Implementing Adaptive Phased Management 2019 to 2023

MARCH 2019

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

The Nuclear Waste Management Organization (NWMO) welcomes all suggestions and ideas about our work and how we can help you learn more about Canada's plan for the safe, long-term management of used nuclear fuel.

Please share your thoughts on this plan by July 12, 2019. We look forward to hearing from you.

Lisa Frizzell
Vice-President, Stakeholder Relations

Nuclear Waste Management Organization
22 St. Clair Avenue East, Sixth Floor
Toronto, ON M4T 2S3
Canada

Fax: 647.259.3692
Email: learnmore@nwmo.ca
Website: www.nwmo.ca/contactus

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Vision, mission and values

Vision

Our vision is the long-term management of Canada's nuclear waste in a manner that safeguards people and respects the environment, now and in the future.

Mission

The purpose of the NWMO is to develop and implement, collaboratively with Canadians, a management approach for the long-term care of Canada's used nuclear fuel that is socially acceptable, technically sound, environmentally responsible, and economically feasible.

Values

SAFETY

We place all aspects of public and employee safety – including environmental, conventional, nuclear, and radiological safety – first and foremost in everything we do.

INTEGRITY

We act with openness, honesty and respect.

EXCELLENCE

We use the best knowledge, understanding, and innovative thinking, and seek continuous improvement in all that we do in our pursuit of excellence.

COLLABORATION

We engage in a manner that is inclusive, is responsive, and supports trust, constructive dialogue, and meaningful partnership.

ACCOUNTABILITY

We take responsibility for our actions, including wise, prudent and efficient management of resources.

TRANSPARENCY

We communicate openly and responsibly, providing information about our approach, processes and decision-making.

Welcome

Welcome to *Implementing Adaptive Phased Management 2019 to 2023*. This is the five-year strategic plan for the NWMO.

Committed to transparency

One of our primary values is transparency, and we always strive to manifest that in our implementation plans. We describe our plans as living documents because they evolve and grow stronger over time. Shaped by input from communities, advances in science and technology, insight from Indigenous Knowledge, changes in societal values, and evolving public policy, our plans are adapted and updated every year.

This plan period is the first to include our 2023 milestone of selecting and announcing the preferred site for the project. The work outlined in this plan covers both our continuing efforts to move towards site selection and also some of the work needed to move us to the next phase after that important decision is made. Your input and feedback help inform that work, and now is an important time for us to hear from you. Included at the back of this document is a summary of the comments we received after publishing last year's plan in March 2018. We invited comments until July 20, 2018.

If you would like to comment on the latest plan as outlined in these pages, please get in touch with us by mail, fax, or email, or through our website or Facebook page, any time through to **July 12, 2019**. To help you share your thoughts with us, we have included a questionnaire on the last page.

This is Canada's plan. This is your plan. We welcome your suggestions and ideas.

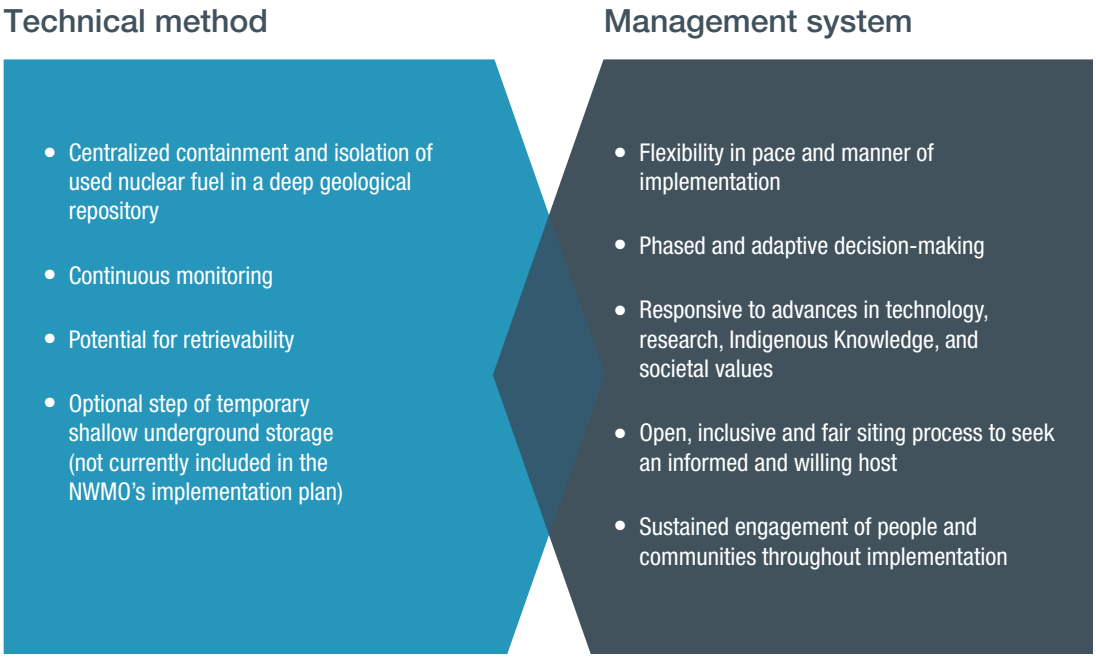
Introduction to the NWMO and our project

Canada has been generating electricity from nuclear power – to light our homes, businesses and towns – for more than half a century. A byproduct of this process is used nuclear fuel, which remains radioactive for hundreds of thousands of years, and is a potential health and safety hazard unless properly managed.

Canadians have said they want to move forward now on managing used nuclear fuel – and not leave it for future generations.

In 2002, the Government of Canada, through the *Nuclear Fuel Waste Act*, assigned responsibility for the long-term management of Canada's used nuclear fuel to the NWMO. The organization was established by Canada's major nuclear fuel waste owners – Ontario Power Generation, Hydro-Québec and New Brunswick Power Corporation – and operates on a not-for-profit basis.

Canada's plan, called Adaptive Phased Management (APM), emerged through a three-year dialogue with Canadians (2002 to 2005), including Indigenous peoples. Details of those conversations were outlined in *Choosing a Way Forward – The Future Management of Canada's Used Nuclear Fuel (Final Study)*, issued in November 2005.



In June 2007, the Government of Canada selected APM as Canada's plan for the long-term management of used nuclear fuel.

APM is a management system and technical method. The management system is based on phased and adaptive decision-making supported by public engagement and continuous learning. The technical method involves the development of a deep geological repository to safely contain and isolate Canada's used nuclear fuel deep underground in a suitable rock formation. This approach is in line with best practices established by countries that have commercial nuclear power production.

A safe and secure transportation system will be developed to transport used nuclear fuel from facilities where it is currently stored on an interim basis to the centralized site. The project also involves the development of a Centre of Expertise for technical, environmental and community studies.

This document provides an overview of the NWMO's plans over the next five-year period as we narrow our focus to one preferred site for the repository and mobilize towards the next phases of work required.

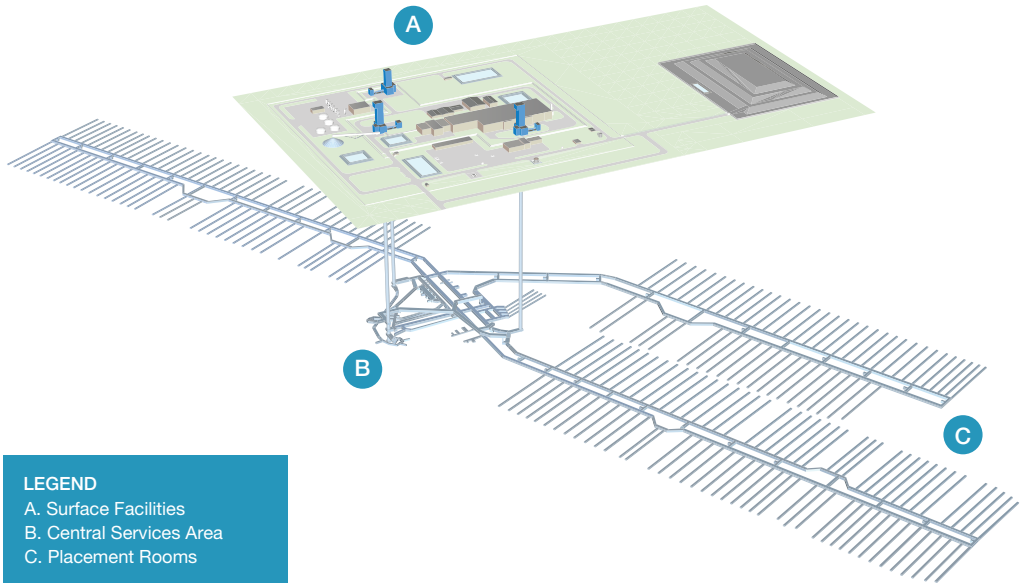
Selecting a site

Where will the deep geological repository be located? In 2010, the NWMO initiated a site selection process that is community-driven, and underpinned by safety, fairness, collaboration, and shared decision-making. Fundamental to the process is the understanding that the APM project will only proceed with the involvement of the interested community, First Nation and Métis communities in the area, and surrounding communities, working in partnership to implement it.

With 22 communities initially expressing interest in learning about and potentially hosting the project, the NWMO began assessments for suitability. A series of progressively more detailed scientific, technical and social assessments has resulted in a gradual narrowing down of potential sites. The NWMO expects to select a preferred single site for the repository by about 2023. More information about the site selection process is available at www.nwmo.ca/sitingprocess.

Key components of the repository

The deep geological repository is a multiple-barrier system designed to safely contain and isolate used nuclear fuel over the long term. It will be constructed at a depth of approximately 500 metres, depending upon the geology of the site, and consist of a series of tunnels leading to a network of placement rooms where the used nuclear fuel will be contained using a multiple-barrier system.



This diagram reflects the latest conceptual layout for the surface facilities, and the underground services area and placement rooms. This will continue to become more detailed as the project progresses.

Surface facilities will provide processes and equipment for receiving, inspecting, repackaging, and moving used fuel to the main shaft to transfer underground, as well as for emplacement in the repository.

Before being transported underground to the repository, the used fuel will be placed into specialized, long-lived containers and encased in a buffer box made of bentonite clay. Once underground, these buffer boxes are to be arranged (e.g., two high) in the horizontal placement room, and any spaces backfilled with bentonite pellets. The current conceptual design of the underground layout assumes a footprint of about two kilometres by three kilometres, but the actual required footprint will be influenced by the geological setting and the ultimate number of fuel bundles to be managed.

By the time construction needs to begin, a robust safety case will have been developed to demonstrate the project can be safely implemented, including transportation, and that it meets or exceeds the requirements of regulatory authorities.

For a more comprehensive description of the project, please see *Description of a Deep Geological Repository and Centre of Expertise for Canada's Used Nuclear Fuel* at www.nwmo.ca/backgrounders.

Centre of Expertise

A Centre of Expertise will be established on the surface, in or near the area selected to host the deep geological repository. The design and use of the centre will be developed collaboratively with those living in the area. The centre's key purpose initially will be to support a multi-year program of technical testing and verification, and to support ongoing planning and discussion with community members. It would later be expanded to support construction and operation of the deep geological repository.

The Centre of Expertise will be home to an active technical and social research and technology demonstration program. It will involve scientists and other specialists in a wide variety of disciplines, including geoscience, engineering, and environmental, socio-economic, and cultural impact assessment. The centre will become a hub for knowledge sharing across Canada and internationally.

An artist's rendering portrays one example of how the Centre of Expertise could look. The final design will be developed collaboratively with those living in the area.

Indigenous engagement

Inclusion of Indigenous perspectives is an essential element of the NWMO's work.

This is manifest in many ways as we implement the Adaptive Phased Management project, from oversight by our Indigenous Relations team, advice from the NWMO's Council of Elders and Youth, cultural awareness training for all NWMO staff and contractors, guidance drawn from the NWMO's groundbreaking Indigenous Knowledge Policy and new Reconciliation Statement, and daily engagement with First Nation and Métis communities.

Through these conduits, we learn to see with fresh eyes, respecting Indigenous peoples' spiritual connection with and responsibility for the natural environment. This includes air, land, fire, water, plants, medicines, animals, and humans. Over the next five years, we will continue to interweave Indigenous Knowledge with western science, and reflect on what we learn from ceremony and traditional teachings.

For example, water is a subject of vital importance to people. Several communities in our site selection process, particularly Indigenous communities, asked us to provide more information about how our project will protect water.

We have been working closely with these communities to tell the story of water's journey deep underground, one of many factors that is important in planning a deep geological repository.

We will continue to reach out to Indigenous peoples to gather their views and questions on water, rock, clay, and other subjects. This ongoing feedback is crucial as Indigenous and other communities consider the project in the context of their long-term interests and well-being.

Building on the Reconciliation Statement that was finalized in 2018, the NWMO is now working on a Reconciliation Policy. The policy will include an implementation strategy to measure annually the organization's progress and commitment to Indigenous peoples, both their history and future.

Members of the NWMO's senior leadership team and Board of Directors, along with the Council of Elders and Youth, signed our Reconciliation Statement during a sacred ceremony.

Cost and funding

Canadians expect that the money necessary to pay for the long-term care of used nuclear fuel will be available when needed. This expectation is being met.

The funders of this project are the major owners of used nuclear fuel in Canada: Ontario Power Generation (OPG), NB Power (NBP), Hydro-Québec (HQ), and Atomic Energy of Canada Limited (AECL). The amounts they pay are proportional to the total number of fuel bundles produced by each company.

The NWMO determines what costs can reasonably be expected to arise over the life of the project, along with a contingency for unexpected events, and to design a system that collects enough money to fund it.

The eventual cost of the project is impacted by many factors, including the volume and type of used nuclear fuel to be managed, location of the facility, surrounding infrastructure, rock type and characteristics, design of the repository, and length of time allocated to monitoring the site following fuel placement.

The existing inventory of used nuclear fuel in Canada is about 2.9 million bundles. Used fuel continues to be produced in order to generate electricity, and the eventual number of bundles to be managed will depend on factors such as the longevity and productivity of the nuclear reactors and decisions on refurbishments.

For planning purposes, our latest cost estimate is based on an expected volume of about 5.2 million fuel bundles. On that basis, the total lifecycle cost of Adaptive Phased Management (APM) – from the beginning of site selection in 2010 to the completion of the project – is approximately $23 billion (in 2015 dollars). This includes costs already paid for and also accounts for more than 160 years of lifecycle activity at the facility.

It is also important to calculate what amount is required, in today's dollars, in order to have the necessary funds in place when needed in the future. We know that the funds in place today will grow based on continued additional payments from the funders of the project and through expected investment income that will also grow over time.

The funding required (using Jan. 1, 2019, present value) to manage 5.2 million fuel bundles from 2019 onwards is $9.2 billion. Included in the $9.2 billion estimate are both pre-construction costs of approximately $2.8 billion and post-construction costs of approximately $6.4 billion.

Pre-construction work includes selecting a site for the repository, completing a detailed design, developing the Centre of Expertise, acquiring the site, evaluating environmental impacts, and obtaining a site preparation and construction licence. These costs are paid for annually by the waste owners based on the NWMO's annual budget as approved by our Board of Directors.

Post-construction costs include completing construction, transporting the used fuel to the repository, and operating, closing, and monitoring the repository. The *Nuclear Fuel Waste Act* (*NFWA*) requires that these post-construction costs must be funded through contributions to the *NFWA* Trust Funds.

As of December 2018, the total value of the trust funds was approximately $4.3 billion.

Audited financial statements of the trust funds are required to be submitted to the Minister of Natural Resources annually and posted on the NWMO's website. We will monitor the development of new reactors and new owners of used nuclear fuel, applying the appropriate principle to update the funding formula when specific circumstances arise.

The next full update of the APM cost estimate is planned for 2021.

Planning timelines

The following graphic provides a glimpse of planning estimates for upcoming milestones, and where they fall within the broader historic and future milestones of the project.

Developing Canada's plan	2002	The NWMO is created.
	2005	The NWMO completes three-year study with interested individuals, including specialists, Indigenous peoples and the Canadian public.
	2007	Government of Canada selects Adaptive Phased Management and mandates the NWMO to begin implementation.
Developing the siting process	2008 to 2009	Work takes place with citizens to design a process for selecting a preferred central site for the deep geological repository and Centre of Expertise.
Identifying a site using the siting process	2010	The siting process is initiated, with a program to provide information, answer questions and build awareness.
	2010 to 2013	Twenty-two communities initially express interest. In collaboration with interested communities, the NWMO conducts initial screenings.
	2012 to 2015	Preliminary studies are initiated to further assess suitability. Areas with less potential to meet project requirements are eliminated from further consideration.
	2015 to 2023	The NWMO expands assessment to include field studies. Areas with less potential are eliminated from further consideration.
	2017	Initial borehole drilling begins.
	2018	**Five communities remain in the site selection process.**
	2019 to 2023	Narrowing down process and subsurface studies continue.
	2023	A single preferred site is identified.
Towards construction	2024	Detailed site characterization begins. Construction of the Centre of Expertise begins.
	2028	Construction licence application submitted.
	2032	Construction licence granted (estimate).
Beginning operations	2040 to 2045	Operations of the deep geological repository begin.

Keeping abreast of the external landscape and adapting to change

The NWMO is committed to staying abreast of local, national and international developments that may either change the landscape in which we operate or impact our project directly. We continue to monitor advances in the energy sector, innovations in nuclear waste management, changes in energy and environmental policy, potential developments involving new nuclear reactor units, as well as changes in society's expectations, values, and insights.

We also regularly report on new developments. We maintain a watching brief on used nuclear fuel reprocessing and alternative used nuclear fuel management technologies, and update it annually (www.nwmo.ca/adaption). In Canada, there is an active research sector exploring new technologies such as small modular reactors (SMRs), fuel reprocessing and other types of advanced reactors. The NWMO understands that we will also be responsible for the long-term management of nuclear fuel waste from advanced reactors and SMRs. We encourage organizations developing new concepts to work with us to identify the types of fuel waste that may result. Once we have sufficient information about new types of fuel to be managed, we will determine potential impacts to repository designs and how our funding formulas can be adapted to include new entrants. We also monitor and report on potential inventories of used nuclear fuel quantities and types for implications to repository design (www.nwmo.ca/howmuchfuel).

A core principle of Adaptive Phased Management is the commitment to adapt plans in response to direction obtained through engagement activities. By way of example, we are continuing to respond to interest from stakeholders on the subjects of how water behaves in the underground environment, and how our plans can be adapted to include fuel waste that may be generated in the future as new technologies emerge.

Planning priorities

Throughout our history, we have been guided by an Ethical and Social Framework that sets out clear principles to follow when deciding our work priorities and while conducting engagement and decision-making activities. Our adherence to this framework has not wavered. In 2018, at the suggestion of our Advisory Council, the NWMO initiated work to refine the framework to ensure it more explicitly aligns with the current stage of work.

In late fall, conversations were initiated with communities engaged in the site selection process and groups such as the NWMO's Municipal Forum, as assembly of leaders with experience and expertise on municipal issues and challenges, to reflect on the framework. This conversation will continue in 2019.

Other changes to our planning include how we describe our five-year objectives. As our goals become more tangible and our view more focused, we are structuring our work plans around seven priorities – engineering, site assessment, safety, mobilization, licensing, engagement, and transportation.

In this section, we will outline our plans within these work streams.

IDENTIFY A PREFERRED SITE

Single site for deep geological repository

ENGINEERING

- Design and manufacture prototypes, and demonstrate performance of engineered-barrier system
- Develop site-specific facility designs, update lifecycle cost estimate, and confirm performance of engineered-barrier system

SITE ASSESSMENT

- Complete deep borehole testing and preliminary environmental baseline monitoring at preferred repository locations
- Develop integrated site assessments considering repository engineering, geoscience, environment, and safety assessments to support site evaluation

SAFETY

- Develop preliminary site-specific safety cases
- Maintain collaboration agreements and participate in joint international efforts as appropriate

MOBILIZATION

- Develop human resources strategy, manage gradual increase in public profile, and implement IT systems and other support infrastructure
- Advance planning for the Centre of Expertise

LICENSING

- Develop and implement licensing and regulatory approval strategy
- Conduct studies to determine changes to the natural environment, health and social well-being to support sustainability

ENGAGEMENT

- Advance engagement and field studies to narrow down the number of study areas
- Establish partnership agreements with communities
- Engage key stakeholders to seek alignment of priorities

TRANSPORTATION

- Advance engagement with stakeholders and conduct technical work to build confidence

PRIORITY: ENGINEERING

The NWMO will:

- Design and manufacture prototypes, and demonstrate performance of the engineered-barrier system (EBS);
- Develop site-specific conceptual facility designs; and
- Update the lifecycle cost estimate.

The deep geological repository is an effective way to safely contain and isolate used nuclear fuel because of the engineered barriers placed around the waste and the natural barrier provided by the rock formation in which the repository will be located.

Over the next five years, our technical program will further develop engineering designs and demonstrate their effectiveness. Physical prototypes of the long-lived repository containers will be manufactured and tested. This work will incorporate robust design practices and proven manufacturing technologies, and demonstrate the NWMO's ability to meet the rigorous requirements of the repository environment. Specialists at our proof test facility will continue to investigate manufacturing and prototype testing technologies.

In the period 2019 to 2023, the NWMO will also:

- Prepare conceptual site-specific repository designs that incorporate data collected through borehole drilling and preliminary environmental baseline investigations;
- Complete the design, fabrication, and testing of prototype repository containers, buffer, and emplacement systems;
- Maintain a prototype test and demonstration facility for engineered-barrier evaluations;
- Update the conceptual designs and cost estimate for Adaptive Phased Management as required, and initiate design and development of used fuel handling systems; and
- Arrange independent peer reviews of specific aspects and features of the engineered-barrier design, and seek reviews of the EBS testing program.

Scientists from the NWMO and Western University visit a national research facility where copper coatings are made and applied to prototype used nuclear fuel containers.

PRIORITY: SITE ASSESSMENT

The NWMO will:

- Complete deep borehole testing and preliminary environmental baseline monitoring at potential repository locations;
- Develop preliminary integrated site assessments that consider repository engineering, geoscience, environment, and safety assessment to support site evaluation; and
- Continue to develop a good understanding of regional priorities, politics and relationships with key players.

The period 2019 to 2023 will see an acceleration of activities that lead to the conclusion of the site selection process.

As increasingly detailed site investigations continue, interested communities, First Nation and Métis communities, and surrounding communities continue to reflect on the environmental, social, cultural, and economic effects of the project.

Involving people in the broader area helps ensure that a wide range of potential effects, both positive and negative, are recognized and considered. The NWMO's commitment is that the long-term well-being or quality of life of the community and area will be fostered through participation in this project.

In the technical realm, work will focus on assessing the suitability of potential sites through geoscientific and environmental evaluation studies.

The NWMO keeps provincial governments briefed on Adaptive Phased Management so they are ready to support community interest, and address inquiries about our use of Crown land, and provincial regulations and approvals. Over the five-year planning period, the NWMO expects to continue to seek provincial authorizations as required for initial borehole drilling.

In the period 2019 to 2023, the NWMO will also:

- Continue borehole drilling and expand field studies to inform the assessment of geoscientific, engineering, environmental, and safety factors, and factors identified by Indigenous Knowledge holders and communities in areas with strong potential to meet the requirements of the project; and
- Continue to narrow down the number of study areas through stock-taking of findings with communities.

Members of the NWMO's Geoscientific Data Management System team manage information from borehole samples.

PRIORITY: SAFETY

The NWMO will:

- Develop preliminary site-specific safety cases;
- Maintain active technical research programs through partnerships with industry, academia and international organizations; and
- Maintain collaboration agreements and participate in joint international efforts as appropriate.

The NWMO is committed to keeping people and the environment safe. We place all aspects of public and employee safety – including environmental, conventional nuclear and radiological safety – first and foremost in everything we do.

The preferred site for the deep geological repository will be in a rock formation with characteristics (geological, hydrogeological, chemical, and mechanical) that support the safe, long-term containment of used nuclear fuel. Repository performance must meet or exceed the regulatory expectations of the Canadian Nuclear Safety Commission.

The NWMO has prepared generic safety case studies for crystalline and sedimentary settings by applying our preclosure and postclosure safety assessment methodology. These assessments examine features of the repository system, test key safety parameters, and confirm that people and the environment will be safe in the long term under various scenarios.

In the period 2019 to 2023, the NWMO will build on this work by developing preliminary site-specific safety assessments.

The NWMO will also continuously improve technical knowledge in collaboration with international partners. We will continue to participate in the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD) to exchange information in such areas as safety case development.

Thomas Ernst, CEO of Nagra (Switzerland), and Laurie Swami, President and CEO of the NWMO, commit to co-operation between their respective organizations.

We are continuing to conduct joint research projects with international organizations and counterparts in other countries, including Sweden, Switzerland, Finland, France, Korea, Japan, and the United Kingdom. Partnering with other radioactive waste management organizations allows the NWMO to foster international co-operation on technology research and development, learn from other countries' experience, and keep abreast of developments in geoscience and safety cases for various host rock formations.

Research partnerships with universities also play an important role in ensuring the NWMO's technical work is scientifically rigorous.

In the period 2019 to 2023, the NWMO will also:

- Advance understanding of scientific aspects of the project through collaboration with universities in Canada and internationally, with the results presented in journal articles, conference papers and technical reports;
- Continue to support Canada's international obligations under the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (*Joint Convention*). Canada will next report at the 2021 convention to demonstrate it is meeting international commitments to manage radioactive waste and used nuclear fuel safely;
- Continue to partner in the installation, monitoring and analysis of experiments at the Mont Terri Rock Laboratory Project and Grimsel Test Site, both in Switzerland, along with researchers from Switzerland, France, Spain, Germany, Belgium, and the United States;
- Continue to participate in national and international conferences and workshops sponsored by organizations such as the Canadian Nuclear Society, the NEA, and the International Atomic Energy Agency, including participation in the OECD NEA's Radioactive Waste Management Committee and Integration Group for the Safety Case, the NEA's Thermodynamics Database Project, and BIOPROTA, an international forum on biosphere modelling for radioactive waste facilities;
- Continue to host an annual Geoscience Seminar to bring together researchers from academia and industry;
- Continue to support, along with the Natural Sciences and Engineering Research Council of Canada (NSERC), graduate students through the NSERC's Industrial Postgraduate Scholarships Program;
- Support and build discussion to increase the understanding of safety among community members;
- Maintain and improve safety assessment models, including the evaluation of groundwater flow, containment release and transport, and coupled thermal-hydraulic-mechanical processes;
- Further enhance scientific understanding of processes that may influence repository safety; and
- Continue to explore technical safety considerations through illustrative site-specific postclosure safety assessments of the deep geological repository.

PRIORITY: MOBILIZATION

The NWMO will:

- Develop a human resources strategy to prepare for the next phases of work;
- Increase awareness of the project among key stakeholder groups;
- Implement information technology systems and other support infrastructure; and
- Advance the planning process for the Centre of Expertise.

As the completion of the site selection process comes into focus, the NWMO is mobilizing towards the next phases of work. This plan period is the first to include our 2023 milestone of selecting and announcing the final site of our project, and future iterations of this implementation plan will take us to a planning period beyond the selection of the site.

Adaptive Phased Management (APM) is a multi-generational project that will be developed and implemented in phases over more than 150 years. The project will generate hundreds of direct and indirect jobs, and create new opportunities involving scientists, engineers, tradespeople, and others.

Once a preferred site is selected for the APM project in about 2023, there will be an escalation of activity on many fronts in the local and regional area. As a large national infrastructure project, it will result in significant economic benefits to the area, including jobs for the initiating community and region, as well as First Nation and Métis communities in the area and within the province.

To prepare for this increased activity, internally, we will ensure we have the human, organizational and information capital in place to proceed in conducting detailed site characterization, making regulatory submissions, and constructing and operating the deep geological repository. We will also be prepared to manage the opportunities and challenges that arise from an increase in public scrutiny.

The number of jobs sourced from the siting area will depend in part on the location of the repository, and the capacity of communities in the siting area and economic region. The NWMO will seek to maximize job opportunities in the local area and to build capacity in communities to secure jobs on the project.

In the period 2019 to 2023, the NWMO will also:

- Develop work plans and assess resource requirements to advance detailed site characterization, environmental assessments, engineering designs, and safety case development for the selected siting area in support of the future licensing application;
- Advance the definition of the concept and scope for the national Centre of Expertise that will be constructed in the selected siting area;
- Continue to build a stronger local staffing presence in potential siting areas and provide local contracting opportunities for the project; and
- Invest in building skills and capacity of youth and community members in the municipalities, and First Nation and Métis communities engaged in the site selection process to position them to secure jobs related to future phases of the APM project or other large projects in the area.

PRIORITY: LICENSING

The NWMO will:

- Develop and begin to implement a licensing and regulatory approval strategy; and
- Conduct studies to determine changes to the natural environment, health and social well-being to support sustainability.

The NWMO's overriding objective in implementing the Adaptive Phased Management (APM) project on behalf of Canadians is safety and security. We will have to demonstrate that the project meets or exceeds strict regulatory requirements to protect the health, safety, and security of people and the environment, while also respecting Canada's international commitments.

Thus, our site investigations and associated technical studies adhere to relevant municipal, provincial and federal requirements for the project. We keep abreast of all regulatory changes that are pertinent to the project. For example, the federal environmental assessment process is currently undergoing a change with the introduction of new legislation. As of Dec. 31, 2018, the new proposed act is still going through the legislative approval process. In anticipation of these changes, we are also updating our Environment Policy, which will include input from siting communities, both Indigenous and non-Indigenous, NWMO employees, and other interested parties.

We will continue to interact with the Canadian Nuclear Safety Commission (CNSC), consistent with the terms of a special project arrangement prior to submission of a licence application. These activities include providing briefings to the CNSC on the progress of APM implementation.

In the period 2019 to 2023, the NWMO will also:

- Develop impact assessment methodologies in collaboration with siting communities, both Indigenous and non-Indigenous;
- Develop field programs that will provide the information needed to determine the project's contribution to sustainable development in the area;
- Establish baseline environmental monitoring in potential siting areas in close collaboration with community members, as well as Indigenous Knowledge keepers;
- Work with the CNSC and other regulatory authorities to fully understand the requirements of the regulatory process so that we can account for them in our strategy;
- Work with potential host communities to define their role in the regulatory process and then facilitate that involvement so that they can participate in the process; and
- Working with communities and others, identify opportunities to enhance understanding of the local natural environment, including collaboration with Indigenous communities to interweave local traditional knowledge into assessment.

NUCLEAR REGULATORY OVERSIGHT

Implementation of a deep geological repository falls within federal jurisdiction and will be regulated under the *Nuclear Safety and Control Act* (*NSCA*) and its associated regulations. The CNSC, as Canada's independent regulatory authority, regulates the use of nuclear energy and materials to protect the health, safety, and security of Canadians and the environment; and to implement Canada's international commitments on the peaceful use of nuclear energy. The CNSC's mandate also includes the dissemination of objective scientific, technical and regulatory information to the public.

Under section 26 of the *NSCA*, activities associated with a nuclear facility can occur only in accordance with a licence issued by the CNSC. The repository for Canada's used nuclear fuel will be subject to the CNSC's comprehensive licensing system, which covers the entire life cycle of the repository, from site preparation to construction, operation, decommissioning (closure and postclosure), and abandonment (release from CNSC licensing).

This stepwise approach will require a licence for each phase of the repository life cycle. The process for obtaining a "site preparation" licence will be initiated by the NWMO. The NWMO would submit an application for a Licence to Prepare Site (and possibly construct) to the CNSC. A licensing decision by the CNSC on a repository can be taken only after the successful completion of the environmental assessment, following the process established under the *Canadian Environmental Assessment Act* (currently under review). More information about the CNSC's licensing process is available at www.nuclearsafety.gc.ca.

The transportation of used nuclear fuel is jointly regulated by the CNSC and Transport Canada.

Although the CNSC is the main licensing authority, it administers its licensing system in co-operation with other federal and provincial government departments and agencies in areas such as health, environment, transport, and labour.

PRIORITY: TRANSPORTATION

The NWMO will:

- Advance engagement with interested communities, individuals and groups; and
- Conduct technical work to build confidence in transportation plans.

The NWMO is responsible for establishing safe, secure and socially acceptable plans for transporting used nuclear fuel from the current interim storage sites to the used fuel repository.

As part of the process of selecting a site, a transportation route must be identified or have the potential to be developed. Transportation planning and evaluations must fully address regulatory requirements for safely transporting used nuclear fuel through different provinces. From a technical perspective, used nuclear fuel can be transported safely and securely with radiological safety assured through the use of robust transportation packages.

In addition to technical requirements, social and community well-being are important considerations in identifying transportation routes. Therefore, the NWMO will need to demonstrate the safety and security of any transportation system to regulatory authorities and citizens, including Indigenous communities, before transportation to the repository can begin. Transportation is an important focus of public engagement, leading to a better understanding of societal considerations.

In the period 2019 to 2023, the NWMO will also:

- Undertake transportation logistics studies and risk assessments;
- Consider road and rail transport for a variety of used fuel transportation package designs;
- Seek Canadian Nuclear Safety Commission design approval certificates for road and rail transport packages as appropriate;
- Continue ongoing dialogue in municipalities, and First Nation and Métis communities, and with municipal associations and Indigenous organizations, regarding ways to communicate about transportation plans. We will engage with communities that may be on a transportation corridor for used nuclear fuel;
- Conduct dialogue and use public attitude research to explore public understanding, questions and concerns;
- Develop a Transportation Planning Framework based on input received, and share a draft for public dialogue, refinement, and confirmation; and
- Continue review of experience and best practices with transportation of hazardous materials, including transportation of nuclear waste in Canada and internationally, to identify lessons that apply to Adaptive Phased Management.

PRIORITY: ENGAGEMENT

The NWMO will:

- Advance engagement and field studies to select a preferred site around 2023; and
- Establish partnership agreements with communities.

The NWMO continues to build and sustain relationships with interested Canadians and Indigenous peoples of Canada, and involve them in setting future directions.

During the period 2019 to 2023, engagement will focus on identifying common shared values and principles with communities to guide discussions on partnership, and developing area-specific visions for the project.

Funding and resources will be provided to support communities as they build their capacity and understanding of the project, engage in discussions with community members and neighbours, reflect on their interest in the project, and participate in discussions to explore partnership. Engagement will also include continuing to lead activities such as information sessions, briefings, workshops, community events, and open houses.

We will continue to work with the Council of Elders and Youth and the Municipal Forum. We will also work with and learn from Indigenous Knowledge holders, providing opportunities for them to share their knowledge with us. Engaging with youth is also a continuing priority given the long-term nature of the project and the need for intergenerational transfer of knowledge to support project implementation. As per a recommendation from our Advisory Council, we are also establishing an evaluation system for this youth activity to help ensure its effectiveness.

The NWMO has a number of policies and plans in place that guide our work, including our Ethical and Social Framework, Aboriginal Policy, and Indigenous Knowledge Policy. We recognize that there are Indigenous peoples in all areas of Canada where our work will take place. We acknowledge, respect and honour that Indigenous peoples – Indian, Métis and Inuit peoples of Canada – have unique status and rights as recognized and affirmed in section 35 of the *Constitution Act* (1982).

Staff from the NWMO gather input from Ignace and area residents at an open house event.

Going forward, the NWMO will continue to make investments in the well-being of communities in recognition of their participation and advancement of field activities.

In the period 2019 to 2023, the NWMO will also:

- Continue work to increase awareness among – and consider comments from – Canadians and Indigenous peoples of Canada about the implementation of Adaptive Phased Management (APM), the site selection process, the work beyond site selection, and the NWMO, and report publicly on input received;
- Work to increase youth awareness and understanding of the project and capacity for future decision-making related to APM;
- Brief Canada's nuclear host communities about progress in implementing APM, including planning for eventual transportation of used nuclear fuel from their communities to the deep geological repository;
- Develop and sustain relationships with:
  - Interested communities that chose to engage in the site selection process, First Nation and Métis communities in the area, and surrounding communities;
  - National, provincial and regional Indigenous organizations to keep them apprised of progress in implementing APM and the site selection process;
  - A range of municipal associations across provinces, in order to better understand local governments' points of view, and work with them to implement APM; and
  - Federal, provincial and local governments.
- Continue to work with potentially affected Indigenous peoples, including Indigenous Knowledge holders, in recognizing the diversity of cultures and languages, practices, and approaches within Indigenous communities; in identifying sacred areas; in understanding traditional laws, practices, and use of land; and in protecting the environment to sustain community life;
- Build on the NWMO Reconciliation Statement established in 2018 to put in place a Reconciliation Policy that will include a strategy to annually measure the organization's progress and commitment in contributing to reconciliation (please see diagram on the following page);
- More specifically define the terms "social acceptance" and "willing host," and work in collaboration with municipalities, communities, and Indigenous peoples involved in the site selection process to understand how they can be demonstrated;
- Continue to develop exhibits and other plain language communication materials and audiovisual tools to support local and area-based discussions of APM and siting; and
- Expand online engagement through our website and social media platforms.

NWMO

RECONCILIATION STRATEGY

2020 and beyond

Assess corporate reconciliation baseline and develop additional activities

Enhance human resources practices and procedures to address reconciliation

Develop an Indigenous youth strategy to include a scholarship program and recruitment strategy

Enhance procurement program to include an Indigenous strategy

2019

Publish Reconciliation Policy

Develop and deliver reconciliation training program

Develop a corporate reconciliation baseline assessment tool

Enhance sponsorships and donations program to include a focus on reconciliation

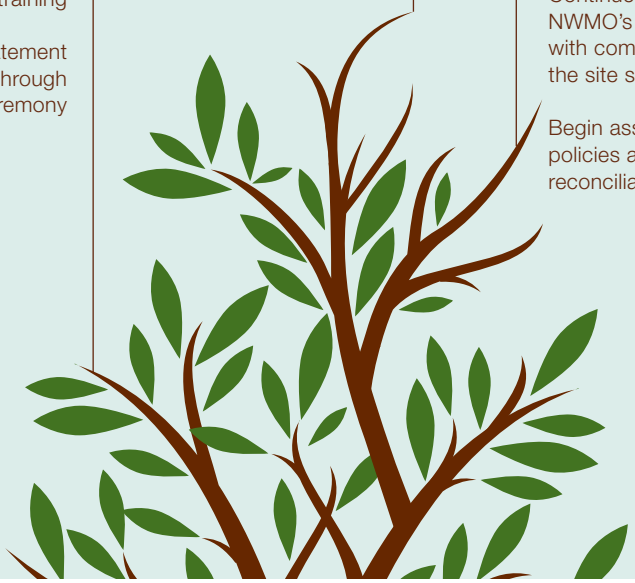
Continue to communicate the NWMO's reconciliation program with communities involved in the site selection process

Begin assessment of the NWMO's policies and procedures against reconciliation assessment tool

2018

85 per cent of NWMO staff received cultural awareness training

Reconciliation Statement finalized through Indigenous ceremony



Ensuring strong governance and accountability

The NWMO will maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of our work.

Our governance structure comprises the member organizations, Board of Directors and Advisory Council. The NWMO is subject to the requirements of the *Nuclear Fuel Waste Act* (*NFWA*) and oversight by the Minister of Natural Resources.

MEMBERS

Ontario Power Generation, New Brunswick Power Corporation and Hydro-Québec are the founding members of the NWMO. The Membership Agreement and bylaws set out member roles and responsibilities in supporting the objectives of the *NFWA* and the NWMO's implementation mandate. The NWMO regularly briefs our member organizations.

BOARD OF DIRECTORS

The Board of Directors is responsible for oversight and taking a leadership role in developing the corporation's strategic direction. The members elect the Board of Directors. There are currently nine directors on the Board, representing a range of perspectives from both within and outside the nuclear industry, including capabilities in Indigenous culture and financial management.

ADVISORY COUNCIL

The *NFWA* requires that the Board of Directors appoints an Advisory Council to review and comment on the NWMO's work. The Council meets regularly with the NWMO's senior management, closely following the organization's plans and activities, and providing ongoing counsel and advice.

Advisory Council members represent a broad range of expertise, including engineering, community engagement, public affairs, environment, sustainable development, law, Indigenous relations, Indigenous Knowledge, and community-based research. This group of individuals is knowledgeable in nuclear waste management issues and experienced in working with citizens and communities on a range of public policy issues.

MANAGEMENT SYSTEM

The NWMO operates using an integrated management system for activities supporting the long-term management of nuclear waste. As part of our plan to ensure safety, excellence and accountability in governance, the organization maintains certifications to ISO 9001:2015 for quality, ISO 14001:2015 for environment, and CSA Z1000:2014 for health and safety management.

In addition to maintaining conformance to these standards, the NWMO's management system is augmented to meet CSA N286-12 Management System Requirements for Nuclear Facilities, which includes nuclear waste facilities. The NWMO's integrated management system ensures the organization is well equipped to implement our vision. The focus on safeguarding people is fully aligned with the CSA N286-12 management principle that safety is the paramount consideration guiding decisions and actions.

INDEPENDENT REVIEWS

As recommended by our Advisory Council, the NWMO will continue to seek external expert review of and comment on our technical program. As the program continues to move from research into design, fabrication, and demonstration, the nature of the reviews is increasingly focused on specific design aspects and features. These reviews benefit program design and delivery, contribute to overall program quality, and help to enhance public confidence in the NWMO's implementation plans and decision-making.

REPORTING

The NWMO maintains high standards of reporting to demonstrate safety, integrity, excellence, collaboration, accountability, and transparency in the implementation of Adaptive Phased Management. We report regularly on our progress, and especially in response to the advice of Canadians and the changing external environment.

The *NFWA* requires the NWMO to issue annual and triennial reports. In each case, reports are to be submitted to the Minister of Natural Resources and to the public at the same time. The minister must table the reports in Parliament and issue a statement on each report.

Glossary

Deep geological repository is a facility for the placement of used nuclear fuel deep underground where both natural and engineered barriers contain and isolate it from humans and the environment. There is the potential for retrieving the used nuclear fuel.

Fuel bundle for CANDU nuclear reactors is manufactured by sintering uranium oxide powder into pellets. The pellets are loaded into Zircaloy (an alloy of the metal zirconium) tubes, which are then welded into a bundle of tubes – a fuel bundle. Each bundle contains about 1,000 uranium oxide pellets.

Long-term management of used nuclear fuel involves containment and isolation of the radioactive material. The radioactivity decreases substantially with time, due primarily to the decay of short-lived radionuclides. The radioactivity of used nuclear fuel decreases to about one per cent of its initial value after one year, decreases to about 0.1 per cent after 10 years, and decreases to about 0.01 per cent after 100 years. After approximately one million years, the radioactivity in used nuclear fuel approaches that of natural uranium.

Optional shallow underground storage facility would involve building a shallow rock cavern storage facility at the chosen site for the deep geological repository. This is included in Adaptive Phased Management (APM) as an option. This option is not expected to be needed and is not included in the current implementation plan.

Retrievability is the ability to remove the used nuclear fuel from where it has been placed. Retrievability is an important component of APM and was included on the direction of Canadians. It is part of a risk management approach to allow corrective action to be taken if the repository does not perform as expected or if new technologies emerge in the future that could significantly improve the safety of used fuel long-term management. While used nuclear fuel will be retrievable as part of APM, the process will become progressively more demanding as the used fuel containers are sealed in the placement rooms, and then years later when access tunnels and shafts are eventually backfilled and sealed.

Safety in this report refers to the protection of individuals, society and the environment from the harmful or dangerous effects of used nuclear fuel, now and in the future.

Used nuclear fuel means the irradiated fuel removed from a commercial or research nuclear fission reactor. Used nuclear fuel is classified as a high-level radioactive waste.

Note about terminology: In this document, we use the terms Aboriginal, Indigenous, First Nation, and Métis. Our intention in the writing is to honour and respect people, nations and communities, as well as historical and contemporary understandings.

What we heard

In March 2018, the NWMO published *Implementing Adaptive Phased Management 2018 to 2022* – our previous five-year strategic plan. The document outlined Canada's approach for the safe, long-term management of Canada's used nuclear fuel, and how the NWMO intends to proceed over that time period.

The document was distributed by mail and email to more than 1,600 people and organizations that had expressed interest in the Adaptive Phased Management (APM) project. It was also used by our staff and contractors as a discussion point in communities, at events, and with people involved in the siting process. We posted it on our website (at www.nwmo.ca) and on LinkedIn, with an invitation to comment by making a submission, sending a letter or email, or filling out the comment form.

We invited comments to reach us by July 20, 2018.

We received responses from a range of people – some representing government agencies or businesses, and others as private individuals. This input is vital because it helps inform our plans and work activity as we continue towards selecting a site and collaboratively implementing Canada's plan for the long-term management of used nuclear fuel.

In addition to generally positive feedback about the APM process and our strategic plans over the next five years, several themes emerged from the suggestions and comments received

The importance of clear communications and engagement

We received input on the need for clear, concise language, and to avoid complex terminology in the documents and material we produce. It was also suggested that a little more detail be included in the implementation plan on our Indigenous Relations team and the work that it does to engage with Indigenous communities (First Nation and Métis).

More details on the wide range of engagement activity undertaken by the Indigenous Relations team is included within this plan and is also communicated in a number of other reports. These include the annual youth engagement report, and the NWMO's annual and triennial reports, and on our website at www.nwmo.ca.

Defining social acceptance and moving forward in a changing political climate

The manner in which the terms “social acceptance” and “willing host” will be defined was a subject we received comment on, and it will be a central tenet to help inform the selection of a site. We also received a question on the difficulties of maintaining forward momentum on such a large project in the face of social and political environments that are continually changing and evolving.

Canada’s plan is adaptive and designed to be responsive to changing societal values and political priorities. The project will span long time frames and multiple generations during which there will be varying prevailing views and priorities. Our strategic plan is regularly assessed and strengthened through continued dialogue and collaborative learning, both technical and social. The relationships we build in communities and within the political landscape will help us keep moving forward.

More specifically, defining the terms “social acceptance” and “willing host” are also a priority for the NWMO, as noted in the *Priority: Engagement* section of this report. Developing a strong framework for these and understanding how they can be demonstrated will be a collaborative effort with municipalities and Indigenous communities involved in the site selection process.

The need to remain adaptive to technical developments

A number of comments that we received concerned technical aspects of the project, ranging from the need to update the size of the underground repository’s expected footprint, to considering the possibilities of spent CANDU fuel reprocessing, through to how to use any heat discharge from ventilation shafts. While we have considered the heat output and could possibly use some of this heat, we have not yet addressed that point in the ventilation system design in detail. This will be addressed much closer to the finalization of the deep geological repository design.

The NWMO is committed to staying abreast of local, national and international developments that may either change the landscape in which we operate or impact our project directly. We continue to monitor advances in the energy sector, innovations in nuclear waste management, changes in energy and environmental policy, potential developments involving new nuclear reactor units, as well as changes in society’s expectations, values, and insights.

We also regularly report on new technical developments. We maintain a watching brief on used nuclear fuel reprocessing and alternative used nuclear fuel management technologies, and update it annually (www.nwmo.ca/adaption).

Share your thoughts on

Implementing Adaptive Phased Management 2019 to 2023

1. Are the priorities that we have identified appropriate? Have we missed key areas?

2. The plan identifies activities we propose to undertake to accomplish these priorities. Have we set out appropriate activities?

3. The plan is intended to anticipate the challenges ahead and plan for them. Over the next five years, what are the key challenges that will need to be addressed?

4. What will the NWMO need to put in place to respond to these challenges?

5. Other comments, questions or suggestions?

Name (optional): _____

Organization (if appropriate): _____ Date: _____

Address: _____

Email: _____ Tel.: _____

Would you like your comments posted on the NWMO website? Yes No

Please reply by
July 12, 2019, to:
Lisa Frizzell
Vice-President,
Stakeholder Relations

By mail
22 St. Clair Avenue East, Sixth Floor
Toronto, ON M4T 2S3
Canada

By fax
647.259.3692

By email
learnmore@nwmo.ca

Implementing Adaptive Phased Management 2019 to 2023

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

@nwmocanada
/company/nwmocanada

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES