, and roles and responsibilities, in the event of an accident;
- An environmental management or protection plan that takes into account the carbon footprint of the transportation program, and environmental response and remediation in the event of an accident;
- A confirmed plan to meet commercial vehicle and railroad safety and security requirements;
- A program for hiring high-quality and well-trained workers and vehicle operators;
- Procedures for safe and secure operations;
- A plan for regular reviews of all required plans, certifications and procedures;
- A 'safety audit' program involving ongoing physical assessment of the roads, bridges, etc. of the route, to identify structural weakness; required repairs to the infrastructure of the selected route – any required improvements or repairs would need to be done in collaboration with the infrastructure owners; and
- A program of reporting with updates on best practice, technologies and evolving state of the art, and ongoing activities to adapt the program in the spirit of continuous improvement.

c. Key milestones and steps

We understand from public discussion that we need to advance the plan through a sequence of steps, which include engagement, collaboration and shared decision-making; putting in place a strong scientific and technical foundation for the program; and meeting or exceeding regulatory requirements. This forms a basic road map to guide our working together with the public. It is important to note that all this work is in preparation for a transportation program. We will continue to talk with Canadians and Indigenous peoples about what shared planning and responsibility looks like after transportation begins in the 2040s.



2023 onwards

Ongoing review and public reporting

Beginning in 2023 and on a triennial basis, the NWMO publishes a report with updates on best practice, technologies, and ongoing adaptation and continuous improvement.

Once transportation begins, the NWMO monitors and regularly reports on public and environmental impacts, reportable events, and action taken in a manner that is understandable and accessible by the public. Ongoing public review is sought, as well as reflected on the shape and form of any refinement or adaptation to the program.

2038 onwards

Initiate capacity-building programs for first responders

Capacity building will provide support to first responders, as needed, along the route in preparation for the initiation of the transportation program and its ongoing implementation. This includes addressing skills development, equipment and service needs, which will be done prior to 2038 as part of Step 3.

• 2040

2024-40

Regulatory review

More detailed plans are developed and published to support transportation-specific regulatory oversight prior to any used fuel being transported.

The NWMO provides an emergency response plan to the CNSC, Transport Canada and the provinces, ensuring that information is available to relevant public emergency response agencies. The NWMO develops the transportation security plan.

~2040 onwards

Begin transporting used nuclear fuel to a deep geological repository

Beginning in about 2040 or so, the transportation program for APM is expected to continue for approximately 40 to 50 years, based on the current and anticipated volume of used fuel.

5. Regulatory decision-making

Canada has in place a stringent framework of regulation and oversight to review and approve transport of used nuclear fuel. Transportation of used nuclear fuel is regulated by the CNSC and Transport Canada. Used nuclear fuel shipments conducted as part of the APM transportation program will need to meet these requirements to ensure they are safe and secure. APM transportation operations will also need to meet federal, provincial and local safety legal requirements, and will be inspected to ensure compliance.

Consistent with this framework of regulation and oversight, we understand that approvals for APM used nuclear fuel transportation will be given if requirements are met. Requirements focus on the strength of the transportation package and include the following:

- 1. Transportation package:** Used nuclear fuel transportation packages are designed and tested to ensure protection of the public during normal operations, as well as during accident conditions. The CNSC, using internationally tested standards, has the responsibility for evaluating the transportation package and certifying its design, the registration of the use of individual packages, and monitoring the package maintenance process.
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. Packages used to transport used nuclear fuel from interim storage facilities to the repository must be certified by the CNSC.
- 2. Radiological safety:** Packages used to transport used nuclear fuel must meet radiation level requirements prescribed by the CNSC's *Packaging and Transport of Nuclear Substances Regulations, 2015*. Regulatory requirements for the package ensure the public and workers are safe. The package is designed and tested to ensure that in the event of an accident, the radiological release will not exceed the 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.
- 3. Emergency response and training:** Transport Canada's *Transportation of Dangerous Goods Regulations* establish requirements for worker and driver training, emergency planning, safety marks, and documentation. Transportation planning needs to address these aspects, and ensure that all equipment, packages, and activities for road and rail shipments meet regulatory requirements. The NWMO will need to demonstrate that all activities will be conducted by trained personnel, including emergency responders. The NWMO will also need to develop an emergency response plan, and ensure workers and emergency responders are trained before shipments can begin.
- 4. Security:** Security provisions during transportation need to ensure CNSC regulatory requirements are met. Security measures are aimed at preventing diversion or sabotage of the transportation package, and include a combination of engineered, physical and monitoring measures to protect the cargo, and provide for detection, alarm, recording, and communication, in the event of an occurrence.

For more information on transportation regulation and oversight, see the NWMO's brochure *Safe and Secure Transportation of Canada's Used Nuclear Fuel*.

6. Next steps



Canada's plan for the long-term management of used nuclear fuel, known as APM, emerged from a dialogue with the public. The starting point for this plan is that this generation is taking responsibility for the management of the used nuclear fuel 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. Together, we can ensure APM transportation is implemented safely, and in a manner consistent with our collective values, priorities, and perspectives.

In this document, we have reported on what we are hearing about the broad framework within which APM transportation should be planned. Building on what we heard, we also describe a flexible and adaptive approach to implementing the transportation program, which continues to involve people at key milestones along the way, responsive to what people said is most important.

This framework document will be the foundation for transportation planning going forward and will be updated on a regular basis to acknowledge the evolving nature of this planning process.

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