Progress Through Collaboration

Triennial Report
2014 to 2016

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Nuclear Waste Management Organization

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NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

The Honourable James Gordon Carr
Minister, Natural Resources Canada
Ottawa, ON K1A 0A6

March 2017

Dear Minister,

We are pleased to submit to you the third triennial report of the Nuclear Waste Management Organization (NWMO). This newest report covers fiscal years 2014 to 2016.

We submit this report in compliance with sections 16(1), 16(2), 18, and 23(1) of the *Nuclear Fuel Waste Act*.

In fulfilment of our obligations under section 24 of the *Act*, we are also making this report available to the public.

Respectfully submitted,

Wayne Robbins
Chairman

Laurie Swami
President and CEO

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Triennial Report 2014 to 2016

Guide to the Triennial Report

Every third fiscal year, the Nuclear Waste Management Organization (NWMO) produces a triennial report. This is the NWMO's third triennial report. It describes what the NWMO did over the past three years (2014 through 2016), and what it plans to do over the next five years (2017 through 2021).

As with its annual reports, the *Nuclear Fuel Waste Act* (*NFWA*) requires the NWMO to make its triennial reports public at the same time it submits them to Canada's Minister of Natural Resources.

The content follows the requirements set out in the *NFWA* of 2002. The following guide outlines where each is addressed in the present report.

16(2) REQUIREMENTS OF EACH REPORT

Each annual report after the date of the decision of the Governor in Council under section 15 must include:

Annual Report Requirements of the *NFWA*	Where these requirements are addressed in the NWMO Triennial Report 2014 to 2016
(a) the form and amount of any financial guarantees that have been provided during that fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act* and relate to implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5);	*Financial Reporting Requirements* (chapter 9.2).
(b) the updated estimated total cost of the management of nuclear fuel waste;	*Financial Reporting Requirements* (chapter 9.2).
(c) the budget forecast for the next fiscal year;	*Financial Reporting Requirements* and *Budget Forecast, 2017 to 2021* (chapters 9.2 and 9.1).
(d) the proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste and an explanation of the assumptions behind each term of the formula; and	*Financial Reporting Requirements* (chapter 9.2).
(e) the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited, and the rationale by which those respective amounts were arrived at.	*Financial Reporting Requirements* (chapter 9.2).

23(1) REQUIREMENTS OF EACH REPORT

The waste management organization shall provide the Minister, within three months after the end of each fiscal year of the organization, with financial statements audited at its own expense by an independent auditor.	*Auditor's Report and Financial Statements* (chapter 13.1).

18 REQUIREMENTS OF EACH TRIENNIAL REPORT

The annual report of the waste management organization for its third fiscal year after the fiscal year in which a decision is made by the Governor in Council under section 15, and for every third fiscal year after that, in this Act called the "triennial report," must include:

Triennial Report Requirements of the *NFWA*	Where these requirements are addressed in the NWMO Triennial Report 2014 to 2016
(a) a summary of its activities respecting the management of nuclear fuel waste during the last three fiscal years, including an analysis of any significant socio-economic effects of those activities on a community's way of life or on its social, cultural or economic aspirations;	*Our Work* (chapter 6). The chapters immediately following this overview detail the activities specific to each of the NWMO's strategic areas of focus over the past three years. The requirement to summarize any significant socio-economic effects resulting from the NWMO's activities is addressed in the following chapters: » *Building Sustainable Relationships* (chapter 6.1): Describes how the project's potential social, economic and cultural effects inform the NWMO's engagement activities; also describes how the NWMO tracks societal expectations so as to meet social, cultural and economic aspirations as they evolve; » *Collaboratively Implementing the Site Selection Process* (chapter 6.2): Includes a description of the economic modelling reports providing initial estimates of the numbers and types of potential jobs the project would bring to individual siting areas, their respective regions and the province as a whole; » *Social, Economic and Cultural Considerations* (chapter 7): Describes the work done to assess whether the project can enhance a community's well-being, and meet its social, cultural and economic aspirations; and » A list of the NWMO's engagement activities between 2014 and 2016, entitled *Engagement Activities, 2014 to 2016*, is published as a separate document and posted on the NWMO website at www.nwmo.ca/reports.

(b) its strategic plan for the next five fiscal years to implement the approach that the Governor in Council selects under section 15 or approves under subsection 20(5);	*Implementing Adaptive Phased Management 2017 to 2021* (chapter 10).
(c) its budget forecast for the next five fiscal years to implement the strategic plan;	*Budget Forecast, 2017 to 2021* (chapter 9.1).
(d) the results of its public consultations held during the last three fiscal years with respect to the matters set out in paragraphs (a) and (b); and	*What We Heard on Implementing Canada's Plan* (chapter 8).
(e) the comments of the Advisory Council on the matters referred to in paragraphs (a) to (d).	*Report of the Advisory Council* (chapter 13.2), as independently prepared by its members and submitted to the NWMO Board of Directors in February 2017 for inclusion in the current Triennial Report.

ADDITIONAL AREAS ADDRESSED IN THIS REPORT

In addition to implementing a long-term plan for safely and securely managing Canada's used nuclear fuel, the NWMO also provides support services to Ontario Power Generation to develop a deep geologic repository for managing low- and intermediate-level waste. These activities are described in *Other Activities: Ontario Power Generation's Deep Geologic Repository Project for Low and Intermediate Level Waste* (chapter 6.9).

Corporate Overview

NWMO MANDATE

The Nuclear Waste Management Organization (NWMO) was established in 2002 by Canada's nuclear electricity corporations in accordance with the *Nuclear Fuel Waste Act* (*NFWA*). Operating on a not-for-profit basis under the *Canada Not-for-profit Corporations Act*, the NWMO is responsible for designing and implementing Canada's plan for the long-term management of used nuclear fuel. Used nuclear fuel is created by generating electricity in nuclear power plants.

Dry storage containers for used nuclear fuel.

Ontario Power Generation (OPG), New Brunswick Power Corporation, and Hydro-Québec (HQ) are the founding Members of the NWMO, and along with Atomic Energy of Canada Limited (AECL), are required to fund the NWMO's operations.

The *NFWA* required the NWMO to study approaches for the long-term management of used nuclear fuel and recommend to the Government of Canada a preferred approach. The NWMO initiated this study in 2002, and in 2005, after a three-year dialogue with Canadians from coast to coast, submitted to the Minister of Natural Resources a proposed approach for the long-term management of Canada's used nuclear fuel.

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

The technical end point of APM is the centralized containment and isolation of the used fuel in a deep geological repository located at a safe site in an area with an informed and willing host. The plan also involves development of a used fuel transportation system to transport used nuclear fuel to the repository site.

The management system involves realistic, manageable phases, each marked by explicit decision points with continuing participation by interested Canadians.

The NWMO is responsible for implementing APM, subject to all necessary regulatory approvals. In implementing APM, the organization is committed to proceeding in stages, in an open, transparent, and inclusive manner, taking the time that is needed to collaboratively plan and then confirm each step with Canadians before moving forward to the next step.

All Canada's used nuclear fuel is safely stored on an interim basis in licensed facilities at or near where it is generated. Used nuclear fuel remains radioactive for hundreds of thousands of years. Canada's plan is responsive to values and objectives identified by Canadians, and it is being implemented using the best available knowledge, including the physical sciences, social science and Indigenous Knowledge. It is designed to safely contain and isolate the material from people and the environment, essentially indefinitely.

An early milestone in implementing APM was the collaborative design of a nine-step process to select a site for Canada's used nuclear fuel repository and Centre of Expertise that will be a hub for national and international collaboration. In 2010, after extensive input from Canadians, that process was finalized. In May of the same year, the NWMO proceeded to the first step in implementing it by initiating a broad program to provide information, answer questions, and build awareness among Canadians about APM and the siting process itself.

The site selection process is community-driven. It is designed to ensure, above all, that the site selected is safe and secure, and has an informed and willing host. The process must meet the highest scientific, professional and ethical standards. The safety and appropriateness of any potential site will be evaluated through a series of progressively more detailed scientific, technical and social assessments over numerous steps spanning many years. A robust safety case will need to demonstrate with confidence that the project can be safely implemented at the site and can meet or surpass the requirements of regulatory authorities.

The *NFWA* requires the nuclear fuel waste owners – OPG, HQ, NB Power, and AECL – to establish segregated trust funds to finance the long-term management of used fuel. These funds were established in 2002. Contributions are made annually by the waste owners, and audited financial statements are posted on the NWMO website at www.nwmo.ca.

In 2008, as required by the legislation, the NWMO proposed a funding formula to determine the deposits to be made each year by the waste owners to pay for APM implementation. The proposed formula was approved by the Minister of Natural Resources in April 2009.

The *NFWA* also required the NWMO to establish an Advisory Council whose independent comments on the organization's work and triennial reports are made public. The Advisory Council meets regularly and provides ongoing advice and guidance on NWMO work plans and activities.

The NWMO Advisory Council provides ongoing advice and guidance on the organization's work plans and activities.

USED NUCLEAR FUEL

Canada has been generating electricity from nuclear power for more than half a century. In that time, just under 2.7 million used fuel bundles have been produced. Each bundle is about the size and shape of a fireplace log, with a total weight of approximately 24 kilograms.

Used nuclear fuel remains radioactive for a long period of time, and the material must be contained and isolated from people and the environment, essentially indefinitely. Canada's used nuclear fuel is currently safely managed in facilities licensed for interim storage at nuclear reactor sites in Ontario, Quebec, and New Brunswick, as well as at Atomic Energy of Canada Limited (AECL) owned sites in Quebec, Ontario, and Manitoba.

Canadian nuclear power plants are fuelled by natural (un-enriched) uranium oxide, formed into ceramic pellets which are encased in Zircaloy tubes that are welded together in a cylindrical fuel bundle. Once the fuel bundle has been used to generate electricity, it is removed from the reactor. Physically, a used bundle looks the same as it did when it was placed in the reactor.

When used nuclear fuel is removed from a reactor, it is considered a waste product, is radioactive and requires careful management. It is first placed in a water-filled pool where its heat and radioactivity decrease. After seven to 10 years, the used bundles are placed in engineered dry storage systems such as containers, silos or vaults.

Dry storage systems have a minimum design life of 50 years. Although its radioactivity decreases with time, the used fuel will remain a potential health risk for many hundreds of thousands of years. For this reason, used fuel requires careful management.

Currently, about 90,000 used nuclear fuel bundles are generated in Canada on average each year. A small amount of used nuclear fuel is also created at research and development facilities owned by AECL, and Canadian university facilities. If the entire inventory of used nuclear fuel bundles could be stacked end-to-end like cordwood, it would fit into a space the size of about seven hockey rinks, from the ice surface to the top of the boards.

The NWMO has a legal obligation to provide long-term management of all Canada's used nuclear fuel, that which exists now and that which will be produced in the future. There are other heat-generating wastes generated in Canada (such as cobalt-60 sources produced in Canadian CANDU reactors and used in industrial and therapeutic radiation devices) that the NWMO is not mandated to manage.

The following table summarizes the inventory of nuclear fuel waste in Canada as of June 30, 2016.

The inventory is expressed in terms of number of used CANDU fuel bundles. It does not include fuel that is currently in the reactors. It is not considered to be "nuclear fuel waste" until it has been discharged from the reactors.

TABLE 1: SUMMARY OF NUCLEAR FUEL WASTE IN CANADA AS OF JUNE 30, 2016

Location	Owner	Wet Storage (No. of Bundles)	Dry Storage (No. of Bundles)	Total (No. of Bundles)	Current Status
Bruce A	OPG[2]	332,844	161,664	494,508	4 units operational
Bruce B	OPG[2]	349,694	310,262	659,956	4 units operational
Darlington	OPG	328,642	179,645	508,287	4 units operational[4]
Douglas Point	AECL	0	22,256	22,256	Permanently shut down in 1984
Gentilly-1	AECL	0	3,213	3,213	Permanently shut down in 1978
Gentilly-2	HQ	28,541	101,400	129,941	Permanently shut down in 2012
Pickering A	OPG	399,655	319,266	718,921	2 units operational, 2 units permanently shut down in 2005
Pickering B					4 units operational
Point Lepreau	NBPN	38,095	98,459	136,554	Operational
Whiteshell	AECL	0	2,268	2,268	Permanently shut down in 1985[1]
Chalk River	AECL	0	4,921	4,921	Mostly fuel from nuclear power demonstration (permanently shut down in 1987), and small amounts from other Canadian reactors and research activities Currently under assessment[3]
Total		**1,477,471**	**1,203,354**	**2,680,825**	

Notes:

AECL Atomic Energy of Canada Limited

HQ Hydro-Québec

NBPN New Brunswick Power Nuclear

OPG Ontario Power Generation

(1) 360 bundles of Whiteshell fuel are standard CANDU bundles (from the Douglas Point reactor). The remaining bundles are various research, prototype and test fuel bundles, similar in size and shape to standard CANDU bundles, mainly from the research/prototype WR-1 reactor.

(2) Bruce reactors are leased to Bruce Power for operation. However, OPG is responsible for the used fuel that is produced.

(3) AECL also owns some 22,000 components of research and development fuels such as fuel elements, fuel pellets and fuel debris in storage at Chalk River. While the total mass of these components is small compared to the overall quantity of CANDU fuel, their varied composition, storage form, dimensions, etc. require special consideration for future handling. There are also small quantities (a few kilograms) of non-CANDU fuel associated with several research reactors in Canada.

(4) Darlington is currently undergoing refurbishment, unit by unit. The first unit (Unit 2) was shut down for refurbishment in mid-October 2016.

Assuming a rounded average of 20 kilograms of heavy metal in a fuel bundle, 2.7 million bundles is equivalent to approximately 54,000 tonnes of heavy metal (t-HM – a standard unit for measuring quantities of used nuclear fuel which includes only the uranium and transuranic isotopes).

Initially, all fuel was wet-stored in the station used fuel storage bays. Dry storage was initiated in the 1970s on a small scale at shutdown AECL prototype reactors. Starting in the 1990s, older fuel in the wet bays at the operating power reactors has been transferred to dry storage on an ongoing basis. In the future, the inventory in wet storage will remain relatively constant (since wet bay space is fixed), while the inventory in dry storage will continue to grow over time.

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

Integrity

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

Excellence

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

Engagement

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

Accountability

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

Transparency

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

REGULATORY OVERSIGHT OF CANADA'S PLAN

The Nuclear Waste Management Organization (NWMO) is committed to meeting or exceeding all applicable regulatory standards and requirements for protecting the health, safety and security of people and the environment.

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 Canadian Nuclear Safety Commission (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 also disseminates 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 by the *Canadian Environmental Assessment Act*, 2012. More information about the CNSC's licensing process is available at www.cnsc-ccsn.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.


Wayne Robbins
Laurie Swami

INTRODUCING WAYNE ROBBINS, OUR NEW CHAIR, AND LAURIE SWAMI, OUR NEW PRESIDENT AND CEO

In September 2016, the Nuclear Waste Management Organization's (NWMO) Board of Directors appointed a new Chair, Wayne Robbins, and a new President and Chief Executive Officer (CEO), Laurie Swami.

Mr. Robbins takes over from Pierre Charlebois, who served as Chair of the Board beginning in 2014. In 2016, Mr. Charlebois reached the end of his term on the Board as both member and Chair.

A member of the NWMO's Board of Directors since 2014 and Vice-Chair since 2015, Mr. Robbins is the retired Chief Nuclear Officer at Ontario Power Generation (OPG). He was responsible for all OPG's nuclear operations, engineering, nuclear waste management, strategic planning, and plant performance. Mr. Robbins served as Senior Vice-President of the Darlington Nuclear Generating Station from 2006 to 2009. He was recognized with OPG's "Power Within Leader of the Year" award in 2008 and received the Ontario Energy Association leadership award in 2009. He has held several other senior positions at OPG and is also past Chair of the Canadian Nuclear Association Board.

Mr. Robbins holds a Bachelor of Science in Civil Engineering from Queen's University and is a member of the Professional Engineers of Ontario. He has also completed the Ivey Executive Program and Rotman's Directors Education Program.

Ms. Swami takes over from Ken Nash, who served as President and CEO beginning in 2007.

Ms. Swami joins the NWMO after a 30-year career at OPG, most recently as Senior Vice-President of Decommissioning and Nuclear Waste Management. Her responsibilities included overseeing operation of OPG's nuclear waste management facilities, as well as implementing OPG's low- and intermediate-level nuclear waste deep geologic repository. She holds a Bachelor of Science in Engineering Chemistry from Queen's University and a Master of Business Administration from the Schulich School of Business.

The NWMO would like to thank both Mr. Charlebois and Mr. Nash for their strong leadership. Under their guidance, the NWMO has built a strong team and organization that has made tremendous progress in advancing Canada's plan.

CHAIRMAN'S MESSAGE

It is a privilege to have taken on responsibility for chairing the Nuclear Waste Management Organization (NWMO) Board of Directors. I am replacing Pierre Charlebois who honourably served in the position from 2014 to 2016. And I look forward to working with Laurie Swami who has joined the NWMO in the capacity of President and Chief Executive Officer.

Ms. Swami succeeds Ken Nash, under whose tenure since 2007, the NWMO team has made outstanding progress. Ms. Swami's extensive experience in the nuclear industry and waste management makes her an ideal leader for our organization. She has a deep understanding and appreciation of both the technical rigour and social responsibility associated with safely managing nuclear fuel waste.

As required by the *Nuclear Fuel Waste Act* (*NFWA*), the NWMO must submit a report every three years to Canada's Minister of Natural Resources, summarizing our activities over the period. This report also includes the strategic plan and budget forecast for the coming five years, the results of its public consultations, and the independent comments of the Advisory Council on its work. This is our third such report.

In its oversight capacity, the Board of Directors has closely scrutinized Preliminary Assessment work conducted by the NWMO and decisions that have been made about narrowing down study areas to those with strong potential to meet the rigorous requirements of the Adaptive Phased Management (APM) Project. We have monitored engagement activities, in particular the expanded engagement now underway with communities neighbouring those that initiated learning in their area and with First Nation and Métis communities.

The Board has carefully considered all aspects of the technical program to ensure safety. Over the past three years, this work has included project execution plans for site selection, proof testing of the new award-winning engineered-barrier system design, and beginning to plan for the safe and secure transportation of used nuclear fuel to a deep geological repository.

Importantly, we have annually approved the NWMO's performance objectives, business plans and budgets. We are committed to ensuring that the necessary human and financial resources are made available to implement Canada's plan for long-term used nuclear fuel management in a manner that is socially acceptable, technically sound, environmentally responsible, and economically feasible. As required by our governing legislation, our five-year implementation plan and budget forecast for the period are included in this report.

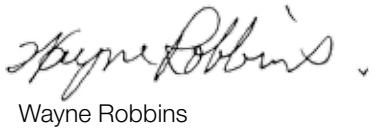
In 2016, the Board accepted an updated lifecycle cost estimate for implementing APM. Periodically updating cost estimates is an important part of ensuring the plan can proceed in an economically responsible manner. Design improvements and changes in planning assumptions about site selection time frames place the current cost of the project at an estimated $22.8 billion (2015 $).

Our member companies (Ontario Power Generation, Hydro-Québec and NB Power Nuclear) and Atomic Energy of Canada Limited continue to make annual deposits to trust funds to ensure there is sufficient money set aside to pay for the plan. Audited financial statements of these funds are posted on the NWMO website at www.nwmo.ca/trustfunds.

The NWMO is grateful for the ongoing advice and recommendations it receives from the Advisory Council. The Board looks forward to continuing the practice adopted in 2015 of convening joint meetings with the Council on an annual basis. As required by the *NFWA*, the Council's independent comments on our work are provided elsewhere in this document.

While we are still early in the process, the NWMO has made significant progress in implementing its important mandate. We understand the challenges and opportunities that lie ahead. We are confident that with ongoing collaboration amongst citizens, specialists, Indigenous and Métis peoples, government, and our member companies, Canada's used nuclear fuel will be managed in a socially, economically and environmentally responsible manner that continues to protect humans and the environment now and in the future.

I encourage all interested Canadians to take this opportunity to read this report of the NWMO's work over the past three years and outlook for the next five, and to visit the NWMO website to learn more about the long-term plan for managing nuclear fuel waste in Canada.



Wayne Robbins
Chairman

PRESIDENT'S MESSAGE

Having taken on leadership of the Nuclear Waste Management Organization (NWMO) in late 2016, I am particularly pleased to be involved with Canada's plan for the long-term management of used nuclear fuel at this important juncture in its history.

It has been almost 10 years since Adaptive Phased Management (APM) was selected as Canada's plan. In that time, working together with interested communities, Indigenous and other neighbouring communities in the area, and Canadians at large, the NWMO has made significant progress.

This, our third triennial report, reflects on the many achievements of the last three years, and the collaboration amongst stakeholders that is essential to advancing the process of identifying a repository site that is both technically suitable and socially acceptable. It also includes our current implementation plan, which looks ahead at work we expect to undertake over the next five years.

Canadians expect safety to be paramount in all our work. Ensuring a sound technical basis for a deep geological repository is critical.

A major innovation since 2013 has been the optimization for CANDU fuel of the engineered-barrier system that will contain and isolate used fuel in a repository. The design was recognized with the Canadian Nuclear Society's Innovative Achievement Award in 2015.

The optimized design for the engineered-barrier system was one of many important inputs to a full update of the costs we expect to occur over the life of APM, published in 2016. This important planning exercise informs the funding formula that is in place to ensure that the money necessary to pay for the long-term care of used nuclear fuel will be available when it is needed, and that the project is fully funded by waste producers as required by the *Nuclear Fuel Waste Act*.

An extensive process to assess and prove the safety performance of the system continues. Much of this work is occurring at the NWMO's proof test facility in Oakville, a place where exciting research is underway to test and demonstrate that the repository we eventually build will be safe.

Over the last three years, the NWMO also continued its work with universities in Canada and elsewhere, and with our international partners, to confirm that APM is benefiting from the best available scientific knowledge.

In addition to technical suitability, the site we ultimately select must be socially acceptable.

In 2015, the organization achieved a major milestone by completing the first phase of Preliminary Assessments, which were requested by 21 communities. This early assessment work contributed to narrowing down the number of communities to nine with strong potential to enter into Phase 2 studies.

As part of Phase 2 activities, we have significantly broadened our engagement activities beyond the communities that initiated their area's involvement to begin to include neighbouring First Nation, Métis, and municipal communities, as well as First Nation, Métis, and Treaty organizations that could be affected by the project.

It is with this local guidance and ongoing involvement with people in the area that we have planned and begun to undertake fieldwork as part of Phase 2 assessments. Activities such as airborne geophysical surveys and direct observations of geological features began in several study areas in 2014 and continue in other areas today. In 2016, we initiated the first environmental characterization studies, an early phase of work that will become progressively more detailed and focused over time. We anticipate borehole drilling could start in the vicinity of one or two communities as early as 2017.

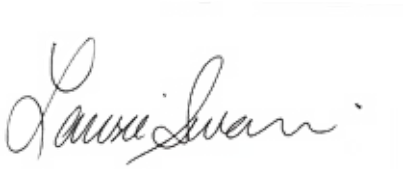
In 2015, the development of a safe and socially acceptable plan for transportation became an important new NWMO strategic objective. In the years ahead, we look forward to an expanded dialogue about transportation of used fuel as we plan for safely moving the material from its current locations to a centralized repository.

Throughout, the Council of Elders and Youth continues to play a crucial role in helping to build and strengthen relationships with First Nation and Métis communities in potential siting areas. Community liaison committees, appointed by the municipal councils of communities engaged in the process, actively advise on and participate in learning activities in their areas.

Most recently, these committees have begun to explore with the NWMO potential social and economic impacts APM might have. We are working together to consider how the project might be leveraged to contribute to the long-term well-being of their regions.

All these activities, from the NWMO's technical research partnerships to the socio-economic studies we are carrying out with communities, are based on collaboration and mutual learning.

I look forward to working collaboratively with the many municipal, First Nation and Métis communities involved in the site selection process underway, as well as the various levels of government staying abreast of the NWMO's work. In that spirit, I encourage all interested Canadians to learn about Canada's plan and participate in its implementation.



Laurie Swami
President and CEO

Highlights 2014 to 2016


Ignace Community Nuclear
Liaison Committee
Website: ww
nfo.ca/ignace
Mail: icnlc.
mail.co
e: 934-2
rporation
ICNLC

HIGHLIGHTS 2014 TO 2016

Building Sustainable Relationships

- Nuclear Waste Management Organization (NWMO) staff engage communities involved in the siting process to plan field studies and advance learning and reflection on the project together in the siting area. This engagement involves an ongoing conversation through open houses, community events, and meetings of community liaison committees and working groups. It also involves meeting with regional planning bodies, forestry management groups, trappers, and others.
- The NWMO participates in conferences of municipal associations and groups, in addition to dozens of events each year with interested municipalities and their community groups in each siting area.
- The NWMO participates in a wide range of First Nation and Métis events, including cultural awareness activities, conferences, general assemblies, and community events.
- The NWMO continues to seek guidance from a wide range of expert groups, including the Council of Elders and Youth and Municipal Forum.
- With the guidance of the Council of Elders and Youth, the NWMO finalizes an Aboriginal Policy in 2014 and also an Indigenous Knowledge Policy in August 2016.
- The Council of Elders and Youth and the NWMO signed a Keepers of the Land Declaration.
- The NWMO acknowledges the contributions of communities and participating neighbours that were screened out of the site selection process as a result of Phase 2 Preliminary Assessments.
- To complement a similar program recognizing participating municipalities, the NWMO introduces its Acknowledging Early Aboriginal Participation program to recognize communities that participated in Phase 1 Preliminary Assessments.
- The NWMO continues to expand opportunities to learn more about Canada's plan and become involved in setting its direction. This is accomplished through a wide range of initiatives, including the launching of a new website, yearly review of the NWMO strategic objectives and activities as outlined in the implementation plan, publications about new topics and updates to existing publications, and production of information videos.
- Youth involvement in science is encouraged through initiatives of the Corporate Social Responsibility Program, as are initiatives in siting areas that enhance community well-being.

Collaboratively Implementing the Site Selection Process

2014
- The year begins with 17 communities participating in the site selection process: one community in Step 2 (Initial Screening); 12 in Step 3: Phase 1 Preliminary Assessments; and four in Step 3: Phase 2 Preliminary Assessments.

» The NWMO and Phase 2 communities initiate a broadened engagement program designed to begin to bring together interested communities, First Nation and Métis communities in the area, and surrounding municipalities to explore potential to work together to implement the project.

» Phase 1 Preliminary Assessments are concluded in Arran-Elderslie (Ont.) and Saugeen Shores (Ont.) after early findings show the two communities have limited potential to contain a site suitable for the project.

» High-resolution airborne surveys are conducted in the vicinities of the Phase 2 communities of Creighton (Sask.), Ignace (Ont.) and Schreiber (Ont.).

» The Township of Nipigon (Ont.) passes a resolution to withdraw from the site selection process after reviewing early findings from Step 3: Phase 1 Preliminary Assessments that identifies that the area has only limited potential to meet the requirements of the project.

» The Municipality of Central Huron (Ont.) passes a resolution to move into Step 3 of the site selection process, after successful completion of Step 2 Initial Screening.

» Direct observations of geological features are completed in the Phase 2 communities of Hornepayne (Ont.) and Ignace (Ont.).

» Phase 1 Preliminary Assessments are completed in Brockton (Ont.), Huron-Kinloss (Ont.), and South Bruce (Ont.). Huron-Kinloss and South Bruce are identified as a focus for more detailed Phase 2 assessments.

2015

» The year begins with 13 communities participating in the site selection process: seven in Step 3: Phase 1 Preliminary Assessments; and six in Step 3: Phase 2 Preliminary Assessments.

» Phase 1 Preliminary Assessments are completed in the Ontario communities of Blind River, Central Huron, Elliot Lake, Manitouwadge, The North Shore, Spanish, and White River. Blind River, Central Huron, Elliot Lake, Manitouwadge, and White River are identified as a focus for more detailed Phase 2 assessments.

» Airborne geophysical surveys of potential siting areas are conducted in the vicinities of the Ontario communities of Hornepayne, Manitouwadge and White River.

» Phase 2 Preliminary Assessments are concluded in Creighton (Sask.) and Schreiber (Ont.) after studies showed geological complexities that reduce the likelihood of finding a suitable site for a used nuclear fuel repository.

» The NWMO launches a program to acknowledge First Nation and Métis communities and organizations involved in early stages of engagement and learning about Canada's plan.

» The NWMO recognizes communities that participated in preliminary assessments and engagement in the areas of Creighton (Sask.) and Schreiber (Ont.).

» Detailed geological mapping is initiated in the vicinity of Ignace (Ont.). An Indigenous Knowledge Program and ceremonies precede fieldwork.

2016

» The year begins with nine communities participating in the site selection process, all in Step 3: Phase 2 Preliminary Assessments.

» In response to requests from communities to further explore the potential to foster well-being in an area, the NWMO shares economic modelling reports with communities as a starting point for discussing how they and their neighbours might maximize the project's economic benefits.

» Direct observations of geological features are conducted around Manitouwadge (Ont.) and White River (Ont.), followed by detailed geological mapping. Detailed geological mapping was also conducted around Ignace (Ont.) and Hornepayne (Ont.).

» Environmental characterization studies are conducted around Hornepayne (Ont.), Ignace (Ont.), Manitouwadge (Ont.), and White River (Ont.).

» Discussions are initiated about the shape and form of the Centre of Expertise, early approaches to skills and capacity building in siting areas to prepare for project implementation, and development of a planning framework for the transportation of used fuel required by the project.

» Community representatives participate in the Canadian Nuclear Society (CNS) Conference on Nuclear Waste Management.

» Community representatives participate in the International Conference on Geological Repositories.

» The year ends with nine of the original 22 interested communities participating in the site selection process, all in Step 3: Phase 2 Preliminary Assessments. A number of First Nation and Métis communities are also involved in learning, which is facilitated by learning agreements. A number of surrounding municipalities are also involved in learning.

Demonstrating Safety and Feasibility of Repository and Engineered-Barrier Design

2014 » The NWMO completes a multi-year design of an engineered-barrier system (EBS) specifically designed for used CANDU fuel and begins implementation of a proof test plan to prove the system's safety performance.

» The NWMO builds its first container designed specifically for used CANDU fuel.

» The NWMO builds its first buffer box, including the steel shell and highly compacted bentonite.

» The NWMO designs specialty handling equipment capable of assisting in the testing of the used fuel container and buffer box system.

» To conduct proof testing activities, the NWMO acquires a preliminary test facility that will be a precursor to the Centre of Expertise to be located in a community once a repository site has been selected.

2015 » The multi-year proof testing plan is completed, and testing begins on the NWMO's EBS design.

» The EBS designed by the NWMO's technical program receives the CNS 2015 Innovative Achievement Award.

» The NWMO designs a slip-skid pallet and fabricates the mechanism for emplacement of the used fuel container.

» The NWMO completes updates to its conceptual repository designs.

» The NWMO establishes process tolerances for cold-spray copper production.

» The NWMO fabricates a full-scale buffer box.

» The NWMO fabricates and pressure-tests a full-scale steel used fuel container prototype.

2016 » The NWMO initiates bentonite backfill (gapfill) emplacement demonstrations.

» The NWMO produces full-sized bentonite buffer blocks and fabricates a beta buffer box.

» The NWMO conducts an independent peer review on the generic corrosion program.

» The NWMO pressure-tests a full-scale copper-coated used fuel container prototype.

» The NWMO completes development of a copper electro-deposition reference procedure.

» The NWMO fabricates an emplacement room mock-up.

» The NWMO carries out demonstrations of the slip-skid placement of full-scale buffer boxes.

Planning for Construction and Operation of Centre of Expertise and Deep Geological Repository

» The NWMO provided technical briefings about the Centre of Expertise within communities engaged in the site selection process to outline the technical and social activities planned for the centre in support of the project.

» The NWMO invited communities engaged in the site selection process to discuss social preferences for how the centre might be designed and developed, should their area be selected for the project.

» The NWMO initiated development of a jobs and skills inventory to identify the professions, trades, skills, and capabilities required to support the Centre of Expertise, the regulatory process, and the construction and operation of the deep geological repository.

» The NWMO initiated a hiring plan to build up locally based staff to support community engagement and field studies in potential siting areas.

» The NWMO initiated discussions with communities engaged in the site selection process about priority steps for developing skills and job opportunities for youth and local community members.

» The NWMO began discussion with communities on what investments in training, strategic hiring or business incubation may be important in building the prospects for local employment and businesses.

Continuously Improving Technical Knowledge

» The NWMO's technical research program continues to attract significant international interest with visiting delegations from Australia, Belgium, Finland, Japan, South Korea, Sweden, Switzerland, the United Kingdom, and the United States.

- The NWMO, together with the Natural Sciences and Engineering Research Council of Canada (NSERC) and the University Network of Excellence in Nuclear Engineering, initiate an Industrial Research Chair in Radiation-Induced Corrosion at Western University.
- NSERC awards a five-year grant to the NWMO and the University of Ottawa to establish a hydrogeochemistry centre of excellence in the university's new Advanced Research Complex.
- The NWMO, together with NSERC, and other partners initiate an Industrial Research Chair in High-Temperature Aqueous Chemistry at the University of Guelph.
- The Korea Radioactive Waste Agency signs a memorandum of understanding with the NWMO, making it the sixth such organization to enter into a research partnership with the NWMO.
- The NWMO initiates a collaborative site analogue study at the Mont Terri Underground Research Laboratory in Switzerland to examine solute migration in geologic time scales.
- NWMO researchers continue to participate in collaborative research projects with their counterparts in other waste management organizations. Ongoing joint projects include the POST (fracture parameterization for repository design and postclosure analysis) project with Sweden and Finland, several experiments at Mont Terri in Switzerland, and the GAST (gas permeable seal test) experiment at Grimsel in Switzerland.
- NWMO researchers published more than 50 conference papers, technical reports and peer-reviewed journal articles.
- The NWMO supports research projects with 15 Canadian universities.
- The NWMO participated in the Nuclear Energy Agency's working groups, including the Expert Group on Operational Safety and its Expert Group in Inventory Reporting and Methodology.
- The NWMO continued to host its annual Geoscience Seminar.

Developing Transportation Plans

- After assessing several conceptual designs for transporting used fuel stored in Atomic Energy of Canada Limited (AECL) designed baskets, the NWMO selects one and initiates development and testing of the design concept.
- The NWMO initiates analytical fire and impact modelling of a used fuel transportation package concept for transporting AECL baskets.
- The NWMO co-organizes panels and presentations on transportation at the 2015 and 2016 annual conferences of the CNS.
- Working with researchers at Carleton University, the NWMO completes a detailed assessment of potential radiological exposure scenarios resulting from the transportation of used fuel in the Used Fuel Transportation Package. The assessment describes Canadian road and land development conditions, and is used to prepare a Canadian-specific dose assessment.

- The NWMO disseminates a transportation discussion document, *Planning Transportation for Adaptive Phased Management*, to encourage and advance discussion with communities.
- The NWMO contracts with third parties to initiate workshops and discussion groups to seek insights into citizen priorities for a safe, secure and socially acceptable approach to transporting Canada's used nuclear fuel.
- The NWMO initiates logistical studies for transporting used nuclear fuel.

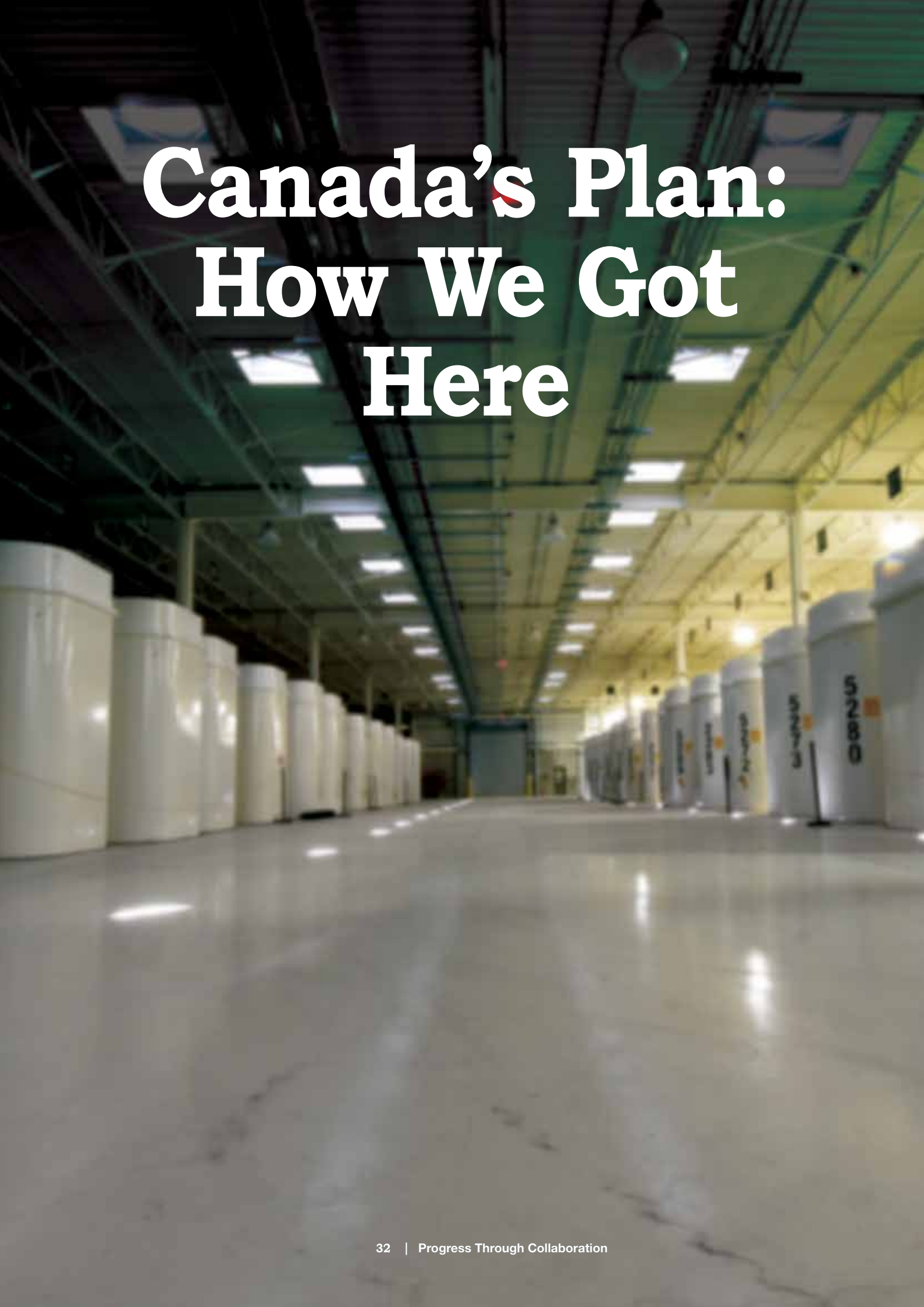
Providing Financial Surety

- The NWMO performed annual assessments of all factors that impact Adaptive Phased Management (APM) cost estimates and funding requirements.
- The NWMO determined annual trust fund contribution requirements in accordance with the funding formula.
- In 2016, the NWMO completed a full update of lifecycle cost estimate for the APM Project.

Ensuring Governance and Accountability

- Annual reviews by the Minister of Natural Resources acknowledge the NWMO's progress in implementing Canada's plan for the long-term management of used nuclear fuel.
- NWMO staff form part of the Canadian delegation to the fifth Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- Through ongoing reviews of approaches, methods, and interpretation of data, the APM-Geoscientific Review Group continues to help ensure preliminary geoscientific assessments are conducted according to best international practice.
- The NWMO's integrated management system is audited annually by an accredited organization and continues to be certified compliant with Canadian (CSA) and international (ISO) management system standards.

Canada's Plan: How We Got Here

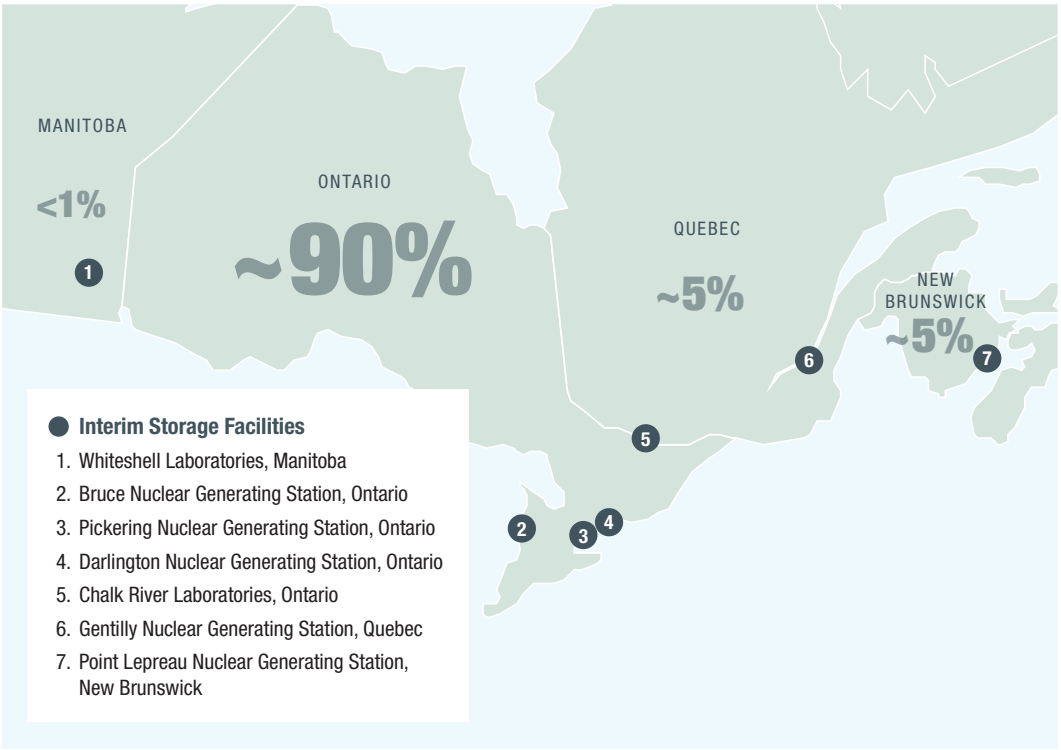


A MATTER OF RESPONSIBILITY

For decades, Canadians have used electricity generated by nuclear power reactors in Ontario, Quebec and New Brunswick.

When used nuclear fuel is removed from a reactor, it is considered a waste product, is radioactive and requires careful management. Although its radioactivity decreases with time, chemical toxicity persists and the used fuel will remain a potential health risk for many hundreds of thousands of years. For this reason, used fuel requires careful management, essentially indefinitely.

Canada's used nuclear fuel is safely stored on an interim basis at licensed facilities located at or near where it is produced. Like many other countries with nuclear power programs, Canada is planning for the future. Putting in place a plan for the long-term, safe and secure management of used nuclear fuel for the protection of people and the environment is an important responsibility we as Canadians share.

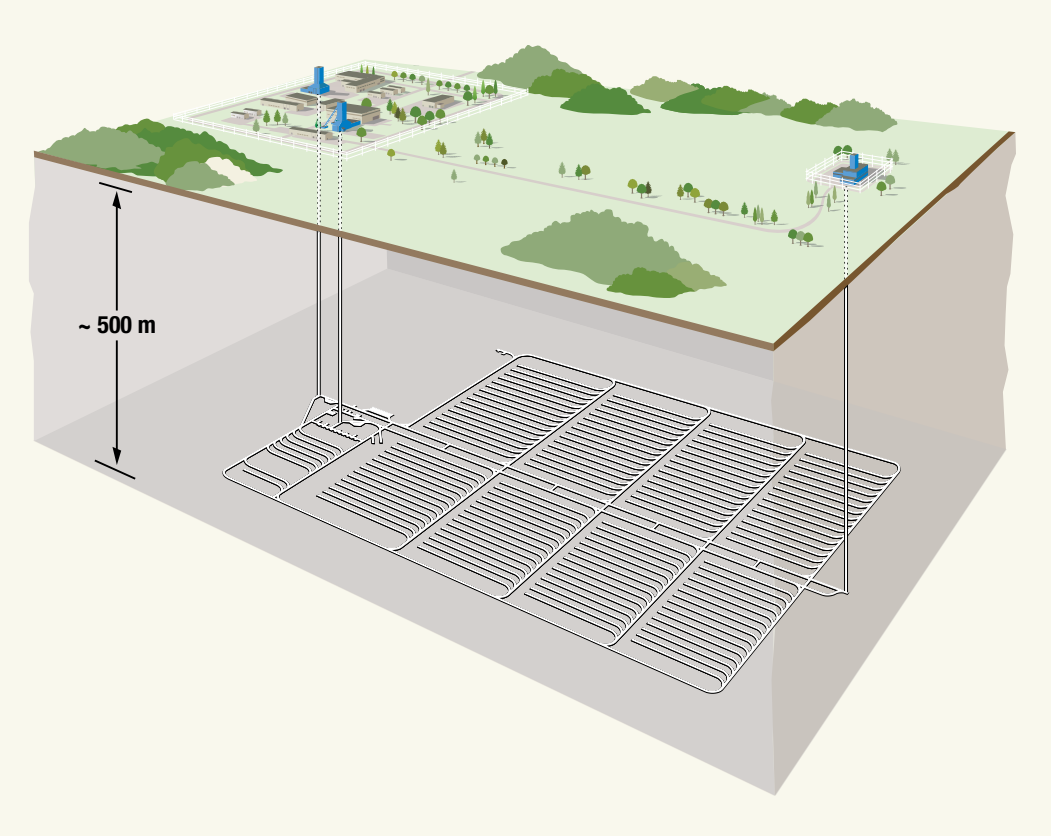


DEEP GEOLOGICAL REPOSITORIES ARE THE PREFERRED APPROACH INTERNATIONALLY

A multiple-barrier system in a stable rock formation is the safest known way of containing and isolating used nuclear fuel over very long time periods. Canada is one of a dozen countries currently planning on developing a repository, including Finland, Sweden and Switzerland. Repositories are also the official policy of the European Union. Under the terms of the "Radioactive Waste and Spent Fuel Management Directive" of 2011, member states have been asked to present national programs, indicating when, where and how they will construct and manage deep geological repositories guaranteeing the highest safety standards.

THE DEEP GEOLOGICAL REPOSITORY CONCEPT

Used fuel storage technologies have been demonstrated for many years at reactor sites where used fuel is cooled and then safely managed in interim storage facilities. The approach Canada has selected for the long-term management of that fuel – containment and isolation in a deep geological repository in a suitable rock formation – is the culmination of several decades of research, development, and demonstration of technologies and techniques in Canada, the United States, Switzerland, Sweden, France, the United Kingdom, and elsewhere. Repositories have been constructed and are operating around the world for various types of radioactive wastes.



In 1978, the governments of Canada and Ontario established the Canadian Nuclear Fuel Waste Management Program to study and advance the technology for the storage, transportation and permanent disposal of Canada's nuclear fuel waste. This was followed, starting in 1989, by an intensive and lengthy period of deliberation by the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel. Chaired by Blair Seaborn, the Panel's mandate was to conduct an environmental assessment of an Atomic Energy of Canada Limited (AECL) proposal for deep geological disposal. In 1998, the Seaborn Panel provided insight and direction on key issues to be addressed in order to move the decision-making forward. With respect to the AECL disposal concept, the Panel concluded that:

- From a technical perspective, the safety of the AECL concept had been on balance adequately demonstrated for a conceptual stage of development, but from a social perspective, it has not;
- Broad public support is necessary in Canada to ensure the acceptability of a concept for managing nuclear fuel wastes; and
- Safety is a key part, but only one part, of acceptability. Safety must be viewed from two complementary perspectives: technical and social.

The Government of Canada considered and responded to the Seaborn Panel Report, and in November 2002, it brought into force the *Nuclear Fuel Waste Act* (*NFWA*).

Working Together to Develop Canada's Plan

The *NFWA* required Canada's nuclear energy generators – Ontario Power Generation (OPG), New Brunswick Power and Hydro-Québec – to establish a waste management organization to study possible approaches to managing Canada's used nuclear fuel over the long term, propose possible approaches to the Government of Canada, and then implement the approach selected by the Government. That waste management organization, founded in 2002, is the Nuclear Waste Management Organization (NWMO).

Acting on this mandate – and on a key recommendation by the Seaborn Panel – the NWMO began by conducting a three-year study (2002 to 2005) involving thousands of citizens, specialists and Aboriginal peoples in every province and territory in Canada. The goal of this dialogue was to develop a long-term management approach that is socially acceptable, technically sound, environmentally responsible, and economically feasible.

Canadians' Objectives for the Long-Term Management of Used Nuclear Fuel, as Identified During the Study Phase (2002 to 2005)

Fairness	To ensure fairness (in substance and process) in the distribution of costs, benefits, risks, and responsibilities, within this generation and across generations.
Public Health and Safety	To protect public health from the risk of exposure to radioactive or other hazardous materials and from the threat of injuries or deaths due to accidents.
Worker Health and Safety	To protect workers from, and minimize hazards associated with, managing used nuclear fuel.
Community Well-Being	To ensure the well-being of all communities with a shared interest.
Security	To ensure the security of facilities, materials and infrastructure.
Environmental Integrity	To ensure that environmental integrity is maintained over the long term.
Economic Viability	To ensure the economic viability of the waste management system, while simultaneously contributing positively to the local economy.
Adaptability	To ensure a capacity to adapt to changing knowledge and conditions over time.

The plan that emerged from this dialogue – Adaptive Phased Management (APM) – enables our generation to proceed in a deliberate and collaborative way to establish the foundation for the safe and secure stewardship of Canada's used nuclear fuel over the long term.

APM involves the containment and isolation of used nuclear fuel in a deep geological repository in a suitable rock formation. Under APM, used nuclear fuel will be safely and securely contained and isolated from people and the environment in the repository using a multiple-barrier system. The plan builds in the potential for retrieval of the used fuel for an extended period, until such time as a future society makes a determination on final closure, along with the form and duration of postclosure monitoring.

In having a deep geological repository as its technical end point, APM embraces the internationally accepted technical approach for the long-term management of used nuclear fuel. As a management plan, it is adaptive, meaning that it is responsive not only to new technologies, but also to the evolving societal expectations and needs of Canadians.

Dialogue: The Key to Developing and Implementing Canada's Plan (2002 to 2005)

During the study phase of work, the NWMO met with thousands of citizens from many parts of Canadian society to hear their advice and suggestions about how to proceed. It has talked to people in their communities; local, provincial and national elected representatives; Aboriginal peoples; technical and social specialists; environmental and faith groups; and business people, about the many social, technical, economic, environmental, and ethical issues involved in managing used nuclear fuel.

A strong sense of responsibility emerged from these conversations. This generation wants to move forward in dealing with our used nuclear fuel, believing it to be imprudent and unfair to future generations to wait any longer.

In 2005, the NWMO made its recommendations to the Government of Canada, which in June 2007 selected APM as the best approach for Canada to safeguard both the public and the environment over the very long time in which used nuclear fuel must be carefully managed.

CANADIANS SAID CANADA'S PLAN MUST:

- Be fair – both to current and future generations – and the outcome must be safe and secure for people, communities and the environment.
- Our generation needs to take active responsibility to achieve a safe, long-term response to our waste problem.
- The plan needs to have a definitive outcome, and it needs to provide flexibility along the way to take advantage of newer and better technologies when they are developed, or to adjust if people's values or priorities change over time.
- We need to provide the option to future generations to monitor the waste over an extended period.

Choosing a Way Forward – The Future Management of Canada's Used Nuclear Fuel (Final Study)

Ongoing dialogue is key to developing and implementing Canada's plan for the long-term management of used nuclear fuel.

Adaptive Phased Management (APM): A Canadian Choice

The *NFWA* required the NWMO to study approaches based on three methods for the long-term management of used nuclear fuel: deep geological disposal in the Canadian Shield; storage at nuclear reactor sites; and centralized storage, either above or below ground, anywhere in Canada. Through the three-year study the NWMO conducted, it became clear that each of these approaches possesses some unique strengths, but also some important limitations. This led to the search for an approach that would better meet the objectives Canadians said are important – safety, security, protection of the environment, community well-being, fairness, and economic viability. APM is this approach.

Other options that had at some point received international attention were also reviewed. These were found to not meet important criteria such as "proof of concept" (they could not be implemented today) or legality. The options considered included recycling or reusing nuclear fuel, which involves reprocessing it with an aim to reduce the volume and toxicity of the high-level waste to be managed. The NWMO continues to keep a watching brief on the development of these and other alternative used nuclear fuel management technologies as part of its ongoing effort to incorporate new learning and knowledge, and to review and adjust the way in which Canada's plan is implemented, as needed.

Engaging With the Public About How Best to Implement Adaptive Phased Management (APM)

Following the government's selection of APM in 2007, the NWMO embarked upon the process of re-engaging with the public as the organization moved from being a study organization to one responsible for the implementation of Canada's plan for the long-term management of the nation's used nuclear fuel. The NWMO invited the people and groups taking part in the study to provide input, along with other Canadians, including Aboriginal peoples, who might have an interest in APM or be potentially affected by its implementation.

The people and groups who participated in this dialogue helped shape the strategic directions and priorities to be followed in implementing APM.

In 2008, the NWMO began to work collaboratively with interested individuals and organizations to help identify the values and objectives that should guide the site selection process. Their input was incorporated in a discussion document outlining the proposed process, which was then widely disseminated for public comment in 2009. At this time, participants delved deeper into some of the issues raised during the previous year's dialogues, while also providing more specific direction on refinements that would strengthen the process.

Over the course of this two-year dialogue, Canadians clearly stated their expectation that a process be outlined as the road map for decision-making. At the same time, it was understood that the road map does not in itself constitute the destination, nor identify every step that will need to be taken along the way.

Their feedback was carefully reviewed and then incorporated in the final document, *Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*. In 2010, the document was published, and the site selection process was launched in May of that year. It is this road map the NWMO is now following as it works collaboratively with interested communities to select a site where Canada's used nuclear fuel may be safely and securely contained and isolated.

Canadians told the NWMO that the site selection process should ensure, above all, that the site selected for a repository be safe and secure – and meet the highest scientific, professional and ethical standards. They wanted a process that ensured the long-term well-being of the community that agrees to host the site. They also wanted a process that is community-driven, meaning that the initiative to enter and then continue in the process must come from the community, and that the selection of a site must be supported by an informed and willing host.

In May 2010, the NWMO initiated the site selection process. Since that time, the NWMO has worked with communities wishing to learn more about APM, and increasingly, with First Nation, Métis and other communities in the surrounding areas to explore potential suitability through initial screenings and preliminary assessments.

The 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.

This Triennial Report details how the NWMO is continuing to implement Canada's plan in a way that meets the priorities of Canadians and the communities that are now participating in the site selection process.

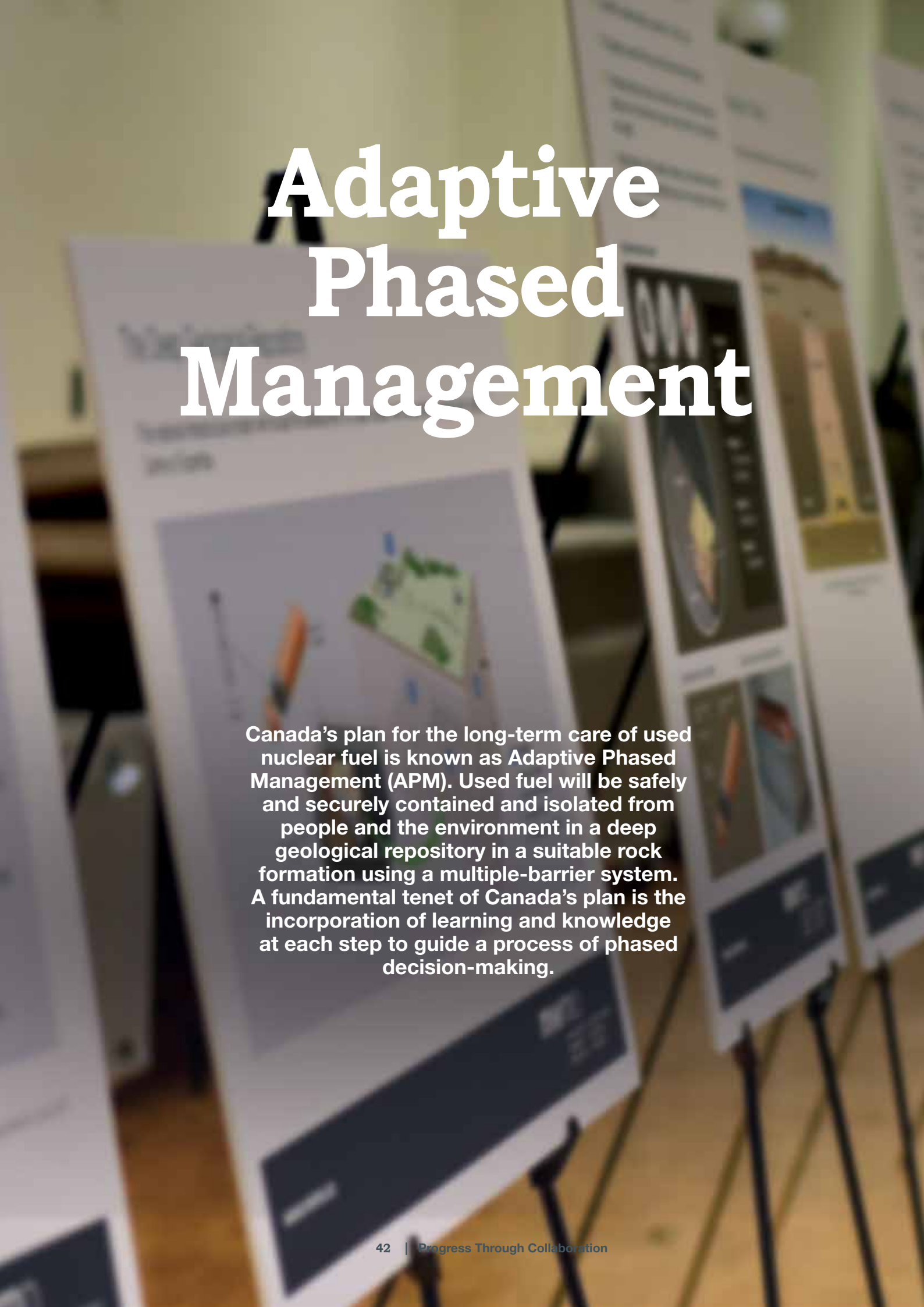
Learning about used nuclear fuel in South Bruce, Ontario.

Milestones in Developing and Implementing Canada's Plan

Canada's Plan Is Developed	2002	*NFWA*	The *NFWA* requires the NWMO to consider alternative technical methods for the long-term management of Canada's used nuclear fuel.
	2002 to 2005	NWMO Study	The NWMO's three-year study with interested Canadians recommends APM as the best approach.
	2007	Government Decision	Government selects APM and mandates the NWMO to begin implementation.
Siting Process Is Developed	2008 to 2009	Design Process for Selecting a Site	The NWMO works collaboratively with citizens to design a process for selecting a preferred central site for the deep geological repository and Centre of Expertise.
Using the Siting Process, a Site Is Identified	2010	Communities Express Interest	The NWMO initiates the siting process with a program to provide information, answer questions and build awareness. Communities begin to identify interest in learning more and initiating studies in the area.
	2010 to 2013	Initial Screening	In collaboration with interested communities, the NWMO conducts high-level desktop reviews to assess potential to meet project requirements in the area.
	2012 to 2015	Preliminary Assessment: Phase 1	The NWMO conducts preliminary studies to further assess suitability. Areas with less potential to meet project requirements are eliminated from further consideration.
	2015 to 2022*	Preliminary Assessment: Phase 2	The NWMO expands assessments to include field studies. As studies advance, areas with less potential to meet project requirements are eliminated from further consideration.
	2023 onwards*	Single Preferred Site Identified, Detailed Site Characterization and Construction of Centre of Expertise Begin	Together with communities in the area, the NWMO selects a preferred site where a strong technical safety case can be developed and a strong partnership can be established involving interested community, First Nation and Métis communities in the area, and surrounding communities.
		Licensing and Environmental Assessment Process	The NWMO submits an application for a Licence to Prepare Site (and possibly construct) to the Canadian Nuclear Safety Commission. This application also initiates an environmental assessment process. Further details are provided in chapter 2.4 (*Regulatory Oversight of Canada's Plan*).
Construction Begins		Construction and Operation of the Facility Proceeds	

**Reference planning timelines*

Adaptive Phased Management



Canada's plan for the long-term care of used nuclear fuel is known as Adaptive Phased Management (APM). Used fuel will be safely and securely contained and isolated from people and the environment in a deep geological repository in a suitable rock formation using a multiple-barrier system. A fundamental tenet of Canada's plan is the incorporation of learning and knowledge at each step to guide a process of phased decision-making.

DESCRIPTION OF THE ADAPTIVE PHASED MANAGEMENT (APM) PLAN

The long-term management of Canada's used nuclear fuel involves the development of a deep geological repository, a used fuel transportation system, and a national Centre of Expertise. This large infrastructure project will generate thousands of jobs in the host area.

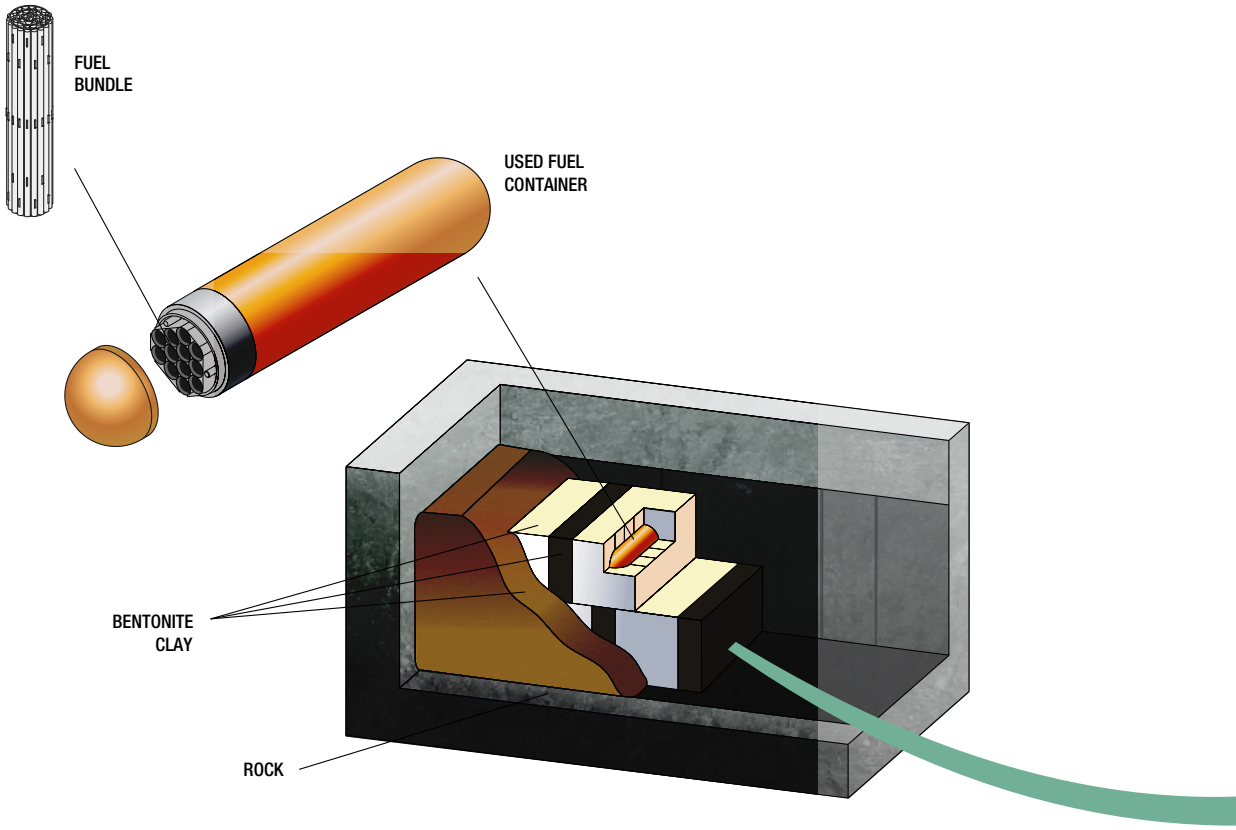
Cornerstones of Adaptive Phased Management (APM)

- Centralized containment and isolation of used nuclear fuel in a repository deep underground in a suitable rock formation;
- A series of steps and clear decision points that can be adapted over time;
- An open, inclusive and fair siting process to identify an informed and willing host;
- Opportunities for people and communities to be involved throughout the implementation process;
- Provision for optional temporary shallow storage at the central site, if needed[1];
- Long-term stewardship through the continuous monitoring of used fuel;
- Ability to retrieve the used fuel over an extended period should there be a need to access the waste; and
- Financial surety and long-term program funding to ensure the necessary money will be available for the long-term care of used nuclear fuel.

[1] Temporary shallow storage at the deep geological repository is optional and not currently included in the Nuclear Waste Management Organization's implementation plan.

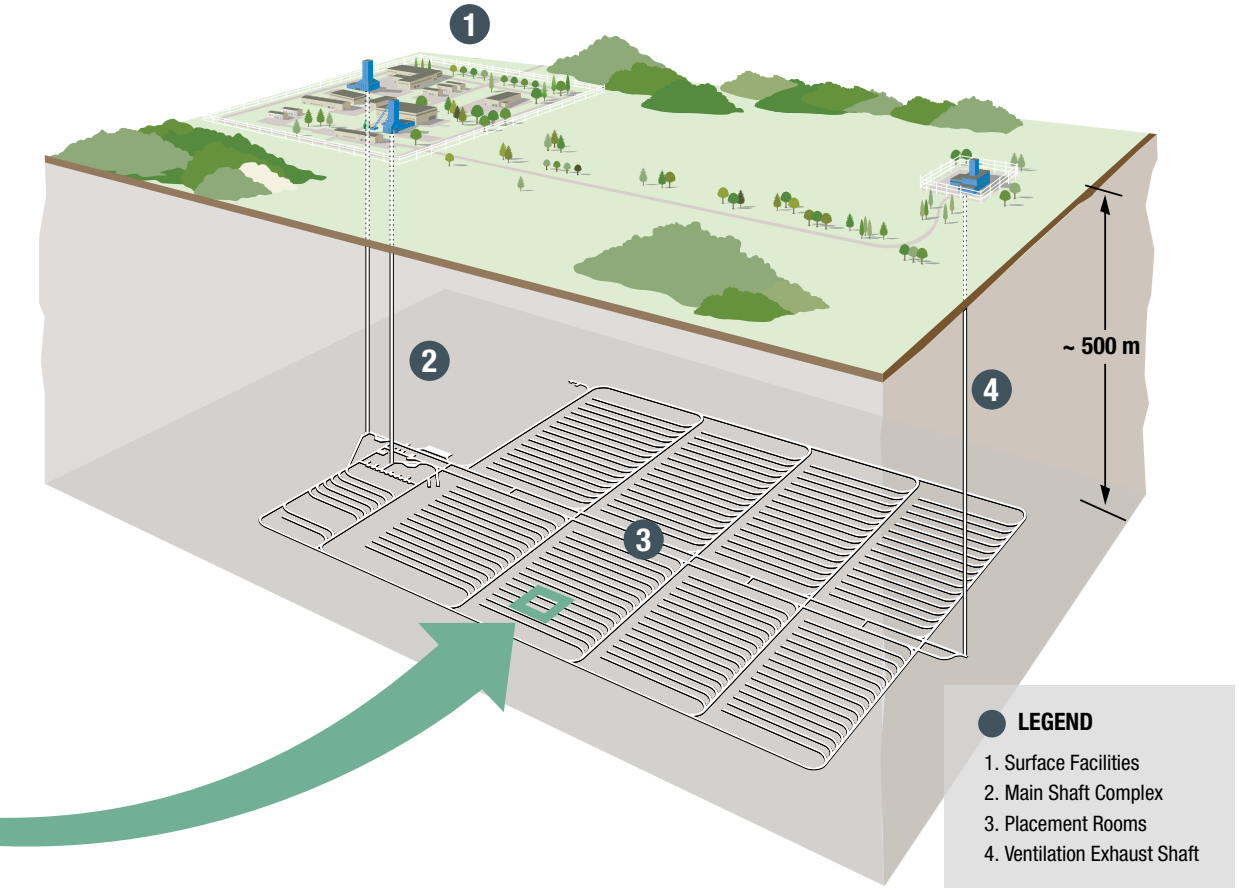
DEEP GEOLOGICAL REPOSITORY

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 specific geology and detailed characteristics of the site. It will consist of a network of placement rooms for the used fuel containers and clay-based sealing systems, as well as a series of access tunnels and shafts to ensure accessibility and monitoring. This project requires a dedicated surface area of about 650 metres by 550 metres for the main buildings and about 100 metres by 170 metres for the ventilation exhaust shaft. The Nuclear Waste Management Organization (NWMO) expects that land above the underground footprint that is not required for surface facilities or to meet regulatory requirements would be available for other uses. The NWMO will have to demonstrate that regulatory or other requirements for safety that could limit those activities in the immediate area surrounding the surface facilities have been met.



A conceptual layout for a repository would require an underground footprint of about two kilometres by three kilometres (about 600 hectares or 1,480 acres).

Used nuclear fuel will be loaded into specially designed and certified containers at the reactor sites and transported to the repository site where it will be repackaged in corrosion-resistant containers for placement in the repository. The containers will be transported underground to one of many placement rooms. Each container will be encased in a buffer box; this box is made of highly compacted bentonite clay, a proven and very stable sealing material that will contribute to the safe containment and isolation of used nuclear fuel.



Monitoring, Decommissioning and Closure Phases

Once placement of the used fuel containers is complete, the emplacement rooms will be sealed, but access tunnels and perimeter tunnels would be left open and maintained to support on-site monitoring activities. The NWMO will have to demonstrate the site's long-term safety during this extended monitoring period, and decommissioning activities would begin after sufficient performance monitoring data have been collected to support a decision to decommission and close the repository. Activities would also be undertaken in discussion with those in the area. The NWMO will seek the appropriate regulatory approvals for decommissioning, closure and postclosure monitoring.

Transportation

Used nuclear fuel is currently safely stored in facilities licensed by the Canadian Nuclear Safety Commission (CNSC) at sites located at or near where it is produced. Placing all Canada's used nuclear fuel in a single central location will require transportation from these interim storage facilities to the deep geological repository. At this early stage of assessment, the NWMO is looking at road and rail access from interim storage sites to communities engaged in the site selection process.

The NWMO will need to demonstrate to regulatory authorities and citizens the safety and security of any transportation system before transport of used nuclear fuel can begin. Transportation of the material will have to meet the stringent requirements of Transport Canada and the CNSC, as described in chapter 2.4 (*Regulatory Oversight of Canada's Plan*).

The NWMO is studying road and rail access from interim storage sites to communities engaged in the site selection process.

Artist's concept of what a Centre of Expertise could look like.

Centre of Expertise

A Centre of Expertise will be established in or near the community, as determined with people who live in the area, to support detailed site evaluation. Its purpose will be to support the multi-year testing and assessment of the site on technical safety and community well-being related dimensions, which are key components of the site selection process. The Centre of Expertise will be home to an active technical and social research and technology demonstration program during this period, involving scientists and other specialists in a wide variety of disciplines, including geoscience, engineering, and environmental, socio-economic, and cultural impact assessment. An engineering test facility will be located within the Centre of Expertise. It may also be developed as a meeting place and learning centre for the community, and as a destination that welcomes interested visitors from the region and beyond.

The centre would be expanded to support construction, and later, operation of the deep geological repository. The centre will become a hub for knowledge sharing across Canada and internationally. It may also serve as a training centre to prepare personnel to work on various aspects of project implementation.

Design details of the Centre of Expertise will be developed with the interested community, First Nation and Métis communities in the area, and surrounding municipalities, with their preferences in mind. One of the topics these groups may want to explore is whether the technologies and processes involved in operating a deep geological repository could be applied to other projects in the area.

A Partnership Approach

The 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.

The NWMO will work with people in the area to harness the economic benefits associated with the project, and to implement it in a way that contributes to their long-term well-being.

At this stage in the site selection process, the NWMO is looking for indicators that a strong partnership might be developed as studies continue in coming years. These indicators include the ability to work together to advance the progressively more detailed technical studies that are required to assess whether project safety requirements can be met. To select the preferred location for a repository at the end of preliminary assessments, the NWMO would need a sufficient degree of confidence that a strong partnership can be developed to support implementation of the project in the area. This process of planning for partnership will take several years, meaning there is time for learning about the project, for questions and concerns to be addressed, and for relationships to be built or strengthened.

Funding

The planning, development and implementation of the project is funded by the major owners of used nuclear fuel in Canada: Ontario Power Generation, NB Power, Hydro-Québec, and Atomic Energy of Canada Limited. The *Nuclear Fuel Waste Act* requires each of these four companies to establish independently managed trust funds and make annual deposits to ensure the money to fund this project will be available when needed.

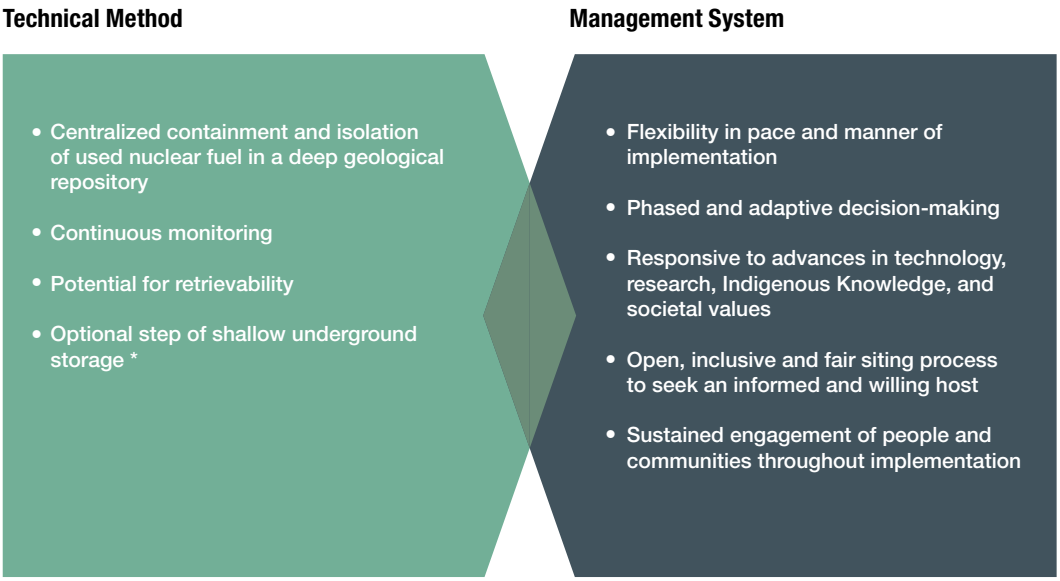
Phased Implementation

The deep geological repository and Centre of Expertise will have a significant impact on any community and area in which they are located. It is a multi-generational project that will be developed in phases. The repository will be sited and constructed over two to three decades. Used nuclear fuel will be placed in the facility over a period of about 40 years, and then monitored for an extended period of time prior to closure.

Adaptive Management

A fundamental tenet of Canada's plan is the incorporation of learning and knowledge at each step to guide a process of phased decision-making. The plan builds in flexibility to adjust it if needed. The plan will be implemented over several decades. Over this period of time, we may experience changes in the values and preferences of Canadian society, advancements in knowledge and technologies, and changes in the use of nuclear technology and fuel volumes. APM is designed to be flexible to ensure new learning and social priorities are incorporated and to allow this plan to adapt to other changes we may encounter along the way.

Adaptive Phased Management at a Glance



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

Our Work

Over the past three years, the Nuclear Waste Management Organization (NWMO) has focused on working collaboratively with interested communities to identify a site where Canada's used nuclear fuel may be safely and securely contained and isolated in a deep geological repository. In that time, it narrowed down the number of potential siting areas to those with strong potential to meet the project's strict technical and social requirements.

The NWMO broadened its engagement of First Nation and Métis communities and municipalities in the surrounding areas. It completed the first phase of preliminary assessments, and began geoscientific and environmental fieldwork around several communities that are now participating in the second phase.

This work with communities was complemented by significant technical advances. The NWMO completed an engineered-barrier system (EBS) design, which has received widespread international attention and was honoured with the Canadian Nuclear Society's 2015 Innovative Achievement Award. Proof testing of the EBS is now well underway. Collaboration, with universities and other nuclear waste management organizations, continued to underpin the NWMO's technical advances, while also ensuring its work is based on international best practice.

If you have followed the NWMO's work over the past three years, you will notice that its strategic objectives have grown (from seven to eight) and that in some instances they have changed. Its objectives necessarily evolve as planning milestones are met and the nature and focus of its work change. To help guide the NWMO in setting those objectives, every year it publishes a draft of its newest implementation plan for public review and comment. Based on comments it received, both on its draft implementation plans and during its engagement activities, the NWMO has made the following changes to its strategic objectives:

2015

- The NWMO added a new strategic objective specific to **developing transportation plans**. The new objective integrates into one program stream its ongoing work to ensure Canada's used nuclear fuel is transported in a way that is safe, secure and socially acceptable.
- It added a new strategic objective specific to **continuously improving technical knowledge**. The new objective brings together in a single program stream the NWMO's long-standing work to contribute to and learn from best practices in Canada and other countries.
- The focus on **adapting plans** has been expanded, and is now subsumed under two objectives: **building sustainable relationships** and **continuously improving technical knowledge**. The first includes an overview of the NWMO's work to keep abreast of changes in societal expectations and public policies, as well as of the ways it incorporates Indigenous Knowledge into its work. The second describes the continuous learning that allows the NWMO to adapt plans in response to technical advances in the field.
- It removed an earlier strategic objective specific to **building and sustaining an effective organization**. While this is no longer a stated planning objective at this point in the NWMO's mandate, the organization remains committed to maintaining an effective organization with the broad range of expertise required to implement Canada's plan.

2016

- The NWMO added a new strategic objective specific to **planning for construction and operation of Centre of Expertise and deep geological repository**. The addition of this objective reflects its commitment to help communities plan for, and benefit from, expanded work and activity, should a site be identified in the vicinity.

ACHIEVEMENTS AGAINST THESE EIGHT STRATEGIC OBJECTIVES ARE SET OUT IN THE CHAPTERS THAT FOLLOW.

STRATEGIC OBJECTIVES 2016

- Build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. Continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies;
- Implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host;
- Conduct testing of the engineered-barrier system in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently;
- Advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project;
- Continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices;
- Establish safe, secure and socially acceptable plans for transporting used nuclear fuel;
- Ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel; and
- Maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

BUILDING SUSTAINABLE RELATIONSHIPS

The Nuclear Waste Management Organization (NWMO) will build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. The NWMO will continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies.

Discussing geology in Central Huron, Ontario.

The NWMO works to maintain strong relationships with the many communities and groups that are working to help ensure Canada's used nuclear fuel is safely and securely managed. These include communities that initiated their area's involvement in the site selection process, First Nation and Métis communities in the area, and nearby municipalities, municipal associations, First Nation and Métis organizations, federal and provincial governments and agencies, interested groups and organizations, and the youth who will one day be responsible for carrying Canada's plan forward.

The NWMO's relationship-building activities are built on a sustained dialogue involving the sharing of information and diverse perspectives. This exchange serves two important purposes: it helps involve many different communities and groups in implementing Canada's plan and setting its direction; and it provides ongoing direction on the values, expectations and concerns the plan will need to meet going forward. Meeting those values, expectations and concerns is part of ensuring Canada's plan can be adapted as the needs of the society it serves evolve. The same goal, of adapting to change, is also why the NWMO closely follows emerging technologies in the field of nuclear waste management.

Between 2014 and 2016, the NWMO significantly broadened its regional engagement. While continuing to build close ties with communities that initiated their area's involvement in the site selection process, the NWMO also worked towards strengthening relationships with those outside the interested communities that would need to be involved in implementing the project, should it be located in the area. The NWMO increased its engagement with First Nation and Métis communities, working with them and the NWMO Council of Elders and Youth to apply Indigenous Knowledge in its engagement and fieldwork. The NWMO's Municipal Forum, in turn, provided valuable guidance on municipal processes and approaches the NWMO might consider in strengthening relationships with municipalities in a siting area. The NWMO continued to be involved with municipal associations and conferences to meet with local officials and representatives across Ontario and nuclear fuel cycle provinces.

HIGHLIGHTS 2014 TO 2016

- NWMO staff engage communities involved in the siting process to plan field studies and advance learning and reflection on the project together in the siting area. This engagement involves an ongoing conversation through open houses, community events, and meetings of community liaison committees and working groups. It also involves meeting with regional planning bodies, forestry management groups, trappers, and others.
- The NWMO participates in conferences of municipal associations and groups, in addition to dozens of events each year with interested municipalities and their community groups in each siting area.
- The NWMO participates in a wide range of First Nation and Métis events, including cultural awareness activities, conferences, general assemblies, and community events.
- The NWMO continues to seek guidance from a wide range of expert groups, including the Council of Elders and Youth and Municipal Forum.
- With the guidance of the Council of Elders and Youth, the NWMO finalizes an Aboriginal Policy in 2014 and also an Indigenous Knowledge Policy in August 2016.
- The Council of Elders and Youth and the NWMO signed a Keepers of the Land Declaration.
- The NWMO acknowledges the contributions of communities and participating neighbours that were screened out of the site selection process as a result of Phase 2 Preliminary Assessments.
- To complement a similar program recognizing participating municipalities, the NWMO introduces its Acknowledging Early Aboriginal Participation program to recognize communities that participated in Phase 1 Preliminary Assessments.
- The NWMO continues to expand opportunities to learn more about Canada's plan and become involved in setting its direction. This is accomplished through a wide range of initiatives, including the launching of a new website, yearly review of the NWMO strategic objectives and activities as outlined in the implementation plan, publications about new topics and updates to existing publications, and production of information videos.
- Youth involvement in science is encouraged through initiatives of the Corporate Social Responsibility Program, as are initiatives in siting areas that enhance community well-being.

Building Relationships With Communities in Siting Areas

As the site selection process continues to move forward, the focus of the NWMO's engagement program has become increasingly regional, encompassing not only communities that initiated their area's participation in the process, but also the communities around them. This regional focus reflects the NWMO's commitment to only implementing the project with the involvement of the community that initially expressed interest, First Nation and Métis communities in the area, and surrounding municipalities.

As part of building strong relationships in and around interested communities, NWMO staff participated in hundreds of local events, meetings and conversations in each siting area between 2014 and 2016, including open houses, events at NWMO community offices, meetings of community liaison committees (CLCs), information sessions, festivals, visiting science classes, and other local activities.

Some of the Places Where Conversations Continued Between 2014 and 2016

- Open houses and events at NWMO community offices
- Classrooms
- Meetings of CLCs
- Festivals, fairs and other local events
- Indigenous cultural activities and events
- Tours of interim nuclear waste storage facilities
- Individual face-to-face meetings
- Community participation at Canadian Nuclear Society conferences to hear a diversity of academics and consultants involved in nuclear waste management

The NWMO booth draws a crowd at the 2016 Blind River Ladies' Night.

The NWMO participates in more than a dozen municipal conferences every year. Here, at the 2016 Ontario Small Urban Municipalities conference, a visitor (right) picks up a copy of the NWMO's latest project description.

Municipal Forum and Municipal Associations

The NWMO's Municipal Forum, established in 2009, met eight times between 2014 and 2016. The Forum provided a municipal perspective on siting activities, communications, and broadened engagement in siting regions, and in the future, with transportation communities.

The NWMO's municipal association conference program continued to help the organization build and strengthen relationships with communities, including neighbours to communities that initiated their area's involvement in the site selection process, and communities that may be on future transportation routes. As part of that program, the NWMO continued to attend the conferences of municipal associations such as the Association of Municipalities of Ontario, the Federation of Canadian Municipalities, the Federation of Northern Ontario Municipalities, the Northwestern Ontario Municipal Association, Ontario Small Urban Municipalities, and the Union of Municipalities of New Brunswick. These events continued to provide unique opportunities for the NWMO to learn more about current priorities and challenges facing municipalities in different regions. At the same time, they provided further opportunities to engage municipal officials, government representatives and business leaders about Canada's plan.

WORKING WITHIN AN ETHICAL AND SOCIAL FRAMEWORK

During the study phase of work (2002-05), a Roundtable on Ethics developed an Ethical and Social Framework within which to consider the management of used nuclear fuel. Focused on the recommendation to government of a management approach, this framework was a point of conversation, and was confirmed, after conversations with Canadians across the country in information and discussion sessions as part of the conversations that occurred to confirm the management approach recommended to government. The Roundtable suggested that the NWMO embed ethics in all its activities in order to ensure that its work reflect the highest ethical standards.

A number of ethical principles were incorporated in the framework. These continue to form a foundation for the NWMO's work: respect for life in all its forms, including minimization of harm to human beings and other sentient creatures; respect for future generations of human beings, other species and the biosphere as a whole; respect for peoples and cultures; justice (across groups, regions and generations); fairness (to everyone affected, and particularly to minorities and marginalized groups); and sensitivity to the differences of values and interpretation that different individuals and groups bring to the dialogue. These principles were intended to apply both to the consultative and decision-making procedures used by the NWMO and to the decisions it makes.

The NWMO built on this in the guiding principles and goals of the process, which underpin the site selection process and which are described in *Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*. These principles continue to guide the implementation of the site selection process and work with communities, including over the last three years. Work to understand the ethical dimensions of the decisions that face us as we implement Adaptive Phased Management (APM) continues. This work includes the development of programs to acknowledge the contribution of both Aboriginal and municipal communities to the advancement of Canada's plan. It also includes reflection on the principles, objectives and key questions that ought to guide planning for APM transportation of used nuclear fuel through an NWMO discussion document published in 2016 to foster broad conversation.

NWMO ABORIGINAL ENGAGEMENT

To learn more about Aboriginal engagement at the NWMO, please go to www.nwmo.ca/AboriginalEngagement.

Involving First Nation and Métis Communities and Organizations

NWMO agreements with First Nation and Métis organizations help support broad-level participation in learning more about the project, building capacity, and sharing information. These organizations have also provided valuable guidance on how best to engage their member communities. Their agreements with the NWMO reflect each organization's unique needs, priorities, cultural diversity, and political protocols.

NWMO Aboriginal Engagement

Aboriginal peoples have a special relationship with the natural environment and have unique stewardship responsibilities that are part of this relationship. The knowledge that comes from this relationship with the land brings special understanding to the broad ranges of factors that should be considered, and the processes that should be used, in assessing the appropriateness of any site.

One of the guiding principles for the NWMO's work with First Nation and Métis peoples is recognition of, and respect for, their unique status and rights as affirmed by section 35 of the *Constitution Act*, 1982. As well, the NWMO seeks to ensure the project fosters the long-term well-being of Aboriginal communities, consistent with their vision for the future. The NWMO recognizes that Aboriginal peoples and communities have unique priorities and processes that need to be understood in order to make certain that those with an interest in the project have an opportunity to be involved in the site selection process in a meaningful way.

At the national level, in 2014 the NWMO entered into an agreement with the Assembly of First Nations (AFN). It provided resources to hire a staff member for ongoing liaison with the NWMO and to co-ordinate AFN activities involving the NWMO. The agreement also allowed the AFN to build on the work completed under a prior NWMO funding agreement, focusing on First Nation youth engagement. The AFN also examined the potential impact of Free, Prior and Informed Consent on current and future NWMO processes, and provide general advice and assistance to the NWMO on First Nations engagement. That agreement expired in 2015.

In 2016, the NWMO entered into a two-year agreement with the AFN that builds on previous years' work with respect to the implications of Aboriginal and Treaty rights on the application of the APM process, as well as the suitability of APM within a Free, Prior and Informed Consent framework. Additionally, this agreement will examine the application of the principles of Ownership, Control, Access, and Possession, given the NWMO's Indigenous Knowledge Policy, as well as the application of First Nation views, laws and processes as a means to improve environmental assessment processes as it relates to APM.

Students attend the NWMO open house in Wabigoon Lake Ojibway Nation in October 2015.

At the provincial level, the NWMO continued to maintain relationships with provincial and treaty organizations in Ontario (e.g., Nishnawbe Aski Nation) and New Brunswick (e.g., Union of New Brunswick Indians). The NWMO also began to develop relationships with regional organizations in potential siting areas and seek their guidance on how best to engage with member communities.

Making Information Available in Aboriginal Languages

The NWMO has a long-standing practice of translating key information materials into Aboriginal languages. Notable examples include a 20-minute video on Canada's plan (available in eight Aboriginal languages) and master documents such as *Choosing a Way Forward: Final Study Report* and *Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*.

In 2016, the NWMO translated its brochure on transportation (*Safe and Secure Transportation of Canada's Used Nuclear Fuel*) into Swampy Cree, Oji-Cree, and two dialects of Anishinaabemowin (Ojibway).

Engaging Federal and Provincial Governments

Since the initiation of the site selection process in 2010, NWMO staff have routinely engaged with representatives of federal and provincial governments to provide information about the project and the progress in implementing it, as well as to identify topics of shared interest such as transportation, the duty to consult Aboriginal peoples, and access to Crown land. With the continued advancement of preliminary assessment activities in numerous communities, NWMO staff and government officials have also discussed fieldwork processes and procedures.

The NWMO worked with a lead ministry in each jurisdiction. This ministry functioned as the NWMO's primary point of contact with other ministries and departments in the jurisdiction. In addition to meeting with government officials, NWMO staff also briefed provincial and federal elected representatives.

By the end of 2016, nine Ontario communities continued to be engaged in the Preliminary Assessment step of the site selection process. Federal and provincial government representatives and elected officials are regularly engaged as the siting process evolves.

Involving Youth in the Project

Between 2014 and 2016, the NWMO continued to engage youth in the project and build their capacity to understand and advance the science behind it. This commitment reflects the long time spans associated with implementing Canada's plan. Implementation, in other words, will require a partnership between generations, not only to transfer knowledge, but also to encourage youth to become involved in implementing Canada's plan.

Corporate Social Responsibility Program (CSRP)

The NWMO's CSRP supports and promotes youth science education, as well as local community initiatives focused on youth and education.

Between 2014 and 2016, CSRP funds helped support the work of four youth science initiatives: the Science Ambassador Program, Science North, Scientists in School, and SHAD.

Youth Science Programs the Corporate Social Responsibility Program (CSRP) Helped Fund Between 2014 and 2016

» In 2014 and again in 2015, the CSRP helped science ambassadors work collectively with teachers and educational assistants. Total students reached: more than 4,000.	The **Science Ambassador Program** enables senior undergraduate and graduate students in the sciences to spend extended periods of time in remote Saskatchewan schools with a high proportion of students of Aboriginal ancestry.
» Between 2014 and 2016, the CSRP provided support to Science North programs to schools in 12 northern Ontario communities. Total programs taught: nearly 500.	**Science North** is a classroom-based program that helps schools in northern Ontario augment their existing science curriculum through hands-on interactive programs.
» Between 2014 and 2016, the CSRP provided support to more than 170 Scientists in School workshops in 49 schools across four school districts in Ontario's Bruce and Huron Counties. Students reached: more than 1,700 a year.	**Scientists in School** helps kindergarten to Grade 8 students develop a lifelong interest in science, technology, math, environmental stewardship, and engineering.
» Between 2014 and 2016, the CSRP helped students to attend SHAD. Students attending interactive presentations by NWMO staff: roughly 300 a year.	Geared toward high-performing high-school students, **SHAD** focuses on developing their skills in science, engineering, technology, leadership, and entrepreneurship.
» Between 2014 and 2016, the CSRP provided sponsorships up to $2,500 each to local initiatives in Phase 2 siting areas. Sponsorships awarded: approximately 230.	Sponsorship of **local initiatives** helps support community well-being.

CORPORATE SOCIAL RESPONSIBILITY PROGRAM (CSRP)

For more about the CSRP, please go to www.nwmo.ca/csrp.

A specialist from the NWMO talks to SHAD students on the Queen's University campus in July 2016.

In 2014, the CSRP was broadened to support local initiatives in and around communities engaged in the second phase of preliminary assessments. Priority was given to initiatives that support community well-being, with approximately 230 grants awarded between 2014 and 2016. Notable examples have included powwows, summer camps, science competitions, culture days, student conferences, an Aboriginal language camp, Medicine walks, hockey programs, playground improvements, and school athletic programs.

Other Youth Engagement

As detailed before, the NWMO also sponsored numerous programs designed to engage First Nation and Métis youth in learning about the project and applying Indigenous Knowledge to its implementation. For its part, the Council of Elders also strongly encouraged youth involvement, changing its name to the Council of Elders and Youth in 2016.

The NWMO continued to encourage university students in relevant disciplines to apply their skills and talents to implementing Canada's plan. It provided support for graduate research projects in such areas as engineering and earth sciences, while staff gave approximately 30 talks to university students between 2014 and 2016.

As well, the NWMO responded to numerous requests to meet with elementary and high-school students in siting areas to learn more about the project. Initiatives included staff talks in local schools, and class visits to open houses where students had opportunities to meet face-to-face with NWMO specialists and ask questions about how the project might affect them and their communities. Through this outreach, NWMO staff engaged approximately 1,300 students in siting areas between 2014 and 2016.

LEARN MORE

Want to learn more about how the NWMO and the Natural Sciences and Engineering Research Council of Canada are teaming up to help promising young researchers?

Go to chapter 6.5 (*Continuously Improving Technical Knowledge*).

University students visit the NWMO booth at the 2016 Canadian Nuclear Association Conference and Trade Show.

Building Understanding and Awareness of the NWMO's Work

Beyond the many face-to-face presentations, meetings, and conversations with individuals and groups in communities in siting areas to help advance learning and understanding of the project, the NWMO supports tours, develops exhibits, produces communications materials, and engages through digital communications.

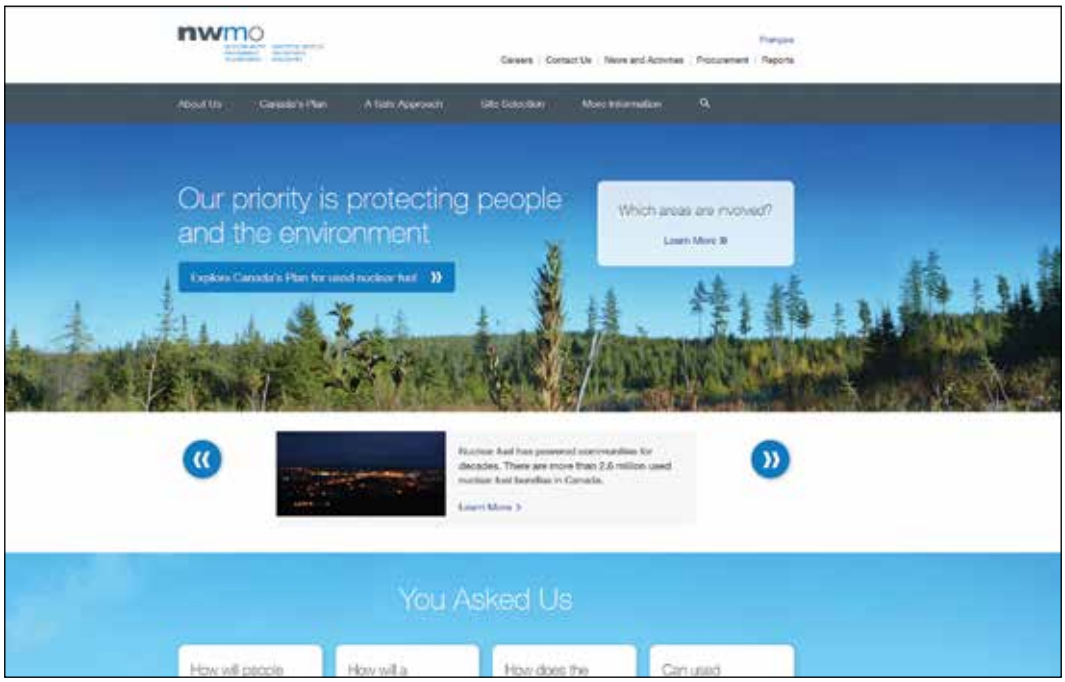
As part of helping people learn more about Canada's plan, the NWMO organized more than 70 tours of interim waste sites between 2014 and 2016. Of these, 30 were for communities that initiated their area's involvement in the site selection process, 34 for First Nation and Métis communities, four for municipalities in the surrounding areas, and five for members of the media. Additional tours were also arranged for NWMO staff, Board and Advisory Council members, and members of the Municipal Forum.

The communications materials the NWMO produced between 2014 and 2016 were likewise designed to help people learn more about Canada's plan and become involved in setting its direction. Toward that end, the NWMO produced materials covering a wide variety of topics, from the transportation of used nuclear fuel to economic modelling reports. To make information more accessible and reach as wide an audience as possible, the NWMO used several different media, including electronic media, print, and exhibits.

Digital Communications

In 2015, the NWMO's digital communications program underwent a major upgrade with a complete redesign of the NWMO's website. One goal of this upgrade was to make it easier for users to access information and become involved in implementing Canada's plan. The new website also features greatly expanded coverage of the NWMO's engagement activities and technical work, and has enhanced the organization's ability to answer questions, provide timely updates about its work, and engage with key audiences.

In 2016, the NWMO further enhanced the new website's capabilities by making it easier for users to share its content across social media.



The NWMO enhanced its website in 2016 to make it easier for users to access information and share content over social media.

The NWMO continually produces and updates backgrounders, pamphlets and other communications materials to support learning about the evolving nature of its work.

Printed Materials

The printed materials the NWMO produced between 2014 and 2016 were focused on helping communities learn more about the project, understand the sorts of work and activities that might be undertaken in the area, and reflect on the impact the project might have, should it be located in their area.

New titles reflected the evolving nature of the work the NWMO and communities are undertaking as the site selection process moves forward. Examples included backgrounders on airborne geophysical surveys, direct observations of geological features, detailed mapping, borehole drilling, and 2D seismic surveys. Each of these activities is associated with types of geoscientific field studies used during preliminary assessments. Because types of fieldwork are determined by local geology, the NWMO tailored several of these backgrounders to specific regions, thereby allowing people in the area to focus on the sorts of fieldwork they might expect as the site selection process unfolds.

Other new publications over the period included studies and pamphlets about potential economic impacts of the project, environmental characterization, and a transportation discussion document. The first are discussed in chapter 6.2 (*Collaboratively Implementing the Site Selection Process*); the second, in chapter 6.6 (*Developing Transportation Plans*).

The NWMO also continued to update existing publications to reflect the latest advances both in its work and in the field of nuclear waste management. In 2016, for example, it updated its backgrounder about how APM is funded to include information from the latest lifecycle cost estimate for the project. The new estimate was based on the latest available information, including the design, completed in 2014, of an engineered-barrier system customized for the long-term management of used CANDU fuel. The revised project description, released in 2015, likewise reflected the latest reference design for surface and underground facilities at the repository site, and included new information about the Centre of Expertise that will support the project and act as a community resource.

MOBILE TRANSPORTATION EXHIBIT

The information panels on the NWMO's mobile transportation exhibit were likewise updated, for which see chapter 6.6 (*Developing Transportation Plans*).

"Ask the NWMO," a local advertising feature launched in 2012, was published through 2015. Installments in the series were published in newspapers and websites serving communities engaged in the site selection process. Each featured commonly asked questions about a particular aspect of Canada's plan, with answers provided by a specialist from the NWMO.

In 2015, the NWMO launched a series of newsletters for individual siting communities. Distributed through local newspapers and mail, these publications covered such topics as local engagement activities, planning for fieldwork, and various aspects of Canada's plan. As in previous years, the NWMO's corporate newsletter, *NWMO News*, continued to provide updates on the site selection process, the APM technical program, and collaborative work with universities and other nuclear waste management organizations.

Exhibits

In late 2016, the travelling exhibit the NWMO takes to open houses was completely refreshed to be rolled out early in 2017. The updates reflect both feedback received from communities and the advances the NWMO has made as it continues to advance the site selection process and its engineering and transportation programs. It stocked community offices with the latest literature as this became available, and updated several local displays to reflect advances in the site selection process and the NWMO's technical program.

In May 2016, the NWMO opened a new Learn More Centre at Ignace's Town Plaza. The new centre features displays, models, exhibits, and publications to help people in the area learn more about Canada's plan and become involved in setting its direction.

Adapting to Change

One of the hallmarks of Canada's plan is its flexibility, meaning that it is designed to learn from, and adapt to, evolving societal expectations and values, insights from Indigenous Knowledge, changes in public policies, and new technologies.

Incorporating Indigenous Knowledge

Working in partnership with First Nation and Métis communities, the NWMO is committed to interweaving local Indigenous Knowledge in all phases of its work. In particular, the organization expects that integrating Indigenous Knowledge into the identification and assessment of potentially suitable sites will lead to an expanded set of considerations to assess the suitability of a site; new and different approaches to data collection and interpretation; and a perspective on ways of life that must inform more detailed studies.

Indigenous Knowledge

Indigenous Knowledge has contributed to the development and implementation of Canada's plan through the sharing of Indigenous teachings concerning values, ethics, principles, and practices.

Indigenous Knowledge recognizes that people are part of and are one with Mother Earth. Indigenous Knowledge systems emphasize the interrelationships among all components of the environment, and as such, believe Aboriginal peoples have a responsibility to be the protectors (guardians) of Mother Earth. Indigenous Knowledge is a complex and sophisticated system of knowledge drawing on millennia of wisdom and experience. It constantly grows and expands with the experience of new generations. It is expected that this knowledge system will continue to provide a source of wisdom through the various stages of project development and implementation. As the project moves through the site selection process and the NWMO engages with communities, there is an opportunity to learn and benefit from local Indigenous Knowledge.

The NWMO respects the value of what both western science and Indigenous Knowledge systems can contribute to the decision-making process.

As described in chapter 6.2 (*Collaboratively Implementing the Site Selection Process*), the NWMO is currently working together with First Nation and Métis communities in potential siting areas to respectfully apply Indigenous Knowledge to both the technical safety and community well-being dimensions of the site selection process. The NWMO will continue to work together with these communities as the process moves forward.

INDIGENOUS KNOWLEDGE POLICY

The NWMO's Indigenous Knowledge Policy is online at www.nwmo.ca/IndigenousKnowledge.

INDIGENOUS KNOWLEDGE POLICY TO HELP GUIDE ADAPTIVE PHASED MANAGEMENT (APM) IMPLEMENTATION

In the latter part of 2016, the NWMO became one of the first organizations in North America to implement an Indigenous Knowledge Policy. It was developed in collaboration with the members of the Council of Elders and Youth, an advisory body that provides counsel on the application of Indigenous Knowledge in the implementation of Canada's plan for the long-term management of used nuclear fuel.

The purpose of this policy is twofold: to set out how the NWMO will support communities; and to guide the work of staff and contractors. The policy is also designed to help ensure that Indigenous Knowledge in all its forms will continue to be valued and respected by the NWMO, and included in planning and decision-making processes. The policy also specifies how Aboriginal intellectual property is to be protected, as agreed with the Aboriginal peoples who choose to share that knowledge.

Members of the Council blessed the policy document through an Indigenous ceremony consisting of a pipe ceremony, smudge, and traditional drum song and dance, as well as each member personally blessing the document.

The Indigenous Knowledge Policy builds on existing positive relationships and earnest collaboration with Aboriginal peoples in Canada by providing a framework and principles to more readily apply Indigenous Knowledge, interwoven with other knowledge systems, to all aspects of the NWMO's work.

"The Indigenous Knowledge Policy is significant. It is the first time we have put a policy in place through ceremony. It is a living document – it has a life, and it is going to inform what we do and guide what we do. It is already doing that."

BOB WATTS
Associate Vice-President, Aboriginal Relations, NWMO

The Council of Elders and Youth meets regularly to provide the NWMO with advice on the application of Indigenous Knowledge in the implementation of Canada's plan for long-term nuclear fuel waste management.

Council of Elders and Youth

The Council of Elders and Youth functions as an advisory body to NWMO management, providing counsel on the application of Indigenous Knowledge in the implementation of APM. Its guidance is meant to help protect and preserve all creation: air, land, fire, water, plants, medicines, animals, and humankind – guided by the seven universal teachings of love, trust, sharing, honesty, humility, respect, and wisdom. The Council also provides advice on matters that could enhance the development and maintenance of good relations with First Nation and Métis communities.

The Council met 10 times between 2014 and 2016.

In 2014, the Council's terms of reference were modified to include youth members. A youth subcommittee was created to interview and nominate youth to the Council. Seven young people were appointed, and the Elders encouraged them not only to learn, but also to voice their opinions and play an active role in the Council's meetings and ceremonies. In addition to learning about the NWMO and APM, the Council's youth are also learning about traditional practices, protocols and processes from the Elders. The youth worked together to develop their own objectives and appointed a youth co-chair to help preside over Council meetings.

In 2016, the Council of Elders and Youth presented its *Declaration of the Keepers of the Land* to the NWMO (see next page). This is a public statement from Council members to assist in maintaining their independence when asked to publicly state their role on the Council. The presentation of the declaration was acknowledged in a ceremony in March 2016.

Council members also attended community events. These included First Nation and Métis community meetings, NWMO open houses, trade shows, and cultural events. Members were able to engage with people, and communicate the Council's role within the NWMO and the types of advice they have provided to the NWMO over the years. These activities have been very well-received and will continue as the site selection process moves forward.

DECLARATION OF THE KEEPERS OF THE LAND

What will we do today to protect Mother Earth and our people?

We, the Council of Elders and Youth of the NWMO, acknowledge the Laws of Life of the Creator as sacred supreme Spiritual Law, universal for all humanity and aligned with the Laws of the Natural World.

The homelands of Turtle Island are gifted to us by the Creator in oral traditions and songs and codified in the Original Instructions called our Sacred Laws.

The land formations of our territories and purposeful usage throughout time, the archaeological evidence within the depth of the ground, the markings on the land thousands of years old, and the bones of our Ancestors ground into the soil under our feet signify our land rights and denote each Nation's responsibilities to care for their traditional territories.

We, the autonomous Indigenous Peoples of Turtle Island, are the Peoples of vision, spiritual in nature, the Keepers of the Land, responsible for stewarding and supporting Creation in all its magnificence.

Every day, we give thanks and ask, *"What can we do today to protect Mother Earth and our people?"*

We declare that:

We take our seats at the Council of Elders and Youth of the NWMO, as independent advisors, to carry out these sacred, inherent obligations for the care of Mother Earth and all Beings within Creation.

We respect and accept the diversity of Indigenous representation on the Council and use a consensual approach to reach a common understanding of traditional knowledge and science.

We are concerned with the effects and storage of used nuclear fuel in Canada and as a collective problem for humanity on a global scale.

We are questioning scientists to learn about their current knowledge and scientific findings on used nuclear fuel.

We are seeking answers, in our way, through ceremonies and by requesting the help of Elders of many Nations, as well as our traditional scientists, in order to seek options for the management of used nuclear fuel.

We will not back away from our responsibilities to protect Mother Earth, Her Laws and the Beings in Creation.

The question of how to manage used nuclear fuel by burying it in deep geological repositories within Mother Earth is a divisive and volatile issue.

Together, we will find answers by Standing Shoulder to Shoulder.

Help Us To Help Mother Earth.

NEW TECHNOLOGIES

The NWMO's research partnerships are detailed in chapter 6.5, *Continuously Improving Technical Knowledge.*

Local Perspectives

Through working with a broad range of individuals and communities, the NWMO has learned from community members, trappers, camp owners and outfitters, seasonal residents, recreationalists, and other individuals and groups in the siting areas about their understanding, interaction and relationship with the land.

This local knowledge has also helped advance understanding of the land as a dynamic and adaptive system. It has informed planning for technical field studies, requiring changes to those plans in some cases to avoid interfering with ongoing activities or sensitive areas. It is an important input to answering the question of how the APM Project might best fit in the area.

Energy Policy

As in previous years, the NWMO continued to monitor the energy policy and status of potential new or refurbished reactors for the implications of these industry developments on the quantities and characteristics of the used nuclear fuel that the organization may be asked to manage in the future. The NWMO updated its inventory of Canada's used nuclear fuel in 2016. It is posted online at www.nwmo.ca.

New Technologies

The NWMO maintains a robust research program to keep abreast of technical issues and advances. This includes joint research projects with its sister organizations in other countries, as well as with universities in Canada and abroad.

Ongoing Monitoring of Advances in Reprocessing Used Nuclear Fuel

As part of its ongoing monitoring, the NWMO closely follows the latest research and development programs in advanced fuel cycles, including reprocessing, partitioning and transmutation. It also closely follows international conferences in the field, as well as related activities in Canada and internationally.

There is no current plan in Canada to adopt advanced reactors or fuel cycles for recycling used nuclear fuel. However, no matter what the reactor or fuel cycle, a deep geological repository is required. To help anticipate any changes in fuel cycles used in Canada and the types of waste that may need to be managed as a result, the NWMO has kept a watching brief on new developments since 2008. This watching brief is updated every year and can be read online at www.nwmo.ca.

Recycling Used Nuclear Fuel Does Not Eliminate the Need for a Deep Geological Repository

Some countries are conducting research on advanced reactors that could also recycle used nuclear fuel, and a small number of countries partly recycle used nuclear fuel in existing reactors. Unlike the once-through fuel cycle currently used in Canada and most other nuclear power countries, these advanced fuel cycles generate high-level waste (HLW), a byproduct with characteristics similar to used fuel.

International scientific consensus, as recognized by the International Atomic Energy Agency, the European Union, the Organisation for Economic Co-operation and Development Nuclear Energy Agency (NEA), and other international bodies, identifies deep geological disposal as the best practice for long-term management for used nuclear fuel and HLW.

Almost all countries with commercial nuclear power production are planning to isolate the byproduct of their nuclear fuel cycle in a deep geological repository, whether this is used fuel or HLW. These countries include the United States, Russia, Sweden, Finland, Switzerland, China, the United Kingdom, Japan, Germany, France, Spain, Belgium, Netherlands, and Hungary.

Planning for the Long Term

As part of the work it does on the international stage, the NWMO continued to participate in the NEA's International Collaboration on Preservation of Records, Knowledge and Memory Across Generations, a project currently in its second phase. The project supports the lengthy and complex decision-making processes that are inherent in the long operational and post-operational lifetimes of radioactive waste repositories. Its particular focus is on sharing international information, comparing approaches, testing potential solutions, and sharing decisions.

COLLABORATIVELY IMPLEMENTING THE SITE SELECTION PROCESS

The Nuclear Waste Management Organization (NWMO) will implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host.

In 2010, the NWMO initiated a multi-year, nine-step process for selecting a site where Canada's used nuclear fuel may be safely and securely contained and isolated in a deep geological repository. This process, developed through a two-year dialogue with interested groups and individuals, relies on community interest and support to move forward.

Collaboration is key to the process because the site selected for the project must not only meet or exceed strict safety and geoscientific requirements, but it must also have an informed and willing host. Working collaboratively with communities, the NWMO made significant progress toward advancing both goals between 2014 and 2016. In that time, it completed the first phase of preliminary assessments that take place in Step 3 of the process, initiated geoscientific fieldwork in several potential siting areas, and broadened engagement with First Nation, Métis, and other communities in the area to collaboratively explore the project and the extent to which it could fit in the area. As the NWMO learned more about the geology of an area and the aspirations of the communities and people for their area, it continued to narrow down siting areas to those showing strong potential to meet the project's rigorous technical requirements and for the project to foster well-being in the area as defined by the people living there.

White River residents learn about Adaptive Phased Management at a local open house.

HIGHLIGHTS 2014 TO 2016

2014

- The year begins with 17 communities participating in the site selection process: one community in Step 2 (Initial Screening); 12 in Step 3: Phase 1 Preliminary Assessments; and four in Step 3: Phase 2 Preliminary Assessments.
- The NWMO and Phase 2 communities initiate a broadened engagement program designed to begin to bring together interested communities, First Nation and Métis communities in the area, and surrounding municipalities to explore potential to work together to implement the project.
- Phase 1 Preliminary Assessments are concluded in Arran-Elderslie (Ont.) and Saugeen Shores (Ont.) after early findings show the two communities have limited potential to contain a site suitable for the project.
- High-resolution airborne surveys are conducted in the vicinities of the Phase 2 communities of Creighton (Sask.), Ignace (Ont.) and Schreiber (Ont.).
- The Township of Nipigon (Ont.) passes a resolution to withdraw from the site selection process after reviewing early findings from Step 3: Phase 1 Preliminary Assessments that identifies that the area has only limited potential to meet the requirements of the project.
- The Municipality of Central Huron (Ont.) passes a resolution to move into Step 3 of the site selection process, after successful completion of Step 2 Initial Screening.
- Direct observations of geological features are completed in the Phase 2 communities of Hornepayne (Ont.) and Ignace (Ont.).
- Phase 1 Preliminary Assessments are completed in Brockton (Ont.), Huron-Kinloss (Ont.), and South Bruce (Ont.). Huron-Kinloss and South Bruce are identified as a focus for more detailed Phase 2 assessments.

2015

- The year begins with 13 communities participating in the site selection process: seven in Step 3: Phase 1 Preliminary Assessments; and six in Step 3: Phase 2 Preliminary Assessments.
- Phase 1 Preliminary Assessments are completed in the Ontario communities of Blind River, Central Huron, Elliot Lake, Manitouwadge, The North Shore, Spanish, and White River. Blind River, Central Huron, Elliot Lake, Manitouwadge, and White River are identified as a focus for more detailed Phase 2 assessments.
- Airborne geophysical surveys of potential siting areas are conducted in the vicinities of the Ontario communities of Hornepayne, Manitouwadge and White River.
- Phase 2 Preliminary Assessments are concluded in Creighton (Sask.) and Schreiber (Ont.) after studies showed geological complexities that reduce the likelihood of finding a suitable site for a used nuclear fuel repository.
- The NWMO launches a program to acknowledge First Nation and Métis communities and organizations involved in early stages of engagement and learning about Canada's plan.

HIGHLIGHTS 2014 TO 2016

» The NWMO recognizes communities that participated in preliminary assessments and engagement in the areas of Creighton (Sask.) and Schreiber (Ont.).

» Detailed geological mapping is initiated in the vicinity of Ignace (Ont.). An Indigenous Knowledge Program and ceremonies precede fieldwork.

2016

» The year begins with nine communities participating in the site selection process, all in Step 3: Phase 2 Preliminary Assessments.

» In response to requests from communities to further explore the potential to foster well-being in an area, the NWMO shares economic modelling reports with communities as a starting point for discussing how they and their neighbours might maximize the project's economic benefits.

» Direct observations of geological features are conducted around Manitouwadge (Ont.) and White River (Ont.), followed by detailed geological mapping. Detailed geological mapping was also conducted around Ignace (Ont.) and Hornepayne (Ont.).

» Environmental characterization studies are conducted around Hornepayne (Ont.), Ignace (Ont.), Manitouwadge (Ont.), and White River (Ont.).

» Discussions are initiated about the shape and form of the Centre of Expertise, early approaches to skills and capacity building in siting areas to prepare for project implementation, and development of a planning framework for the transportation of used fuel required by the project.

» Community representatives participate in the Canadian Nuclear Society Conference on Nuclear Waste Management.

» Community representatives participate in the International Conference on Geological Repositories.

» The year ends with nine of the original 22 interested communities participating in the site selection process, all in Step 3: Phase 2 Preliminary Assessments. A number of First Nation and Métis communities are also involved in learning, which is facilitated by learning agreements. A number of surrounding municipalities are also involved in learning.

Steps in the Site Selection Process

Getting Ready	The NWMO publishes the finalized siting process.
Step 1	The NWMO initiates the siting process with a broad program to provide information, answer questions and build awareness among Canadians about the project and siting process.
Step 2	Communities identify their interest in learning more, and the NWMO provides a detailed briefing and conducts an initial screening.
Step 3	For interested communities that successfully complete an initial screening, a preliminary assessment of potential suitability is conducted in two phases. Preliminary assessments support an ongoing narrowing down of study areas.
Step 4	Detailed site evaluations are completed in one site identified as having strong potential to meet project requirements in Step 3 Preliminary Assessments.
Step 5	Acceptance to host the repository is confirmed.
Step 6	Formal agreement to host the repository is ratified, subject to all regulatory requirements being met and regulatory approval received.
Step 7	An independent, formal and public process is conducted under the Canadian Nuclear Safety Commission's (CNSC) regulatory framework to ensure that all requirements are met (please see chapter 2.4, *Regulatory Oversight of Canada's Plan*).
Step 8	Construction and operation of an underground demonstration facility proceeds.
Step 9	Construction and operation of the facility proceeds.

YOU MAY ALSO WANT TO LEARN MORE ABOUT…

- **Transportation planning**. Go to chapter 6.6 (*Developing Transportation Plans*).
- The NWMO's innovative **engineering** program. Go to chapter 6.3 (*Demonstrating Safety and Feasibility of Repository and Engineered-Barrier Design*).
- The NWMO's extensive **engagement activities**. Go to chapter 6.1 (*Building Sustainable Relationships*).
- **Planning activities with communities**. Go to chapter 6.4 (*Planning for Construction and Operation of Centre of Expertise and Deep Geological Repository*).

Initial Screenings (Step 2)

In 2014, the NWMO completed the last of 22 initial screenings. These screenings are conducted at the request of interested communities and take place in Step 2 of the site selection process. They use published data to evaluate the potential suitability of the community against a list of initial screening criteria. With the completion of these screenings, all 21 communities remaining in the site selection process were in Step 3 (preliminary assessments).

Preliminary Assessments (Step 3)

Preliminary assessments take place in Step 3 of the site selection process. The communities requesting them must first have successfully completed an initial screening (Step 2). In addition to assessing potential to meet the project's rigorous technical requirements, preliminary assessments also look at the project's possible impact on well-being, both in the community requesting the assessment and in the area as a whole.

The goal is to evaluate suitability from a wide variety of perspectives, integrating geoscientific, environmental, engineering, and transportation assessments with Indigenous Knowledge and community well-being studies. Assessments are informed by continuing input from the interested communities, First Nation and Métis communities in the area, and surrounding communities.

Conducted in collaboration with communities, preliminary assessments occur in two phases. The first consists of desktop studies of the communities that requested assessments. If these indicate a strong potential to meet the project's rigorous requirements, a second phase of more detailed studies, including fieldwork, is initiated. This second phase is meant to advance technical assessments and engagement to the point where a decision can be made to narrow down potential sites to one that will be the focus of the detailed site evaluations that take place in Step 4 of the site selection process.

Phase 1 Preliminary Assessments

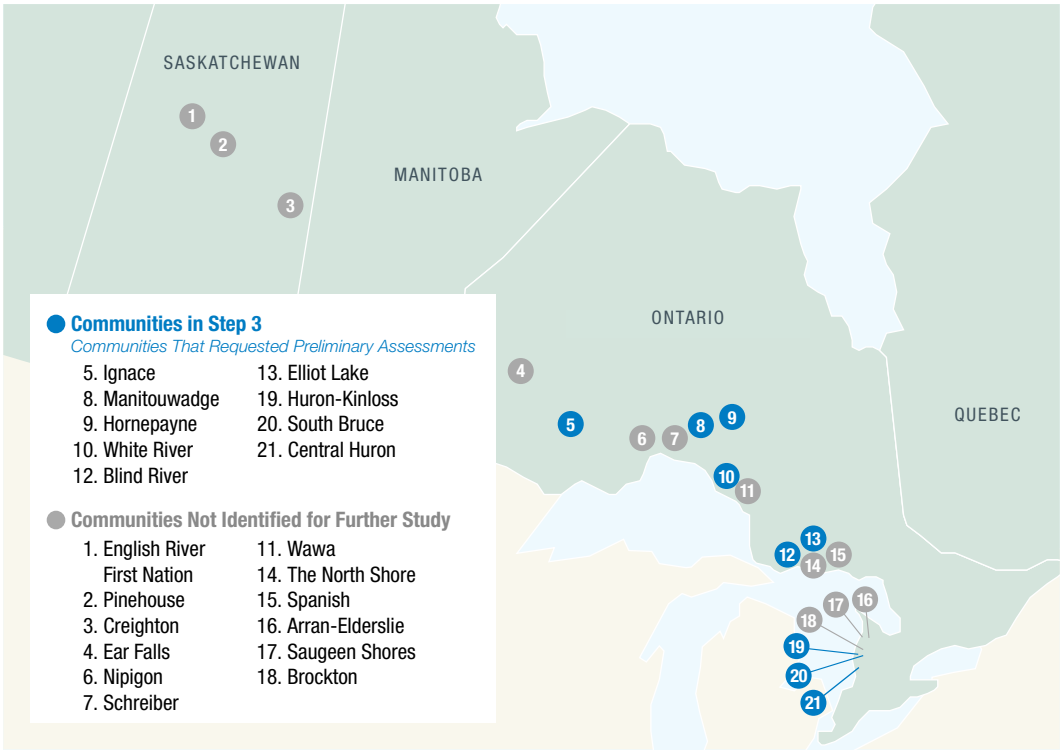
In 2015, the NWMO completed the last of 21 Phase 1 Preliminary Assessments. As these were completed, a smaller number of communities were identified for a second and more intensive phase of assessments, complemented by a broadened engagement of communities in the surrounding areas.

Phase 2 Preliminary Assessments

Six communities were identified for Phase 2 assessments in 2014. Five (Hornepayne, Huron-Kinloss, Ignace, Schreiber, and South Bruce) were in Ontario, and one (Creighton), in Saskatchewan. Five more Ontario communities (Blind River, Central Huron, Elliot Lake, Manitouwadge, and White River) were identified in 2015. That same year, Phase 2 assessments were concluded in Creighton and Schreiber after studies showed geological complexities that reduced the likelihood of finding a suitable site for a used nuclear fuel repository. As a result, the site selection process was narrowed down to nine interested communities and their surrounding areas.

DID YOU KNOW?

Between 2014 and 2016, the NWMO collected geophysical data along 76,000 kilometres of airborne survey lines.



Communities in the Site Selection Process as of 2016.

Geoscientific Fieldwork

Planned together with communities, three types of geoscientific field studies were conducted between 2014 and 2016: airborne geophysical surveys; direct observations of general geological features; and detailed geological mapping. As discussed in chapter 6.8 (*Ensuring Governance and Accountability*), the approach, methods and findings of these studies were reviewed by the Adaptive Phased Management-Geoscientific Review Group, a five-person panel of internationally recognized experts.

DID YOU KNOW?

Between 2014 and 2016, geoscientists working for the NWMO conducted direct observations of the geology at more than 2,300 mapping stations.

Local representatives join NWMO teams in observing general geological features in the vicinity of communities involved in Phase 2 Preliminary Assessments.

Airborne geophysical surveys were conducted around Creighton, Ignace, and Schreiber in 2014, and around Hornepayne, Manitouwadge, and White River in 2015. Surveys were conducted in locations where earlier assessments suggested there may be areas of land with potential to meet the technical safety requirements for a deep geological repository. To conduct the surveys, small, fixed-wing aircraft flew approximately 100 metres above the surface of the land, in straight lines approximately 100 metres apart. The data gathered helped the NWMO and communities in the area build a more detailed understanding of bedrock geology both at the surface and deep underground.

Direct observations of general geological features were conducted around Creighton, Hornepayne, Ignace, and Schreiber in 2014; and around Manitouwadge and White River in 2016. In these studies, geoscientists conducted initial visual observations that helped them better understand the lay of the land, and to confirm the presence and nature of key geological features such as fractures, rock types, extent of bedrock exposure, and surface constraints.

Detailed geological mapping, also known as detailed outcrop mapping, was conducted around Ignace in 2015 and 2016, and around Hornepayne, Manitouwadge, and White River in 2016. In these studies, geoscientists visited as many rock outcrops as possible in each area. They examined the structural character of the bedrock, especially the nature and distribution of fractures, as well as other physical characteristics of the rock such as mineral content, colour and texture. Additional information on the extent of bedrock exposure was also collected. The data gathered helped the NWMO and communities in the area build a more detailed understanding of bedrock geology. The work also provided information about the accessibility of the areas studied.

Environmental Studies

Preliminary environmental studies are conducted early on in Phase 2 assessments. They are meant to help develop an understanding of the general ecology of an area, and are distinct from the formal environmental assessment that will need to be conducted once a preferred site is identified. The first four environmental characterization studies were conducted in 2016 in areas around Hornepayne, Ignace, Manitouwadge, and White River. Teams of specialists conducted non-obtrusive observations of features such as sizes and types of streams in the area, types of local plants and animals, and fragmentation of existing forest. Where appropriate, they collected small samples of soil or plant life for further characterization and study.

Non-obtrusive fieldwork is a critical component of early preliminary assessments currently underway.

Exploring Well-Being

The NWMO is committed to implementing Canada's plan for the long-term management of used nuclear fuel in a manner that contributes to the long-term well-being of the area in which the project is located. Every community has its own views on what constitutes well-being. The factors they weigh include, but are not limited to, such things as economic considerations, population growth, and cultural and spiritual values. The NWMO works with communities to understand their well-being as they define it.

In the first phase of Preliminary Assessments, the NWMO produced community profiles. These descriptions, produced in collaboration with each community that requested an assessment, provide a preliminary look at the vision, objectives, infrastructure, and characteristics of the community. The community well-being assessment then examines the project's potential to foster well-being in the community in light of actual conditions there. The last seven of these studies were completed in 2015.

In Phase 2, work continued to address community-specific priorities, concerns and challenges revealed during Phase 1 dialogues. Among other things, Phase 2 assessments are designed to better understand local interactions with the land, environmental and spiritual considerations, specific economic contributions the project would make to area well-being, social and economic pressures that would occur, and what advance planning is required to address these pressures.

Broadened Engagement

Phase 2 assessments also further explore community and area interest in learning about the project and having it proceed in the area, while continuing to build awareness and understanding. As engagement broadens, spiritual considerations, ways of life, and other components and perspectives on well-being will also need to be considered.

Phase 2 assessments have begun the work of broadening this conversation to include First Nation and Métis communities and municipalities in the broader area. The NWMO continued to provide resources to engaged communities to facilitate their participation in these discussions. A program is also in place to support learning by neighbouring communities. The goal is to better understand the vision people in the area have for their future and then address ways in which the project might best fit with that vision.

Economic Modelling Reports

In 2016, the NWMO completed preliminary economic modelling studies for areas involved in the site selection process. The initial findings were meant as a starting point for discussing one dimension of well-being, namely how to maximize the project's economic benefits in an area. The results were shared with community liaison committees (CLCs) and people in the community and surrounding areas. The analyses provided initial estimates of the number and types of potential jobs the project would bring to the area, region and province as a whole.

Learning More Together

As described in chapter 6.1 (*Building Sustainable Relationships*), the NWMO worked with communities to plan and implement a broad range of opportunities for interested communities and their neighbours to learn more about the project and become involved in setting its direction. In addition to hosting open houses in siting areas and meeting with community groups and residents at community events, the NWMO engaged many individuals in one-on-one and kitchen-table discussions. The organization maintained permanent offices in all nine Phase 2 communities, with detailed exhibits about the project, transportation, community well-being, and other aspects of Canada's plan.

Communities also had opportunities to send representatives to conferences where they might learn more about different aspects of managing used nuclear fuel. At these conferences, attendees were able to meet directly with experts in the field, as well as with their counterparts from other communities.

One notable example included the 2015 Canadian Nuclear Society (CNS) conference. The conference was attended by representatives from communities that initiated their area's involvement in the site selection process, as well as by many of their First Nation, Métis and municipal neighbours.

Community representatives also attended the 2016 CNS Conference on Nuclear Waste Management, Decommissioning and Environmental Restoration.

On both occasions, community representatives were able to meet with nuclear industry representatives, independent subject matter experts, government officials, and elected representatives.

The 2016 International Conference on Geological Repositories, held in Paris and bringing together decision-makers from many countries, was another opportunity for community representatives to engage in learning and exchange on an international platform.

Between 2014 and 2016, the NWMO entered into Learn More Agreements with interested communities and some neighbouring communities to ensure capacity for learning about the long-term management of used nuclear fuel to facilitate engagement and reflection on the project.

The NWMO is represented at the 2016 International Conference on Geological Repositories.

A guest examines a scale model of a used nuclear fuel transportation container at the 2016 Canadian Nuclear Society Conference on Nuclear Waste Management, Decommissioning and Environmental Restoration.

Community Liaison Committees (CLCs)

CLCs help people in and around communities involved in Step 3 learn more about the project, get involved in preliminary assessments, keep abreast of ongoing work, and get answers to their questions. The local Council selects members and sets the mandate. The NWMO will, at the Council's request, cover administrative expenses. The NWMO also provides technical assistance for CLCs to set up their own websites and publish newsletters. Both can be accessed through www.clcinfo.ca.

CLCs played a vital role in facilitating the learning and engagement that take place in Step 3 of the site selection process. They helped plan open houses and other information sessions, invited guest speakers to make presentations, convened regular public meetings, and ensured local concerns and questions were addressed. To keep community members informed about the project and the site selection process, they published newsletters and maintained websites.

Tom Isaacs, the lead advisor to President Obama's Blue Ribbon Commission on America's Nuclear Future, discusses nuclear waste management issues with the South Bruce Community Liaison Committee in March 2016. Between 2014 and 2016, Mr. Isaacs shared his expertise with all nine Phase 2 communities.

Guest speakers the CLCs invited included Tom Isaacs, the lead advisor to President Obama's Blue Ribbon Commission on America's Nuclear Future; Jeremy Whitlock, the Manager of Non-Proliferation and Safeguards at Canadian Nuclear Laboratories; subject matter experts from the NWMO; and representatives from groups opposed to building a repository for managing used nuclear fuel. CLCs also invited staff from the CNSC to explain the Commission's independent regulatory role.

In Phase 1 communities, the CLCs' activities included helping develop community profiles, identifying community leaders, and providing guidance to NWMO relationship managers and consultants on engagement activities and communications materials.

In Phase 2 communities, CLCs supported regional involvement in the site selection process by reaching out to First Nation and Métis communities and municipalities in the surrounding areas. They actively encouraged their neighbours to attend open houses, information sessions and community events where they might learn more about the project and become involved in decision-making. Many CLCs also promoted learning more about Aboriginal culture by participating in cultural awareness sessions moderated by leading practitioners in the field. This activity complemented the NWMO's own direct outreach to First Nation and Métis communities.

Phase 2 CLCs also worked to involve people in their areas in planning the scope and timing of fieldwork. In the case of airborne geophysical surveys, they helped identify potentially affected landowners and trappers in flyover areas, along with others who might have an interest in the surveys. In the case of direct observations of general geological features and detailed geological mapping, they provided information about such factors as seasonal activities, culturally or ecologically sensitive areas, and people living on or using the land.

Plans for the technical studies were designed to address the sensitivities and concerns of people in the area identified through outreach and engagement activities. In many cases, the NWMO was accompanied by local guides knowledgeable about the area. Studies were stopped and restarted in a number of areas as questions arose through the conduct of the studies by people in the area, providing more time for engagement and further planning of the studies together.

Members of the Ignace Community Nuclear Liaison Committee visit one of the planes used to conduct airborne geophysical surveys.

Engaging and Working With First Nation and Métis Communities

As the site selection process has moved forward, the NWMO has significantly increased its engagement of First Nation and Métis communities in the vicinity of potential siting areas. This focus reflected the organization's strong commitment to advancing the project collaboratively, including with the involvement of First Nation and Métis communities.

NWMO staff met regularly to discuss the project in more than 50 First Nation and Métis communities between 2014 and 2016. Community members were encouraged to attend open houses and talk directly with NWMO staff, as well as with leaders and attendees from other communities in the area. Where invited, staff also participated in powwows, meetings, conferences, and other community events. Members of the Council of Elders and Youth accompanied staff to many of these meetings.

Between 2014 and 2016, the NWMO entered into Learn More Agreements with 11 First Nation and Métis communities, and 12 organizations at the local (e.g., Tribal Council), regional (treaty group), provincial, and national levels.

These agreements provided support to communities and organizations to build internal capacity for learning about the long-term management of used nuclear fuel, and to facilitate learn more activities such as briefings, workshops and tours of waste management facilities. The agreements also provide funding to undertake community well-being and traditional use studies, contracting for independent expert advice and communications.

NWMO staff visit the Pays Plat First Nation in Ontario.

Recognizing Community Leadership

Communities that initiated their area's participation in the site selection process have made important contributions to advancing a plan from which all Canadians will benefit. In recognition of their contributions, the NWMO provided $400,000 to each interested community that completed Phase 1 Preliminary Assessments, regardless of whether they were selected for Phase 2 assessments. This recognition was decided upon at the end of Phase 1 work and provided upon the establishment of a Community Well-Being Reserve Fund. Administered by the communities, funds support continuing efforts to build community sustainability and well-being in such areas as youth services, programs for seniors, sustainability, and economic development initiatives.

A similar one-time optional program to acknowledge the important role of First Nation and Métis communities in advancing these early studies was introduced in May 2015. Communities that participated in the first phase of the Preliminary Assessments in the site selection process became eligible to receive $250,000 to support community well-being initiatives such as programs for youth, elders and community sustainability. Contributions of $150,000 were also made available to similarly involved organizations.

In 2015, the NWMO acknowledged the substantial contributions made not only by Creighton (Sask.) and Schreiber (Ont.), but also by their municipal neighbours in advancing the site selection process on behalf of all Canadians. Creighton and Schreiber, and their neighbours Denare Beach (Sask.), Flin Flon (Man.) and Terrace Bay (Ont.), were awarded with $250,000 each after Phase 2 assessments indicated that both communities had geological complexities that reduce the likelihood of finding a suitable site in either area to safely host a deep geological repository for used nuclear fuel.

Following the exclusion of Creighton from further study, the NWMO also completed its engagement with Aboriginal communities and organizations in Saskatchewan. The NWMO provided briefings to explain why studies were concluded, and acknowledged the contributions of Aboriginal groups.

Looking Ahead

The NWMO's current reference plans anticipate that Phase 2 Preliminary Assessments may be concluded by the end of 2022. This assumption, adopted for planning purposes only, was developed based on a detailed review of the technical studies and the dialogue and engagement the NWMO believes will be required. Between now and then, it is anticipated that as studies are completed, decisions will be made to narrow down the number of study areas to focus on sites showing strong potential for strong safety cases, and strong potential for support and partnership among area communities. During that time, there will continue to be ongoing stock-taking by the NWMO and communities as results from progressively more detailed assessments become available and dialogue continues.

NEXT STEPS IN THE SITE SELECTION PROCESS

For more details about the next steps in the site selection process, please see chapter 10 (*Implementing Adaptive Phased Management 2017 to 2021*).

DEMONSTRATING SAFETY AND FEASIBILITY OF REPOSITORY AND ENGINEERED-BARRIER DESIGN

The Nuclear Waste Management Organization (NWMO) will conduct testing of the engineered-barrier system (EBS) in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently.

Canada's plan for the long-term management of used nuclear fuel relies on separate barriers to safely contain and isolate it on an indefinite basis. The outermost barrier is the natural rock formation enclosing the repository. The remaining are engineered and together known as the EBS. Each of the barriers provides a unique and stand alone level of protection.

This approach is internationally recognized as the safest and most responsible method of managing radioactive waste over the long term. It is the approach adopted by most countries with commercial nuclear power production, including Finland, France, Sweden, Switzerland, and the United Kingdom.

Between 2014 and 2016, the NWMO's engineering and design program made significant strides toward its goal of safely containing and isolating Canada's used nuclear fuel. It completed, in 2014, an award-winning EBS design. Since that time, it has further optimized that design, in part to take advantage of current manufacturing capabilities. A proof testing program was initiated to demonstrate that the EBS can meet the project's rigorous technical requirements. The NWMO also updated the conceptual repository designs to reflect the new reference EBS system.

In 2015, the NWMO was presented with the Canadian Nuclear Society Innovative Achievement Award for its leading-edge work in developing an engineered-barrier system for safely containing and isolating used CANDU fuel over the long term.

HIGHLIGHTS 2014 TO 2016

2014

- The NWMO completes a multi-year design of an engineered-barrier system (EBS) specifically designed for used CANDU fuel and begins implementation of a proof test plan to prove the system's safety performance.
- The NWMO builds its first container designed specifically for used CANDU fuel.
- The NWMO builds its first buffer box, including the steel shell and highly compacted bentonite.
- The NWMO designs specialty handling equipment capable of assisting in the testing of the used fuel container and buffer box system.
- To conduct proof testing activities, the NWMO acquires a preliminary test facility that will be a precursor to the Centre of Expertise to be located in a community once a repository site has been selected.

2015

- The multi-year proof testing plan is completed, and testing begins on the NWMO's EBS design.
- The EBS designed by the NWMO's technical program receives the Canadian Nuclear Society's 2015 Innovative Achievement Award.
- The NWMO designs a slip-skid pallet and fabricates the mechanism for emplacement of the used fuel container.
- The NWMO completes updates to its conceptual repository designs.
- The NWMO establishes process tolerances for cold-spray copper production.
- The NWMO fabricates a full-scale buffer box.
- The NWMO fabricates and pressure-tests a full-scale steel used fuel container prototype.

2016

- The NWMO initiates bentonite backfill (gapfill) emplacement demonstrations.
- The NWMO produces full-sized bentonite buffer blocks and fabricates a beta buffer box.
- The NWMO conducts an independent peer review on the generic corrosion program.
- The NWMO pressure-tests a full-scale copper-coated used fuel container prototype.
- The NWMO completes development of a copper electro-deposition reference procedure.
- The NWMO fabricates an emplacement room mock-up.
- The NWMO carries out demonstrations of the slip-skid placement of full-scale buffer boxes.

The NWMO's Christopher Boyle on-site at the Applied Research Laboratory's High-Pressure Test Facility at Pennsylvania State University.

Used Fuel Container

In 2014, the first NWMO-designed copper-coated used fuel container prototype was manufactured using the selected reference manufacturing process. In 2015, the NWMO continued with used fuel container prototype development and testing. This work included the fabrication of full-size copper-coated containers, as well as a steel prototype for the purpose of pressure testing. The results demonstrated that the container can withstand loads in excess of those anticipated at repository depth and matched the predicted failure load from the NWMO's computer models.

The NWMO produced additional used fuel containers to further support proof testing activities. In 2016, a full-sized copper-coated container underwent pressure testing at the Applied Research Laboratory's High-Pressure Test Facility at Pennsylvania State University. The results were consistent with those of the steel container testing in 2015, showing that the container performance is consistent with the NWMO model expectations.

Buffer Box

Key to the Canadian EBS is the buffer box, which encloses the used fuel container. The performance of the buffer box is based on achieving an overall dry density suitable to prevent microbial and chemical corrosion of the container from the adjacent rock and groundwater.

Why Bentonite?

Bentonite clay is basically weathered volcanic ash. It is an ideal sealing material because it is both very stable and forms a natural barrier to water flow. In the repository, the chemical properties of the bentonite clay would also help trap any radionuclides in the unlikely event of their escaping from the container.

In 2015, the NWMO initiated the development and testing of bentonite blocks to be used to surround the used fuel container in the buffer box. NWMO engineers worked with researchers at Pennsylvania State University and industry to develop equipment and procedures for manufacturing large buffer blocks. The result are highly compacted bentonite blocks, formed under very high pressure, which are then shaped to receive the used fuel container, with matching blocks on the top and bottom.

Top left: This prototype slip skid, designed by NWMO engineers, is designed to lift, transfer, and emplace the buffer box assembly onto a floor, as well as to stack buffer boxes.

Top right: The screw conveyor prototype designed by NWMO engineers fills the gap between the buffer box and the rock wall with densely packed pellets of bentonite clay.

Bottom: This structure, designed by NWMO engineers, is used to test whether gapfill has completely filled the space between a buffer box and the excavated rock wall.

Bentonite Placement

The NWMO made progress in 2014 and 2015 on the production and placement methods for bentonite pellets, or gapfill, which will be placed around the buffer boxes in the emplacement rooms underground. Bentonite powder is pressed into pellets, and these pellets are then placed by an auger into the void spaces around the buffer boxes until all space is filled.

Small-scale placement trials were completed in 2015, and building from that experience, full-size demonstrations were completed in 2016. The trials demonstrated the ability to fill the voids around the buffer boxes using a robotic auger to the required in-situ densities.

The NWMO team has been exchanging data on bentonite manufacturing and placement with Nagra, Switzerland's radioactive waste management organization, to the benefit of both organizations.

Proof Testing of the NWMO's Engineered-Barrier System (EBS) Design

In 2014, the NWMO completed a multi-year design of an EBS that has been optimized for CANDU fuel. In parallel, the NWMO developed a proof test plan to demonstrate key aspects of the system's safety performance. The plan serves two purposes: (1) to provide evidence in a licence application that the design meets the requirements of the NWMO's safety case; and (2) to show that the NWMO can successfully and repeatedly manufacture and operate all components of the EBS. The proof test plan includes work to demonstrate the functionality and operability of the used fuel container, including its ability to withstand repository loads and resist corrosion throughout the life of the repository.

In 2015, the NWMO finalized the proof testing plan and continued to further the design on elements of its EBS. Performance of many of its components were demonstrated through the fabrication and testing of physical prototypes. The results of these tests further demonstrated the NWMO's ability to meet the rigorous requirements of the repository environment, as well as the ability to manufacture using proven processes and practices. Designs and prototypes were also developed for emplacement equipment required to place the buffer boxes underground.

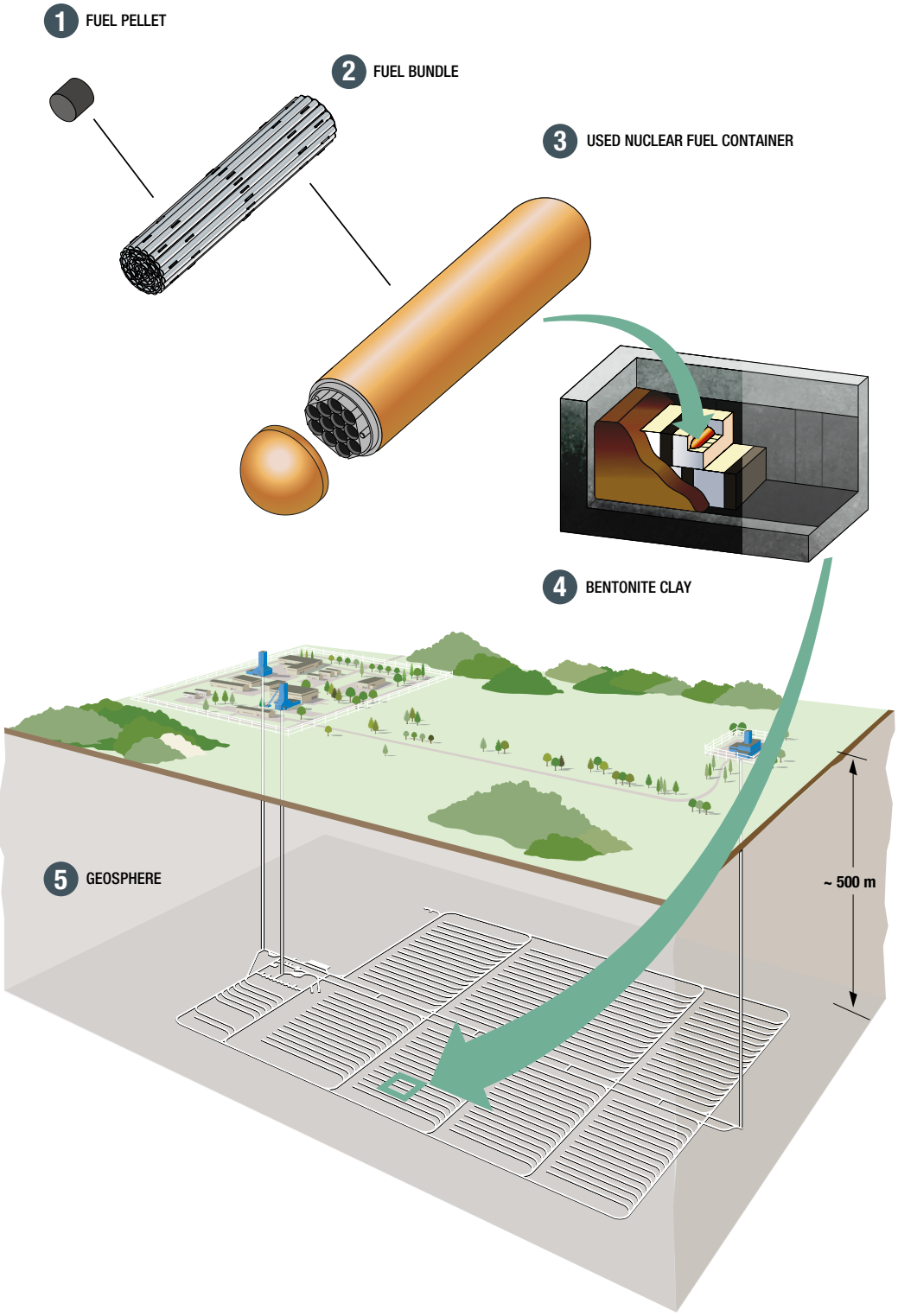
In 2016, the proof test facility was expanded so that the NWMO could conduct equipment trials and test material and component performance over the duration of proof testing. The NWMO continued to work with industry and academic partners for specific elements of the proof testing plan, including the hybrid laser arc welding of the used fuel container, and the electrodeposition and cold spray application of the copper coating. The NWMO has also advanced the development of process tolerances and non-destructive examination techniques, and equipment required to support the initiation of serial used fuel container production trials in 2017.

Conceptual Repository Designs

In 2014, the NWMO began the process of updating the conceptual repository designs for both crystalline and sedimentary geospheres to reflect the NWMO-designed EBS. This update helped inform both the updated project description published in 2015 and the updated lifecycle cost estimate published in 2016. At the same time, the NWMO implemented a configuration management system to host the engineering design data. The system will ensure engineering and design information, as well as the rationale behind the design evolution and changes over time, is controlled and available to all designers over the decades-long timeline of the Adaptive Phased Management Project.

The conceptual repository designs were completed in 2015. This work included assessing the impacts of the EBS design on the repository layout, used fuel container handling, and surface facilities. The conceptual repository designs supported both the update to the lifecycle cost estimate (completed in 2016) and further development of preliminary safety assessments.

Further optimization of various elements of the conceptual designs were carried out in 2016. The underground layout, and considerations for surface facilities, repository access, constructability, and schedule were incorporated to develop an alternative layout in crystalline rock.


1 FUEL PELLET
2 FUEL BUNDLE
3 USED NUCLEAR FUEL CONTAINER
4 BENTONITE CLAY
5 GEOSPHERE
~ 500 m

PLANNING FOR CONSTRUCTION AND OPERATION OF CENTRE OF EXPERTISE AND DEEP GEOLOGICAL REPOSITORY

The Nuclear Waste Management Organization (NWMO) will advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project.

In 2016, the NWMO introduced a new strategic objective to advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project.

Once a preferred site is selected for the Adaptive Phased Management (APM) Project – for planning purposes, assumed to be as early as 2023 – there will be an escalation of activity on many fronts in the local and regional area. These activities include a range of verification and demonstration activities, and initiation of the regulatory processes to support the future construction and operation of the deep geological repository and related surface facilities.

Artist's concept of what a Centre of Expertise could look like.

HIGHLIGHTS 2016

- The NWMO provided technical briefings about the Centre of Expertise within communities engaged in the site selection process to outline the technical and social activities planned for the centre in support of the project.
- The NWMO invited communities engaged in the site selection process to discuss social preferences for how the centre might be designed and developed, should their area be selected for the project.
- The NWMO initiated development of a jobs and skills inventory to identify the professions, trades, skills, and capabilities required to support the Centre of Expertise, the regulatory process, and the construction and operation of the deep geological repository.
- The NWMO initiated a hiring plan to build up locally based staff to support community engagement and field studies in potential siting areas.
- The NWMO initiated discussions with communities engaged in the site selection process about priority steps for developing skills and job opportunities for youth and local community members.
- The NWMO began discussion with communities on what investments in training, strategic hiring or business incubation may be important in building the prospects for local employment and businesses.

Planning for Construction and Operation

The NWMO's overriding objective in implementing the APM Project on behalf of Canadians is safety and security, for people and the environment. The NWMO will have to demonstrate that the project meets or exceeds strict regulatory requirements to protect the health, safety, and security of Canadians and the environment, while also respecting Canada's international commitments on the peaceful use of nuclear energy. The Canadian Nuclear Safety Commission (CNSC) is the main licensing authority for the APM Project. Please see chapter 2.4 (*Regulatory Oversight of Canada's Plan*).

In 2016, the NWMO provided technical briefings to the CNSC regarding siting field activities, technical design development and future plans. The NWMO also progressed discussions with the Ontario government to clarify processes for advancing fieldwork.

The NWMO initiated development of a preliminary jobs and skills inventory to identify the professions, trades, skills, and capabilities required to support the Centre of Expertise, the licence application process, and the construction and operation of the deep geological repository. The focus of this initial inventory was on the Centre of Expertise and site characterization that is planned to commence immediately following site selection.

The NWMO also developed a hiring plan to build up locally based staff to support community engagement and field studies in siting study areas. It discussed with communities in the site selection process what investments in training, strategic hiring or business incubation may be important in building the prospects for local employment and businesses.

Centre of Expertise

The Centre of Expertise will be located in or near the area selected to host the deep geological repository. Its key purpose following site selection will be to support the multi-year program of technical testing, verification, and demonstrations, and to support ongoing planning and discussion with community members. The Centre of Expertise would later be expanded to support construction and operation of the deep geological repository.

Once a preferred repository site is identified, the Centre of Expertise will support detailed underground site characterization work that will take place to confirm geological conditions at depth and gather additional data to develop the safety case. It may also serve as a training centre to prepare personnel to work on various aspects of project implementation.

The Centre of Expertise will be home to an active technical and social research and technology demonstration program during this period, involving scientists and other specialists in a wide variety of disciplines, including geoscience, engineering, and environmental, socio-economic, and cultural impact assessment. It will become a hub for knowledge sharing across Canada and internationally. International collaboration on the APM Project will be expanded as the centre welcomes scientists and visitors from abroad who wish to benefit from the work being led at Canada's national facility.

In 2016, the NWMO further developed the technical function and requirements of the Centre of Expertise, and initiated dialogue with the communities engaged in the site selection process to begin to understand community preferences for how the centre should be developed. Communities identified opportunities for the design and implementation of the centre beyond the technical requirements identified by the NWMO that would help make the project a good fit for their area. In 2016, the NWMO began discussions to better understand these opportunities. These discussions are expected to broaden and deepen as siting activities narrow and focus on a smaller number of communities and siting areas over the course of Phase 2 studies.

The NWMO updated the *Description of a Deep Geological Repository and Centre of Expertise for Canada's Used Nuclear Fuel* in late 2015 to incorporate additional information of interest to communities, including an elaborated description of the technical activities at the Centre of Expertise to support the construction and operation of the repository. NWMO staff continued to discuss the centre at community liaison committee meetings, and with other individuals and groups to explore opportunities for the centre to provide synergies with other local and area plans and aspirations. As discussion continues through Phase 2 studies, the plans and aspirations of First Nation and Métis communities will also be an important input to this discussion.

Conversations to date suggest there may be some important opportunities in the design and implementation of the centre:

- Location: Locating facility activities in the siting area, in a manner that recognizes and respects the municipal, First Nation and Métis communities in the vicinity, will be important.
- Physical design: Involving communities in the physical design of the facility to make sure it fits in with their vision for the future of the area, and is inclusive of the history and culture of the area, will be important.
- Community building: The centre could contribute to community building in the area. This might require including social amenities in the facility such as meeting spaces and more. This might also include contributing the expertise brought together in the centre to support important initiatives in the area beyond the APM Project such as environmental remediation.
- Training: The centre could be a hub for training, including a focus on the development of youth education and capacity development.
- Area economy: The centre could support other aspects of the area's economy through the use of the expertise brought together in the centre. Depending on the economy of the area, this could involve contributing to activities such as tourism and agri-business.

CONTINUOUSLY IMPROVING TECHNICAL KNOWLEDGE

The Nuclear Waste Management Organization (NWMO) will continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices.

The technical end point of Canada's plan is a deep geological repository where used nuclear fuel will be safely contained and isolated on an indefinite basis. By collaborating with leading researchers, both in Canada and other countries, the NWMO helps ensure its work is based on international best practices. At the same time, by sharing its own research advances, the NWMO is making significant contributions to the field of nuclear waste management, both in the geoscience of deep geological repositories and in the optimization of engineered-barrier systems (EBS).

Every June, the NWMO hosts a Geoscience Seminar that brings together specialists and scientists from around the world to discuss the latest advances in site characterization techniques. Among the attendees between 2014 and 2016 were representatives from more than a dozen universities, the Canadian Nuclear Safety Commission, the Geological Survey of Canada, and the nuclear waste management organizations of Finland, Sweden, Switzerland, and the United Kingdom. Graduate students whose work is supported by the NWMO made presentations at each of these seminars.

HIGHLIGHTS 2014 TO 2016

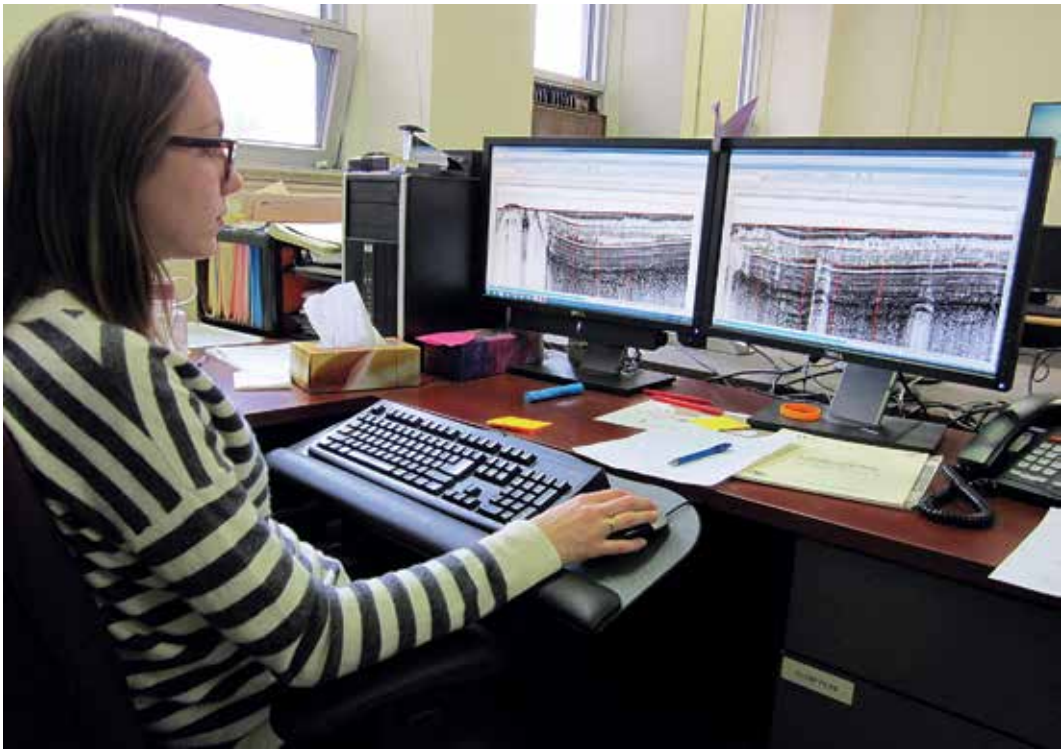
- The NWMO's technical research program continues to attract significant international interest with visiting delegations from Australia, Belgium, Finland, Japan, South Korea, Sweden, Switzerland, the United Kingdom, and the United States.
- The NWMO, together with the Natural Sciences and Engineering Research Council of Canada (NSERC) and the University Network of Excellence in Nuclear Engineering (UNENE), initiate an Industrial Research Chair in Radiation-Induced Corrosion at Western University.
- NSERC awards a five-year grant to the NWMO and the University of Ottawa to establish a hydrogeochemistry centre of excellence in the university's new Advanced Research Complex.
- The NWMO, together with NSERC, and other partners initiate an Industrial Research Chair in High-Temperature Aqueous Chemistry at the University of Guelph.
- The Korea Radioactive Waste Agency signs a memorandum of understanding with the NWMO, making it the sixth such organization to enter into a research partnership with the NWMO.
- The NWMO initiates a collaborative site analogue study at the Mont Terri Underground Research Laboratory in Switzerland to examine solute migration in geologic time scales.
- NWMO researchers continue to participate in collaborative research projects with their counterparts in other waste management organizations. Ongoing joint projects include the POST (fracture parameterization for repository design and postclosure analysis) project with Sweden and Finland, several experiments at Mont Terri in Switzerland, and the GAST (gas permeable seal test) experiment at Grimsel in Switzerland.
- NWMO researchers published more than 50 conference papers, technical reports and peer-reviewed journal articles.
- The NWMO supports research projects with 15 Canadian universities.
- The NWMO participated in the Nuclear Energy Agency's working groups, including the Expert Group on Operational Safety and its Expert Group in Inventory Reporting and Methodology.
- The NWMO continued to host its annual Geoscience Seminar.

Geoscientific Research

The key objective of the NWMO's geoscience program is to advance the understanding of the geosphere, in both crystalline and sedimentary settings, as part of developing a safety case for a deep geological repository for used nuclear fuel.

Key activities between 2014 and 2016 focused on the continued development and refinement of multidisciplinary surface-based site characterization and interpretative methods necessary to assess site-specific suitability for repository implementation and safety case development. Examples include:

- Characterization of the chemical and isotopic composition of porewaters occurring in low permeability sedimentary and crystalline rock that provide in-situ evidence of fluid origin, residence time and solute mobility;
- Estimation of the diffusive properties of low porosity, low permeability rock formations that can govern radionuclide migration rates and create passive natural barriers;
- Estimation of the sorptive properties of sedimentary rocks and bentonite under expected repository conditions;
- Assessment of far-field natural barrier integrity and repository geomechanical stability under extreme loading scenarios, involving, among others, used fuel canister heating, repository gas generation, glaciation, and earthquakes;
- Application of the innovative multi-scale synthetic rock mass approach for numerical estimation of rock mass displacements, yielding, and stability during repository development and postclosure;
- Development and validation of a geostatistical tool to generate 3D discrete fracture network models of fracture systems in crystalline terrain that influence repository positioning and passive safety;
- Development of optimized realizations of long-term climate change, including glaciation, permafrost, and glacial isostasy that can influence deep-seated groundwater system stability and repository performance;
- Characterization of fracture infill mineralogy with respect to the timing and composition of ancient fracture fluid movement and fracture creation;
- Assessment of paleohydrogeology in exploring the response of low permeability deep-seated crystalline and sedimentary groundwater systems to glacial loading and infiltration of glacial meltwater;
- Characterization of subsurface microbial communities that could influence radionuclide release and mobility and act as environmental tracers to further yield evidence of groundwater system isolation;
- Development and benchmarking of a numerical reactive transport code for use at multiple scales – repository to regional groundwater system – in estimation of coupled phenomena influencing system evolution and stability; and
- Assessment of the long-term strength threshold of sedimentary rock as relevant to the prediction of repository rock mass stability and excavation damage zone formation and mitigating measures.



The NWMO is working with the Geological Survey of Canada (GSC) to examine whether layers of lake bed sediments may preserve evidence of moderate to strong earthquake activity that occurred many thousands of years ago. This type of information is helpful in evaluating the long-term safety of a deep geological repository. Here a GSC co-op student uses geophysical interpretative software to mark the top and bottom of submarine landslide deposits.

Repository Safety

The objective of the repository safety program is to evaluate the long-term safety of any candidate repository site and design in order to assess and improve the safety of the proposed facility.

Between 2014 and 2016, the NWMO further developed its illustrative postclosure safety assessments. This work included the assessment of the updated design of the EBS and updated conceptual repository design.

Other activities included:

- Preliminary preclosure ALARA (as low as reasonably achievable) and hazard identification assessment;
- Analysis of the criticality safety of used CANDU fuel;
- Updated models and data for assessment of dose to plant and animal life;
- Characterization of the properties of sealing materials, especially under highly saline conditions;
- Characterization of the processes relevant to the long-term stability of used fuel;
- Support for prototype buffer/backfill tests underway at Grimsel and Mont Terri in Switzerland;
- Development of capabilities for determining element solubilities;
- Modelling of thermal conditions inside a container, in the repository area and in the geosphere; and
- Modelling of the impacts of glaciation on groundwater movement and contaminant transport.

THE NWMO'S PARTICIPATION IN THE NUCLEAR ENERGY AGENCY'S EXPERT GROUP ON OPERATIONAL SAFETY (NEA'S EGOS)

The NWMO is an active participant in the NEA's EGOS. Created in 2013 to identify and define international best practices in safely operating geological repositories for radioactive waste, the EGOS consists of members from 11 countries and the International Atomic Energy Agency. Between 2014 and 2016, the NWMO attended technical meetings of the EGOS to discuss operational safety topics, including fire protection measures, design and operation of ventilation systems, management of underground excavation and emplacement at the same time, and on-site transfer of radioactive waste and waste emplacement in geological repositories.

Between 2014 and 2016, the NWMO participated in several meetings and workshops organized by the Nuclear Energy Agency (NEA), including the June 2016 Joint NEA-International Atomic Energy Agency Workshop on Operational Safety of Geological Repositories.

In 2016, NWMO researchers and their counterparts at the University of Alberta and Queen's University completed a five-year research project to learn more about how deep geological repositories might respond to external stresses occurring thousands and even hundreds of thousands of years into the future. Co-funded by the Swedish Nuclear Fuel and Waste Management Company, the Natural Sciences and Engineering Research Council of Canada, and the NWMO, the project was designed to contribute to repository safety by better understanding rock mass strength over time.

Partnerships With Universities

Research partnerships with universities play an important role in ensuring the NWMO's technical work is scientifically rigorous. Between 2014 and 2016, the NWMO supported research with 15 universities, most of them in Canada.

Much of this research was aided by grants from the Natural Sciences and Engineering Research Council of Canada (NSERC). In 2015, for example, the NWMO, together with NSERC and the University Network of Excellence in Nuclear Engineering (UNENE) initiated an Industrial Research Chair in Radiation-Induced Corrosion at Western University. That same year, NSERC awarded a five-year grant to the NWMO and the University of Ottawa to establish a hydrogeochemistry centre of excellence in the university's new Advanced Research Complex. In 2016, NSERC, the NWMO, UNENE, and other partners initiated an Industrial Research Chair in High-Temperature Aqueous Chemistry at the University of Guelph. These grants also provided support to promising graduate and postgraduate students researching different aspects of nuclear waste management.

In 2015, NWMO-supported PhD candidates (third, fourth and fifth from left) took the top three prizes in the University Network of Excellence in Nuclear Engineering's annual poster competition.

The NWMO continued its participation in UNENE. An alliance of universities, nuclear power utilities, and research and regulatory agencies, UNENE is a not-for-profit corporation for the support and development of nuclear education, research, and development capacities in Canadian universities.

Other Collaborative Work

Partnering with other radioactive waste management organizations allows the NWMO to foster international co-operation on the development and demonstration of technology, learn from other countries' experience, and keep abreast of developments in repository design and safety case development for various host rock formations. The NWMO has co-operation agreements with its counterparts in Sweden, Finland, France, Switzerland, the United Kingdom, and South Korea.

Between 2014 and 2016, the NWMO continued to conduct and support joint research projects with international organizations and its counterparts in other countries, including Finland, France, Sweden, Switzerland, and the United Kingdom. These included the POST (fracture parameterization for repository design and postclosure analysis) project with Sweden and Finland, several experiments at Mont Terri in Switzerland, and the GAST (gas permeable seal test) experiment at Grimsel, also in Switzerland.

In May 2014, the NWMO and the Korea Radioactive Waste Agency signed a memorandum of understanding to share scientific and technical information.

The Greenland Analogue Project involved researchers from six countries. Findings were published in 2016.

Another notable example was the Greenland Analogue Project, a collaborative research project that brought together specialists, research scientists and engineers from six countries. The research, conducted between 2008 and 2013, focused on increasing scientific understanding of how an ice sheet interacts with areas both above and below ground – a key factor in evaluating the performance of a deep geological repository in future ice ages. In 2016, together with the nuclear waste management organizations of Sweden and Finland, the NWMO published and released the findings.

The NWMO participated in, or supported the organization and planning, of a variety of national and international technical conferences in the reporting period. These included the 2016 Canadian Nuclear Society Conference on Nuclear Waste Management, Decommissioning and Environmental Restoration, where the NWMO was a host sponsor. NWMO technical staff and contractors presented more than 30 papers, covering such topics as the EBS, repository design, site selection, and transportation of used nuclear fuel.

THE NWMO CO-HOSTS INTERNATIONAL CONFERENCE ON CORROSION

In May 2016, the NWMO, Ontario Power Generation and Canadian Nuclear Laboratories sponsored the sixth International Workshop on Long-Term Prediction of Corrosion Damage in Nuclear Waste Systems. The four-day conference, which was also supported by the European Federation of Corrosion, was held in Toronto.

The conference brought together some 70 researchers and industry professionals from more than a dozen countries. Attendees included representatives from the national waste management organizations of Canada, the Czech Republic, France, Japan, Sweden, Switzerland, and the United Kingdom.

In addition to nearly 40 presentations, there were 30 poster presentations highlighting the work of students and other researchers in the field. Five of the students are studying under professors whose research the NWMO jointly funds with NSERC.

Attendees of the 2016 International Workshop on Long-Term Prediction of Corrosion Damage in Nuclear Waste Systems visit the NWMO's proof testing facility.

DEVELOPING TRANSPORTATION PLANS

The Nuclear Waste Management Organization (NWMO) will establish safe, secure and socially acceptable plans for transporting used nuclear fuel.

Canada's plan for the long-term management of used nuclear fuel will require the material to be transported from sites where it is currently being stored on an interim basis to a single repository site where it will be safely and securely contained and isolated over the long term. Though selection of a site is a number of years into the future, work is already well underway to ensure that fuel will be transported in a way that is safe, secure and socially acceptable.

Two complementary programs support this work: a technical program that addresses all aspects of technical safety and security, and an engagement program that helps communities and other interested people learn more about the transportation of used nuclear fuel and encourages their involvement in planning.

Between 2014 and 2016, NWMO staff engaged extensively with both local and provincial first responders. In this photo, taken in 2014, a NWMO relationship manager (middle) meets with first responders in Ignace, Ontario.

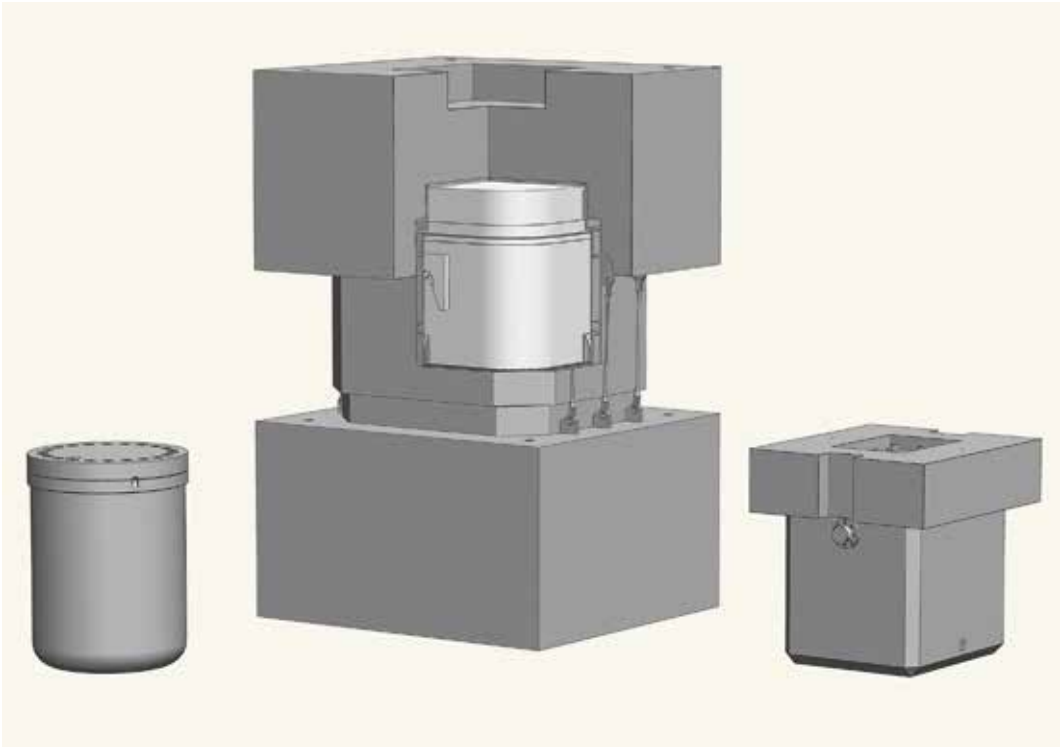
HIGHLIGHTS 2014 TO 2016

- After assessing several conceptual designs for transporting used fuel stored in Atomic Energy of Canada Limited (AECL) designed baskets, the NWMO selects one and initiates development and testing of the design concept.
- The NWMO initiates analytical fire and impact modelling of a used fuel transportation package concept for transporting AECL baskets.
- The NWMO co-organizes panels and presentations on transportation at the 2015 and 2016 annual conferences of the Canadian Nuclear Society.
- Working with researchers at Carleton University, the NWMO completes a detailed assessment of potential radiological exposure scenarios resulting from the transportation of used fuel in the Used Fuel Transportation Package. The assessment describes Canadian road and land development conditions, and is used to prepare a Canadian-specific dose assessment.
- The NWMO disseminates a transportation discussion document, *Planning Transportation for Adaptive Phased Management*, to encourage and advance discussion with communities.
- The NWMO contracts with third parties to initiate workshops and discussion groups to seek insights into citizen priorities for a safe, secure and socially acceptable approach to transporting Canada's used nuclear fuel.
- The NWMO initiates logistical studies for transporting used nuclear fuel.

Technical Program

Used nuclear fuel transportation packages are designed and tested to ensure protection of the public and environment during normal operations, as well as during severe accident conditions. Before a transportation package can be used in Canada, the Canadian Nuclear Safety Commission must certify the design as meeting its regulatory requirements, which incorporate international safety standards published by the International Atomic Energy Agency. The requirements include successfully passing tests designed to demonstrate the package's ability to withstand severe impact, fire and immersion in water.

Two existing used nuclear fuel transportation packages are certified for use in Canada that could be used to transport used fuel to the repository: a Used Fuel Transportation Package (UFTP) and a Dry Storage Container Transportation Package (DSC-TP). In 2015, the NWMO began reviewing design concepts for transporting Atomic Energy of Canada Limited (AECL) used fuel storage baskets. Cylindrical in design, these baskets are used for interim storage of the used nuclear fuel produced by AECL, New Brunswick Power Corporation and Hydro-Québec. In 2016, the NWMO selected a design and began computational analysis of its shielding, thermal and impact performance. This package is known as a Basket Transportation Package (BTP).



From left to right: a Basket Transportation Package (under development), Dry Storage Container Transportation Package and Used Fuel Transportation Package.

In 2015, the NWMO began an intensive engineering training program for transportation package design and testing, including the application of state-of-the-art software to simulate thermal and impact scenarios. This program reflects the NWMO's commitment to developing its own highly trained and skilled design team, rather than relying solely on outside vendors for transportation packaging. As part of the training program, staff attended advanced courses offered by the Argonne National Laboratory, Lawrence Livermore National Laboratory, the US Nuclear Regulatory Commission, and the US Department of Energy. These courses focused on package design, testing, verification, and analysis.

Researchers from Carleton University collect data on Canadian road conditions. Previous estimates were based on generic, internationally available exposure time, distance and frequency assumptions. The Carleton researchers considered a wide variety of possible exposure scenarios, including people living along transportation routes, pedestrians, hitchhikers, and drivers and passengers in the truck's vicinity.

A STRONG INTERNATIONAL TRACK RECORD

For more than half a century, Canada and countries around the world have been safely transporting used nuclear fuel by road, rail and water. During that time, there have been more than 20,000 shipments, with no serious injuries, health impacts, fatalities, or environmental consequences attributable to the radiological nature of used nuclear fuel shipments.

Dose Assessments

In 2014, the NWMO contracted with researchers at Carleton University to conduct a detailed assessment of potential radiological exposure scenarios resulting from the transportation of used nuclear fuel in a UFTP. The assessment looked at scenarios where members of the public along potential Canadian road transportation routes could receive a radiation dose. Using this Canadian-specific information, the NWMO prepared an assessment of potential dose to the public, and in each case, it found annual doses to be significantly below the regulatory public dose limit of 1 milliSievert (mSv) per year. The assessments showed that shipments of used fuel can be made safely, ensuring protection of Canadians and the environment.

Transportation: A Key Component in the NWMO's Preliminary Assessments

Phase 1 and Phase 2 Preliminary Assessments both include a transportation component. Phase 1 assessments are based on available published materials, and address the question of whether a safe and secure transportation route could be identified or developed from current interim storage locations to potential host sites. Phase 2 assessments use an expanded set of safety and security criteria, and include logistics and route assessment studies for illustrative road and rail routes. These studies are expected to take several more years to complete.

The NWMO's mobile transportation exhibit pays a visit to Elliot Lake, Ontario, in 2016. Between 2014 and 2016, the exhibit travelled almost 40,000 kilometres to 55 separate events. In addition to community events, it was also seen at conferences, including the 2014 meetings of Ontario Small Urban Municipalities and the Federation of Northern Ontario Municipalities; the 2014 and 2016 meetings of the Transportation Association of Canada; the 2015 and 2016 meetings of the Canadian Nuclear Society; and the 2016 International Workshop on Long-Term Prediction of Corrosion Damage in Nuclear Waste Systems.

Engagement Program

Transportation was an important focus in the NWMO's engagement activities between 2014 and 2016. NWMO staff had opportunities to engage with community members and interested individuals at a wide variety of venues, including meetings, briefings, monthly meetings of community liaison committees, open houses, and festivals and other local events. At the same time, NWMO outreach broadened to include First Nation and Métis communities and municipalities in the surrounding areas.

Through these activities, the NWMO continued to learn about the social considerations for developing transportation plans, along with the values, objectives and processes that will need to guide those plans.

Specific engagement activities included presentations by NWMO subject matter experts and hands-on viewing in communities and at conferences of the mobile transportation exhibit. To help visitors learn more about transportation planning, the exhibit underwent updates in 2016. Additions included information about DSC-TPs and BTPs, as well as display material explaining the concepts and engineering behind the container in which the fuel will be repackaged for storage in a deep geological repository.

As well, the NWMO continued to meet with local emergency management authorities to share information and seek their perspectives. At the provincial and federal levels, it continued to meet with officials in ministries and departments responsible for transportation safety.

Discussing Transportation at Conferences

The conferences and trade shows the NWMO attends provide numerous opportunities to bring people together to learn more about transportation planning and share their ideas. Examples included the annual conferences of the Ontario Good Roads Association and the Transportation Association of Canada (TAC), as well as the trade shows of municipal associations such as the Association of Municipalities of Ontario and its affiliates, the Federation of Canadian Municipalities, the Northwestern Ontario Municipal Association, and the Union of Municipalities of New Brunswick. In each of these events, the NWMO was able to engage municipal representatives in learning about transportation plans and discussing areas of mutual interest.

In 2015, the NWMO hosted a panel on transportation at the annual meeting of the Canadian Nuclear Society (CNS). At the 2016 CNS meeting, the NWMO participated in a technical session on waste transportation. Both meetings were attended by representatives from communities involved in the siting process, including First Nation and Métis communities and municipalities in the surrounding areas. At the 2016 TAC conference, the NWMO organized a panel discussion in which international and Canadian representatives spoke about safe transportation practices and experience from around the world.

Transportation Planning: An Ongoing Dialogue

In 2016, the NWMO began engagement with municipalities and Indigenous communities around a discussion document, entitled *Planning Transportation for Adaptive Phased Management*. The document is designed to seek insights from Canadians regarding their priorities for the future development of a plan for transporting used nuclear fuel that would meet their needs.

The NWMO also initiated public attitude research in order to learn more about the questions it needs to address in transportation planning, as well as the values, objectives and processes that need to inform that planning. In 2014, it commissioned Environics Research to conduct focus groups. Participants identified and explored issues the NWMO should be addressing as it broadens engagement around transportation planning. The findings were published in 2015 and are available on the NWMO website.

In addition to publishing a discussion document and seeking insight from communities involved in the siting process, in 2016 the NWMO began to broaden this dialogue with the planning of workshops and discussion groups organized by third-party consultants. Targeting a cross-section of Canadians, this early work is designed to ensure a diversity of views and perspectives shape the development of transportation plans.

PROVIDING FINANCIAL SURETY

The Nuclear Waste Management Organization (NWMO) will ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.

Canadians expect that the money necessary to pay for the long-term care of used nuclear fuel will be available when it is needed and will be fully funded by the waste producers. Financial surety has the objective of determining what costs can reasonably be expected to occur over the life of the project, along with a contingency for unexpected events, and then designing a system that collects enough money from the waste producers and protects this money to ensure that the entire cost can be covered under a variety of social and economic circumstances, and within the required time frame.

The NWMO completed a full update of these estimates in 2016. The updated cost estimate covers many decades of Adaptive Phased Management (APM) lifecycle activity for the deep geological repository and related transportation of used fuel. The eventual cost of this project is impacted by several variable factors, including the number of fuel bundles to be managed, the location of the facility, the nature of the surrounding infrastructure, the rock type and characteristics, the design of the repository, and the length of time allocated to monitoring the site following fuel placement.

The following table shows how estimated costs might differ depending on the amount of used nuclear fuel to be managed.

Estimated cost (2015 $) of APM from site selection start (2010) onwards

2.7 million fuel bundles (current number produced as of June 2016)	3.6 million fuel bundles	5.2 million fuel bundles	7.2 million fuel bundles
$16.3 billion	**$18.3 billion**	**$22.8 billion**	**$28.4 billion**

These cost estimates include the costs to develop, construct and operate a central long-term facility, including a deep geological repository and transportation for the used nuclear fuel to the repository, which are carried out and funded by the NWMO. Reactor site storage is carried out and directly funded by the individual waste owners.

The NWMO is committed to providing regular assessments on all those factors to ensure that sufficient funds are set aside.

The NWMO will also be monitoring any development in new reactors and new owners of used nuclear fuel, applying the appropriate principles to the update of the funding formula when the specific circumstances arise.

The APM program is implemented with waste owner funds collected from ratepayers through the sale of electricity and with funds from Atomic Energy of Canada Limited commensurate with its small volume of used fuel that will need to be managed. The NWMO is committed to the prudent use of these resources.

As required by the *Nuclear Fuel Waste Act*, the NWMO's annual and triennial reports must outline the funding formula for the next fiscal year to ensure funds required to cover the full costs of the implementation of APM is borne by the waste producers and an explanation of assumptions is provided. Trust funds must be maintained, and annual contributions made by major waste producers, reflecting the funding formula. Please see chapter 9.2 (*Financial Reporting Requirements*).

HIGHLIGHTS 2014 TO 2016

- The NWMO performed annual assessments of all factors that impact Adaptive Phased Management (APM) cost estimates and funding requirements.
- The NWMO determined annual trust fund contribution requirements in accordance with the funding formula.
- In 2016, the NWMO completed a full update of lifecycle cost estimate for the APM Project.

ENSURING GOVERNANCE AND ACCOUNTABILITY

The Nuclear Waste Management Organization (NWMO) will maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

Multiple layers of oversight and peer review help ensure the integrity of the NWMO's work. Internally, the organization is governed by its Board of Directors. In addition, numerous external reviews and reports, along with a robust management system, help ensure that Canada's plan is implemented in a way that meets the highest standards.

Annual Reporting to the Minister of Natural Resources

The NWMO continued to report to Canada's Minister of Natural Resources, as required by the *Nuclear Fuel Waste Act* (*NFWA*). In compliance with the *Act*, the NWMO submitted two annual reports, in 2014 and 2015, and one longer triennial report, covering the years 2011 through 2013. This last report, also a requirement under the *NFWA*, included the comments of the Advisory Council, a summary of comments and other feedback received from the public on the NWMO's work, and the organization's implementation plan for the next five years (2014 through 2018). All three reports were made public and tabled in Parliament. The reports can be read at www.nwmo.ca. The minister's comments on each can be read at www.nrcan.gc.ca.

HIGHLIGHTS 2014 TO 2016

- Annual reviews by the Minister of Natural Resources acknowledge the NWMO's progress in implementing Canada's plan for the long-term management of used nuclear fuel.
- NWMO staff form part of the Canadian delegation to the fifth Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- Through ongoing reviews of approaches, methods, and interpretation of data, the Adaptive Phased Management-Geoscientific Review Group continues to help ensure preliminary geoscientific assessments are conducted according to best international practice.
- The NWMO's integrated management system is audited annually by an accredited organization and continues to be certified compliant with Canadian (CSA) and international (ISO) management system standards.

FROM THE COMMENTS MADE BY THE MINISTER OF NATURAL RESOURCES ON THE NWMO'S ANNUAL AND TRIENNIAL REPORTS

"So far, I am encouraged by the results of the siting process, which was launched by the NWMO in 2010, to find an interested community. Twenty-two communities came forward to learn more about the plan and to express their interest in hosting a national facility. Through the NWMO's siting process of mutual learning and evaluation, there are now 14 communities continuing on in the process. I would like to extend my appreciation to all of the communities and citizens that have come forward to help shape the direction of this plan and, at the same time, contribute to such an issue of national importance. Community involvement and engagement is an essential ingredient of this process."

– The Honourable Greg Rickford on
Learning More Together: Triennial Report 2011 to 2013

"I am pleased with the progress the NWMO has achieved toward the site selection process launched in 2010. By the end of 2014, it had actively engaged with 21 communities in Ontario and Saskatchewan, including First Nations and Métis communities that had expressed an interest in hosting the waste management facility. The ultimate success of the project depends upon community engagement and lasting partnerships."

– The Honourable Greg Rickford on
Progress Through Collaboration: Annual Report 2014

"The report describes the NWMO's activities and achievements in community and government engagement, public outreach and education, research and technology development and international collaboration. It also highlights the NWMO's extensive efforts to reach out to Indigenous communities to benefit from their partnership, knowledge and experience…The Government of Canada believes strongly in the importance of the NWMO's mandate, and will continue to ensure that the organization fulfills its responsibilities under the *Nuclear Fuel Waste Act* as it implements Canada's plan for nuclear fuel waste."

– The Honourable James Gordon Carr on
Progress Through Collaboration: Annual Report 2015

Technical Review

Peer review by internationally recognized experts plays a crucial role in helping ensure the NWMO's technical work follows best international practice. A notable example is the Adaptive Phased Management-Geoscientific Review Group (APM-GRG). Established by the NWMO in 2012, the APM-GRG provides advice and review on the preliminary geoscientific assessments conducted in Step 3 of the site selection process.

The APM-GRG's reviews focus on:

- The approach, methods and criteria used to conduct Phase 1 desktop geoscientific assessments and to identify critical uncertainties relevant for selecting a subset of communities suitable for Phase 2 assessments;
- The approach and methods used to plan and conduct initial Phase 2 field activities, including the acquisition and interpretation of airborne geophysical surveys, lineament interpretation using the newly acquired high-resolution geophysical and remote sensing data, and geological mapping; and
- The approach and methods to assess the overall geoscientific suitability of communities in the site selection process.

The APM-GRG's findings and recommendations are presented to the Board of Directors and Advisory Council, and its reports are posted on the NWMO's website.

MEET THE MEMBERS OF THE NWMO'S ADAPTIVE PHASED MANAGEMENT-GEOSCIENTIFIC REVIEW GROUP (APM-GRG)

The APM-GRG is composed of five internationally recognized experts from Canada, Sweden, Switzerland, and Australia. They combine extensive multidisciplinary experience in areas relevant to the siting of deep geological repositories in both crystalline and sedimentary rock formations.

1 Dr. Andreas Gautschi is Chief Geoscientific Advisor at the Swiss National Cooperative for the Disposal of Radioactive Waste. Dr. Gautschi has more than 30 years of geoscience experience related to the planning, co-ordination and implementation of site evaluation programs for deep geological repositories in both crystalline and sedimentary rocks. He co-ordinated successful geoscience activities that contributed to the selection of the Opalinus Clay formation as the preferred geologic setting for the long-term management of high-level waste in Switzerland. He also has a lectureship at ETH Zurich.

2 Dr. Alexander Cruden is a Professor and Head of the School of Earth, Atmosphere and Environment at Monash University (Australia). Dr. Cruden has more than 25 years of geoscience experience related to structural geology, analysis and characterization in both crystalline and sedimentary rock settings. Dr. Cruden completed a fault reactivation analysis and structural characterization of southwestern Ontario as part of site characterization activities for Ontario Power Generation's proposed low- and intermediate-level waste deep geologic repository at the Bruce site.

3 Dr. Richard Smith is a Professor in the Department of Earth Sciences at Laurentian University, where he is the Industrial Research Chair of Exploration Geophysics. He has expertise in the application of geophysical methods generally and airborne methods specifically to investigate the geosphere at depth. Dr. Smith brings over 20 years of experience working in the exploration business. In 2015, he was asked by the Geological Society of London and the UK Department of Energy and Climate Change to be a member of the National Geological Screening Independent Review Panel. This panel is reviewing and evaluating the national screening guidance that the Radioactive Waste Management Limited has developed and will apply in order to select regions that would be suitable for a deep geological repository.

4 Dr. Peter Kaiser, Chair of the APM-GRG, is Professor Emeritus of Mining Engineering at

Laurentian University, former Chair for Rock Engineering and Ground Control, former Director of the Rio Tinto Centre for Underground Mine Construction, and former Founding Director of the Centre for Excellence in Mining Innovation. His interests lie in geomechanics, underground excavation stability, mine design, mechanized excavation, and the applications of other emerging technologies that increase mining safety and productivity. Dr. Kaiser is a Fellow of the Canadian Academy of Engineers and a Fellow of the Engineering Institute of Canada. He is the author of more than 350 technical and scientific publications.

5 Dr. Michael Stephens is a retired Senior State Geologist with the Geological Survey of Sweden in Uppsala. Dr. Stephens has been actively involved in the Swedish site evaluation process, including country-wide reconnaissance studies conducted in Sweden to identify potentially suitable regions for hosting a deep geological repository, geoscientific feasibility studies, and the detailed site characterization of the Forsmark site which was selected by SKB (the Swedish Nuclear Fuel and Waste Management Company) as the site for the deep geological repository for used nuclear fuel in Sweden.

In June 2016, the NWMO convened an expert panel to review its corrosion program. The three reviewers were Dr. Damien Féron of France's Alternative Energies and Atomic Energy Commission, Dr. Hannu Hänninen of Aalto University, and Dr. John Scully of the University of Virginia. Following a day of presentations by members of the Adaptive Phased Management technical program, the reviewers questioned NWMO staff and researchers about the results of work completed so far and the directions of future work.

Other Technical Review

As the work of the APM technical program becomes increasingly specialized, the NWMO will co-ordinate independent reviews of its work by assembling groups of experts with relevant subject matter expertise. In 2016, for example, the NWMO convened an expert panel to review its copper corrosion program. Copper is used on the exterior of used fuel containers to minimize corrosion, and the panel discussed safety issues around the metal's performance in a deep geological repository.

NWMO Participation at the Joint Convention

Internationally, Canada reports on its progress at meetings of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Canada's reports to the Joint Convention are made under the auspices of the Canadian Nuclear Safety Commission (CNSC), and are part of the convention's requirement that Canada and other signatory nations demonstrate that they are meeting international commitments to manage radioactive waste and used nuclear fuel safely.

In 2014, the NWMO participated in the development of the Canadian National Report for the 2015 review meeting of the Joint Convention. At the meeting itself, NWMO staff provided an update on progress made toward the long-term management of Canada's used nuclear fuel since 2012, the year of the previous review meeting of the Joint Convention. The update included the current inventory of Canada's used nuclear fuel, the status of the site selection process, and current studies on the NWMO's engineered-barrier system.

The Canadian National Report, questions on it from other countries and Canada's responses, and the Canadian presentation to the 2015 meeting are posted on the CNSC's website.

Quality Management

In alignment with its fundamental values pertaining to accountability, engagement, and excellence, the NWMO continued to maintain an integrated management system compliant with Canadian and international standards. The organization has maintained certifications to ISO 9001:2008 for quality, ISO 14001:2004 for environment, and CSA Z1000:2006 for safety management. In addition to maintaining conformance to these standards, the NWMO's management system was further enhanced to meet the requirements of CSA N286-12 (Management System Requirements for Nuclear Facilities), which includes nuclear waste facilities.

The management system requires careful planning of work to ensure the organization's products and services consistently and reliably satisfy the needs of communities, regulators and others who may be affected by the project. The system also ensures the NWMO considers and plans for contingencies, and meets high standards for quality, safety and the environment.

As the organization continues to implement APM and progresses through the site selection process, the management system will be further refined to meet the requirements and become certified to the new ISO 9001:2015 standard for quality and the new ISO 14001:2015 standard for environment.

The Canadian delegation to the 2015 review meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The delegation was led by Ramzi Jammal, Executive Vice-President and Chief Regulatory Officer at the Canadian Nuclear Society Commission (CNSC), and included representatives from the CNSC, Natural Resources Canada, industry, and the NWMO.

RADIOACTIVE WASTE

Low-level radioactive waste consists of industrial items that have become contaminated with low levels of radioactivity during routine cleanup and maintenance activities at nuclear generating stations.

Intermediate-level radioactive waste consists primarily of used nuclear reactor components, ion-exchange resins, and filters used to purify reactor water systems.

OTHER ACTIVITIES: ONTARIO POWER GENERATION'S DEEP GEOLOGIC REPOSITORY PROJECT FOR LOW AND INTERMEDIATE LEVEL WASTE

Since 2009, the Nuclear Waste Management Organization (NWMO) has been under contract to Ontario Power Generation (OPG) to develop and support the application for a site preparation and construction licence for a deep geologic repository for the long-term management of low- and intermediate-level radioactive waste at the Bruce nuclear site in the Municipality of Kincardine. In 2011, OPG further contracted with the NWMO to manage the detailed design and construction of the future repository following receipt of a licence for the repository.

The NWMO's work on behalf of OPG is separate from its mandate to implement Adaptive Phased Management (APM). The OPG repository would be used only to contain and isolate low- and intermediate-level waste from the Bruce, Pickering and Darlington generating stations. (The APM repository, by contrast, would be used to contain and isolate used nuclear fuel from all Canadian nuclear stations.) In both cases, a licensing decision can be taken only after the successful completion of the environmental assessment process under the *Canadian Environmental Assessment Act* (*CEAA*), 2012. The NWMO's involvement in the project reflects its unique expertise in repository development. Once complete, OPG will assume operation of the repository.

The OPG deep geologic repository would be approximately 680 metres below ground in low permeability limestone, beneath a 200-metre-thick layer of low permeability shale. These sedimentary bedrock formations provide multiple natural barriers which will safely contain and isolate the radioactive waste for 100,000 years and beyond.

In October 2014, attendees at the Eastern Section Meeting of the American Association of Petroleum Geologists made a field trip to the Kincardine site. The tour included a review of the deep borehole pressure monitoring, viewing of core samples, information on geoscientific verification, and discussion during which ideas and insights were shared.

Site Investigations

For the period of 2014 to 2016, site activities have been limited to maintaining baseline monitoring of both groundwater and surface water. The site's shallow and deep boreholes were routinely monitored, including sampling of sediments, surface water and shallow water quality, surface water flows, and shallow groundwater quality. In the deep boreholes, although there is no flowing groundwater present at repository depth, measurements of hydraulic formation pressures were continued. These measurements help verify that conditions in the deep bedrock are stable.

Regulatory Approvals

The Joint Review Panel (JRP) established in 2012 is responsible for (1) examining the potential environmental effects and preparing a Panel report in accordance with the requirements of the *CEAA*; and (2) considering OPG's licence application submitted under the *Nuclear Safety and Control Act* to prepare a site and to construct the deep geologic repository facility.

In May 2015, following 33 days of public hearings conducted in 2013 and 2014, the JRP delivered its Report to the federal Minister of Environment for review and decision under the *CEAA*. Citing "a strong safety case," "highly suitable geology," and "robust engineering," it concluded that the "project is not likely to cause significant adverse effects on the health and safety of the public and workers taking into consideration the commitments made by OPG, the proposed mitigation measures, and the additional recommendations from the Panel."

Following the release of the report, the Canadian Environmental Assessment Agency invited public comments on potential conditions related to possible mitigation measures and follow-up requirements that could be necessary should the project be authorized to proceed.

On February 18, 2016, the Minister of Environment and Climate Change requested further information be provided by OPG before a decision is made on the environmental assessment. The NWMO supported OPG in the preparation of responses to the minister's request, and OPG provided the material at the end of 2016. A decision on the environmental assessment is expected in 2017.

More information about the project and regulatory approvals process is available online at www.opgdgr.com.

Social, Economic and Cultural Considerations

The Nuclear Waste Management Organization (NWMO) has adopted a collaborative approach to the implementation of Canada's plan for managing used nuclear fuel over the long term. This collaborative approach is the foundation for building relationships, shared learning, and planning and implementing preliminary assessments. Identifying the social, economic, and cultural considerations, understanding these considerations, and seeking the advice and participation of the communities it is working with to address them at each phase of work is a key component of the NWMO's approach to its work and engagement of communities.

Broad Framework

In order to ensure a broad, inclusive and holistic approach, a well-being framework was used as the starting point for the social assessments. These studies formed part of the first phase of preliminary assessment focused on the communities that entered the siting process and initiated work in their area. The framework is used to help explore the project, understand how communities and the surrounding area may be affected should the project be implemented in the area, and identify opportunities to leverage the project to achieve other objectives important to people in the area. The framework was designed to encourage exploration of the project through five different "lenses."

- People or Human Assets: How might the implementation of the project affect people?
- Economics or Economic Assets: How might the implementation of the project affect economic activity and financial health of the area?
- Infrastructure or Physical Assets: How might the implementation of the project affect infrastructure and the physical structures that the community has established?
- Society and Culture or Social Assets: How might the implementation of the project affect the sense of belonging within the community and among residents, and the services and network of activities created to serve the needs of community members?
- Natural Environment or Natural Assets: How might implementation of the project affect the natural environment and the community's relationship with it?

Enhancing the Framework

Many Dimensions of Well-Being	
People	» Employment » Training » Opportunities for population growth
Infrastructure	» Water and wastewater » Schools and libraries » Emergency services » Roads
Environment	» Land » Livable communities » Protection of environmental values
Community and Culture	» Enhancement of community values » Ways of life » Cultural traditions
Economics and Finance	» Economic diversity » Revenue

The NWMO initiated work to re-examine this framework for appropriateness as it advanced to the second phase of preliminary assessment, which by design extends beyond the interested community to include First Nation and Métis communities in the vicinity, as well as surrounding communities.

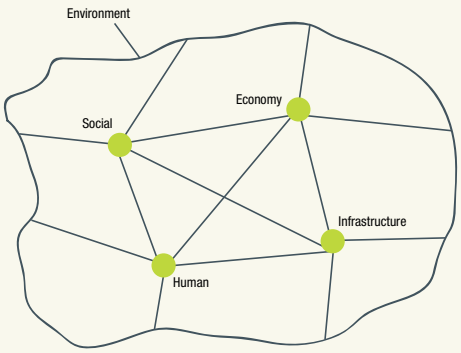
In 2014, the NWMO hosted a workshop to review the framework and identify opportunities for refinement to include considerations relevant to Aboriginal communities and surrounding municipalities. Facilitated by Joanne Barnaby and Elder Fred Kelly, the workshop involved community well-being practitioners, consultants, Elders, and NWMO staff. This group encompassed a diverse background and experience in planning and consulting with communities, particularly in rural and remote regions of Canada.

In exploring how the framework may need to evolve, participants created images to explore key components of well-being, and how to better visualize these components and their interrelationships. Among the images emerging from the discussion, one focused on how the environment relates to other components of the well-being framework, and was reflected in a community well-being web or net. The environment exists, whether or not other components are present. Another reflected a softer and rounded (circular) face leveraging the current well-being assets.

A number of important reflections for moving forward emerged from these discussions. There is a need to ensure that any plan for addressing the questions inherent in community well-being needs to be flexible enough to accommodate different world views. Workshopping approaches on a regional basis with Aboriginal communities that surround those under consideration may provide an opportunity to establish planning parameters, as well as measures of success. What is key is that individual communities are supported to develop a vision that gives them a way forward and that is meaningful to them.

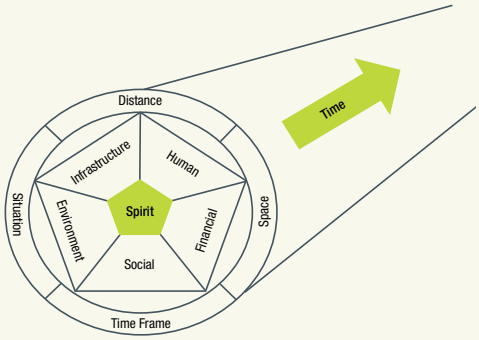
This community-driven approach has guided the NWMO's work as it has broadened engagement. This has meant taking the time to understand the community through the community's own eyes, as well as the effects of the project and project-related activities. The NWMO continues to learn from communities about the many dimensions of well-being that are important to people in an area. Conversations continue about the many aspects of well-being that need to be considered.

The Community Well-Being Web/Net



Environment is not just one asset or consideration. It is the context within which other assets or considerations are evaluated.

The Community Well-Well-Being Circle Over Time



Spirit = Desires = Aspirations

The intent is to measure implications to community well-being over time since events and situations are dynamic, but always linked to spirit at the core.

These images were created in a 2014 workshop to explore key components of well-being.

The NWMO works collaboratively with local users of the land, knowledge holders, and communities to plan and implement field studies.

Activities

The NWMO completed the first phase of preliminary assessment for the last of 21 communities engaged in the site selection process in October 2015. Study reports and decision documents for those that continue to be a focus of study, and others that are no longer being studied, are published on the NWMO website and can be accessed in the *What We've Done* section under each community at www.nwmo.ca/StudyAreas.

A Broader Focus

With the subset of nine communities advancing in the siting process, the second phase of preliminary assessment continues to focus on a holistic approach to identifying, understanding, and shaping decisions to address social, economic, and cultural considerations. Moving beyond the initially interested community, studies continue to include a well-being focus, gradually broadening out to activities and analysis of effects at a broader area or regional level.

Among other activities, the NWMO conducted a workshop with economic development officers in the area around Blind River and Elliot Lake; made presentations to and held discussions with planning groups such as Northeast Superior Mayors' group, Algoma Futures, and PACE, a Community Futures Development Corporation in northwestern Ontario; and engaged environmental planning groups, including several Forest Management Citizen Advisory Committees.

Social and cultural considerations are identified and interwoven in the approach to the planning, conduct and interpretation of fieldwork. For example, timing, ecologically sensitive areas and the movement and activities of sensitive species, harvesting, and recreational activities are taken into account in the planning of airborne surveys. Ceremonies, local guides, timing, and suitable areas for study are collaboratively decided upon before geophysical and environmental mapping occurs. Similar collaborative planning and social review is underway as the NWMO begins discussions on technically suitable areas and next steps for borehole studies. The NWMO's Aboriginal Policy and Indigenous Knowledge Policy are designed to support these discussions.

Economic Modelling

As communities advanced in the second phase of preliminary assessment, they became more interested in some of the well-being aspects of Canada's long-term plan for used nuclear fuel. Activities undertaken to support this discussion included economic modelling and traditional land use studies.

In 2015, the NWMO commissioned a model to help understand economic effects associated with the project. The model uses a community-based approach and economic multiplier information derived from Statistics Canada's Interprovincial Input-Output Model of the Canadian Economy to provide a general idea of expected job numbers, based on currently available information.

A preliminary analysis was conducted for each study area, and the resulting reports, shared with communities and published on the NWMO website. The information was used to facilitate conversations with communities involved in the site selection process, and these conversations continue.

The modelling confirmed that if the project proceeds in an area, it will create many jobs. Given the extended implementation time frame, there would be many opportunities for people living in the area. New families would be attracted to the host region and would also contribute to communities in the area.

Resources

Throughout its preliminary assessment work, the NWMO has provided resources to communities involved in the siting process to cover costs associated with their participation through funding programs, including funding for strategic planning. As communities moved into the second phase of preliminary assessment, enhanced funding programs were established to encourage planning at an area level and help facilitate partnership.

Similar funding mechanisms are in place to support First Nation and Métis communities in potential siting areas as they develop their understanding of how the project might align with their values and long-term objectives. Resources are made available for communities to explore historical, current and future land uses in their traditional territories. Current and enhanced programs in place for both Indigenous and non-Indigenous communities are outlined on the NWMO website at www.nwmo.ca/ResourcestoSupportParticipation.

Looking Ahead

Throughout the site selection process, all work is planned and conducted in collaboration with interested communities, First Nation and Métis communities in the area, and surrounding communities. In response to interest expressed by communities, the NWMO has begun to explore with them some of the social, economic and cultural considerations for key components of the project.

Discussions have begun with community liaison committees, at open houses, and with Indigenous communities about skills training and capacity building to help prepare areas to potentially receive and participate in the project. In 2016, conversations were initiated with communities about priority areas for skills training and education, and how best to invest in capacity building. Programs will be put in place beginning in 2017 and extend throughout the duration of preliminary assessment studies. While the long-term goal of these investments is to equip community members, including youth, to work at the Centre of Expertise, and in subsequent site preparation, construction, and operation activities, initially the programs would offer modest support for the development of transferable skills that could be applied to other projects as well.

Communities are also interested in the Centre of Expertise and how it could fit into their area. Planning includes discussions about its design, and how it might reflect local, regional, and First Nation and Métis history, and social, cultural, spiritual, and economic values and priorities.

Analysis of Significant Effects

The NWMO completed Phase 1 Preliminary Assessments for the first eight communities that entered the site selection process in 2013. Four were identified for further study; four were not. One community discontinued its involvement as a potential host in 2014. The remaining first phase preliminary assessments were concluded or completed in late 2014 and 2015.

In the first phase of preliminary assessment, potential suitability was studied for each interested community, exploring the areas of safety and community well-being. Findings were presented in a series of assessment reports for each community, focusing on individual aspects of the studies, and were summarized in a *Preliminary Assessment Report* that brings findings from individual studies together in single documents. These reports are posted on the NWMO website in the *What We've Done* section for each community at www.nwmo.ca/StudyAreas.

Studies found potential to meet project requirements in the areas of engineering, transportation, environment, and safety in each of the communities. There was also some potential in all of them to address the all-important requirements related to geoscientific suitability – a key safety requirement – and social, economic and cultural considerations. However, important differences among the communities were noted that influenced NWMO decision-making on where best to focus more detailed studies.

The social, economic and cultural assessment component of the work found that potential for the project to foster well-being varies across communities. Differences were found in each community's potential to foster well-being through the implementation of the project and sustain interest to support further learning.

When findings from the assessments for the individual communities were taken into account, including social, economic, and cultural considerations, the NWMO identified a subset of communities as having strong potential to meet the requirements for the Adaptive Phased Management (APM) Project and invited them to be the focus of more detailed study.

At the end of 2016, nine communities and areas continued to learn more about Canada's plan for the long-term management of used nuclear fuel. Many more years of study and engagement will be required before a preferred site can be identified and communities can decide whether the project is a good fit for the area.

Transportation

Within the next 30 years, Canada's used nuclear fuel will start to be moved from licensed interim storage locations to a deep geological repository for safe and secure, long-term containment and isolation. Working collaboratively with Canadians, the NWMO is now beginning to put in place a plan for this transportation.

In fall 2016, the NWMO published a discussion document to initiate early conversations about the social and cultural considerations that need to guide future transportation planning. Ultimately, the APM transportation plan will need to lay out clear objectives, the issues that will need to be addressed, the factors to consider in making decisions, and the means the NWMO will use to ensure the plan includes best knowledge and experience, as well as the values and priorities of citizens.

To get the conversation started, five questions have been identified:

1. What basic requirements or factors should form the starting foundation for the APM transportation plan?
2. Which objectives, principles and key questions should guide development of an APM transportation plan?
3. How can we ensure the design and implementation of the APM transportation plan is sufficiently inclusive to ensure good decisions are made?
4. What information will we need from technical specialists to develop the plan and support decision-making?
5. What factors should be considered in future decisions about modes and routes?

These questions will form the basis of early conversations about transportation planning as the NWMO begins to identify a framework to guide planning, and the information that will be needed from technical and other knowledge specialists to make important decisions in the future.

Looking Forward

A decision on a preferred site for a deep geological repository is not anticipated before 2023. As Canada moves forward with its plan for managing used nuclear fuel over the long term, the NWMO will continue working together with interested communities, First Nation and Métis communities, and surrounding municipalities to plan and implement studies, and explore both safety and well-being.

In the near term, the NWMO looks forward to:

- Advancing with discussions of borehole drilling with people living in the broad area;
- Advancing with discussions to inform future transportation planning; and
- Continuing to broaden the social, economic and cultural framework in both these areas as we work together to advance studies and build partnership.

What We Heard on Implementing Canada's Plan

The Nuclear Waste Management Organization (NWMO) continued to implement Canada's plan to safely manage used nuclear fuel over the course of 2014 to 2016, engaging in site selection activities in and around communities that expressed interest in learning about it and the potential to host the project in the area.

WHAT WE HEARD

Implementing the plan involves a series of progressively more detailed social and technical studies in potential host areas, as well as a program of local and regional engagement. Engagement has focused on continuing dialogue and supporting opportunities for learning and reflection. It has also included collaboratively planning technical field studies. A number of themes have run strongly throughout these conversations.

The **health and safety of people and the environment** was an important topic of discussion for many people in communities. Initially, people are interested in the basis for confidence in safety. Others with longer involvement in NWMO learning programs focused on safety updates, and specific local safety concerns, among other topics. People asked questions about the safety and security of the transportation of used nuclear fuel, the safety of underground storage and impacts to freshwater resources, the safety of storage over long time frames, emergency response planning, and facts about the effects of radiation.

Subject matter specialists and NWMO staff from a variety of speciality areas, as well as third-party experts selected by communities themselves, took part in detailed conversations with members of the public looking to learn more about the production of CANDU fuel bundles, the stability and durability of the ceramic fuel pellets, and the multiple-barrier system designed to protect people and the environment. Safety conversations were also supported with physical exhibits of both the copper and steel emplacement container, and used nuclear fuel bundle model. These helped people to better understand the multiple-barrier system concept, and importantly, that used nuclear fuel is a solid, not a liquid or gas.

A revised *Description of a Deep Geological Repository and Centre of Expertise for Canada's Used Nuclear Fuel* was completed in 2015 and shared with communities throughout 2016. The document helped facilitate robust discussions about the repository and engineered features designed to keep people and the environment safe. Other material produced to support the discussion included a pamphlet on the multiple-barrier system, using a new and more accessible graphic format.

Interest in and conversations about **community well-being** evolved over the three years. Initially, communities focused on the results of community well-being assessments in their area, including consultants' studies on economic, social, environmental, and infrastructure assets held by each community.

Later, regional economic modelling studies, contracted for by the NWMO at the request of communities, generated conversations focused on regional employment and economic development opportunities. People were interested in the types and numbers of direct, indirect and induced jobs generated over the project life cycle; the types of procurement opportunities expected to be generated by the project; additional spend in the community impacting the growth of local enterprise; measures to be taken that would ensure maximum benefits are retained by the area; and how communities could prepare to participate in the project and optimize local benefits.

NWMO Senior Geologist Andre Vorauer answers questions from a young Manitouwadge resident and his mother at an open house in the community.

In this period, some communities began to look for assurances from the NWMO about the extent to which the community and area will benefit from the project. Negative experience with resource extraction projects that did not deliver promised benefits to the community and area has led to some general scepticism and a desire to explore this topic at some depth over the course of preliminary assessment studies.

Community members continued to probe to better understand the **site selection process**, how a preferred site would ultimately be selected, and the time frames for decision-making. Early in the three-year period, communities focused on how they might reach out to their neighbours and involve them in learning and reflection on the project, as required by the second phase of preliminary assessment studies, and how the NWMO might help. Since then, in collaboration with communities, the NWMO has increasingly involved neighbours and regional organizations in Learn More tours, studies, events, and presentations.

Over the course of the three years, communities began to turn their attention to working with their neighbours to build towards the partnership required to advance the project in the area. Additional discussion topics emerged reflecting the new phases of work, including a desire to understand the evolving timelines associated with the project, to find and create opportunities for building relationships with neighbours where these do not already exist, and to understand regional interests and benefits.

In 2016, the NWMO announced that a single site with strong potential to host the project could be identified in 2023. This decision reflects an evolving understanding of the requirements for technical and social assessments in order to select a safe and secure site with a willing host. Although those supportive of the project are keen to move forward sooner and feel some frustration with what they perceive to be the slow pace of the process, many appreciated that extended timelines are needed to ensure communities are informed and supportive.

With the extended time frames, communities expressed interest in understanding and capitalizing on near-term benefits associated with participating in the site selection process. Local and Aboriginal procurement strategies were implemented by the NWMO to begin to maximize local involvement in the conduct of the progressively more detailed studies. The NWMO also began to work with communities to anticipate and plan for more near-term initiatives such as the design and implementation of the Centre of Expertise.

The **transportation** of used nuclear fuel has been a significant theme in engagement activities. In 2014, the Used Fuel Transportation Package exhibit began making community visits. This stimulated conversations on the robustness of the transportation container, transportation routes, transportation security and safety, shared road use, and emergency response. Although transportation of used nuclear fuel will not begin for many years, strong interest was expressed in beginning discussions about planning how future transportation decisions will be made.

In conversations with communities, the NWMO heard that the **Centre of Expertise** is an important component of the project and of great interest to communities. Discussions to date suggest there may be some important opportunities that could help foster community building through inclusion of social amenities in the facility, or through contributing expertise brought together at the centre to support important local initiatives beyond the Adaptive Phased Management Project.

The NWMO's efforts to reach out to and engage First Nation and Métis communities has necessarily broadened through the period.

Understanding the land from the perspective of Indigenous people in the area, and involving them in the conduct of field studies and reflection on whether the project is a good fit for the area, is an important focus of the broadened engagement at this phase of work.

The NWMO has heard that learning together involves studies of traditional land use and ceremonies to seek guidance. It has also heard that good decisions require interweaving western science with Indigenous Knowledge and has adopted this principle into its process. This, in turn, requires the provision of resources for communities to conduct their own studies, the development of culturally appropriate processes to work together to plan and implement field studies, and measures to determine if and how the community wishes to share its Indigenous Knowledge.

Indigenous Knowledge of traditional and current land uses in and around interested communities, combined with non-Aboriginal local knowledge, helped to guide preliminary assessment over this period. In discussions with local land users, the NWMO gathered details about the specific parcels identified for preliminary studies, including observing general geological features and studies of local environmental features.

Land users, including hunters, trappers, anglers, camp owners, and recreational users, provided valuable insight into the uses and features of local land. The location of key ecological areas such as breeding grounds were identified, as were mineral and other rock outcroppings. Local access conditions were also frequently well-known and enthusiastically shared (e.g., “That land is flooded now,” or “That area is only accessible from this way”), as were details around likely land users (e.g., the presence of camps and traplines), and the likelihood that nearby assessment activity could disturb people, animals or the environment and needs to be adjusted. Combined with local Indigenous Knowledge and the conduct of traditional cultural ceremonies that was shared in some nearby Aboriginal communities, this input helped to begin creating a rich understanding of the land areas being studied.

Over the past three years, municipal, First Nation and Métis communities have helped the NWMO understand how to implement an **open and inclusive process** of learning and reflection. The NWMO continues to receive guidance from communities involved in the site selection process with an open and positive spirit.

As part of the broader dialogue, the NWMO also continues to hear opposition to the project from some individuals and organizations that would like to stop the process of learning and discussion in their area or as a whole. This includes some groups that are opposed to nuclear-generated electricity, or are opposed to development in their area or as a whole. Some are concerned about the safety of nuclear power, some are concerned about the ability to safely contain and isolate used nuclear fuel for the long time periods required, and some are convinced that the repository will contaminate water, precious to all life. What distinguishes these individuals and groups is that they are either uninterested in learning and engaging in discussion, or in principle, are not supportive of continued discussion or learning on this topic. This is a part of the ongoing dialogue related to implementing the project, and the dynamic of learning and discussion. The NWMO will continue to seek participation of all communities of interest in dialogue to help implement Canada’s plan.

HOW WE RESPONDED TO INPUT RECEIVED

» Worked with communities to develop and implement a program of speakers to explore their questions and help facilitate their learning in areas of interest;

» Organized learning opportunities at conferences that bring many experts together for representatives of communities;

» Developed new and expanded information displays, and developed enhanced exhibits for community offices;

» Refined the website to provide easier access to information as requested by communities;

» Developed additional information material to address areas of community interest, and moved to a more accessible visual communication style on community request;

» Advanced important conversations in response to community interest, including early investments in education and skills, and the Centre of Expertise;

» Expanded resource programs to ensure the costs of participation in the siting process are covered as the needs of communities evolve through progressively more detailed phases of work;

» Developed programs to acknowledge the contribution of First Nation, Métis and municipal communities to advance Canada's plan for the long-term management of used nuclear fuel;

» Revised the *Description of a Deep Geological Repository and Centre of Expertise for Canada's Used Nuclear Fuel* brochure to respond to increasingly more detailed questions;

» Conducted regional economic modelling studies at the request of communities;

» Released a discussion document to help facilitate conversations on transportation in response to interest expressed; and

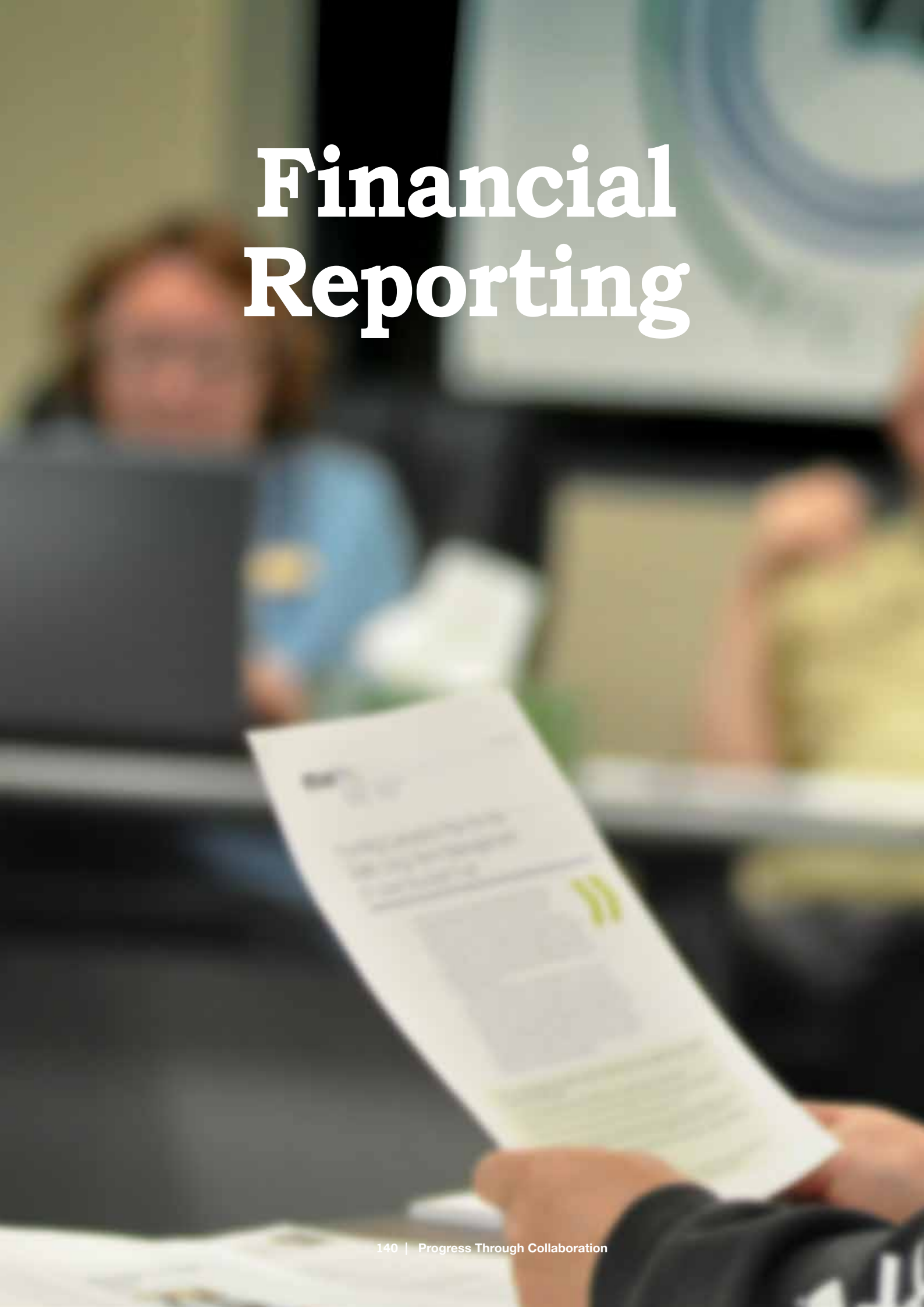
» Introduced programs to facilitate the conduct of traditional land use studies.

WHAT WE HEARD: STRATEGIC PLANS

Each year, the NWMO solicits comments and direction from interested individuals and groups on its annually updated strategic plan, *Implementing Adaptive Phased Management*, which describes its strategic objectives and five-year work plan. An overview of comments received and NWMO actions taken is published each year at www.nwmo.ca. A number of important refinements were made to the plan in response to comments received.

Based on feedback regarding the draft 2016-2020 report, a new strategic objective focused on transportation was added. Public comment on the draft 2015-2019 plan resulted in a new strategic objective, focusing on advancing planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project. Activities were also refined, and content was added in response to what we heard.

Financial Reporting



BUDGET FORECAST, 2017 TO 2021

The *Nuclear Fuel Waste Act* requires that the triennial report include the budget forecast for the next five fiscal years to implement the strategic plan for the used fuel management program. This chapter presents the Nuclear Waste Management Organization's (NWMO) five-year budget forecast for the 2017 to 2021 Adaptive Phased Management (APM) strategic plan, which is presented in chapter 10, *Implementing Adaptive Phased Management 2017 to 2021*.

The NWMO's Annual Budget Process

The NWMO's business planning process begins with senior management's planning discussions to confirm proposed strategic directions and objectives for the five-year planning period. The development of each five-year plan takes into account the input received through public reviews of implementation plans and engagement activities. Each year, the five-year business plan is presented to the Board of Directors for a process of review and discussion. Budgets are approved on an annual basis. Each fall, the Board approves the budget for the upcoming fiscal year. The 2017-2021 strategic plan for APM is presented in chapter 10, *Implementing Adaptive Phased Management 2017 to 2021*.

In addition to managing the implementation of APM, the NWMO has been under contract since 2009 to Ontario Power Generation (OPG) to help develop a deep geologic repository (DGR) for the long-term management of low- and intermediate-level waste (L&ILW) at the Bruce nuclear site in the Municipality of Kincardine.

The NWMO also provides Lifecycle Liability Management (LLM) services to OPG, under a contract whose terms are similar to those as for the L&ILW DGR. Work plan objectives for the LLM program include providing OPG with assistance in meeting its requirements related to the *Ontario Nuclear Funds Agreement*, the Canadian Nuclear Safety Commission Financial Guarantee, the Ontario Energy Board, and the Financial Accounting Reporting, as well as providing annual report of lifecycle liability plan, cost estimates, fund contribution, and supporting reports.

The total projected costs for the NWMO's activities in these three program areas for the period 2017 to 2021 are presented below.

Total Projected Costs ($ million)

Program	2017	2018	2019	2020	2021
APM	84.5	90.9	92.3	112.9	113.6
OPG DGR for L&ILW	8.6	36.7	38.9	92.9	131.2
LLM	1.3	1.5	1.5	1.6	1.6
Proposed Plan	**94.4**	**129.1**	**132.7**	**207.4**	**246.4**

IN THE SECTION THAT FOLLOWS, THE FIVE-YEAR BUDGET FOR APM IS PRESENTED IN DETAIL.

Adaptive Phased Management (APM) Budget Forecast, 2017 to 2021

The budget forecast supports the major APM work program objectives described in the five-year strategic plan in chapter 10, *Implementing Adaptive Phased Management 2017 to 2021*. A summary of the work program costs in each of the seven strategic work program areas and common services is provided in the table below.

APM Projected Costs ($ million)

Program	2017	2018	2019	2020	2021
Building Relationships	3.2	3.4	3.6	3.8	3.7
Siting Process	29.5	33.4	34.7	49.8	55.6
Engineered-Barrier Design and Proof Testing	13.3	12.6	13.3	17.5	11.4
Technical Research and Collaboration	3.5	3.8	3.9	3.9	4.0
Transportation of Used Fuel	2.2	5.1	3.8	4.1	4.2
Funding Formula/ Financial Surety	0.1	0.1	0.1	0.1	0.1
Governance Structure	0.7	0.7	0.7	0.7	0.7
Common Services	10.5	9.7	9.4	9.6	9.9
Staffing	21.5	22.0	22.7	23.3	24.0
Proposed Plan	**84.5**	**90.9**	**92.3**	**112.9**	**113.6**

Adaptive Phased Management (APM) Project Costs

The 2017 to 2021 business plan period covers the next five years of implementation of APM. The strategic plan, set out in chapter 10, *Implementing Adaptive Phased Management 2017 to 2021*, and the associated budget are based upon a set of strategic objectives:

- The NWMO will build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. The NWMO will continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies.
- The NWMO will implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host.
- The NWMO will conduct testing of the engineered-barrier system in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently.
- The NWMO will advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project.
- The NWMO will continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices.
- The NWMO will establish safe, secure and socially acceptable plans for transporting used nuclear fuel.
- The NWMO will ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.
- The NWMO will maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

The budget forecast reflects the NWMO's desire to be prepared and well-resourced to provide capacity-building opportunities to communities and to work collaboratively as they come forward. The NWMO is committed to a stepwise and collaborative decision-making approach, and will only proceed to the next step after careful consideration and only when satisfactory social conditions exist.

FINANCIAL REPORTING REQUIREMENTS

The *Nuclear Fuel Waste Act* (*NFWA*) specifically addresses the future financial obligations for managing used fuel over the long term. The requirements of the Act are described below. This chapter of the Triennial Report is structured to be consistent with requirements defined in subsection 16(2) of the *NFWA*.

Requirements of the *NFWA* (2002)

The Nuclear Waste Management Organization (NWMO) is required to provide a range of financial information in each of its annual reports following the government's decision, as defined in subsection 16(2) of the *NFWA*.

16(2) Each annual report after the date of the decision of the Governor in Council under section 15 must include:

(a) the form and amount of any financial guarantees that have been provided during that fiscal year by the nuclear energy corporations and Atomic Energy of Canada Limited under the *Nuclear Safety and Control Act* and relate to implementing the approach that the Governor in Council selects under section 15 or approves under subsection 20(5);

(b) the updated estimated total cost of the management of nuclear fuel waste;

(c) the budget forecast for the next fiscal year;

(d) the proposed formula for the next fiscal year to calculate the amount required to finance the management of nuclear fuel waste and an explanation of the assumptions behind each term of the formula; and

(e) the amount of the deposit required to be paid during the next fiscal year by each of the nuclear energy corporations and Atomic Energy of Canada Limited, and the rationale by which those respective amounts were arrived at.

The *NFWA* requires the establishment of trust funds by each waste owner. The funds were established in 2002, and annual contributions have been made by each waste owner since. The total value of these funds, including investment income, was approximately $4 billion as of the end of 2016. This money is in addition to other segregated funds and financial guarantees the companies have set aside for nuclear waste management and decommissioning.

Owner	Trust Fund Balance ($ million) December 2016
Ontario Power Generation (OPG)	3,687
Hydro-Québec (HQ)	142
NB Power Nuclear (NBPN)	152
Atomic Energy of Canada Limited (AECL)	50
Total	**4,031**

Experience in other countries has demonstrated the importance of safeguarding these funds so that they will be preserved for their intended purpose. The *NFWA* built in explicit provisions to ensure that the trust funds are maintained securely and used only for their intended purpose. The NWMO may have access to these funds only for the purpose of implementing the management approach selected by the Government once a construction or operating licence has been issued under the *Nuclear Safety and Control Act* (*NSCA*).

These legislated obligations are the responsibilities of the individual companies named, and not the responsibility of the NWMO. The trust funds are noted here because of their significance in the overall provision for long-term nuclear waste management.

As required by the *NFWA*, the NWMO makes public the audited financial statements of the trust funds when they are provided by the financial institutions annually. They are posted at www.nwmo.ca/trustfunds.

Reporting of the Canadian Nuclear Safety Commission (CNSC) Financial Guarantees as Required by *NFWA* Section 16(2)(a)

As required under section 16(2) of the *NFWA*, this report requires reporting the form and amount of any financial guarantees that have been provided during the fiscal year by all NWMO members – OPG, HQ and NBPN – and AECL. Financial guarantees are required by the CNSC under the *NSCA* to cover the cost (in present value terms) associated with decommissioning, interim storage and long-term management of radioactive waste (including used nuclear fuel) produced to date. These financial guarantees available for year 2017 total $20 billion and are reviewed independently by the CNSC as part of the waste owner licence requirements. A large portion of these guarantees, approximately $18 billion (as of year-end 2016), exists in segregated funds dedicated to nuclear waste management and decommissioning, with any of the remainder in the form of Provincial Guarantees.

Details of the status of these guarantees are presented in Attachment 1.

Total Cost Estimate as Required by *NFWA* Section 16(2)(b)

The *NFWA* requires the NWMO to address the cost and funding of the long-term management of used nuclear fuel. The NWMO completed a full update of the cost estimates for Adaptive Phased Management (APM) in 2016. This estimate provides the basis for financial planning and trust fund deposits for future years.

Since the last update in 2011, the NWMO has advanced the previous conceptual design and associated cost estimate for the APM deep geological repository and used fuel transportation system. The most significant changes are in the engineered-barrier system design, and planning assumptions for the duration to select a single site and obtain the construction licence. Currently, for financial planning purposes, a single site selection is assumed in 2023, and the deep geological repository is assumed to be operational in 2043.

For the purposes of this full estimate update, two used nuclear fuel inventory scenarios were analyzed: 3.6 million and 7.2 million used fuel bundles. These two scenarios form the baselines, from which cost estimates for an inventory between these two points can be derived. The following table shows how estimated costs might differ depending on the amount of used nuclear fuel to be managed.

Estimated cost (2015 $) of APM from site selection start (2010) onwards			
2.7 million fuel bundles (current number produced as of June 2016)	3.6 million fuel bundles	5.2 million fuel bundles	7.2 million fuel bundles
$16.3 billion	**$18.3 billion**	**$22.8 billion**	**$28.4 billion**

For example, the 2016 cost estimate for the APM program for managing 3.6 million bundles is $18.3 billion (2015 $), or taking into account the time value of money, present value of $7.2 billion (2015 $). The eventual cost of this project may differ from these estimates, depending on a number of factors, including the volume of used fuel to be managed, location of the facility, surrounding infrastructure, rock type and characteristics, design of the repository, and period of extended monitoring following used fuel placement.

When updated to January 1, 2017, present value, the APM costs to be funded under a scenario of 3.6 million lifecycle bundles is $7.5 billion (for liabilities from 2017 onwards). Of the $7.5 billion, approximately $6.4 billion relates to developing and building a repository, transporting the used fuel, and operating the repository for the 2.7 million fuel bundles produced as of the end of June 2016. The $6.4 billion present value to be funded for a deep geological repository for the 2.7 million used fuel bundles includes $2.5 billion to develop the repository to a point of obtaining a construction licence and $3.9 billion to complete construction, transport the fuel to the repository, and operate, close, and monitor the repository.

The costs of interim storage at the reactor sites and recovery of the used fuel from storage are not included as part of the $7.5 billion to be funded through the NWMO since they are the responsibility of the waste owners.

In addition to a regular baseline cost estimates update on a five-year cycle, the NWMO is committed to providing annual assessments on all factors that impact these cost estimates. Any material change in the cost estimates will be dealt with and disclosed in the NWMO Annual Report.

Cost to Be Funded Through the *NFWA* Trusts

The *NFWA* requires that post-construction licence costs (currently estimated at $3.9 billion) must be funded through contributions to the *NFWA* trust funds established by OPG, HQ, NBPN, and AECL. As of December 2016, the total value of these funds, including investment income, was approximately $4 billion.

Budget Forecast for 2017 as Required by the *NFWA* Section 16(2)(c)

In addition to making financial provision for work required post-construction licence, the NWMO will incur costs of approximately $2.5 billion (as stated in present value as of January 1, 2017) to site the long-term management option, develop its detailed design, develop the Centre of Expertise, acquire a site, evaluate its environmental impacts, and obtain a site preparation and construction licence from the CNSC. For 2017, the NWMO Board of Directors approved a budget envelope of $84.5 million. Annual costs beyond 2017 are subject to further review. Sharing of these costs will be in accordance with the percentages defined in the Membership Agreement, as amended from time to time.

Funding Formula as Required by *NFWA* Section 16(2)(d)

In accordance with the requirements under the *NFWA*, the NWMO proposed a funding formula to address the future financial costs of implementing the APM approach in its 2007 Annual Report. This followed the Government's selection, in June 2007, of the APM approach for the long-term management of used fuel.

The funding principles used to develop the funding formula are consistent with the intent of the *NFWA*, the approach used for financial guarantees under the *NSCA*, and the approaches used in other member countries of the Organisation for Economic Co-operation and Development:

- Producer pays
- Financial conservatism
- Uncertainty analysis
- Intergenerational fairness
- Fund growth

The funding formula, based partly on projections of used fuel to be generated by each waste owner, allocates liabilities to each of the corporations for their portion of the estimated total cost. It identifies trust fund contributions by each nuclear waste owner for their portion of the estimated total cost. The funding formula was approved by the Minister of Natural Resources in April 2009.

Cost Sharing

For the purpose of sharing NWMO costs, cost sharing is based on the number of fuel bundles produced as of June 30, 2013, adjusted to account for the assumed timing of transfer of used fuel to the repository. For OPG, this transfer is assumed to start in 2043. For HQ, NBPN and AECL, this transfer is assumed to start in 2058. The current cost-sharing percentage among the waste owners is approximately: OPG: 91.94%, HQ: 3.64%, NBPN: 3.49%, and AECL: 0.93%. These cost-sharing percentages are subject to periodic review and update.

These percentages apply to the sharing of costs common to all waste owners. Costs specific to a nuclear fuel waste owner, such as special fuel and special transportation costs that are owner-specific, are attributed to the owner.

Possible Future Reactors

In response to the request of the Minister of Natural Resources, discussions were held with a number of stakeholders regarding the development of a funding formula that could apply to possible new waste owners and used fuel from new reactors. The results of the discussions are summarized below:

1. The principles used in the approved funding formula are reasonable and should apply to new owners and new reactors.
2. Fixed and variable costs and investments made to date need to be considered in any new funding formula for new owners and new reactors.
3. The characteristics of new fuel types must be considered.
4. The existing funding formula should be developed when specific circumstances are clear for new reactors and new owners.
5. The changes in funding formula for new owners of new reactors may be different than the changes for an existing owner with new reactors.

The NWMO proposed to apply the above principles to specific circumstances related to new owners and new reactors when they arise.

Trust Fund Deposits 2012 to 2016 as Required by *NFWA* Section 16(2)(e)

Beginning in 2002, used nuclear fuel owners have been making annual contributions to the *NFWA* Trust Funds. The contributions for each waste owner are shown in the following table.

Contributions to *NFWA* Trust Funds

Owner	Total Deposits to Trust Funds				
	2012 ($ million)	2013 ($ million)	2014 ($ million)	2015 ($ million)	2016 ($ million)
OPG	149	154	161	188	200
HQ	8	8	9	7	5
NBPN	5	5	6	9	10
AECL	1	1	2	1	1
Total	**163**	**168**	**178**	**204**	**215**

Trust Fund Deposits for 2017 as Required by *NFWA* Section 16(2)(e)

The 2017 *NFWA* trust fund deposits stated herein have been developed based on the APM cost estimate completed in 2016. This estimate reflects updated engineered-barrier system design and planning assumptions for the duration to select a single site. The adoption of the updated cost estimate resulted in lower trust fund deposit requirements.

Under the approved funding formula, the funding for the post-construction licence costs is divided into two parts:

1. Funding for historical used fuel bundles (Committed Liability)
2. Funding for used fuel to be produced each year (Future Liability)

Committed Liability represents all costs that will be incurred regardless of whether any further used fuel bundles are generated in the future. This liability includes all fixed costs for the facility and variable costs attributed to the historical used fuel bundles. Contributions for the Committed Liability are to be amortized to the year 2043 in equal present value payments. The rationale for this amortization period is that 2043 is consistent with the earliest planned date when the deep geological repository would be available. This funding method has the advantage of distributing the funding obligations evenly to each year taking into account the time value of money.

Future Liability represents the incremental cost of transferring to the repository, facility expansion, and additional operating and monitoring costs of used fuel bundles to be produced each year. Each future used fuel bundle would incur the same cost in present value terms taking into account the time value of money.

The 2017 Trust Fund Deposits are shown in the table below.

Total Trust Fund Deposits: Year 2017

Owner	Trust Fund Balance ($ million)	Deposits to Trust Funds (Committed and Future Bundles) ($ million)*
	December 2016	2017
OPG	3,687	51
HQ	142	0.3
NBPN	152	3
AECL	50	0.04
Total	**4,031**	**54**

*Annual trust fund deposits are required to be made within 30 days of the submission of the Annual Report. A deposit date of April 30 is assumed for illustrative purposes.

Attachment 1
Financial Guarantee Status – Used Fuel Owners

Ontario Power Generation (OPG)

Effective July 31, 2003, OPG provided the CNSC with a Decommissioning Financial Guarantee that included a guarantee associated with the long-term management of used fuel arising from the operation of OPG-owned nuclear stations and waste management facilities, including those leased by Bruce Power. The Decommissioning Financial Guarantee also covers liabilities associated with long-term management of low- and intermediate-level waste, as well as plant decommissioning.

Development and maintenance of the Financial Guarantee considers the following points:

- The Financial Guarantee covers the liability based on projected waste arising to year-end in any given year. As a result, the value of the used fuel Financial Guarantee changes annually to recognize the incremental cost associated with additional used fuel generated during that year.
- The initial Financial Guarantee submission covered the five-year period to year-end 2007. It has been updated twice since then, in 2007 and 2012 respectively. The latest approved 2012 Financial Guarantee submission covered from January 2013 to year-end 2017.
- The Financial Guarantee is satisfied in part by the actual accumulation of funds within both a Used Fuel Fund and a Decommissioning Fund under the *Ontario Nuclear Funds Agreement* (*ONFA*) between OPG and the Province of Ontario. This value is supplemented by a Provincial Guarantee which is executed between the Province of Ontario and the CNSC.
- The *NFWA* Trust Fund forms part of the Used Fuel Fund under the *ONFA*.

The Provincial Guarantee Agreement provides an unconditional and irrevocable guarantee to supplement monies set aside by OPG in segregated funds, including the *NFWA* Trust Fund, to satisfy the total Financial Guarantee required by the CNSC.

OPG submitted documents to the CNSC in 2012 to support its application to update the Financial Guarantee for the period from January 1, 2013, to year-end 2017. The CNSC hearing for this application was held in October 2012. The CNSC accepted the Financial Guarantee proposal on December 20, 2012.

The Annual Report to the CNSC for year 2017 shows a Financial Guarantee requirement of $15,690 million. This will be satisfied by a 2016 year-end *ONFA* segregated funds balance of $17,463 million, and a Provincial Guarantee of $1,551 million, for a total available guarantee of $19,014 million.

The value of the OPG *NFWA* Trust Fund as of year-end 2016 is $3.7 million. This value forms part of the segregated fund balance shown above.

Hydro-Québec (HQ)

The HQ *NFWA* Trust Fund contained $142 million as of December 31, 2016, and the fair value is estimated at $161 million.

In addition to the trust fund, HQ has provided the CNSC with a Decommissioning Financial Guarantee of $685 million that includes a guarantee associated with used fuel arising from the operation of Gentilly-2 and the cost of station decommissioning, including the long-term management of low- and intermediate-level radioactive waste. The guarantee is in the form of an expressed commitment of the Province of Quebec to HQ that provides a guarantee of payment.

The *NFWA* Trust Fund and the Financial Guarantee provided by the Province of Quebec covered the future financial obligations as follows:

- $502 million for decommissioning and long-term management of low- and intermediate-level radioactive waste
- $315 million for used fuel

NB Power Nuclear (NBPN)

NBPN has provided the CNSC with a Decommissioning Financial Guarantee that covers the costs associated with the long-term management of used fuel projected to be produced from the Point Lepreau Generating Station and the cost of station decommissioning, including the long-term management of low- and intermediate-level radioactive waste.

- The Financial Guarantee requirement is based on the present value of future costs to manage used fuel produced to the end of 2016 and present value of future estimated costs for station decommissioning.
- The Financial Guarantee requirement is satisfied by three separate funds: a Used Fuel Fund, a Station Decommissioning Fund, and the *NFWA* Trust Fund.
- The total market value of the funds at December 31, 2016, was approximately $706 million and was comprised of the following:
    - Used Fuel Fund – $228 million
    - Station Decommissioning Fund – $326 million
    - *NFWA* Trust Fund – $152 million

Atomic Energy of Canada Limited (AECL)

AECL is not a member of the NWMO. Its Financial Guarantee is in the form of an expressed commitment by the Government of Canada to the CNSC, combined with supporting estimates of the financial liability and the basis for same. The AECL *NFWA* Trust Fund contained approximately $49.6 million as of December 31, 2016.

Implementing Adaptive Phased Management 2017 to 2021

nwmo

NUCLEAR WASTE MANAGEMENT ORGANIZATION

SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Implementing Adaptive Phased Management 2017 to 2021

MARCH 2017

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The NWMO is guided by five fundamental values:

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

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

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

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

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

Preface

The Nuclear Waste Management Organization (NWMO) is responsible for the implementation of Adaptive Phased Management (APM), Canada's plan for the safe, long-term care of used nuclear fuel. APM involves the development of a large infrastructure project that will include a deep geological repository and Centre of Expertise for technical, environmental and community studies.

The NWMO invites all Canadians and Aboriginal peoples of Canada to learn more and become involved in the management of Canada's used nuclear fuel. To support this involvement and demonstrate its commitment to transparency and accountability, the NWMO publishes an annual update to its five-year strategic plan, titled *Implementing Adaptive Phased Management*. The plan is regularly assessed, strengthened and redirected as appropriate in the face of new information and comments the NWMO receives through its engagement initiatives.

Implementing Adaptive Phased Management 2017 to 2021 was released in draft for public review through to October 31, 2016. Following the review period, the plan was revised to reflect comments received. An overview of comments received about the draft plan and how they helped to refine the plan is published along with the revised 2017 to 2021 plan at www.nwmo.ca.

The NWMO welcomes all suggestions and ideas about its work and how it can help you learn more about APM.

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Executive Summary

The NWMO is responsible for the long-term care of Canada's used nuclear fuel. *Implementing Adaptive Phased Management 2017 to 2021* describes its five-year work program.

Adaptive Phased Management (APM), Canada's long-term plan for used nuclear fuel, 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 end point of the technical method is a repository that will contain and isolate Canada's used nuclear fuel deep underground in a suitable rock formation. A safe and secure transportation system will be developed to transport used nuclear fuel from the facilities where it is currently stored on an interim basis to the centralized site. The NWMO's primary motivation is safety – to protect people and the environment from Canada's highly radioactive used nuclear fuel. This objective and common vision underpins all the work of the NWMO. All aspects of the NWMO's work will meet or exceed all applicable federal and provincial regulatory standards and requirements for protecting the health, safety, and security of humans and the environment.

One focus of the 2017 to 2021 period will be on siting and working with potentially interested communities as they move through the Preliminary Assessments step in the siting process. Activities will support community learning and engagement, as well as site evaluation. Importantly, this involves working with interested and potentially affected First Nation and Métis communities, and other surrounding communities to learn about and consider whether the project might fit in the area.

Twenty-one communities successfully passed an initial screening and elected to advance to the preliminary assessment step of the site selection process. These Phase 1 assessments, now complete, have guided a gradual narrowing-down process. Siting activity is now focused on a smaller number of areas, as the NWMO works with communities on multi-year Phase 2 Preliminary Assessments.

Currently, work is continuing in and around nine of the communities[1] that initiated their areas' involvement in the process. Aboriginal peoples and communities in the surrounding area are progressively being engaged in learning and decision-making. The NWMO expects that the advancement of preliminary assessments over the five-year planning period will continue to build information to guide a future decision on selection of the preferred area to proceed to site characterization.

Another important focus of the next five years will be to demonstrate the safety performance of the engineered-barrier system, and that it can be produced effectively and efficiently through continued proof testing activities. Over the planning period, the NWMO will complete design, fabrication, and testing of prototype repository containers, buffer and emplacement systems in its test facility.

The NWMO will continue to refine conceptual designs and postclosure safety assessments for a repository in both crystalline and sedimentary rock formations, and keep the Canadian Nuclear Safety Commission informed about its work. Throughout the planning period, engagement and social research will continue. Attention to sound governance and assurances around program funding will be maintained. Investing in people and the skills key to program success and continuity will remain a priority.

The NWMO will continue to escalate planning activity during the planning period for next steps in APM implementation. The NWMO and communities involved in the site selection process will continue planning for the establishment of the Centre of Expertise and many local activities that will be initiated once a preferred site is identified, which may be as early as 2023.

[1] Blind River, Central Huron, Elliot Lake, Hornepayne, Huron-Kinloss, Ignace, Manitouwadge, South Bruce, and White River.

Key milestones for the next five-year planning period include:

- Advance preliminary field studies and technical assessments to assess safety, and work to develop a strong partnership to support a further narrowing down of study areas throughout this planning period;
- Advance preliminary field studies and assessments, and work to develop a strong partnership to support the identification of a preferred site to be the focus of detailed site characterization, which may begin as early as 2023;
- Conduct this work collaboratively with the communities involved, including First Nation and Métis communities in the area, and surrounding communities in order to establish a foundation to proceed in partnership to implement the project;
- Design and manufacture physical prototypes of the used nuclear fuel container and transportation containers at the NWMO test facility;
- Complete an integrated review of microbiological processes that could occur within the repository environment;
- Advance planning for the design of the national Centre of Expertise to be established at the selected site, through discussion with communities engaged in the site selection process;
- With communities in the site selection process, expand opportunities for local employment and building capacity and skills for future jobs associated with APM construction and operations;
- Advance transportation plans through container design and testing, and through engagement of citizens to inform the development of a planning framework; and
- Work with waste owners in planning for future transport of used nuclear fuel from the interim storage facilities where it is currently stored.

This strategic plan is a 'living' document that is regularly assessed, strengthened and redirected in the face of new information, direction and guidance from communities, advances in science and technology, insight from Indigenous Knowledge, changes in societal values, and evolving public policy. APM will only proceed as quickly as Canadians, successful technology development and demonstration, and the regulatory authorities allow.

The plan for the next five years is organized along eight strategic objectives outlined in the following pages. The NWMO continues to evolve these objectives as implementation of APM progresses.

The NWMO approaches its work with the following vision: the long-term management of Canada's nuclear waste in a manner that safeguards people and respects the environment, now and in the future.

Strategic Objectives 2017 to 2021

The NWMO will:

- Build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. Continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies;
- Implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host;
- Conduct testing of the engineered-barrier system in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently;
- Advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project;
- Continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices;
- Establish safe, secure and socially acceptable plans for transporting used nuclear fuel;
- Ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel; and
- Maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

Progress Since Last Implementation Plan

The NWMO reports in detail on its progress in achieving the activities outlined in the Implementation Plan each year in its Annual Report and every three years in its Triennial Report. Selected highlights of progress in 2016 against the strategic objectives that guided that work are outlined below.

Build Sustainable Relationships and Continue to Adapt Plan

The NWMO continued to engage with interested individuals and groups, communities, and Aboriginal peoples of Canada in the development and implementation of NWMO plans. The NWMO also continued a program of continuous learning in order to adapt plans in response to evolving societal expectations and values, changes in public policies, and insight from Indigenous Knowledge. The NWMO:

- Continued to work with the Municipal Forum to develop a better understanding of the needs and processes of municipalities involved in the site selection process and of the communities in the surrounding area;
- Worked closely with the Council of Elders and Youth to finalize an Indigenous Knowledge Policy and incorporate Indigenous Knowledge in the NWMO's work;
- Engaged with a broad range of municipalities and Aboriginal organizations through a program of involvement in municipal association conferences, and First Nation and Métis organization events and learning agreements;
- Strengthened relationships with federal and provincial governments, and briefed elected representatives about the project and site selection process;
- Reviewed with governments the process for fieldwork activities;
- Supported initiatives designed to increase youth interest and participation in science, including SHAD, the Science North School Outreach Program, and Scientists in School;
- Completed a full update of its website, and used a wide variety of communications media to keep communities and the public at large informed about the NWMO, its work and the site selection process; and
- Continued to solicit input on its plans, including evolving societal expectations and values, and also insight from Indigenous Knowledge, in order to adapt plans as needed.

Collaboratively Implement Process to Select a Site

Working with communities, the NWMO continued to advance preliminary assessments of site suitability. The NWMO:

» Continued the preliminary assessment studies in the vicinity of nine communities that expressed interest in the project: Blind River, Central Huron, Elliot Lake, Hornepayne, Huron-Kinloss, Ignace, Manitouwadge, South Bruce, and White River;

» Worked independently and with interested communities to continue to engage, build relationships, and learn about and consider the project with potentially affected First Nation and Métis peoples and other communities in the area, with the objective of developing a partnership to support implementation; and

» Supported engagement and learning with communities – including discussion of economic effects, Centre of Expertise and capacity building – with the objective of seeking an informed and willing host for the facility.

Demonstrate Safety and Feasibility of Repository and Engineered-Barrier Design

The NWMO continued development of the repository design and proof testing of the engineered barriers. The NWMO:

» Demonstrated container and buffer system emplacement, and fabricated a mock-up of the repository emplacement room;

» Prepared alternative repository layouts for a variety of geosphere conditions;

» Continued to update the repository safety case studies;

» Conducted an independent peer review of the generic corrosion program;

» Established procedures for the used fuel container serial production trials;

» Fabricated a full-scale beta buffer box; and

» Fabricated and pressure-tested a full-scale copper-coated prototype used fuel container.

Continuously Improve Technical Knowledge

The NWMO continued to collaborate with universities and international partners to stay abreast of best practice and developments in the field of used nuclear fuel management. The NWMO:

» Completed swelling and hydraulic conductivity tests on bentonite seal materials;

» Hosted the annual Geoscience Seminar;

» Participated in collaborative research programs in international underground research labs, including the POST project with Sweden and Finland, various experiments at Mont Terri in Switzerland, and the GAST experiment at Grimsel in Switzerland;

» Published peer-reviewed journal articles, conference papers, and technical reports; and

» Supported research projects with 15 Canadian university groups.

Develop Transportation Plans

The NWMO made progress in its technical program, which is designed to address all aspects of safety and security, and its engagement program to help communities learn about transportation of used nuclear fuel and become involved in its planning. The NWMO:

- Prepared the preliminary design description of the Basket Transportation Package (BTP);
- Prepared the scope of work for the fabrication of the BTP;
- Prepared a preliminary transportation risk assessment memorandum;
- Prepared the Phase 2 logistics memorandum;
- Facilitated community learning with visits of the mobile transportation exhibit, participation at municipal conferences, and community briefings and discussions; and
- Updated material to further support learning and discussions, including development of a discussion document.

Provide Financial Surety

The NWMO, in compliance with the *Nuclear Fuel Waste Act* (*NFWA*), continued to monitor the trust funds whose sole purpose is to fund the implementation of the deep geological repository and facilities, provided a construction licence has been granted by the Canadian Nuclear Safety Commission, many years in the future. In 2016, the NWMO completed a full update of the lifecycle cost estimate for Adaptive Phased Management.

Ensure Governance and Accountability

Multiple layers of oversight and peer review, complemented by externally audited international certifications, helped ensure that the NWMO's work was both transparent and guided by the highest scientific and professional standards. The NWMO:

- Continued to seek independent review of its work through independent technical reviews, its Advisory Council, and its Council of Elders and Youth; and
- Continued to report annually to the Minister of Natural Resources Canada, as required by the *NFWA*.

NWMO Organization

NWMO Vision: The long-term management of Canada's nuclear waste in a manner that safeguards people and respects the environment, now and in the future.

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

Over the period 2002 to 2005, the NWMO engaged a broad cross-section of citizens in a study to examine options for the long-term care of Canada's used nuclear fuel. The study and NWMO's recommendation to the Government of Canada are available on the NWMO website at www.nwmo.ca.

In 2007, the Government of Canada, based on the NWMO's recommendation, selected Adaptive Phased Management (APM) as the best plan for Canada for safeguarding both the public and the environment over the very long time in which used nuclear fuel must be managed. Implementation of a deep geological repository under APM will be regulated by the Canadian Nuclear Safety Commission (CNSC) under the *Nuclear Safety and Control Act* (*NSCA*) and its associated regulations.

Since its inception in 2002 and as required by Canada's plan, the NWMO has advanced and refined designs for a deep geological repository for the long-term containment and isolation of used nuclear fuel. This work has advanced substantially since 2002, and proof testing is an important focus of current work.

In 2010, the NWMO initiated the site selection process, following a two-year dialogue with Canadians to design a community-driven process for identifying the location for the deep geological repository. Since that time, the NWMO has worked with communities that chose to become involved in the site selection process through the early steps of learning more about APM and the project. As the siting process advances, an increasingly important focus is working with these communities to engage and build relationships with First Nation and Métis peoples, and other communities in the area to learn about and consider the project together. Technical assessments in the areas of these communities are advancing from desktop studies to field studies, including airborne surveys, and geological and environmental mapping.

The NWMO continues to build a multidisciplinary team with a range of experience in the fields of social research, technical research and development, engineering and design, public engagement, Aboriginal relations, communications, finance, and governance. The NWMO continues to collaborate with an extensive network of consultants, practitioners and academics from across Canada and around the world to ensure that its work benefits from the best available knowledge. Investment in human resources, skills training, and networks of specialists is important to building and sustaining a capability for inquiry, assessment and decision-making to support the implementation of APM. These specialists are critical to implementing the siting process, supporting

community interest and partnerships, and undertaking technical, socio-economic and cultural site investigations.

Management of used nuclear fuel is a very long-term responsibility. The NWMO must be steady, stable, and long term in its outlook and actions. This requires sustained investment in the organization to ensure resource capacity, capability, expertise, and sound administrative and management policies and practices that provide a foundation for operations spanning decades. The long time frames associated with management of used nuclear fuel give rise to the additional priority of intergenerational knowledge management. The preservation and transfer of knowledge and institutional memory across generations will be integral to supporting lengthy decision-making processes, and the integration of technical, scientific, and social information over long periods of time.

As the NWMO proceeds with the implementation of APM and builds partnerships to facilitate it, having capacity at the local and regional levels to participate will become a critical component of the larger organization required to implement the project. Going forward, the NWMO will continue to seek opportunities to meet emerging resource needs by recruiting staff locally in the siting areas wherever possible. The organization will also work with communities to build capacity, training and skills for jobs associated with the APM Project in the years ahead, and to ensure well-being is fostered.

In addition to its responsibility for implementing Canada's plan for the long-term management of used nuclear fuel, the NWMO is assisting OPG in seeking regulatory approval to prepare a site and construct a proposed deep geologic repository for the long-term management of low- and intermediate-level waste from OPG-owned or -operated reactors. The NWMO has provided expertise in repository design and implementation to OPG's project.

Regulatory Oversight of Adaptive Phased Management

The NWMO is committed to meeting or exceeding all applicable regulatory standards and requirements for protecting the health, safety and security of people and the environment.

Implementation of a deep geological repository falls within federal jurisdiction and will be regulated under the *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 also disseminates 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 by the *Canadian Environmental Assessment Act*, 2012. More information about the CNSC's licensing process is available at www.cnsc-ccsn.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.

Canada's Plan for Used Nuclear Fuel

Canada's plan for the long-term care of used nuclear fuel is known as Adaptive Phased Management (APM). Used nuclear fuel will be safely and securely contained and isolated from people and the environment in a deep geological repository in a suitable rock formation using a multiple-barrier system. A fundamental tenet of Canada's plan is the incorporation of learning and knowledge at each step to guide a process of phased decision-making. APM is designed to be flexible and respond to new learning, social priorities and evolving public policy.

The development of the long-term management facility for Canada's used nuclear fuel is a national infrastructure project (see *The Project* on page 14). The facility is to be sited in an area with an informed, willing host. The process for identifying the site reflects the ideas, experience and best advice of a broad cross-section of Canadians who participated in dialogues conducted over a two-year period to design the process to select a site.

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

Adaptive Phased Management

- Centralized containment and isolation of used nuclear fuel in a repository deep underground in a suitable rock formation;
- A series of steps and clear decision points that can be adapted over time;
- An open, inclusive and fair siting process to identify an informed and willing host;
- Opportunities for people and communities to be involved throughout the implementation process;
- Provision of optional temporary shallow storage at the central site, if needed[2];
- Long-term stewardship through the continuous monitoring of used nuclear fuel;
- Ability to retrieve the used nuclear fuel over an extended period should there be a need to access the waste or take advantage of new technologies; and
- Financial surety and long-term program funding to ensure the necessary money will be available for the long-term care of used nuclear fuel.

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

Canadians' objectives for the long-term management of used nuclear fuel, as identified during the study phase:

- **Fairness:** To ensure fairness (in substance and process) in the distribution of costs, benefits, risks, and responsibilities, within this generation and across generations.
- **Public Health and Safety:** To protect public health from the risk of exposure to radioactive or other hazardous materials, and from the threat of injuries or deaths due to accidents.
- **Worker Health and Safety:** To protect workers from and minimize hazards associated with managing used nuclear fuel.
- **Community Well-Being:** To ensure the well-being of all communities with a shared interest.
- **Security:** To ensure the security of facilities, materials and infrastructure.
- **Environmental Integrity:** To ensure that environmental integrity is maintained over the long term.
- **Economic Viability:** To ensure the economic viability of the used nuclear fuel management system, while simultaneously contributing positively to the local economy.
- **Adaptability:** To ensure a capacity to adapt to changing knowledge and conditions over time.

Used Nuclear Fuel

Used nuclear fuel is a byproduct of the generation of electricity by nuclear power plants[3]. It remains radioactive for a long period of time, and the material must be contained and isolated from people and the environment essentially indefinitely. Canada's used nuclear fuel is currently safely managed in facilities licensed for interim storage at nuclear reactor sites in Ontario, Quebec, and New Brunswick, as well as at Atomic Energy of Canada Limited (AECL) owned sites in Quebec, Ontario, and Manitoba.

Canadian nuclear power plants are fuelled by natural uranium, formed into ceramic pellets which are encased in Zircaloy tubes welded together in the shape of a fireplace log weighing approximately 24 kilograms. Once the fuel bundle has been used to generate electricity, it is removed from the reactor. Physically, the bundle looks the same as when it was placed in the reactor. When used nuclear fuel is removed from a reactor, it is considered a waste product, is radioactive and requires careful management. It is first placed in a water-filled pool where its heat and radioactivity decrease. After seven to 10 years, the used bundles are placed in dry storage containers, silos or vaults. The storage containers have a minimum design life of 50 years. Although its radioactivity decreases with time, many radionuclides associated with used nuclear fuel have very long half-lives and will remain radioactive for many hundreds of thousands of years. Chemical toxicity also persists, and the used nuclear fuel will remain a potential health risk for many hundreds of thousands of years. For these reasons, used nuclear fuel requires careful management.

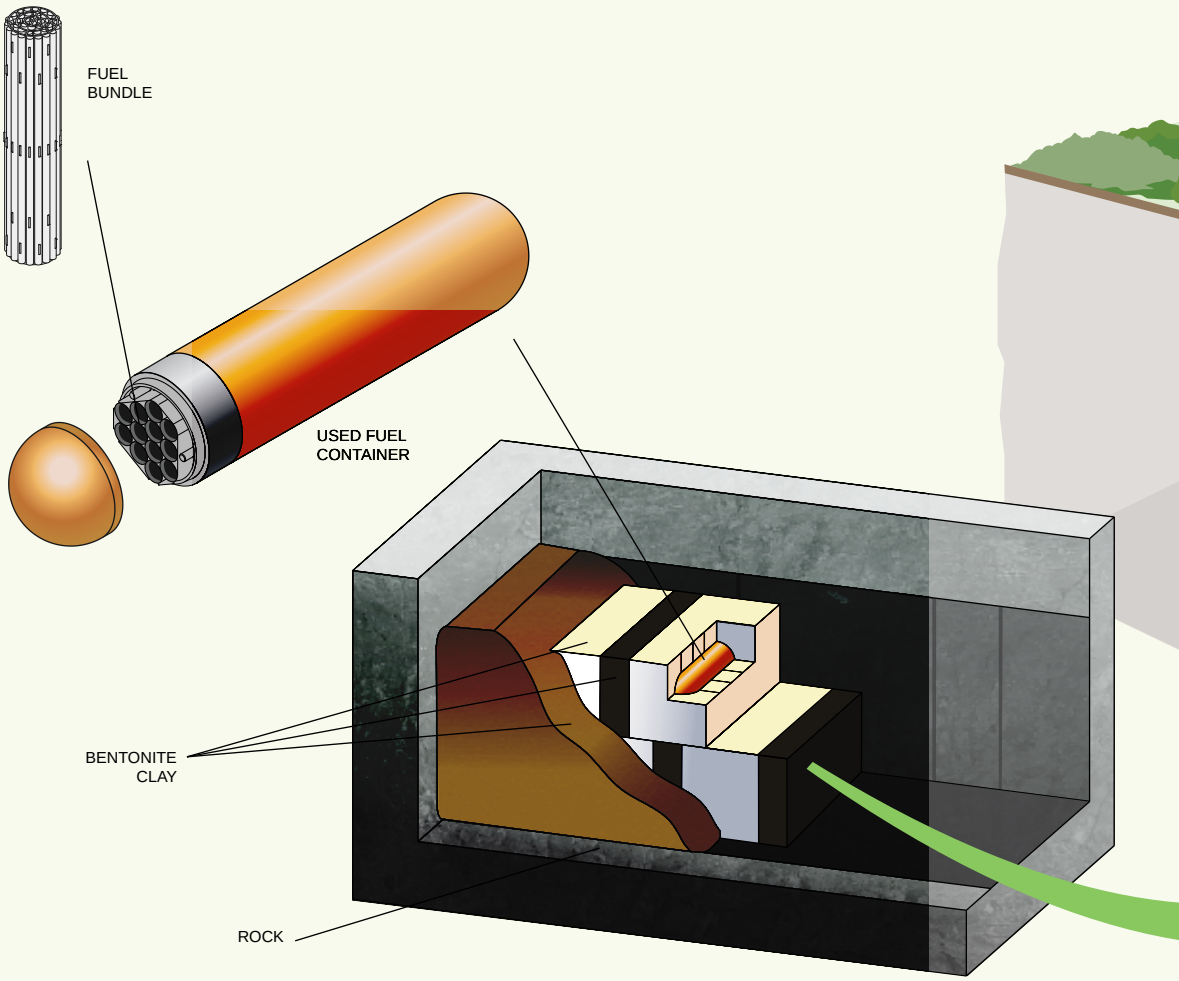
About 90,000 used nuclear fuel bundles are generated in Canada on average each year. Over more than 50 years, Canada's nuclear power program has produced just under 2.7 million used nuclear fuel bundles. A small amount of used nuclear fuel is also created at research and development facilities owned by AECL, and Canadian university facilities. If the entire inventory of used nuclear fuel bundles could be stacked end-to-end like cordwood, it would fit into a space the size of seven hockey rinks, from the ice surface to the top of the boards. The NWMO publishes an annual update on the number of fuel bundles currently in storage, along with a range of projections for future quantities. This report, *Nuclear Fuel Waste Projections in Canada*, is available on the NWMO website at www.nwmo.ca/reports.

The NWMO has a legal obligation to provide long-term management of all Canada's used nuclear fuel, that which exists now and that which will be produced in the future.

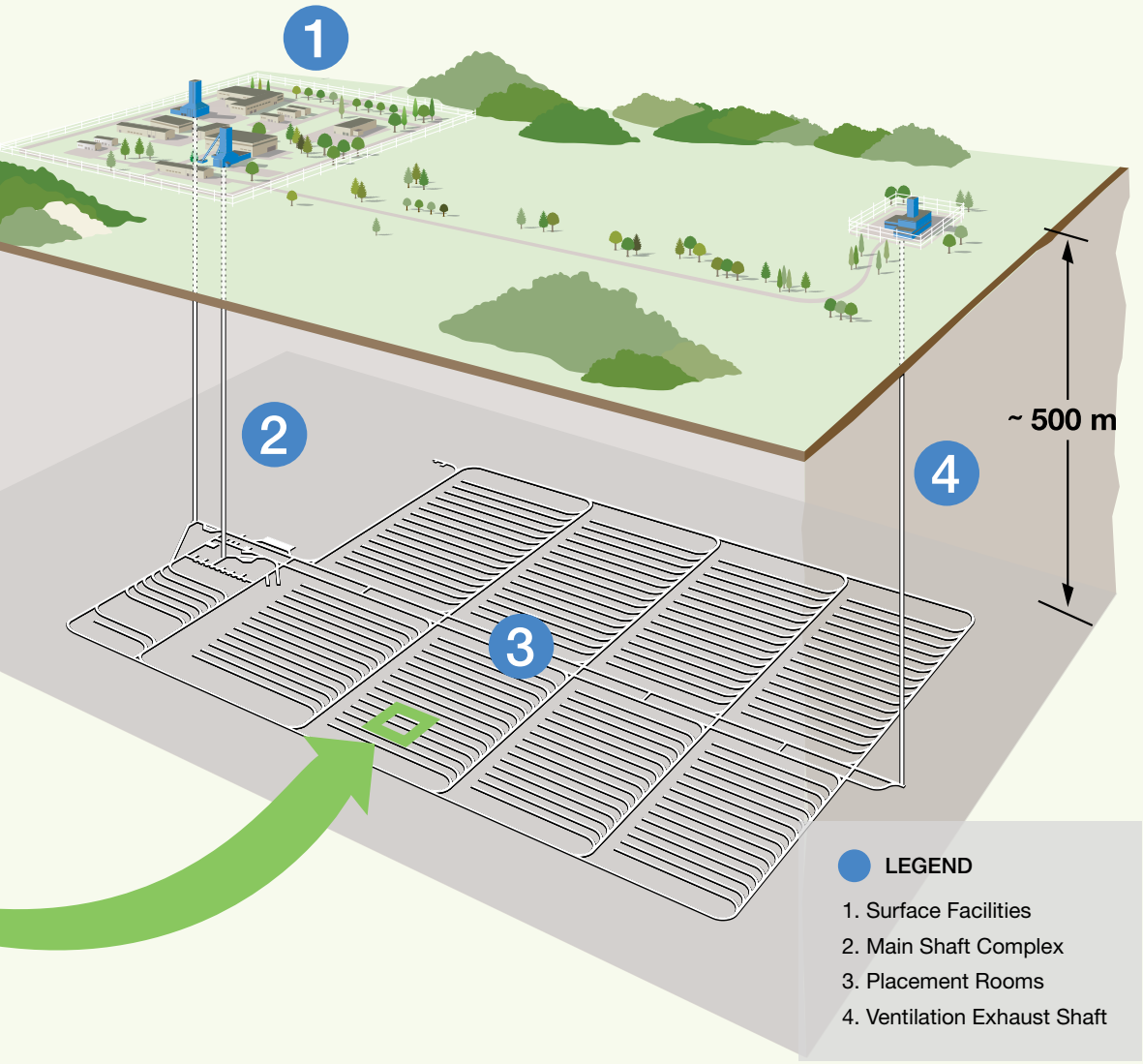
[3] A small amount of used nuclear fuel comes from research reactors. In addition to used nuclear fuel, the operation of nuclear reactors produces low- and intermediate-level waste that is managed at the reactor sites and Ontario Power Generation's Western Waste Management Facility. Waste owners are directly responsible for management of low- and intermediate-level waste. See glossary for more information about low- and intermediate-level waste.

The Project

This national infrastructure project will include the development of a deep geological repository and used nuclear fuel transportation system, and a national Centre of Expertise.



The containers will be placed into a bentonite buffer box in the Used Fuel Packing Plant (UFPP). These buffer boxes are stacked (two high) in the horizontal placement room, and any spaces are backfilled with bentonite pellets.



Deep Geological 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 network of placement rooms for the used nuclear fuel. The surface facilities require a dedicated surface area of about 650 metres by 550 metres for the main buildings and about 100 metres by 170 metres for the ventilation exhaust shaft. The NWMO expects that land above the underground footprint that is not required for the surface facilities or to meet regulatory requirements would be available for other uses. The NWMO will have to demonstrate that regulatory or other requirements for safety that could limit those activities in the immediate area surrounding the surface facilities have been met. Based on current inventory projections and depending on local geology, the underground repository requires a subsurface area in suitable host rock of about two kilometres by three kilometres (about 600 hectares or 1,480 acres).

In addition to the surface area described above, the excavated rock from the underground repository will need to be managed for use in backfilling and sealing the repository. Any remaining excavated rock may have a public or commercial use by the community and surrounding region as aggregate for construction. An excavated rock management area could require a surface area of about 460 metres by 380 metres, with a height of 15 metres. The footprint, height and location(s) of excavated rock could be planned in a way that takes into account community preferences. The area will also include a stormwater runoff pond to collect and manage surface water. The excavated rock management area is currently assumed to be located off-site; its size and location will be determined in collaboration with the community and surrounding area.

Used nuclear fuel will be loaded into specially designed and certified transportation packages at the reactor sites and transported to the repository site where it will be repackaged in corrosion-resistant containers for placement in the repository. The containers will be packed into buffer boxes in the UFPP and transported underground to one of the many placement rooms. The containers will be placed horizontally within the confines of a placement room and sealed with an effective sealing material such as bentonite clay.

The used nuclear fuel will be monitored to ensure safe management and retrievability throughout all phases of implementation consistent with the direction from Canadians. Once a decision has been made to close the facility, the NWMO will seek the appropriate regulatory approvals prior to decommissioning. Any remaining equipment will be removed, and then the access tunnels and shafts will be backfilled and sealed. The nature and duration of postclosure monitoring of the facility will be decided in the future in collaboration with those living in the community once safety requirements have been met.

A robust safety case must be developed to demonstrate that the project can be safely implemented at the site, including transportation, and that it can meet or exceed the requirements of regulatory authorities and the host. Further details on regulatory oversight are provided on page 10.

No foreign waste (used nuclear fuel from outside Canada) will be placed in this facility.

Transportation of Used Nuclear Fuel

Used nuclear fuel is currently safely stored in facilities licensed by the Canadian Nuclear Safety Commission (CNSC) at or near sites where it is produced. Placing all Canada's used nuclear fuel in a single central location will require transportation from these interim storage facilities to the deep geological repository. The NWMO will need to demonstrate to regulatory authorities and citizens the safety and security of any transportation system before transport of used nuclear fuel to the repository can begin. Transportation of the used nuclear fuel will have to meet the stringent packaging and transport requirements of the CNSC and Transport Canada regulations prior to obtaining the certificate for the design of the package and a licence to transport being issued. For more information, please see *Safe and Secure Transportation of Canada's Used Nuclear Fuel* at www.nwmo.ca.

Centre of Expertise

A Centre of Expertise will be established at a location selected for detailed site evaluation (Step 4 of the siting process). The centre will be located at or near this site, as determined with communities in the area. Its purpose will be to support the multi-year testing and assessment of the site on technical safety and community well-being related dimensions, which are key components of the site selection process. It will be the home for an active technical and social research and technology demonstration program during this period. It will involve scientists and other experts in a wide variety of disciplines, including geoscience and engineering. It will also involve specialists in environmental, socio-economic and cultural impact assessment. The technologies and monitoring processes involved in the operation of a deep geological repository may be of interest and have applications in the community beyond the deep geological repository. This will be explored with the community.

The design details of the Centre of Expertise would be developed with the interested community, First Nation and Métis communities in the area, and surrounding communities with their preferences in mind. Discussion of the design details is also an important opportunity for involvement of youth. The Centre of Expertise could also be designed as a focus for engaging members of the community to learn more about the project, and to view the scientific and engineering work-in-progress involved in site assessment, through public viewing galleries and interactive displays. The centre could be created as a small science centre, highlighting and demonstrating the science and technology being used to determine whether the site is suitable. It may be developed as a meeting place and learning centre for the community, and as a destination that welcomes interested visitors from the region and beyond.

The Centre of Expertise would be expanded to support construction and operation of an underground facility at the repository site designed to confirm the characteristics and operating performance of the site. The centre would become a hub for knowledge sharing across Canada and internationally.

As with some other aspects of the project, the exterior design of facilities and the way they are incorporated into the landscape will be a subject of discussion and shared planning with those living in the area.

Read more about the Centre of Expertise in the chapter beginning on page 44.

A Partnership Approach

The 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.

The NWMO will work with the interested community, First Nation and Métis communities in the area, and surrounding communities to harness the economic benefits associated with the project in a manner that will directly and positively contribute to the well-being of not only the interested community, but also other communities within the surrounding area, and as much as possible, drive future growth, capabilities and expertise that will sustain the community over time.

By working with the NWMO, action plans will be developed to ensure the well-being goals communities have set for themselves help guide decision-making at each phase of the project, from construction through operation and long-term monitoring, so that each phase benefits the community.

For a fuller 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.

Planning Priorities for 2017 to 2021

To guide implementation of Adaptive Phased Management (APM), the NWMO has established eight strategic objectives. The objectives identify program areas in the implementation of APM and the planning priorities for 2017 to 2021.

First developed in 2007, the objectives were the subject of public review and discussion in 2007 and 2008. Subsequent evolution of the strategic objectives reflects advancement in the implementation of APM, as planning milestones are met and major areas of focus for the used nuclear fuel program evolve. On an annual basis, the NWMO publishes for review and comment the rolling five-year implementation plan for APM to confirm support for the strategic direction and invite suggestions on the associated work programs.

The NWMO has adapted its strategic objectives to capture the priorities identified in public review and reflect the advancement in implementation of APM.

The strategic objectives guiding the next five years of work on the APM program are summarized hereafter. These strategic objectives also provide the framework for the specific activities and deliverables outlined in this document.

Strategic Objectives 2017 to 2021

The NWMO will:

- Build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. Continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies;
- Implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host;
- Conduct testing of the engineered-barrier system in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently;
- Advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project;
- Continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices;
- Establish safe, secure and socially acceptable plans for transporting used nuclear fuel;
- Ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel; and
- Maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.

Planning Priorities

In May 2010, the NWMO initiated a multi-year process for selecting an informed, willing host for a national facility for the long-term care of used nuclear fuel. The primary focus of the APM program over the five-year planning period will be on two multi-year projects:

- The delivery of Phase 2 Preliminary Assessments in support of the APM site selection process, with the objective of identifying in the future the preferred siting area to take forward for detailed site characterization; and
- The proof testing of the engineered-barrier system for the used fuel repository, with the objective of demonstrating that it meets design requirements.

Over the period 2017 to 2021, the NWMO will continue to implement the process to decide where to contain and isolate Canada's used nuclear fuel for the long term. Site selection for the APM Project is, by design, a community-driven process in which potentially interested communities have initiated a process of learning in their area to explore potential suitability to host the project through a range of technical studies and assessment activities. Over the course of the studies, First Nation and Métis communities in the vicinity and surrounding communities are engaged. The NWMO's current planning assumptions anticipate that all Phase 2 assessments may be completed in 2022, enabling selection of the preferred site in 2023. To ensure organizational readiness, the NWMO will undertake preparatory work so it is positioned at that time to move forward the next steps of site characterization with local communities.

In this same period, a program of proof testing will serve two main purposes: 1) to demonstrate the performance of the engineered barriers to provide evidence that the design meets the safety requirements; and 2) to prove that the NWMO can successfully and repeatedly manufacture and operate all components of the engineered-barrier system. The proof test plan includes work to demonstrate the functionality and operability of the engineered-barrier system, including the ability of the container to withstand repository loads and resist corrosion throughout the life of the repository. From an operability perspective, the plan includes development of a manufacturing program for welding and copper coating of the used fuel container.

A wide range of technical work programs and activities are planned for 2017 to 2021 to ensure the organization is prepared for each sequence of field investigations and detailed assessment, transportation planning, refined repository design, and safety case development. Preparatory work on the Centre of Expertise will be an important focus as the NWMO ensures it is ready to start site characterization, demonstration and verification work as early as 2023. The detailed scoping of activities and schedules for these projects will be further articulated over the planning period. For planning purposes, the NWMO is assuming operations could begin between 2040 and 2045.

Reference Planning Timelines

By design, the NWMO has not prescribed schedules or set deadlines for reaching each milestone related to APM Project implementation. The pace and manner of progressing through the site selection process will necessarily reflect timelines shaped by communities. The time required to move through implementation steps will also be determined by the time needed to complete the rigorous process of confirming safety. The NWMO is committed to leading quality processes to establish strong technical, scientific and social bases for siting decisions. The NWMO will take the time required to complete community engagement, learning, and technical assessments needed to confirm safety and community well-being.

While it is not appropriate to set deadlines for APM implementation steps, it is understandable that the many communities and organizations with whom the NWMO works wish to understand the potential duration of these steps and the overall process. To guide project planning, it is also important that the NWMO establish reference assumptions about timing associated with the phases of APM work. This planning process ensures that budgets are anticipated and money is set aside in trust funds to fully cover project implementation costs at each stage. Reference planning assumptions help ensure the NWMO prepares in advance and is in a state of readiness to move forward to each future phase of work.

This plan outlines the NWMO's most current understanding of the time that may be required to complete Phase 2 siting assessments and to support a decision on a preferred location, based on latest available information.

The NWMO will continue to report its best assumptions on expected timing of siting and other stages of the project as work advances.

Adaptive Phased Management History and Plans

Canada's Plan Is Developed	2002	*Nuclear Fuel Waste Act (NFWA)*	The *NFWA* requires the NWMO to consider alternative technical methods for the long-term management of Canada's used nuclear fuel.
	2002 to 2005	NWMO Study	The NWMO's three-year study with interested Canadians recommends APM as the best approach.
	2007	Government Decision	Government selects APM and mandates the NWMO to begin implementation.
Siting Process Is Developed	2008 to 2009	Design Process for Selecting a Site	The NWMO works collaboratively with citizens to design a process for selecting a preferred central site for the deep geological repository and Centre of Expertise.
Using the Siting Process, a Site Is Identified	2010	Communities Express Interest	The NWMO initiates the siting process with a program to provide information, answer questions and build awareness. Communities begin to identify interest in learning more and initiating studies in the area.
	2010 to 2013	Initial Screening	In collaboration with interested communities, the NWMO conducts high-level desktop reviews to assess potential to meet project requirements in the area.
	2012 to 2015	Preliminary Assessment: Phase 1	The NWMO conducts preliminary studies to further assess suitability. Areas with less potential to meet project requirements are eliminated from further consideration.
	2015 to 2022*	Preliminary Assessment: Phase 2	The NWMO expands assessments to include field studies. As studies advance, areas with less potential to meet project requirements are eliminated from further consideration.
	2023 onwards*	Single Preferred Site Identified, Detailed Site Characterization and Construction of Centre of Expertise Begin	Together with communities in the area, the NWMO selects a preferred site where a strong technical safety case can be developed and a strong partnership can be established involving interested community, First Nation and Métis communities in the area, and surrounding communities.
		Licensing and Environmental Assessment Process	The NWMO submits an application for a Licence to Prepare Site (and possibly construct) to the Canadian Nuclear Safety Commission. This application also initiates an environmental assessment process. Further details are provided in *Regulatory Oversight of Adaptive Phased Management* on page 10.
Construction Begins		Construction and Operation of the Facility Proceeds	

*Reference planning timelines

Build Sustainable Relationships

The NWMO will build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. The NWMO will continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies.

Engagement is one of the five fundamental values that guide the work of the NWMO. Involving Canadians and Aboriginal peoples of Canada at all stages and in key decisions is critical to meeting the challenges of the long-term management of used nuclear fuel. Through open, transparent and inclusive engagement processes, the NWMO will continue to build awareness and understanding of Adaptive Phased Management (APM), and will seek and respond to a diversity of views and perspectives. Interweaving of Aboriginal world views and knowledge systems with APM will strengthen the long-term management of used nuclear fuel. The NWMO's commitment to engagement and shared decision-making helps ensure that APM continues to respond to the values and concerns of Canadians. Building awareness and confidence in APM, and in the NWMO as implementer, will continue throughout the planning period.

During the period 2017 to 2021, engagement will focus on strengthening established relationships to sustain program momentum. This includes engagement activities, such as information sessions, briefings, and joint projects and partnerships, which will be undertaken with municipal, provincial, federal, and Aboriginal governments, and interested individuals and organizations. The organization will continue to work with the NWMO Council of Elders and Municipal Forum. The NWMO will also work with and learn from Indigenous Knowledge holders, to share that knowledge to the extent they wish. The NWMO will also continue to build knowledge and understanding, and establish relations with a broader audience through expanding its outreach to organizations and the broader public at large, with provision of information and dialogue. In the early days of its mandate, much of the NWMO's work focused on developing plans, policies and processes collaboratively with Canadians to support the implementation of APM. Its engagement activities related to the broad Canadian public. As the siting phase of the implementation of APM progresses, the engagement program is evolving to focus more directly on the communities interested in hosting the project in the area, First Nation and Métis communities in the area, and surrounding communities, as well as transportation communities as a group with a shared interest. Engagement of 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.

In building and sustaining relationships, the NWMO is mindful of its obligations throughout the conduct of its work. These obligations include: to Canadians and Aboriginal peoples, to manage used nuclear fuel over the long term; to the local communities, and Aboriginal peoples in potential host communities and regions, to identify an appropriate site for a deep geological repository; and to communities and Aboriginal peoples along transportation routes and in transportation hubs, to ensure that used nuclear fuel is transported responsibly and safely.

The NWMO recognizes that there are Aboriginal peoples in all areas of Canada where the NWMO's work will take place. The NWMO acknowledges, respects and honours that Aboriginal 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). As a result, the Crown has a legal duty to consult and accommodate when its decisions may have an adverse impact on potential or established Aboriginal or treaty rights. The NWMO will support the Crown's work to meet those obligations. Understanding the nature of any impacts of the implementation of APM on the exercise of Aboriginal rights, and how impacts on the exercise of Aboriginal rights could be mitigated, is an important component of the NWMO's work. The NWMO needs to ensure effective engagement with Aboriginal peoples so that those who could be affected have the opportunity for meaningful involvement. To this end, the NWMO wishes to build long-term relationships with Aboriginal peoples that have an interest in the implementation of APM.

Adapting plans in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies

A fundamental tenet of APM is the commitment to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies. Developments throughout the implementation of APM may pose technical and ethical challenges. The NWMO's approach and response to these challenges will be critical to the success of APM. One of the strengths of APM is the flexibility to adapt to evolving societal objectives and priorities, and sharing of insight from Indigenous Knowledge.

The NWMO has identified five fundamental values – integrity, excellence, engagement, accountability, and transparency – that inform its work. A series of principles to guide the siting process, identified in dialogue with Canadians and informed by an Ethical and Social Framework, further builds on these values. Through regular engagement of citizens, specialists and potentially affected communities, the NWMO monitors, reviews, reports, and discusses the challenges that may need to be addressed in implementing APM and changes in the management of used nuclear fuel, especially in the areas of technology development, societal expectations, and energy and environmental policy.

The NWMO continues to learn from best practices and experience with project implementation in Canada and other countries, including ongoing participation in the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency's (NEA) Radioactive Waste Management Committee and Forum on Stakeholder Confidence, which focuses on community-based site selection processes and citizen engagement.

Developments in environmental and energy policies are particularly relevant to APM. For example, nuclear reactor refurbishment projects and new nuclear reactor units would produce new quantities of used nuclear fuel, potentially with different characteristics. The NWMO continues its ongoing monitoring, review and discussion of the potential implications of these developments on the quantities and characteristics of used nuclear fuel that the organization may be asked to manage in the future.

Consistent with the NWMO Transparency Policy and Engagement Procedure, the NWMO reports regularly to the public on its progress in implementing APM, especially in response to the advice of Canadians and the changing external environment. The NWMO also seeks formal opportunities, such as the House of Commons Standing Committees, for open and transparent review of the implementation of APM at key milestones and decision points.

Recycling

Canada's approach to the management of its used nuclear fuel is consistent with best practices around the world. Almost all countries with commercial nuclear power production are planning to isolate the waste byproduct of their nuclear fuel cycle in a deep geological repository. A small number of countries partly recycle their used fuel in existing reactors. Some are conducting research on advanced reactors that could also recycle used nuclear fuel.

Currently, the NWMO does not have a mandate to reprocess nuclear fuel. If Canada chooses to reprocess nuclear fuel in the future, it would require a decision by governments and energy producers – not the NWMO. A decision to reprocess and reuse nuclear fuel would need to consider whether the technology to reprocess the fuel and use it in advanced nuclear reactors has been developed to the point that it is feasible, economical and safe. Such a decision would also require plans for a fleet of advanced nuclear reactors.

To help anticipate any changes in fuel cycles used in Canada, and the types of waste that may need to be managed, the NWMO keeps a watching brief on advanced fuel cycles. The NWMO updates it annually, and it is available on its website at www.nwmo.ca.

Going Forward

In the period 2017 to 2021, to build sustainable, long-term relationships, the NWMO will:

- Continue work to increase awareness among Canadians and Aboriginal peoples of Canada about APM, the site selection process and the NWMO;
- Implement communications and media relations programs to help interested individuals and organizations understand APM;
- Seek and consider comment from interested individuals and organizations on the NWMO's plans and the implementation of APM;
- Advance plan to increase youth awareness and understanding of the project and capacity for future decision-making as required by APM through activities such as presentations to youth in potential siting areas, engaging youth through post-secondary institutions, supporting activities of municipal, First Nation and Métis communities to involve youth in the process, and through other approaches identified by communities;
- Brief waste owners on plans for the implementation of APM and seek regular input and direction so the NWMO may ensure APM plans are aligned with waste owner needs;
- 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 choose to engage in the site selection process, First Nation and Métis communities in the area, and surrounding communities. This is expected to include working together in the planning and conduct of studies;
- Develop and sustain relationships with municipal associations to better understand local governments' points of view, and work with them to implement APM;

- Develop and maintain relationships with the federal government, provincial and local governments, and First Nation and Métis communities and organizations in provinces that produce used nuclear fuel to help co-ordinate and support their contribution to the implementation of APM;
- Develop and maintain relationships with national, provincial, and regional Aboriginal organizations, and keep them apprised of progress in the implementation of APM and the site selection process;
- Continue to seek the advice of First Nation and Métis Elders and youth, and develop awareness and learning opportunities for NWMO staff about cultures, traditional practices, protocols, and governance of Aboriginal peoples;
- Continue to build the foundation of knowledge to ensure that informed choices can be made by Aboriginal communities;
- Continue to work with potentially affected Aboriginal peoples, including Indigenous Knowledge holders, in recognizing the diversity of cultures and languages, practices, and approaches within Aboriginal communities; in identifying sacred areas; in understanding traditional laws, practices, and use of land; and in protecting species to sustain community life;
- Continue to work with Natural Resources Canada to implement the memorandum of understanding on the NWMO's obligations with respect to the Crown's constitutional duty to consult;
- Continue to assess the effectiveness of the NWMO website, social media engagement activities and other communication vehicles to identify opportunities for improvement and make refinements;
- Continue to advance, refine and build upon NWMO engagement activities, including contribution to building partnerships to advance the project; and
- Continue to report publicly on the input that the NWMO receives and how this advice has been considered.

In the period 2017 to 2021, to continue to adapt plans, the NWMO will:

- Continue to build understanding of best practices in engagement, capacity building, impact assessment, and sustaining community well-being;
- Advance learning and exchange experiences on such issues as retrievability, monitoring, and intergenerational knowledge transfer through collaboration with interested academics and organizations in Canada and internationally, including the OECD NEA's Radioactive Waste Management Committee and Forum on Stakeholder Confidence;
- Continue to seek the input of citizens on priorities and concerns relating to APM;
- Build understanding of approaches to the interweaving of Indigenous Knowledge and other assessment approaches into implementation;
- Continue to implement the Ethical and Social Framework and refine as appropriate;
- Continue to share research papers and the results of engagement activities on the NWMO website;
- Continue to seek the input of Canadians on how the implementation of APM should be adapted in response to current and projected inventories of used nuclear fuel;
- Continue to monitor developments in energy and environmental policy;
- Continue to monitor, assess and discuss the impact of potential new nuclear reactor units on the long-term management of used nuclear fuel;
- Continue to monitor, assess and plan for changes in industry waste management activities and plans; and
- Continue work to identify and plan for a range of scenarios reflecting possible changes in societal capacity to implement APM in the future.

In 2017, the NWMO will:

- Provide briefings and information upon request to interested individuals and organizations about APM and the site selection process;
- Continue to support interested communities, First Nation and Métis peoples, and surrounding communities as they explore their interest in the project and the siting process, including collaborating to facilitate engagement of third-party knowledge specialists to assist in community learning about the project;
- Provide briefings and information to governments to support their participation in the implementation of the site selection process, and ensure that they have the information needed to address inquiries from communities;
- Meet on request with nuclear community organizations and their committees, such as the Canadian Association of Nuclear Host Communities, and regional health committees;
- Convene with municipal associations individually and as a forum through meetings, briefings, conferences, trade shows, and special events;
- Continue to seek advice from the Council of Elders and Youth on interweaving Indigenous Knowledge into the NWMO's work and on respectful engagement of Aboriginal peoples;
- Continue broad-based briefings for Aboriginal organizations and engagement of Elders;
- Continue to develop communications materials and exhibits to support the siting process for a range of audiences;
- Continue to implement the NWMO Corporate Social Responsibility Program;
- Continue to develop and implement an education, outreach and capacity-building strategy for young Canadians and Aboriginal youth that incorporates both technical and social disciplines;
- Maintain, and advance as appropriate, engagement activities using social media platforms; and
- Continue to advance the framework for preliminary assessments with advice and input, including Indigenous Knowledge, from First Nation and Métis communities, organizations, and individual knowledge holders.

Collaboratively Implement the Site Selection Process

The NWMO will implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host.

In 2010, the NWMO initiated the site selection process. The development of the process began in 2008 with a variety of engagement activities to ensure that a diversity of perspectives was considered. The product of this collaborative process is described in *Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*, May 2010, available on the NWMO website at www.nwmo.ca.

Implementation of the process, including the selection of an informed and willing host, and demonstration of a safe and secure transportation system, must meet the expectations of Canadians. It must also address their key issues, such as the protection of people and the environment, and fairness. Collaboration, shared decision-making and willingness underpin the siting process.

The decision about an appropriate site will be made over a series of steps (see a list of the steps on page 32). It is expected that communities and areas will proceed through the process at a pace and in a manner that reflect their needs and preferences. The siting process begins with a period of learning and capacity building to engage in discussions about the project. Preliminary assessments (feasibility studies) of potential sites will be done in partnership with communities that expressed interest in the project, First Nation and Métis communities in the areas, and surrounding communities.

Work can proceed only with the involvement of the community that initially expressed interest, First Nation and Métis communities in the area, and surrounding communities. The deep geological repository and Centre of Expertise involve a large project that has the potential to benefit a large area. Planning at a broader area scale will ensure benefits associated with the project are maximized. It will also help ensure that questions and concerns are addressed, and that the foundation is established to move forward together in the implementation of the project.

The nine-step site selection process spans from communities learning about the project to construction and operation. In the planning period, the NWMO will support communities and Aboriginal peoples in learning about the project and exploring how long-term well-being or quality of life of the area might be fostered through the implementation of the project.

Through working with communities that have come forward to participate in the site selection process, and through initial outreach with surrounding communities and Aboriginal peoples, the nature and shape of the partnerships required to implement the Adaptive Phased Management (APM) Project together are beginning to emerge. This project will only proceed with the involvement of the interested community, First Nation and Métis communities in the area, and surrounding communities.

In implementing the site selection process, the NWMO is mindful of its obligations throughout the conduct of its work. These obligations include: to Canadians and Aboriginal peoples, to manage used nuclear fuel over the long term; to the local communities and Aboriginal peoples in potential host communities and regions, to identify an appropriate site for a deep geological repository; and to communities and Aboriginal peoples along transportation routes and in transportation hubs, to ensure that used nuclear fuel is transported responsibly and safely.

The focus of the 2017 to 2021 planning period is on delivery of Phase 2 of the preliminary assessment step in the site selection process. The NWMO will continue to work with communities to assess suitability of potential siting areas to host the APM Project. As the site selection process advances, work will proceed together with the involvement of the interested community, Aboriginal peoples and surrounding communities. Work plans for the 2017 to 2021 period will ensure the NWMO is prepared to support all aspects of the site selection process.

Successful implementation of the siting process will require a good understanding of regional priorities,

politics and key players. Through dialogue, the interested community, First Nation and Métis communities, and surrounding communities will reflect on environmental, social, cultural, and economic effects, and detailed site investigations. Involving the broad area will help ensure that the range of potential effects, both positive and negative, associated with implementation at a particular site are recognized and considered. Involvement of those along the transportation route, as a large group with a shared interest, will ensure that effects associated with the transportation of used nuclear fuel are taken into account in decision-making on a preferred site. The NWMO keeps provincial governments briefed on APM so they are ready to support community interest, and address inquiries about Crown land, and provincial regulations and approvals. Over the five-year planning period, the NWMO expects to be seeking provincial authorizations as may be required for initial borehole drilling.

Throughout the siting process, the NWMO will support and assist communities to build understanding of APM, and to address questions and concerns, including how used nuclear fuel will be contained and isolated to ensure the safety of people and the environment, considering air, land and water. The NWMO also supports communities to build understanding of how the project may help or hinder the community and area's ability to achieve its long-term plan and to engage citizens in learning and assessment. Funding and resources are provided to support communities as they work through each step.

As the NWMO continues to learn together with communities through implementation of the site selection process, understanding what would constitute a 'compelling demonstration of willingness', inclusion and shared decision-making are important questions. Working collaboratively with those involved in the siting process to articulate expectations in these areas is an important objective. This collaboration will inform work to explore the potential to work together to implement the project in partnership.

In the next few years, technical support to the siting process will focus on assessing the suitability of potential sites through geoscientific and environmental evaluation studies in the vicinity of interested communities. Beyond ensuring safety, 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. The technical program will be complemented by a phased and progressively more detailed assessment of the suitability of a site in terms of environmental, social, cultural, and economic factors. These assessments will continue for the duration of the planning period. They will support a continual narrowing down of potential siting areas, and eventually, selection of a preferred location to be the focus of detailed site characterization. Detailed site characterization will begin once the preferred location is selected. It will include further geological investigations, safety assessments, environmental studies, and social and economic impact assessments. This work will be planned and conducted in collaboration with interested communities, First Nation and Métis communities, and surrounding communities. The application of Indigenous Knowledge throughout this work is an important objective.

The NWMO continues to develop the institutional policies, practices and structures required to support the different phases of the siting process. The NWMO will work to ensure that implementation of the site selection process is inclusive, fair, and transparent, and continues to build trust and confidence in the NWMO and its operations. Any site that is selected to host this facility must be demonstrated by the NWMO to be able to safely contain and isolate used nuclear fuel for a very long period of time. It must have an informed and willing host, and a strong partnership must be established with local Aboriginal and non-Aboriginal communities. The objectives of the site selection process and the main site evaluation stages are outlined in the description that follows.

The NWMO is committed to reviewing and refining the process with Canadians, and in particular, those in areas involved in the site selection process, to ensure that it continues to meet needs and expectations. The NWMO will continuously advance knowledge and adapt plans consistent with international best practices.

As it continues implementing the site selection process, the NWMO understands it will take our best knowledge and expertise, and all of us working together to implement Canada's plan. Among the many challenges to be addressed along the way is the low level of familiarity with and understanding of used nuclear fuel, which leads to fear among some people becoming involved in learning about this project. Information, effective communication and dialogue are key.

Preliminary Assessment of Potential Suitability

All communities presently involved in the siting process have successfully completed an initial screening and have requested that Preliminary Assessments be undertaken in their area. These studies are an opportunity for the community, First Nation and Métis communities in the area, surrounding communities, and the NWMO to explore suitability of the area to host the project.

Preliminary assessment of potential suitability is conducted in two phases as part of Step 3 in the nine-step process described below. Phase 1 work was completed at the end of 2015. Phase 2 studies are ongoing.

Getting Ready	The NWMO publishes the finalized siting process.
Step 1	The NWMO initiates the siting process with a broad program to provide information, answer questions and build awareness among Canadians about the project and siting process.
Step 2	Communities identify their interest in learning more, and the NWMO provides a detailed briefing and conducts an initial screening.
Step 3	**For interested communities that successfully complete an initial screening, a preliminary assessment of potential suitability is conducted in two phases. Preliminary assessments support an ongoing narrowing down of study areas.**
Step 4	Detailed site evaluations are completed in one site identified as having strong potential to meet project requirements in Step 3 Preliminary Assessments.
Step 5	Acceptance to host the repository is confirmed.
Step 6	Formal agreement to host the repository is ratified, subject to all regulatory requirements being met and regulatory approval received.
Step 7	An independent, formal and public process is conducted under the Canadian Nuclear Safety Commission's regulatory framework to ensure that all requirements are met (see *Regulatory Oversight of Adaptive Phased Management* on page 10).
Step 8	Construction and operation of an underground demonstration facility proceeds.
Step 9	Construction and operation of the facility proceeds.

Assessing Site Suitability in 2017 to 2021: Phase 2 Preliminary Assessments

What is the purpose of Phase 2 assessments?

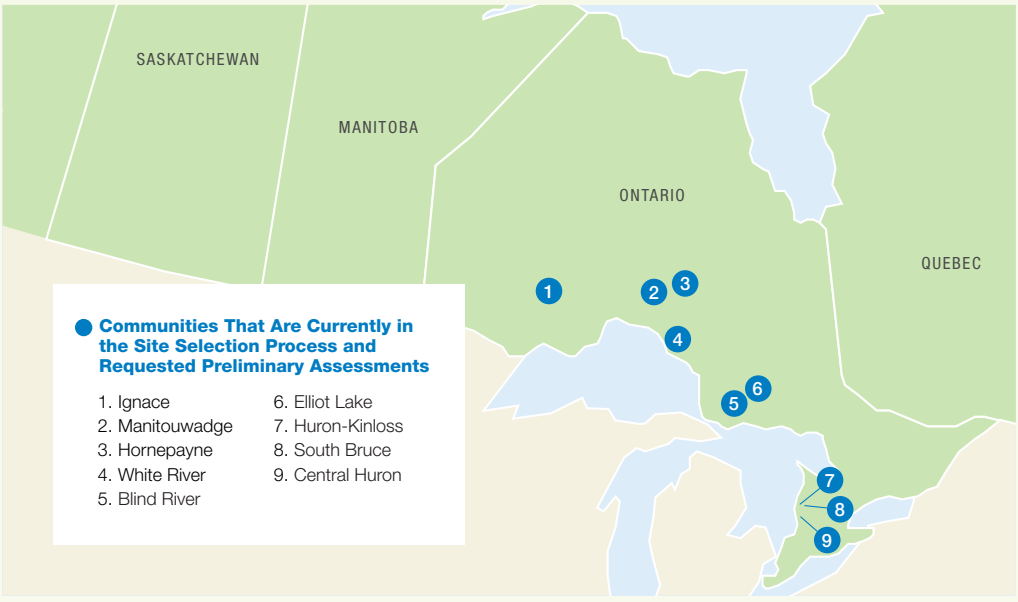
The primary objective of Phase 2 Preliminary Assessments is to advance technical and social assessments to the point where a decision can be made to narrow down to one location to be the focus of detailed site characterization. In order to select the preferred location for siting the APM repository, the NWMO would need to have a sufficient degree of confidence from Phase 2 preliminary assessment work that:

- A deep geological repository can be developed with a strong technical safety case at that location;
- A safe, secure and socially acceptable transportation plan can be developed to transport used nuclear fuel to that location; and
- A strong partnership can be developed with the interested community, First Nation and Métis communities in the area, and surrounding communities.

Which areas are being studied?

Phase 2 assessments will concentrate on the smaller number of study areas that earlier studies identified as having strong potential to meet siting requirements.

Assessments are underway in several areas of Ontario, as indicated in the map below. The communities that initially expressed interest in the project and requested studies in the area are shown on the map. Assessments include broadened dialogue and engagement with surrounding communities, involving municipal, First Nation and Métis communities in the area.



What is involved in the assessments?

Phase 2 assessments will build upon the learning from Phase 1 studies. The multi-year program of study and engagement is designed to facilitate further learning, deepen understanding of the project and further explore potential suitability of the area being studied. This learning and reflection involves the interested community, First Nation and Métis communities in the area, and surrounding communities. In this phase:

- Technical evaluation of potentially suitable areas will continue in greater detail, focusing on geoscientific suitability, engineering, transportation, environment, and safety.

- Geological field investigations will provide site-specific information that will examine whether a suitable location can be identified for the deep geological repository that will ensure safe and secure long-term containment and isolation of used nuclear fuel. Activities may include a sequence of airborne geophysical surveys, geological field mapping, and environmental surveys, and should the findings from these studies warrant, deep borehole drilling and testing. People in the area will be engaged to help identify and refine the list of potentially suitable sites that would be socially acceptable.

- Environment and safety evaluations will focus on specific areas guided by input from the interested community, First Nation and Métis communities in the area, and surrounding communities. Field studies and discussions will build understanding of the environmental conditions of the areas being studied, and potentially the early identification of Valued Components, as defined under the *Canadian Environmental Assessment Act*, 2012.

- Potential transportation routes and modes to each potential repository site will be identified against technical safety criteria. Transportation planning and evaluations also need to be aligned with community input.

- Engineering designs for the deep geological repository, safety assessments, transportation assessments, and environmental studies will be further developed and refined over the course of Phase 2 for specific study sites. The purpose is to determine whether all technical and safety criteria can be met.

- Engagement in the interested community and with First Nation and Métis communities in the area, and surrounding communities, will support more detailed reflection and assessment. Phase 2 provides the opportunity for all to develop a more detailed understanding of project benefits, opportunities to work together and how potential negative effects of the project can be managed. Interest will be explored while continuing to build awareness and understanding of the project.

- The NWMO, the interested community, Aboriginal peoples in the area, and surrounding communities will together reflect on the suitability of the area to host the project and whether there is a foundation to work together to implement it. Phase 2 activities will explore whether an implementation plan can be developed to ensure safety, align with expectations of the community and area, and be economically feasible.

- Partnership, and the ability to develop a partnership involving the interested community, First Nation and Métis communities in the area, and surrounding communities, will be assessed as a necessary requirement for advancing the project in the area. An important outcome of Phase 2 will be to identify the terms under which a working partnership can be developed to implement the project and evaluate the ability to implement this partnership.

- Indigenous Knowledge will help guide the planning and implementation of NWMO activities in a siting area, including field studies, as shared by First Nation and Métis communities in the area.

» Engagement processes for understanding and testing community support and partnership potential will be developed and implemented by the NWMO and communities involved in the siting process.

Review by Geoscientific Review Group

Geoscientific studies are reviewed by the APM-Geoscientific Review Group (APM-GRG), and their reports are published on the NWMO website at www.nwmo.ca/apm-grg. This group was established by the NWMO to provide advice and guidance on the approach, methods and findings of the geoscientific preliminary assessments that are part of the studies conducted in Step 3 of the site selection process. The five APM-GRG members are internationally recognized experts from Canada, Switzerland, Sweden, and Australia. They bring a wide range of expertise and experience relevant to geoscientific site evaluations.

What kind of partnership is needed for the project to proceed?

The NWMO has committed to only implementing the project in partnership with those in the area. The NWMO thinks that a partnership involves people and groups working together to achieve mutually agreed upon objectives. The NWMO understands there are many forms of partnership, and just like other aspects of APM, the specifics will emerge through collaboration among people in the area and the NWMO.

To select the preferred location for a repository at the end of Phase 2 studies, the NWMO would need a sufficient degree of confidence that a strong partnership can be developed to support implementation of the project in the area. This process of planning for partnership will take several years, which means there is time for learning about the project, for questions and concerns to be addressed, and for relationships to be built or strengthened.

Building a plan for partnership in any of the study areas will need to involve the community that initiated the process and nearby First Nation and Métis communities. It may also involve nearby municipalities. In the area that is selected to host the project, these communities would be expected to be partners with the NWMO in implementing it.

As it works with communities over the course of Phase 2 assessments, the NWMO will explore with them the relationships that will be needed and the interests that would bring people together to advance Canada's plan. We will also need to discuss roles and responsibilities in a way that brings communities together for shared planning of the project.

In early Phase 2 activities, the NWMO is looking for indicators that a strong partnership might be developed as studies continue in coming years. These indicators include the ability to work together to advance the progressively more detailed technical studies that are required to assess whether project safety requirements can be met. For example, we will need to work together to develop detailed mapping plans, and then identify locations for drilling boreholes at sites that meet technical requirements and could be socially acceptable locations for a repository. The ability for the NWMO and communities to work together to foster learning about the project to support future decision-making is also an indicator a strong partnership may be possible in the future.

By the end of Phase 2 studies, a preliminary implementation plan for the project in the area would need to have been developed and confirmed by the NWMO and the communities involved.

How long will Phase 2 assessments take?

The NWMO's current reference plans anticipate that Phase 2 Preliminary Assessments may be concluded by the end of 2022, which the NWMO believes is a realistic assumption given information available to it today. This assumption, adopted for planning purposes, was developed based on a detailed review of the technical studies and the dialogue and engagement the NWMO believes will be required. The NWMO drew on the latest information available, including the number of areas engaged in the siting process, the specific geospheres being studied, and the nature of fieldwork required to thoroughly assess each geological setting against best international practice. It also took into account the importance of providing time for communities to learn, engage fully and develop the capacity to make informed decisions.

It must be emphasized that this timeline was developed only for planning purposes. As the steward of the siting process, the NWMO must take the time required to carefully assess sites and confirm a strong safety case. Communities and areas will also dictate the pace at which they are prepared to proceed. The NWMO will take the time needed to implement APM properly.

With the benefit of further experience, the NWMO and communities may continue to evolve understanding about time required to safely select a site and advance the APM Project together. As the NWMO moves forward, it may find the need to move at a different pace or conduct additional technical work. For example, further into the process, the NWMO may find a need to conduct additional studies on a small number of sites to develop sufficient confidence to identify one preferred site. A need for additional studies would extend the time required to select a site.

When will a preferred location be identified?

Findings from Phase 2 assessments will inform the NWMO's selection of the preferred location. If Phase 2 assessments are concluded by 2022, the NWMO could be in a position to complete its analysis and take a decision on the preferred location in 2023. This area would then become the focus of the next step in the site selection process: detailed site characterization.

For planning purposes and to ensure the NWMO's readiness to advance site characterization work as soon as the site is selected, it is adopting 2023 as a reference planning date for a decision on the preferred site.

What can communities expect during the Phase 2 assessment process?

The NWMO is committed to delivering a process that is respectful to the many communities engaged in Canada's site selection process for this important national initiative. The NWMO is also committed to building the skills and capacities of communities to be part of the APM Project.

As communities continue in the siting process, they can expect the following from the NWMO:

- Resources and support for learning about the project and building capacity to take informed decisions;
- Funding to cover costs associated with participation in the project throughout all phases of work;
- Inclusion in collaborative development, refinement, and delivery of plans and dialogues;
- Processes that respond well to local needs, and social and cultural priorities;

- Procurement processes for goods and services that give preference to qualified local and Aboriginal suppliers in potential siting areas;

- A gradual expansion of local hiring in potential siting areas; and

- Investments in training and education to equip community members, including youth, to work at the Centre of Expertise, and in subsequent site preparation, construction and operation activities. These would be transferable skills that could be applied to other projects as well. The NWMO will discuss with communities the priority areas for skills training and education, and how best to invest in that capacity building. Programs could be put in place early in the planning period and extending throughout the duration of involvement in Phase 2 studies.

Will the areas of focus be narrowed down during Phase 2?

Yes. It is expected that as initial studies are completed in other siting areas, decisions will be taken to further reduce the number of study areas to focus on sites showing the most potential for strong safety cases and strong potential for support and partnership among area communities. It is difficult to predict with certainty the timing for further narrowing down decisions. The NWMO will continue to make decisions as studies are completed and information becomes available. Communities that enter Phase 2 will not necessarily continue for the entire study period.

There will be ongoing stock-taking by the NWMO and communities as results from assessments become available and dialogues continue.

What happens after a preferred site is identified?

Once a preferred site is selected, there will be a further escalation of activity in the area. This will include construction of the Centre of Expertise, detailed site characterization activities, launch of a range of verification and demonstration activities, and initiation of regulatory processes to support future construction and operation of the deep geological repository and related surface facilities. Based on its latest understanding of the time and work required, for planning purposes the NWMO is assuming operations could begin between 2040 and 2045. See page 44 for a description of these activities.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Continue preliminary assessments in study areas identified to be the focus of Phase 2 study;
- Significantly advance understanding of suitability of study areas through delivery of Phase 2 Preliminary Assessments and engagement of local communities, First Nation and Métis communities in the area, and surrounding communities;
- Seek a more detailed understanding of the potential of each study area, based on whether:
  - a deep geological repository can be developed with a strong technical safety case at that location;
  - a safe, secure and socially acceptable transportation plan can be developed to transport used nuclear fuel to that location; and
  - a strong partnership can be developed with the interested community, First Nation and Métis communities in the area, and surrounding communities.
- Undertake geoscientific assessment of study areas in both crystalline and sedimentary rock settings through such studies as: airborne geophysical surveys, mapping to observe general geological features, detailed geophysical mapping, seismic reflection studies, and a limited number of boreholes;
- Undertake engagement activities to understand and test potential in the area for advancing the project in partnership;
- Initiate limited borehole drilling and expand field studies to inform the assessment of geoscientific, engineering, environmental and safety factors, and factors identified by Indigenous Knowledge holders;
- Submit for advice and review by the APM-GRG the proposed approach, methods and findings of the geoscientific preliminary assessments. Publish reports of the APM-GRG on the NWMO website;
- Develop conceptual engineering designs to support evaluation of candidate sites;
- Deliver preliminary environment and safety assessments to support evaluation of candidate sites;
- Respectfully apply Indigenous Knowledge to both technical safety and community well-being aspects of the site selection process, and the approach to engagement with Aboriginal communities and local Elders, taking into account spiritual and cultural considerations, and effective and meaningful relationships between generations and within and between communities;
- Continue to explore technical safety considerations through illustrative postclosure safety assessments of the deep geological repository;

- Develop and implement engagement activities to discuss and seek input on field studies and assessment work in study areas;
- Engage communities in more intensive learning and dialogue about the project, and explore and help assess the extent to which the project might contribute to or detract from the well-being of local municipal, First Nation and Métis communities in each siting study area;
- Continue to narrow down the number of study areas over the course of Phase 2 assessments through ongoing stock-taking of assessment findings with communities. Areas with relatively low potential to be suitable for the project will be screened out;
- Through completion of increasingly intensive Phase 2 studies, build information to guide a future decision on the selection of the preferred siting area to be the focus of detailed site characterization;
- Continue to support communities in developing capacity to consider their interest in potentially hosting the APM Project in the area;
- Continue to develop exhibits and other communication tools to support local- and area-based discussions of APM and siting;
- Continue to support communities in responding to the values-based requirements of the process, including appropriate engagement of citizens and transparency in decision-making;
- Working with communities, refine and enhance approaches to assessing willingness, partnership and opportunity to advance the project in the area;
- Refine and enhance approaches to informing and engaging the interested community, First Nation and Métis communities, and those in the surrounding area in siting decision-making in the spirit of partnership;
- Work with municipal and First Nation and Métis communities, and refine tools and methods for assessment of sites in terms of environmental, social, cultural, and economic factors, including factors identified by Indigenous Knowledge and traditional approaches to land use mapping and planning;
- Establish and sustain an NWMO presence in communities that remain in the site selection process, and in the broader area, to provide information and support public engagement;
- Continue to seek advice of municipal associations and Aboriginal organizations on materials and tools to support a community-driven siting process;
- Conduct research on partnership and power-sharing frameworks for consideration in structuring agreements with the community, Aboriginal peoples and the area, once selected;
- Explore the need to design and implement a property value protection program to support the implementation of the project; and
- Explore long-term knowledge transfer considerations, such as markers and archives, as part of international collaborative research efforts (Nuclear Energy Agency).

In 2017, the NWMO will:

- Work in partnership with communities as they proceed through the siting process;
- Implement, support and further develop the Learn More Program that is described on the NWMO website for community capacity building to meet the needs of interested communities, First Nation and Métis peoples, and surrounding areas;
- Develop approaches to more comprehensive multi-year agreements to support the increased level of collaboration as field studies advance;
- Develop and implement local engagement activities with community members in potential siting areas to discuss and seek input on field studies and assessment work;
- Advance Phase 2 Preliminary Assessments by conducting field studies upon request of interested communities with strong potential to meet the requirements of the project;
- Review geoscientific assessment methods, plans and findings with the APM-GRG;
- Continue discussions with Aboriginal communities engaged in the site selection process about how Indigenous Knowledge should be respectfully reflected in preliminary siting assessments;
- Develop and implement local and regional outreach plans to build awareness of the project, deepen understanding of regional perspectives and build relationships in the broader area;
- Continue to seek opportunities to engage First Nation and Métis peoples at the local and regional level through collaborative work with communities, and regional or provincial Aboriginal organizations involved in the siting area;
- Continue to advance co-ordination and collaboration with provincial governments aimed at identifying mechanisms and processes to address provincial areas of interest, and preparing for the permitting process that may be required to support fieldwork; and
- Continue to develop communication materials to support learning and dialogue on activities involved in the multi-year Phase 2 site selection assessments, the project description, the safety of the repository, and transportation considerations.

Demonstrate Safety and Feasibility of Repository and Engineered-Barrier Design

The NWMO will conduct testing of the engineered-barrier system in order to demonstrate that it meets safety requirements, and can be produced effectively and efficiently.

The ability of the deep geological repository to safely contain and isolate used nuclear fuel relies on the form and properties of the waste, the engineered barriers placed around the waste, and the natural barriers provided by the rock formation in which the repository will be located. The preferred site will be in a rock formation with desirable characteristics (geological, hydrogeological, chemical, and mechanical) that support long-term containment and repository performance to meet or exceed the regulatory expectations of the Canadian Nuclear Safety Commission. The repository will be consistent with the guidance of the International Atomic Energy Agency and the experience in other countries.

The NWMO's technical program supports Adaptive Phased Management (APM) in three key areas: site selection, engineering design and costing, and safety assessment. The NWMO's technical program objectives are reviewed and updated annually to ensure that they are consistent with the strategic direction from the NWMO Board of Directors and planning assumptions related to progress in implementing APM.

A strong technical program ensures that APM benefits from knowledge and innovation in the long-term care of used nuclear fuel from Canada and abroad, including Finland, France, Japan, Sweden, Switzerland, and the United Kingdom. It also ensures that NWMO staff sustain the expertise required to implement the adaptive program.

The NWMO is further developing its technical program in engineering design and demonstration. Over the next five years, physical prototypes of the long-lived repository containers will be manufactured and tested. This will incorporate robust design practices and proven manufacturing technologies, and demonstrate the NWMO's ability to meet the rigorous requirements of the repository environment. Further, the NWMO will continue to conduct testing of used fuel and transportation containers at the established test facility. This facility will continue to investigate manufacturing technologies and prototype testing.

In order to support understanding and broad dialogue on design and safety considerations, and in particular the development of the safety case, communication materials written in plain language will be prepared. This material will include periodic reports on work to date, as well as discussion of the parameters and assumptions being used in the safety assessments, and how detailed information about a site, once known, will be used to refine work in the future.

Adapting plans to incorporate new learning and knowledge

A fundamental tenet of APM is the ongoing incorporation of new learning and knowledge to guide decision-making. The NWMO is committed to re-evaluating decisions where warranted, maintaining the option to change course and being prepared to act on new knowledge or information. A program that is implemented over a long time will have many opportunities to improve safety and performance, enhance effectiveness, build understanding, and reduce uncertainty. One of the strengths of APM is the incorporation of new learning and knowledge.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Seek pre-licensing reviews of safety assessments based on hypothetical repositories in crystalline and sedimentary rocks;
- Update the conceptual designs and cost estimate for APM as required;
- Complete design, fabrication, and testing of prototype repository containers, buffer, and emplacement systems;
- Conduct independent peer reviews of specific aspects and features of the engineered-barrier design;
- Seek reviews of the engineered-barrier design and proof testing program;
- Initiate design and development of used fuel handling systems;
- Complete an integrated review of the microbiological process that could occur within the repository environment in support of corrosion models;
- Maintain and improve safety assessment models, including groundwater flow, containment release and transport, and coupled thermal-hydraulic-mechanical processes;
- Further enhance scientific understanding of processes that may influence repository safety; and
- Maintain a prototype test and demonstration facility for engineered-barrier evaluations.

In 2017, the NWMO will:

- Continue prototype and equipment testing at the test facility;
- Conduct an independent peer review of the generic corrosion program;
- Complete an update of the safety assessment reflecting the updated repository and engineered-barrier designs;
- Fabricate and pressure test a prototype copper-coated used fuel container;
- Further develop used fuel container manufacturing process tolerances;
- Fabricate buffer box emplacement equipment and undertake placement room mock-ups;
- Fabricate a full-scale shaped bentonite buffer block and associated buffer box assembly; and
- Demonstrate backfill bentonite pellet placement.

Focus on Safety

Used Nuclear Fuel Repository Container

The NWMO's container technology program focuses on integrating state-of-the-art manufacturing and materials technologies related to geometry (container size and shape), corrosion barrier (coating and fabrication), welding, and inspection to develop and demonstrate robust containers for holding the used nuclear fuel within the repository. An extensive proof testing of the containers and engineered-barrier system is planned.

Health and Safety of the Public and Workers

The NWMO's repository will protect public health and worker safety. The design will be optimized to minimize the risk of exposure to radioactive or other hazardous materials, and the risk from accidents. This will be tested in part through safety assessments, which examine the behaviour of the design under both likely and unlikely scenarios. The NWMO is continuing to apply and improve its safety assessment approach, considering both operational and long-term safety.

Case Studies

The NWMO continues to conduct case studies by applying its postclosure safety assessment methodology to designs and illustrative geological settings. 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. The NWMO will use these studies to discuss safety aspects of the repository system, and build broad awareness and understanding of safety with community members.

Plan for Construction and Operation of Centre of Expertise and Deep Geological Repository

The NWMO will advance planning and capabilities for the construction and operation of the deep geological repository and the associated Centre of Expertise at the site selected to host the project.

Once a preferred site is selected for the Adaptive Phased Management (APM) Project, for planning purposes assumed to be as early as 2023, there will be an escalation of activity on many fronts in the local and regional area. These activities include a range of verification and demonstration activities. Processes will also be initiated to support the future construction and operation of the deep geological repository and related surface facilities.

The NWMO is committed to working closely with communities to initiate planning for these important future phases of work. As part of its 2017 to 2021 work plan, the NWMO will work with communities engaged in the site selection process to initiate important preparatory work in support of this eventual expansion of local activity at the selected site. Activities during this period will include detailed site characterization, and preparing for future regulatory submission, construction and operation phases of the project. This advance planning will make it possible for the project to proceed expeditiously once the preferred location is identified. It will also make it possible for communities to be prepared to participate in the project through associated jobs and services.

Getting Ready for Activity at the Site

Planning for Future Regulatory Approvals

The NWMO's overriding objective in implementing the APM Project on behalf of Canadians is safety and security. The NWMO 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 on the peaceful use of nuclear energy.

The Canadian Nuclear Safety Commission (CNSC) is the main licensing authority for the APM Project. The CNSC's comprehensive licensing system is described in *Regulatory Oversight of Adaptive Phased Management* on page 10.

The NWMO will prepare comprehensive and high-quality plans and processes to conduct site investigations and associated technical studies based on relevant municipal, provincial and federal requirements for the project.

Planning the Centre of Expertise

The Centre of Expertise will be located in or near the area selected to host the deep geological repository. The centre's key purpose following site selection will be to support the multi-year program of technical testing, verification, and demonstrations, and to support ongoing planning and discussion with community members. The Centre of Expertise would later be expanded to support construction and operation of the deep geological repository.

Once a preferred repository site is identified, the Centre of Expertise will support detailed underground site characterization work that will take place to confirm geological conditions at depth and gather additional data to develop the safety case. It may also serve as a training centre to prepare personnel to work on various aspects of project implementation.

An engineering test facility will be located within the Centre of Expertise. Activities in this facility will include demonstrations of container laser welding and copper coating processes, bentonite clay buffer shaping and forming, as well as container placement equipment for the underground repository. The engineering test facility will also house mock-ups of fuel handling cells to show how the used nuclear fuel would be packaged into containers and prepared for emplacement in the repository.

The Centre of Expertise will be home to an active technical and social research and technology demonstration program during this period, involving 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. The high level of international collaboration on the APM Project will be expanded as the centre welcomes scientists and visitors from abroad who wish to benefit from the work being led at Canada's national facility.

Designing the Centre of Expertise With Communities

Planning the Centre of Expertise will take into account local preferences. A first step following site selection would be to elaborate plans so that construction could begin as soon as possible. The NWMO would work with local communities to lead detailed planning for the centre. It is important that communities be part of this discussion so that design details of the centre can reflect preferences and priorities of the municipal and First Nation and Métis communities in the area. The Centre of Expertise provides an opportunity for the NWMO and communities to consider how it may provide synergies with other local plans and aspirations.

Discussions with communities and those living in the area began in earnest in 2016 and will continue throughout the planning period on considerations such as:

- Potential locations for the Centre of Expertise within the siting area;
- Design features such as the exterior appearance of facilities, and the way they are best incorporated into the surrounding landscape;
- Local, regional, and First Nation and Métis history, and social, cultural, spiritual, and economic values and priorities that could be reflected in the centre;
- Activities that might be incorporated to engage and inform the community about the project, and to facilitate viewing of scientific and engineering work involved in site assessment;
- Opportunities to incorporate activities to support youth science literacy and capacity development;
- Activities that could be included in a learning and demonstration area about how Indigenous Knowledge is being applied to the project;
- Opportunities to incorporate public spaces that support activities beyond the APM Project, such as a meeting place and learning centre for community activities; and
- The application of repository-related knowledge and technologies to other areas of interest to the community and area, such as monitoring and protection of natural water systems in the area, environmental sustainability planning in the area, and opportunities to enhance the area's natural environment or other economic activities.

These early illustrations show just two examples of how a Centre of Expertise could be designed. Communities are invited to consider what architectural design styles and features they would prefer.

Advancing Plans for Confirming Site Characteristics and Demonstrating Safety

Once the NWMO selects the preferred site, it will become the focus of detailed investigations to verify and demonstrate safety in specific in-situ conditions. The purpose of verification activities is to confirm the properties/characteristics of the site (geological, hydrogeological, geomechanical, surface geotechnical). This site characterization work will be important to confirm and verify the underground conditions required to support a final safety case based on the specific site proposed for the project.

The detailed investigations will build on work completed in Phase 2 assessments, and will include activities such as advancing borehole drilling and monitoring, and detailed geotechnical assessments of areas where the surface facilities and waste rock management area will be constructed. The NWMO will also conduct detailed environmental studies at the proposed site to provide an understanding of baseline environmental conditions and to assess the potential impacts of the repository.

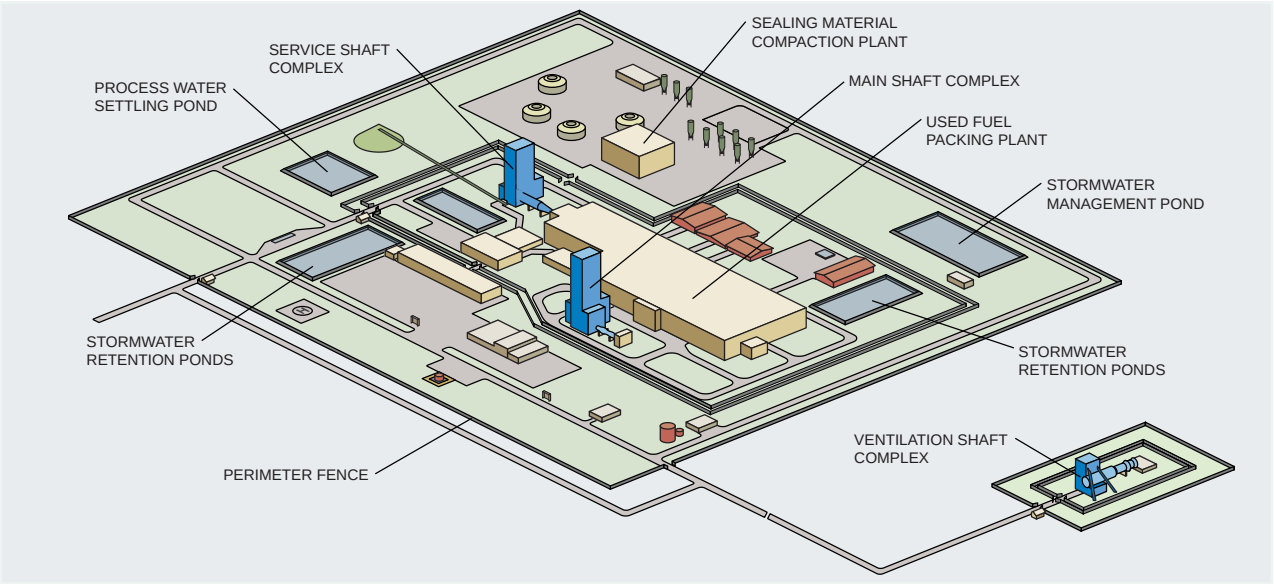
Over the 2017 to 2021 business planning period, the NWMO will prepare detailed plans and steps required to fully understand the site at depth. This will involve reviewing draft plans with the APM-Geoscientific Review Group. This important confirmatory work will contribute to safety case development and documentation required for the future regulatory approvals process.

Subsurface verification activities would later be used to confirm detailed site characterization completed during surface investigations and monitoring. These activities would be done during the construction of the shafts and initial development at the repository level.

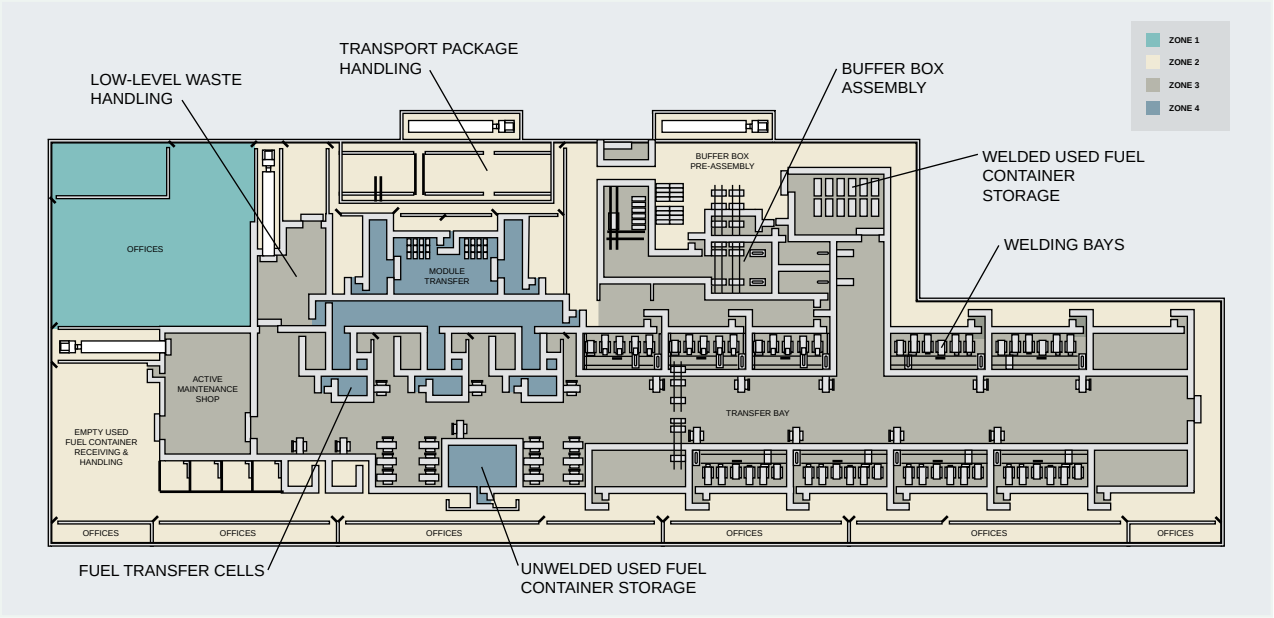
The initial repository development will include an Underground Demonstration Facility (UDF). The UDF will be used to conduct geological and geomechanical investigations, and to provide an opportunity for in-situ demonstrations of used fuel emplacement processes and equipment.

Detailing Engineering Designs and Infrastructure Requirements

Following selection of the site for the APM Project and building from subsequent detailed site characterization activities, more detailed designs will be completed for all aspects of the deep geological repository and associated surface facilities, such as the Used Fuel Packing Plant (UFPP). Designs will be developed to reflect the specific location for the repository and facilities as agreed with communities.



Example of a Layout of APM Surface Facilities for a Deep Geological Repository



Example of a Layout for a UFPP

The engineered-barrier design will also be assessed against the specific conditions of the selected site. This will include verification of the design for factors such as geological loading conditions, site-specific water chemistry and groundwater flow.

Building Local Capacity and Employment Opportunities

The APM Project is a large national infrastructure project that will bring about significant economic benefits to the area in which it is sited, including jobs for the initiating community, First Nation and Métis communities in the area, and the host province. It is a multi-generational project that will be developed and implemented in phases over a period spanning more than 150 years. The project will generate hundreds of direct, indirect, and induced jobs involving scientists, engineers, trades people, and others with transferable skills and capacities in the siting region for many decades. The number of jobs sourced from the siting area will depend in part on the location of the repository and the capacity of the communities in the siting area, economic region and host province to support the project.

The NWMO will seek to maximize job opportunities that will go to the local area hosting the project, and to build capacity in communities to secure jobs on the APM Project. Lead times associated with the siting process, construction and operations provide opportunities for the NWMO to work closely with communities to invest in training, transferable skills and business development. For example, the used fuel container and supporting components will be manufactured and assembled at a container manufacturing plant, which could potentially be located in the host area. Possible locations for this facility would be the subject of dialogue between the NWMO and communities over the 2017 to 2021 time period.

Over the 2017 to 2021 planning period, the NWMO will continue to build on and plan for a stronger local staffing presence.

- The NWMO will build its local staffing presence in potential siting areas during Phase 2 Preliminary Assessments of sites. As Phase 2 assessments continue, the NWMO plans to expand its hiring to have some locally based staff to support community engagement and field studies in each area.
- During Phase 2 assessments, local contract opportunities for businesses in municipal and Aboriginal communities to supply goods and services in each siting area will also build capacity of suppliers to contribute to future APM-related work.
- The NWMO will invest in building capacity in potential siting communities to compete for jobs related to APM implementation. The NWMO will seek to enable capacity development for communities by building up skills and trades that will also be applicable to other projects. Plans will be developed with communities to identify priority areas for training and capacity building.

Immediately following site selection, the NWMO will start to significantly increase its local staffing levels. Skills needed would include geoscience, drilling, engineering, equipment operation, technical support, environmental assessment, safety assessment, monitoring, engagement, social science, and communications. As part of planning for these future opportunities, the NWMO will discuss in more detail with communities the numbers and range of jobs that will be created in future phases of the project. In planning for future employment potential, the NWMO will also discuss what additional investments in training, strategic hiring or business incubation may be important in building prospects for local employment and businesses.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Seek input from the CNSC consistent with the pre-licensing agreement with respect to identifying regulatory requirements for a deep geological repository;
- Plan for the future federal environmental assessment by preparing to meet requirements under the *Canadian Environmental Assessment Act*, 2012;
- Confirm provincial regulatory requirements and approvals required for the APM Project;

- Develop work plans and assess resource requirements to progress detailed site characterization, environmental assessments, engineering designs, and safety case development for the selected siting area in support of the future licensing application;
- Define the technical and demonstration plans for the UDF;
- Advance the definition of concept and scope for the national Centre of Expertise that will be constructed in the selected siting area;
- Elaborate technical requirements and plans for the Centre of Expertise;
- Further define the pre-construction technical demonstration activities that will be conducted at the Centre of Expertise;
- Continue discussion with local municipal, First Nation and Métis communities in Phase 2 study areas on the Centre of Expertise, and their respective local preferences to be considered, should the APM Project be hosted in their area;
- Continue to build a stronger local staffing presence in the potential siting areas through locally based NWMO staff;
- Where possible, meet the NWMO's growing project needs for engagement and technical studies through staff based in potential siting areas;
- Invest in building the skills and capacity of youth and community members in the municipal, First Nation and Métis communities engaged in siting studies to position them to secure jobs related to future phases of the APM Project, or other large projects in the area;
- Invest in building the transferable skills and capacity of community members that will also be applicable to other projects beyond APM; and
- Provide local contracting opportunities in each potential siting area for municipal and Aboriginal communities that may be qualified to supply goods and services for the project.

In 2017, the NWMO will:

- Seek guidance from the CNSC with respect to identifying regulatory requirements for the initial licensing phases of a deep geological repository;
- Confirm with governments the nature of provincial approvals required for borehole drilling;
- Continue technical briefings about the Centre of Expertise within communities engaged in the site selection process to outline the technical and social activities planned for the centre in support of the project;
- Continue to invite communities engaged in the site selection process to discuss social preferences for how the centre might be designed and developed, should their area be selected for the project;
- Continue development of a jobs and skills inventory to identify the professions, trades, skills, and capabilities required to support the Centre of Expertise, siting, design, construction, and operation of the deep geological repository;
- Continue to implement a hiring plan to build up locally based staff to support community engagement and field studies in potential siting areas;
- Continue to engage communities in the site selection process in discussions about priority steps for developing skills and job opportunities for youth and local community members; and
- Continue discussions with communities about what investments in training, strategic hiring or business incubation may be important in building the prospects for local employment and businesses.

Continuously Improve Technical Knowledge

The NWMO will continuously improve technical knowledge in collaboration with universities and international partners, and adapt plans consistent with international best practices.

The technical end point of Adaptive Phased Management (APM) is a deep geological repository where Canada's used nuclear fuel will be safely contained and isolated on an indefinite basis. Through improving our understanding of processes relevant to the safety case, including geoscience and safety assessment, the APM technical program works to ensure the repository will meet high technical standards.

In support of this program, the NWMO contributes to and learns from best practices and experience with project implementation in Canada and other countries. The NWMO continues 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.

The NWMO also participates in international research projects. The APM technical program conducts joint research projects with international organizations and counterparts in other countries, including Sweden, Switzerland, Finland, France, and the United Kingdom. Partnering with other radioactive waste management organizations allows the NWMO to foster international co-operation on research, development and demonstration of technology; learn from other countries' experience; and keep abreast of developments in geoscience and safety case development for various host rock formations.

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

The NWMO regularly reports on new learning through reports such as a watching brief on used nuclear fuel reprocessing and alternative used nuclear fuel management technologies. It also monitors potential inventories of used nuclear fuel quantities and types for implications to repository design.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Advance understanding of relevant processes through collaboration with universities in Canada and internationally, with the results presented in journal articles, conference papers and technical reports;
- 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 the OECD NEA's Radioactive Waste Management Committee and Integration Group on the Safety Case;
- Continue to support the NEA's Thermodynamic Database Project, which is developing a quality-assured database for key elements in radioactive waste management systems;
- Continue to participate in BIOPROTA, an international forum on biosphere modelling for radioactive waste facilities;
- Continue to collaborate with researchers from the United States Geological Survey, the Geological Survey of Finland, and swisstopo, Switzerland's geoinformation centre;
- Continue to participate in workshops and conferences sponsored by organizations such as the Canadian Nuclear Society, the NEA, and the International Atomic Energy Agency;
- 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;
- Publish reviews of developments in used nuclear fuel reprocessing and alternative used nuclear fuel management technologies;
- Publish an annual update on current and future potential inventories of used nuclear fuel quantities and types in Canada;
- Continue to monitor, assess and plan for changes in industry waste management activities and plans;
- Continue to reflect upon lessons learned from work to date on the Ontario Power Generation deep geologic repository for low- and intermediate-level waste; and
- Brief federal and provincial government departments on its technical program to continuously improve technical knowledge related to health, safety and the environment.

Develop Transportation Plans

The NWMO will establish safe, secure and socially acceptable plans for transporting used nuclear fuel.

Transportation of used nuclear fuel is an important element of the Adaptive Phased Management (APM) Project. Implementation of the APM program will involve transporting used nuclear fuel from the current interim storage sites to the used fuel repository.

From a technical perspective, used nuclear fuel can be transported safely and securely with radiological safety assured through the robust transportation packages.

As part of the process of selecting a site, a transportation route must be identified, or be capable of development, by which used nuclear fuel can safely and securely be transported from the locations at which it is currently stored. Transportation planning and evaluations must fully address regulatory requirements for transporting used nuclear fuel through different provinces. During the Phase 2 Preliminary Assessments of different potential siting areas, an important focus will be identifying potential transportation routes and modes to each site against technical safety criteria. Phase 2 assessment activities will provide additional information to assess and compare potential areas for siting the used fuel repository and Centre of Expertise.

Beyond safety, transportation is also an important consideration in identifying and assessing effects on community well-being. The NWMO will need to demonstrate the safety and security of any transportation system to regulatory authorities and citizens before transportation of used nuclear fuel to the repository can begin. Transportation planning and evaluations will also need to be aligned with community input, which requires taking into account social values, as well as understanding and addressing social questions and concerns. This also requires inviting input from communities on potential transportation routes as a group with a shared interest. Through the multi-year period of Phase 2 assessments of different potential host areas for the APM Project, transportation will be an important focus of public engagement, led by the NWMO, to understand societal considerations. It is expected that groups and individuals will have questions and concerns to be addressed as assessments continue through this second phase of study and engagement.

Outreach and engagement activities in this period include taking information out to communities, first responders and regional groups, beginning with those in siting areas. This includes the mobile transportation exhibit showcasing the robust transportation container, open houses covering all aspects of the APM Project, and participation in community and area events. Sharing information more broadly at industry, municipal association and Aboriginal organization conferences throughout Ontario and beyond will also help advance early conversation on this important topic and prepare the way for more detailed discussion in the future. Booklets, brochures and a discussion document support these activities and the advancement of discussion at this early phase. Conversations with government and industry to share information and understand expectations are also an important part of the plan.

The transportation program is designed to achieve a number of specific outcomes by the end of the multi-year Phase 2 siting assessments:

- Completed assessments of preferred and alternative road and rail routes between each of the interim storage sites and each Phase 2 siting study area;
- Identified and designed the necessary transportation equipment and facilities;
- Completed a transportation risk assessment, including public and worker dose assessments;
- Defined an approach for emergency response;
- Clearly identified security requirements;
- Addressed and took into account questions and concerns of potentially affected Aboriginal communities and transportation communities in decision-making on a preferred site; and
- Ensured the transportation program meets or exceeds regulatory requirements.

Specific activities planned in support of these desired outcomes involve both a technical program and an engagement program.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Undertake transportation logistics analyses;
- Conduct transportation risk assessment study;
- Construct and test all equipment required for loading, transporting and unloading used nuclear fuel transportation packages, including truck trailers and railcars;
- Develop updated package designs for transportation containers, with consideration of 'beyond-design-basis' scenarios;
- Seek Canadian Nuclear Safety Commission design approval certificates for road and rail transport packages;
- Work closely with waste owners in planning for future transport of used nuclear fuel from the facilities where it is currently stored on an interim basis;
- Continue to develop communication materials to support learning and dialogue about transportation safety and transportation considerations;
- Continue to seek advice from municipal associations and Aboriginal organizations regarding ways to communicate transportation plans and engage with communities that may be on a transportation corridor for used nuclear fuel;
- Provide briefings and information about the transportation of used nuclear fuel, seek input to enhance the technical development program, and refine processes and plans;
- Conduct dialogue and use public attitude research techniques to explore public understanding, questions and concerns; 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 APM.

Provide Financial Surety

The NWMO will ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.

Canadians expect that the money necessary to pay for the long-term care of used nuclear fuel will be available when it is needed and will be fully funded by the waste producers. The NWMO has the objective of determining what costs can reasonably be expected to occur over the life of the project, along with a contingency for unexpected events, and then designing a system that collects enough money from the waste producers and protects this money to ensure that the entire cost can be covered under a variety of social and economic circumstances, and within the required time frame.

Adaptive Phased Management (APM) cost estimates include costs to develop, construct and operate a central long-term facility, including a deep geological repository and transporting the used nuclear fuel to the repository. These activities will be carried out and funded by the NWMO. Reactor site storage is carried out and directly funded by individual waste owners.

The NWMO completed a full update of these estimates in 2016. The updated cost estimates cover many decades of APM life cycle activity for the deep geological repository and related transportation of used nuclear fuel. The eventual cost of the project is impacted by many factors, including the volume of used nuclear fuel to be managed, the location of the facility, surrounding infrastructure, the rock type and characteristics, the design of the repository, and the length of time allocated to monitoring the site following fuel placement.

The following table shows how estimated costs might differ depending on the amount of used nuclear fuel to be managed. The next full update of the APM cost estimate will be completed in 2021.

Estimated cost (2015 $) of APM from site selection start (2010) onwards

2.7 million fuel bundles (current number produced as of June 2016)	3.6 million fuel bundles	5.2 million fuel bundles	7.2 million fuel bundles
$16.3 billion	**$18.3 billion**	**$22.8 billion**	**$28.4 billion**

The *Nuclear Fuel Waste Act* (*NFWA*)

The planning, development and implementation of the APM Project is funded by the major owners of used nuclear fuel in Canada: Ontario Power Generation, New Brunswick Power Corporation, Hydro-Québec, and Atomic Energy of Canada Limited (AECL). The *NFWA* (2002) requires each of these four companies to establish independently managed trust funds and make annual deposits to ensure the money to fund this project will be available when needed.

The *NFWA* includes explicit provisions to ensure the trust funds are maintained securely and used only for the intended purpose.

As required by the *NFWA*, the NWMO's Annual Report must outline the funding formula for the next fiscal year to ensure funds required to cover the full cost of APM implementation is borne by the waste producers and an explanation of assumptions is provided. Trust funds must be maintained, and annual contributions made by major waste producers, reflecting the updated funding formula. At the end of 2016, trust fund balances were at $4 billion.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Incorporate revised cost estimates for APM into the annual trust fund deposit calculation by 2017;
- Annually assess all factors that impact APM cost estimating and funding requirements;
- Continue to publish the audited financial statements for nuclear fuel waste trust funds, established by the Members and AECL, as they are provided by the financial institutions (see www.nwmo.ca), and provide updates to confirm that they are meeting their financial obligations; and
- Monitor the development of new reactors and new owners of used nuclear fuel, applying the appropriate principles to update the funding formula when the specific circumstances arise.

Ensure Governance and Accountability

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

The NWMO's governance comprises the Member organizations, the Board of Directors and its Advisory Council. The NWMO is subject to the requirements of the *Nuclear Fuel Waste Act* (*NFWA*) and oversight by the Minister of Natural Resources Canada.

The NWMO's implementation of a repository as part of Adaptive Phased Management (APM) will eventually be regulated under the *Nuclear Safety and Control Act* and its associated regulations to protect the health, safety, and security of Canadians and the environment, and to respect Canada's international commitments on the peaceful use of nuclear energy.

For more information about regulatory oversight, please see page 10.

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 its member organizations.

BOARD OF DIRECTORS

The Board of Directors is responsible for oversight of the organization and taking a leadership role in the development of the corporation's strategic direction. The Members appoint the Board of Directors. There are currently eight members of the Board of Directors, representing a range of perspectives from both within and outside the nuclear industry, including capabilities in Aboriginal culture and finance management. The membership of the Board is profiled on the NWMO website.

ADVISORY COUNCIL

The *NFWA* requires that the governing body of the NWMO appoint an Advisory Council to review and comment on its work as part of the NWMO's triennial reports. In addition to fulfilling its legislated reporting requirements, the Council meets regularly with the NWMO's senior management, closely following the development of the organization's plans and activities, and providing ongoing counsel and advice. At any time, the Council may choose to deliberate in camera. The Board of Directors appointed the Advisory Council in 2002, with membership renewed at regular intervals.

Current membership of the Advisory Council represents a broad range of expertise, including geotechnical engineering, chemical engineering, nuclear engineering, engagement, public affairs, nuclear community relations, environment, sustainable development, law, political science, municipal affairs and government relations, Aboriginal 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. The membership of the Advisory Council is profiled on the NWMO website.

The NWMO Board continues to ensure appointments remain consistent with the requirements of the *NFWA*, and take into account the range of expertise required to support the regional and local activity associated with APM site selection. As the NWMO's work leads to the selection of an informed and willing host community, and as affected Aboriginal organizations and the host region are identified, the *NFWA* requires that representatives from these communities be included in the Advisory Council. This is in addition to members with expertise in a broad range of scientific, technical and social disciplines, as well as expertise in Indigenous Knowledge, as outlined in the *NFWA*.

MANAGEMENT SYSTEM

In 2010, the NWMO established its integrated management system for activities in support of the long-term management of nuclear waste. As part of its plan to ensure excellence and accountability in governance, the organization obtained certifications to ISO 9001:2008 for quality, ISO 14001:2004 for environment, and CSA Z1000:2006 for health and safety management. In addition to maintaining conformance to these standards, the NWMO's management system was further enhanced to meet the requirements of 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 its vision, which 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". The focus on safeguarding of people is fully aligned with the CSA N286-12 management system principle that safety is the paramount consideration guiding decisions and actions.

INDEPENDENT TECHNICAL REVIEWS

The NWMO will continue to seek external expert review and comment of its technical program. As the technical program moves from research into design, fabrication, and demonstration, the nature of the technical reviews will be more focused to the specific design aspects and features. The results of these reviews would help guide the technical program and inform NWMO stakeholders.

PEER REVIEWS

The NWMO will continue to seek opportunities for peer review of its work and to invite independent comment.

The APM-Geoscientific Review Group (APM-GRG), described earlier, is an example. This will 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 integrity, excellence, engagement, accountability, and transparency in the implementation of APM. The NWMO reports regularly on its progress, and especially in response to the advice of Canadians and the changing external environment.

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

INTERNATIONAL COMMITMENTS

The NWMO will continue to report internationally on its progress at meetings of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management* (*Joint Convention*). Under the *Joint Convention*, Canada must demonstrate that it is meeting international commitments to manage radioactive waste and used nuclear fuel safely. The NWMO will next contribute to Canada's reporting at the 2018 convention.

Going Forward

In the period 2017 to 2021, the NWMO will:

- Convene regular meetings of NWMO Members, Board of Directors, Board Committees, and Advisory Council;
- Co-ordinate reviews of the NWMO's technical program;
- Co-ordinate annual reviews of the APM geoscience plans with the APM-GRG;
- Conduct assessments and audits, benchmark, and improve processes to maintain and improve the management system, including maintaining certifications to standards for quality, safety and environment management;
- Continue to interact with the Canadian Nuclear Safety Commission consistent with the terms of the arrangement prior to submission of a licence application. These activities include providing briefings to the Commission on the progress of APM implementation;
- Report to Canadians on progress in implementing APM. The NWMO will submit its Annual Report to the Minister of Natural Resources Canada and the public in the first quarter of each year, including its third triennial report in 2017;
- Publish the five-year strategic plan, *Implementing Adaptive Phased Management*;
- Publish the minutes of the meetings of the Board of Directors and Advisory Council;
- Report internationally on progress for the long-term management of Canada's used nuclear fuel at the 2018 and 2021 meetings of the *Joint Convention*; and
- Undertake membership review, and make appointments to the Advisory Council to ensure members bring a broad range of expertise.

The Road Ahead

The NWMO invites all Canadians and Aboriginal peoples of Canada to stay involved in Adaptive Phased Management (APM) of Canada's used nuclear fuel. *Implementing Adaptive Phased Management* is updated annually to guide the five-year planning period ahead. As such, the plan is regularly assessed, strengthened and redirected, as needed.

Implementation of the site selection process for the deep geological repository for used nuclear fuel has begun. This process, led by communities in study areas, is supported by the resources and work programs described in this plan. APM will proceed as quickly as Canadians, successful technology demonstration and the regulatory authorities allow.

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.

Intermediate-level radioactive waste consists primarily of used reactor core components, and resins and filters used to keep reactor water systems clean. It requires shielding to protect workers during handling. Intermediate-level waste is stored mainly in steel-lined concrete containers that have been set into the ground.

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 percent of its initial value after one year, decreases to about 0.1 percent after 10 years, and decreases to about 0.01 percent after 100 years. After approximately one million years, the radioactivity in used nuclear fuel approaches that of natural uranium.

Low-level radioactive waste consists of common industrial items that have become contaminated with low levels of radioactivity during routine cleanup and maintenance at the nuclear generating stations. Low-level waste includes mops, rags, paper towels, temporary floor coverings, floor sweepings, protective clothing, and hardware items such as tools. It consists of paper, plastics, metal, rubber, cotton, and other miscellaneous materials. Low-level waste can be safely handled using normal industrial practices and equipment without any special radiation protection.

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.

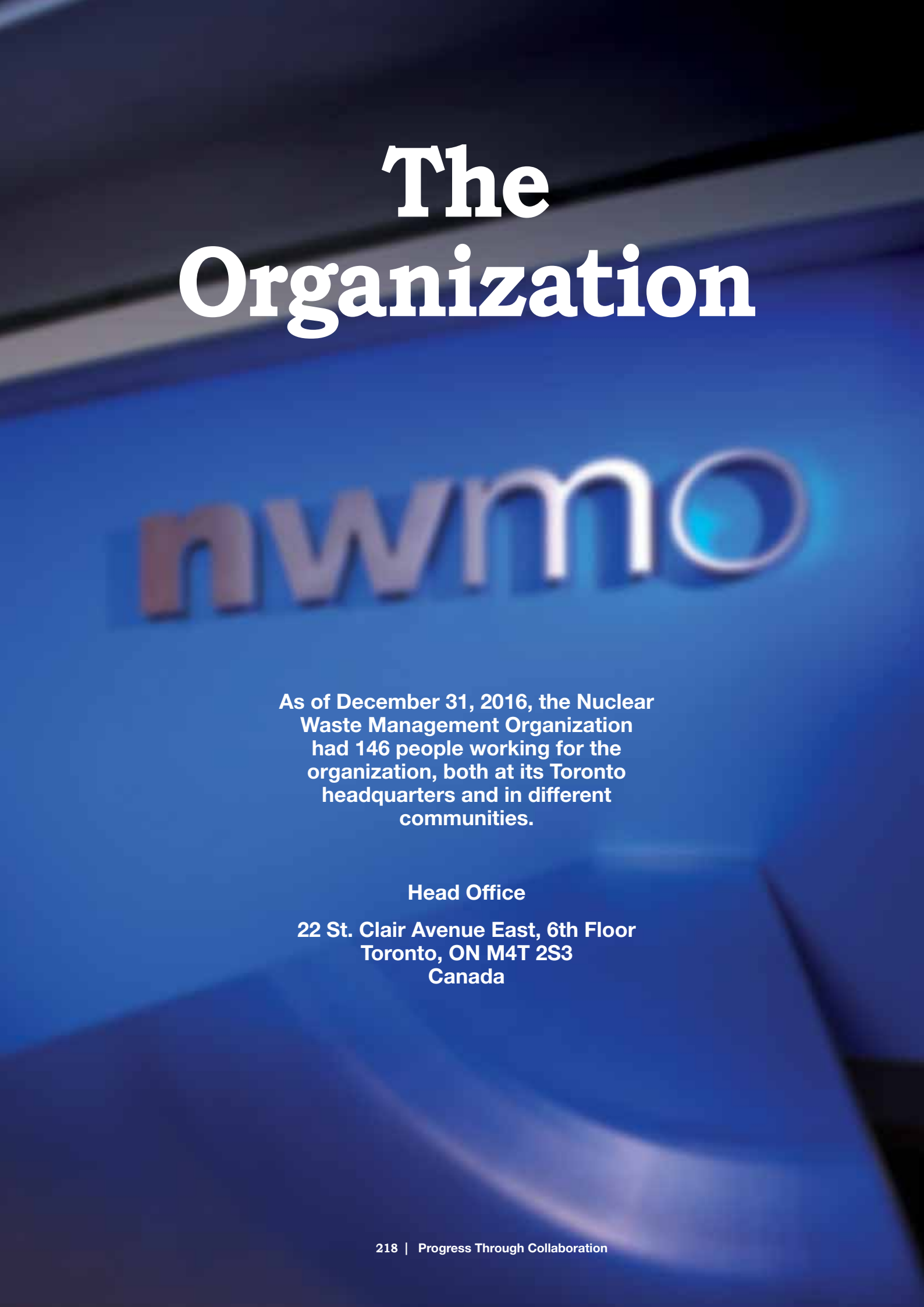
Safety is the protection of individuals, society and the environment, from the harmful or dangerous effects of used nuclear fuel, now and in the future.

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

Acronyms

AECL	Atomic Energy of Canada Limited
APM	Adaptive Phased Management
BTP	Basket Transportation Package
CNSC	Canadian Nuclear Safety Commission
GRG	Geoscientific Review Group
NEA	Nuclear Energy Agency
NFWA	*Nuclear Fuel Waste Act*
NSCA	*Nuclear Safety and Control Act*
NSERC	Natural Sciences and Engineering Research Council of Canada
NWMO	Nuclear Waste Management Organization
OECD	Organisation for Economic Co-operation and Development
OPG	Ontario Power Generation
UDF	Underground Demonstration Facility
UFPP	Used Fuel Packing Plant

The Organization



As of December 31, 2016, the Nuclear Waste Management Organization had 146 people working for the organization, both at its Toronto headquarters and in different communities.

Head Office

22 St. Clair Avenue East, 6th Floor
Toronto, ON M4T 2S3
Canada

THE MEMBERS

The Nuclear Waste Management Organization (NWMO) was established in 2002 by Canada's nuclear electricity generators in accordance with the *Nuclear Fuel Waste Act*.

Ontario Power Generation, New Brunswick Power Corporation, and Hydro-Québec are the founding Members, and along with Atomic Energy of Canada Limited, are required to fund the NWMO's operations.

BOARD OF DIRECTORS

The Board of Directors is responsible for oversight of the organization and taking a leadership role in the development of the corporation's strategic direction.

As of December 31, 2016, the Board was composed of eight directors. Mr. Wayne Robbins served as Chair, and Ms. Laurie Swami as President and CEO. Of the remaining six directors, Ms. Josée Pilon was appointed by Hydro-Québec (HQ); Mr. Darren Murphy by the New Brunswick Power Corporation; and Mr. Carlo Crozzoli, Mr. Mark Elliott, Mr. Ronald L. Jamieson, and Mr. C. Ian Ross by Ontario Power Generation (OPG).

The Board of Directors convened 13 formal meetings between 2014 and 2016. The minutes can be viewed online at www.nwmo.ca/board. At the request of the Advisory Council, joint meetings of the Board and Council were also convened in 2015 and 2016.

Between 2014 and 2016, the Board continued its close oversight of Canada's plan for the long-term management of used nuclear fuel. Among others, it reviewed:

- Findings from preliminary assessments and decisions about narrowing down study areas to those with strong potential to meet the project's rigorous requirements;
- Engagement activities to support the site selection process, including enhanced engagement with First Nation and Métis communities and municipalities in the vicinity of potential siting areas;
- The latest cost estimate for implementing Adaptive Phased Management (APM);
- The interrelationship of OPG's Low- and Intermediate-Level Waste Deep Geologic Repository Project with the implementation of APM;
- Project execution plans for site selection and proof testing;
- The Nuclear Waste Management Organization's (NWMO) business plans and budgets;
- Audited financial statements;
- The NWMO's performance objectives and measures;
- Proof testing of the NWMO's engineered-barrier system design;
- Progress in planning for the safe and secure transportation of used fuel to a deep geological repository;
- The findings of the APM-Geoscientific Review Group (APM-GRG);
- The NWMO's Indigenous Knowledge Policy;
- The recommendations of the Advisory Council; and
- The membership of the Advisory Council.

Committees of the Board of Directors

Audit, Finance and Risk Committee

The committee met 13 times between 2014 and 2016. The committee oversees external audits of the NWMO's financial statements. It also advises the Board annually on the selection of the auditor for the following year and the terms of the Audit Service Plan. Meetings are held with the auditor each year to discuss their findings.

The committee also regularly reviewed in-year financial statements and reported its findings to the Board. It reviewed the NWMO's audited pension and financial statements and recommended approval. The committee's other activities included reviews of:

- The NWMO's business plans and budgets;
- The updated cost estimate for implementing APM;
- Key risks for the APM program, and for the design and construction phase of OPG's Low- and Intermediate-Level Waste Deep Geologic Repository Project;
- The NWMO's internal governance and audit systems;
- The NWMO's pension fund;
- Lifecycle liability management work programs;
- Reports covering financial results, a cash flow forecast, and compliance;
- Expenses reported by the Chair, President and Executive Committee;
- The NWMO's procurement process;
- The committee's charter; and
- The *Nuclear Fuel Waste Act* trust fund contributions.

In 2015 and 2016, two joint meetings of the Audit, Finance and Risk Committee, and the Human Resources and Compensation Committee were held – one to review the NWMO's pension plan funding and sustainability; the other to review the NWMO's corporate performance for the current year and corporate objectives for the following year. In 2014, a joint meeting of the two committees was held on the NWMO's pension plan funding and sustainability.

As of December 31, 2016, there were four directors on the committee:

- C. Ian Ross, Chair;
- Carlo Crozzoli;
- Ronald L. Jamieson; and
- Josée Pilon.

Siting Committee

The NWMO Siting Committee provides a vehicle through which the Board may maintain close oversight of this important element of the NWMO's mandate and manage the risks associated with the execution of the site selection process. The committee met 12 times between 2014 and 2016. Its activities included reviews of:

- Activities and progress associated with Phase 1 and Phase 2 Preliminary Assessments;
- The NWMO's engagement program, including municipal and Aboriginal engagement plans and activities in communities currently undergoing Phase 2 Preliminary Assessments;
- The APM siting project execution plan;
- Capacity-building plans in siting areas;
- The work of the APM-GRG;
- Updates about the work of the Council of Elders;
- Programs to recognize the contributions of communities upon completion of Phase 1 and Phase 2 studies;
- The NWMO's Indigenous Knowledge Policy;
- Aboriginal and local procurement policies; and
- The committee's charter.

As of December 31, 2016, there were four directors on the committee:

- Ronald L. Jamieson, Chair;
- Mark Elliott;
- Darren Murphy; and
- Wayne Robbins.

Human Resources and Compensation Committee

The committee met 12 times between 2014 and 2016. It is responsible for overseeing the NWMO's human resources functions, including compensation practices, human resources policy, organization design, labour relations, and pension plan.

As of December 31, 2016, the committee had four directors:

- C. Ian Ross, Chair;
- Darren Murphy;
- Carlo Crozzoli; and
- Josée Pilon.

Low- and Intermediate-Level Waste Deep Geologic Repository Oversight Committee

The committee met five times between 2014 and 2016. It has responsibility for monitoring the NWMO's role in managing the regulatory approvals, engineering, procurement, and construction for OPG's Deep Geologic Repository Project in Kincardine, Ontario. This includes review of the NWMO's performance under its Deep Geologic Repository Services Agreement, and Engineering, Procurement and Construction Management Agreement with OPG, as well as risk management related to the project.

Other activities included reviews of:

- Updated regulatory approvals processes, and design and construction work plans;
- Planning assumptions;
- Recommendations of the Joint Review Panel on OPG's Low- and Intermediate-Level Waste Deep Geologic Repository; and
- The business plans finalized and approved by OPG.

As of December 31, 2016, the committee had six members:

- Mark Elliott, Chair;
- Wayne Robbins;
- C. Ian Ross;
- Carlo Crozzoli;
- Morris Medd (non-director committee member); and
- Wolf Seidler (non-director committee member).

MEMBERS OF THE BOARD OF DIRECTORS

Wayne Robbins – Chair

Mr. Wayne Robbins is the retired Chief Nuclear Officer at OPG. He was responsible for all OPG's nuclear operations, engineering, nuclear waste management, strategic planning, and plant performance. Mr. Robbins served as Senior Vice-President of the Darlington Nuclear Generating Station from 2006 to 2009. He was recognized with OPG's "Power Within Leader of the Year" award in 2008 and received the Ontario Energy Association leadership award in 2009. He has held several other senior positions at OPG and is also past Chair of the Canadian Nuclear Association Board. Mr. Robbins holds a Bachelor of Science in Civil Engineering from Queen's University and is a member of the Professional Engineers of Ontario. He has also completed the Ivey Executive Program and Rotman's Directors Education Program.

Laurie Swami – President and CEO of the NWMO

Ms. Laurie Swami is the President and CEO of the NWMO. She was appointed to the role in 2016 and is responsible for implementing Canada's plan for the long-term management of used nuclear fuel. Ms. Swami previously served as Senior Vice-President of Decommissioning and Nuclear Waste Management at OPG. Her responsibilities included overseeing operation of OPG's nuclear waste management facilities, as well as implementing OPG's low- and intermediate-level nuclear waste deep geologic repository. She began her career at OPG in 1986 and held various roles with increasing responsibility in the Nuclear Division. She holds a Bachelor of Science in Engineering Chemistry from Queen's University and a Master of Business Administration from the Schulich School of Business.

Carlo Crozzoli

Mr. Carlo Crozzoli is the Senior Vice-President of Corporate Business Development and Chief Risk Officer at OPG. He began his career at OPG in 1999 and has served in various roles with increasing responsibility in the areas of information technology, business development, project development, and risk management. Prior to joining OPG, Mr. Crozzoli worked at Ernst & Young. He obtained a Bachelor of Commerce degree from Laurentian University, is a Chartered Professional Accountant (CPA, CA), sat on the Board of Advisors for the Construction Industry Institute, and has completed the Construction Industry Institute Executive Leadership Program through the McCombs School of Business at the University of Texas.

Mark Elliott

Mr. Mark Elliott is the retired Chief Nuclear Engineer at OPG. He was responsible for all engineering for the Pickering and Darlington nuclear stations and for OPG's nuclear waste facilities. In this role, Mr. Elliott led the life extension of the Pickering station. He served as Senior Vice-President of the Pickering A nuclear generating station from 2007 to 2010, while two of the four units were being placed in long-term safe storage. He has held several other senior positions at OPG, including Senior Vice-President, Inspection and Maintenance. Mr. Elliott holds a Bachelor of Engineering in Engineering Physics from McMaster University and is a member of the Professional Engineers of Ontario. He has completed the Queen's University Executive Program and the Advanced Management Program at Harvard Business School.

Ronald L. Jamieson

Mr. Ronald L. Jamieson is a member of the Board of Directors of the Ontario Power Authority. Prior to his retirement in late 2005, he served as Senior Vice-President of Aboriginal Banking at BMO Financial Group. Mr. Jamieson has held several senior executive positions in the financial services industry. Throughout his career, he has also been active in economic development initiatives for Aboriginal communities across Canada. Mr. Jamieson also served as Chair, President and CEO of Ontario Energy Corporation, whose mandate was to invest or participate in energy projects throughout Canada. He is also Chair of the Canadian Council for Aboriginal Business and was recently named President of First Canadian Property Investments Ltd. In 2014, Mr. Jamieson was awarded the Order of Ontario and the Order of Canada, as well as received an honorary doctoral degree from Nipissing University.

Darren Murphy

In June 2012, Mr. Darren Murphy was appointed as Vice-President of Corporate Services and Chief Financial Officer at NB Power. His areas of responsibility include finance, human resources, information systems, voice services, environment, safety, regulatory affairs, corporate compliance, and corporate project management.
Mr. Murphy joined NB Power's executive team in 2007, and in addition to his current role, he has held a number of executive positions, including Vice-President of Distribution and Customer Service, and Vice-President of Transmission. He had worked for over 17 years in Distribution field operations before joining the executive team. Mr. Murphy is a member of the Board of Directors for the New Brunswick Investment Management Corporation and the New Brunswick Energy Marketing Corporation.

Josée Pilon

Ms. Josée Pilon is a Master of Business Administration graduate of Laval University. She was a member of the steering committee on the evaluation project for the rehabilitation of Gentilly-2.
As a special projects manager, she is responsible for evaluating business opportunities for new sources of energy from the private sector, including wind power, biomass and hydro-electric. She is also involved on the financial impact evaluation of new hydroelectric projects on municipalities. Prior to her current position, she held numerous business development positions in international projects.

C. Ian Ross

Mr. C. Ian Ross served at the Richard Ivey School of Business at Western University from 1997 to 2003. Most recently, he was Senior Director, Administration in the Dean's Office, and was also Executive in Residence for the School's Institute for Entrepreneurship, Innovation and Growth. He has served as Governor, President and CEO of Ortech Corporation; Chair, President and CEO of Provincial Papers Inc.; and President and CEO of Paperboard Industries Corp. Mr. Ross currently serves as a director for a number of corporations and is Chair of GrowthWorks Canadian Fund Ltd. He served as a Director of OPG from December 2003 to April 2014. He is also a member of the Law Society of Upper Canada.

PAST MEMBERS OF THE BOARD OF DIRECTORS

Pierre Charlebois (September 2008 to September 2016)

Robin Heard (September 2014 to December 2014)

Gary Kugler (June 2006 to September 2014)

Kenneth E. Nash (May 2002 to September 2016)

Deborah C. Poff (March 2007 to June 2016)

Beth Summers (December 2014 to December 2015)

OFFICERS AND EXECUTIVE COMMITTEE

Officers

Chair of the Board
Wayne Robbins

President and CEO
Laurie Swami

Vice-Presidents

Mahrez Ben Belfadhel	Vice-President, APM Engagement and Site Selection (since January 3, 2017)
Michael Hung	Treasurer and Chief Financial Officer
Jennifer Spragge	Vice-President, Human Resources
Derek Wilson	Vice-President, Design and Construction

Board Secretary
Gillian Morris

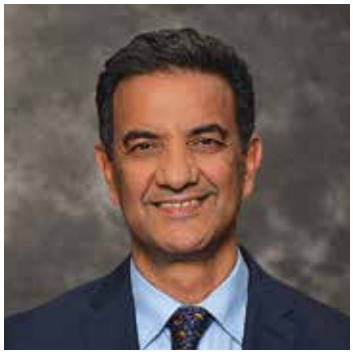
Executive Committee

Laurie Swami	President and CEO
Mahrez Ben Belfadhel	Vice-President, APM Engagement and Site Selection (since January 3, 2017)
Paul Gierszewski	Director, Safety and Licensing
Marni Halter	Senior Counsel (since October 2015)
Christopher Hatton	Director, Nuclear Design and Transportation
Michael Hung	Treasurer and Chief Financial Officer
Jennifer Spragge	Vice-President, Human Resources
Robert Watts	Associate Vice-President, Aboriginal Relations
Derek Wilson	Vice-President, Design and Construction

EXECUTIVE COMMITTEE

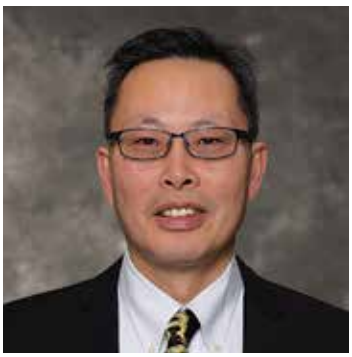
Laurie Swami

President and CEO



Mahrez Ben Belfadhel

Vice-President,
APM Engagement
and Site Selection
(since January 3, 2017)



Michael Hung

Treasurer and
Chief Financial Officer

Jennifer Spragge

Vice-President,
Human Resources

Paul Gierszewski

Director,
Safety and Licensing

Marni Halter

Senior Counsel
(since October 2015)

Christopher Hatton

Director,
Nuclear Design and
Transportation

Robert Watts

Associate Vice-President,
Aboriginal Relations

Derek Wilson

Vice-President,
Design and Construction

NOTE

Mr. Kenneth E. Nash was President and CEO until September 2016.

Ms. Kathryn Shaver was Vice-President, APM Engagement and Site Selection until November 2016.

Mr. Patrick Moran was General Counsel and Corporate Secretary until September 2015.

Mr. Sean Russell was Director of Environmental Assessment until May 2015.

Advisory Council

As required by the *Nuclear Fuel Waste Act* (*NFWA*), the Nuclear Waste Management Organization (NWMO) Board of Directors established an Advisory Council in 2002. In 2016, the Advisory Council comprised 10 members, with the Honourable David Crombie continuing to serve as Chair.

The Advisory Council comprises individuals knowledgeable in nuclear waste management issues, and experienced in working with citizens and communities on a range of public policy issues. Current membership represents a broad range of expertise, including geomechanical engineering, chemical engineering, nuclear engineering, engagement, public affairs, nuclear community relations, environment, sustainable development, law, political science, municipal affairs and government relations, Aboriginal relations, Indigenous Knowledge, and community-based research.

ADVISORY COUNCIL'S INDEPENDENT COMMENTS

For the Advisory Council's independent comments on the NWMO's work over the past three years, please see chapter 13.2 (*Report of the Advisory Council*).

Statutory Reporting Requirements

Under the *NFWA*, the Advisory Council is required to provide its independent comments on the NWMO's work for inclusion in the triennial reports. These comments include the Council's observations on the results of the NWMO's work over the previous three years, the results of the NWMO's public consultations during those three years, the NWMO's strategic plan for the next five years, and the budget forecast for implementing that strategic plan. The Council's comments and an overview of its activities in the 2014-2016 period are presented in chapter 13.2 (*Report of the Advisory Council*).

Council Operations

The Advisory Council meets regularly with the NWMO to review the organization's plans and provide ongoing advice on a range of topics. At each meeting, Council members are updated on plans under development, milestones in the technical and social research programs, and public engagement activities and findings. Agendas often incorporate topics selected by the Council as items of interest for discussion, and include presentations by management and staff to support the Council's deliberations. Each Advisory Council meeting includes an in-camera session, where members reflect privately in the absence of NWMO staff or management.

At the Advisory Council's request, formal minutes of its meetings are recorded and posted online at www.nwmo.ca/AdvisoryCouncil.

In addition to attendance at regular meetings, each year individual members of the Advisory Council have participated in meetings of the NWMO's Municipal Forum. A Council member has begun to regularly attending meetings of the Council of Elders and Youth as an observer. In 2015, two Advisory Council members met with a delegation from Belgium's national agency for radioactive waste to provide the perspectives of the NWMO Advisory Council.

The Advisory Council Chair has direct access to NWMO Board meetings to ensure a comprehensive exchange of information, and to provide a conduit for the Chair to keep the Council fully informed on Board matters, and vice versa. The Board and Council also convened joint meetings in 2015 and 2016 to facilitate the exchange of ideas and information.

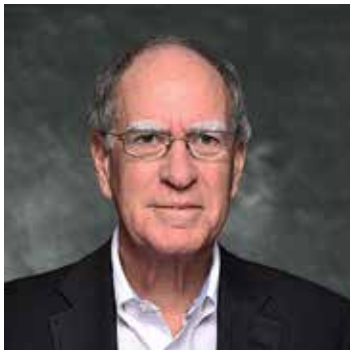
Advisory Council Membership

Current appointments to the Advisory Council conclude at the end of 2017, and are based on several criteria: the type of work the NWMO will be engaged in going forward, the expertise that work will require, and the specific provisions of the *NFWA*. In 2015, the Board of Directors asked the Council for advice on the sorts of expertise it should be looking for in appointing new members. Among the areas members identified were Indigenous Knowledge relevant to regions where the NWMO works and the management of nuclear waste issues at the community level. Ms. Diane M. Kelly, Dr. Dean Jacobs, and Ms. Linda Thompson were accordingly appointed to the Council in April 2015. Hydro-Québec nominated Mr. Joseph Cavalancia to the Advisory Council in 2015, and he was appointed by the Board in September of that year. The Honourable David Crombie agreed to continue as the Advisory Council Chair, while Dr. David R. Cameron accepted the newly created position of Vice-Chair.

The NWMO gratefully acknowledges the important contributions of the members of the Advisory Council who completed their terms in 2015: Dr. Marlyn A. Cook, Dr. Wesley Cragg, Dr. Frederick Gilbert, and Mr. Michel R. Rhéaume.

In 2015, Council members reviewed proposed revisions to the Council's Terms of Reference, which were approved by the Board of Directors in February 2015.

MEMBERS OF THE ADVISORY COUNCIL



David Crombie – Chair

The Honourable David Crombie is the President of David Crombie and Associates, the Chair of Toronto Lands Corporation, and past Chair of Ontario Place. He is the immediate past President and CEO of the Canadian Urban Institute. He is also a past mayor of the City of Toronto and a Privy Councillor.
Mr. Crombie was the first Chancellor of Ryerson University and is the recipient of honorary doctorates of law from the University of Toronto and the University of Waterloo. Mr. Crombie is an Officer of the Order of Canada and the Order of Ontario.

David R. Cameron

Dr. David R. Cameron, a Fellow of the Royal Society of Canada, is a Professor of Political Science at the University of Toronto. His professional career has been divided between public service – in Ottawa and at Queen's Park, Ontario – and academic life. A longtime student of Canadian federalism and Quebec nationalism, he has turned his attention to constitution-making and government design in conflict and post-conflict situations in Sri Lanka, Iraq, Somalia, the Western Sahara, and Jerusalem. He is currently the Dean of the Faculty of Arts and Science at the University of Toronto.

Joseph Cavalancia

Mr. Joseph Cavalancia, a Chartered Professional Accountant, has more than 35 years' experience in the area of financial management, and has been responsible for financial controls, treasury, risk management, and taxation, among other activities. Holding a Bachelor of Business Administration from HEC Montréal and a Management Diploma from McGill University, Mr. Cavalancia has spent most of his career in the private sector, mainly in the engineering and construction fields. He has extensive experience as a senior executive in both private and public companies.

Dean Jacobs

Dr. Dean Jacobs is the Consultation Manager for Walpole Island First Nation (WIFN). For the past 43 years, he has been the driving force behind WIFN's internationally acclaimed community-based research program called Nin.Da.Waab.Jig. (those who seek to find). He is a member of the International Joint Commission's Great Lakes Water Quality Board.
Dr. Jacobs is a former Chief of WIFN, and is the recipient of two eagle feathers and three honorary doctorate degrees.

Diane M. Kelly

Ms. Diane M. Kelly is an experienced leader, visionary and strongly committed to empowering decision-making through Traditional Governance. Ms. Kelly inherently believes that forging strong alliances can be achieved by working together. She became the first Anishinaabe woman lawyer in the Treaty 3 Nation. She has extensive experience in First Nations governance, board training, land claims research and development, treaty negotiations, education policies, and all aspects of child welfare. She specializes in facilitating conflict resolution through creative strategies and empowerment. As the first woman Grand Chief of Treaty 3 from 2008 until 2012, she honourably carried the responsibility of protecting, preserving and enhancing treaty rights for 28 First Nation communities in 55,000 square miles of Treaty 3 territory in northwestern Ontario and southeastern Manitoba.
Ms. Kelly is currently the Assistant Deputy Minister of the Child and Family Services Division of the Manitoba Department of Families.
She is a recipient of the Queen Elizabeth II Diamond Jubilee Medal.

Eva Ligeti

Ms. Eva Ligeti teaches Environmental Law and Policy in the graduate program in Environmental Science at the University of Toronto. As the Executive Director of the Clean Air Partnership, she worked to make Toronto more environmentally sustainable and a world leader in clean air. A lawyer, she served as Ontario's first Environmental Commissioner from 1994 to 1999. Ms. Ligeti has served on numerous boards and committees, including the Council of the Federation of Canadian Municipalities' Green Municipal Fund, as a member of the Province of Ontario's Expert Panel on Climate Change Adaptation, and as a co-chair of the Greening Greater Toronto Task Force.

Derek H. Lister

Dr. Derek H. Lister is Professor Emeritus in the Chemical Engineering Department at the University of New Brunswick in Fredericton, where he also holds the Research Chair in Nuclear Engineering. His main research interests are in chemistry and corrosion associated with nuclear and other power systems, areas in which he has published widely. He holds positions on a number of national and international committees advising government and industry.

Dougal McCreath

Dr. Dougal McCreath is Professor Emeritus in the Bharti School of Engineering at Laurentian University in Sudbury, Ontario. A Fellow of both the Engineering Institute of Canada and Canadian Academy of Engineering, he has wide teaching, research and international consulting interests, ranging from the design of deep underground excavations to the recovery and sustainability of damaged ecosystems. He has served on two Canadian Environmental Assessment Agency review panels dealing with nuclear related issues.

Donald Obonsawin

Mr. Donald Obonsawin is an independent consultant providing policy, management, operational, and strategic planning services. From 2003 to 2007, he was President and CEO of Jonview Canada Inc. Previous to that, he enjoyed a 25-year career in both the provincial and federal public services, including 15 years as Deputy Minister of seven Ontario government ministries. He also held senior positions with the federal departments of Indian Affairs and Northern Development Canada, and Health and Welfare Canada. Mr. Obonsawin is a member of the Abenaki First Nation of Odanak.

Linda Thompson

With 25 years' management experience, Ms. Linda Thompson was first elected to the Municipality of Port Hope Council in 2000, serving as Councillor and Deputy Mayor, then as Mayor from 2006 to 2014. Port Hope is one of the world's oldest nuclear communities, home to Cameco Corporation's conversion and fuel manufacturing facilities, and the site of Canada's largest federal cleanup of low-level radioactive waste. In her time as Mayor, Ms. Thompson was an active member of the Canadian Association of Nuclear Host Communities, Mayors Nuclear Technology Caucus, and the NWMO Municipal Forum.

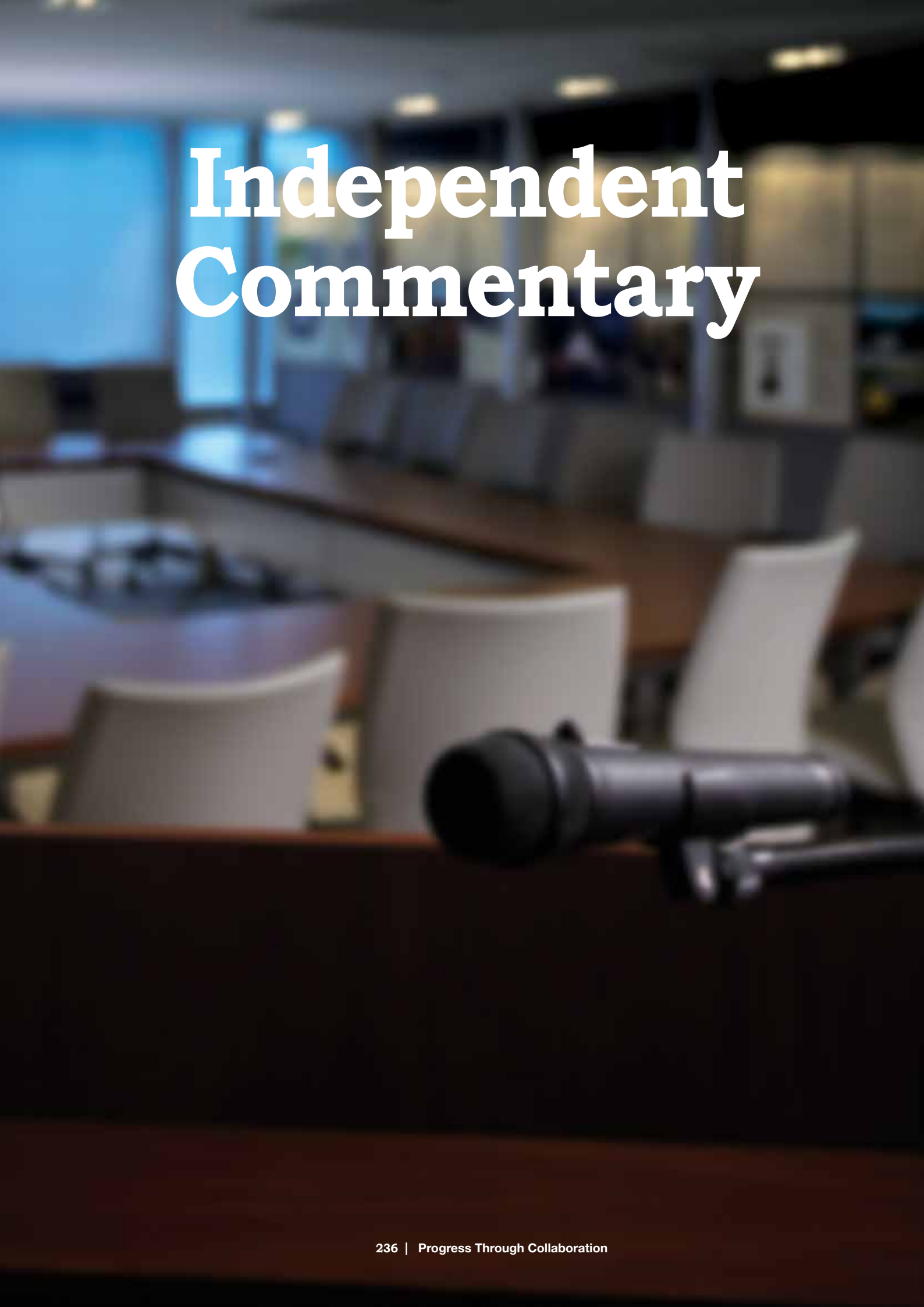
PAST MEMBERS OF THE ADVISORY COUNCIL

Marlyn A. Cook (September 2010 to March 2015)

Wesley Cragg (January 2012 to March 2015)

Frederick Gilbert (September 2002 to March 2015)

Michel R. Rhéaume (September 2010 to March 2015)



Independent Commentary

AUDITOR'S REPORT AND FINANCIAL STATEMENTS

Management's Responsibility for Financial Reporting

The accompanying financial statements of the Nuclear Waste Management Organization (NWMO) and all the information in this annual report are the responsibility of management and have been approved by the Board of Directors.

The financial statements have been prepared by management in accordance with Canadian accounting standards for not-for-profit organizations set out in Part III of the Chartered Professional Accountants Canada Handbook. When alternative accounting methods exist, management has chosen those it deems most appropriate in the circumstances. Financial statements are not precise since they include certain amounts based on estimates and judgments, particularly when transactions affecting the current accounting period cannot be finalized until future periods.

Management has determined such amounts on a reasonable basis in order to ensure that the financial statements are presented fairly, in all material respects, and in light of information available up to February 17, 2017.

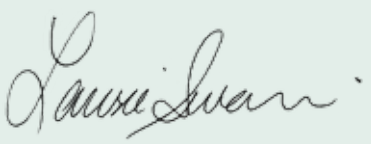
Management has a system of internal controls designed to provide reasonable assurance that the financial statements are accurate and complete in all material respects. The internal control system includes an established business conduct policy that applies to all employees. Management believes that the systems provide reasonable assurance that transactions are properly authorized and recorded, financial information is relevant, reliable and accurate, and the Organization's assets are appropriately accounted for and adequately safeguarded.

The Board of Directors is responsible for ensuring management fulfils its responsibilities for financial reporting, and is ultimately responsible for reviewing and approving the financial statements. The Board carries out this responsibility through its Audit, Finance and Risk Committee (the Committee).

The Committee is appointed by the Board and meets periodically with management, as well as the external auditor, to discuss internal controls over the financial reporting process, auditing matters and financial reporting issues; to satisfy itself that each party is properly discharging its responsibilities; and to review the financial statements and the external auditor's report. The Committee reports its findings to the Board for consideration when approving the financial statements for issuance to the members. The Committee also considers, for review by the Board and approval by the members, the engagement or reappointment of the external auditor.

The financial statements have been audited by Deloitte LLP, the independent external auditor, in accordance with Canadian generally accepted auditing standards on behalf of the members.

February 17, 2017



Laurie Swami
President and CEO

Michael Hung
Chief Financial Officer

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INDEPENDENT AUDITOR'S REPORT

To the Members of
Nuclear Waste Management Organization

We have audited the accompanying financial statements of Nuclear Waste Management Organization, which comprise the statement of financial position as at December 31, 2016, and the statements of operations, changes in net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained in our audit is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of Nuclear Waste Management Organization as at December 31, 2016, and the results of its operations and its cash flows for the year then ended, in accordance with Canadian accounting standards for not-for-profit organizations.

Deloitte LLP

Chartered Professional Accountants
Licensed Public Accountants
February 17, 2017
Vaughan, Ontario

Statement of financial position as at December 31, 2016

	2016	2015
	$	$
Assets		
Current assets		
Cash	2,344,119	1,915,785
Accounts receivable	751	150,751
Member contributions receivable (Note 5a)	7,279,915	5,784,851
Prepaid expenses and deposits	852,831	796,920
	10,477,616	8,648,307
Capital assets (Note 3)	3,788,446	3,456,844
Other assets (Note 4)	-	5,000
Deferred pension asset (Note 7)	36,848,322	36,726,610
	51,114,384	48,836,761
Liabilities		
Current liabilities		
Accounts payable and accrued liabilities (Note 12)	10,583,376	8,564,064
Deferred lease inducements (Note 8)	26,229	75,717
Deferred/payable member contributions (Note 5b)	168,011	128,526
	10,777,616	8,768,307
Deferred capital contribution (Note 6)	3,788,446	3,456,844
Deferred member contributions (Note 5c)	11,349,500	10,495,462
Other post-employment and pension benefits liability (Note 7)	20,034,868	17,915,794
	35,172,814	31,868,100
Net assets	5,163,954	8,200,354
	51,114,384	48,836,761

Approved by the Board of Directors, February 17, 2017

Laurie Swami
President and CEO
Toronto, Ontario

C. Ian Ross
Chair – Audit, Finance and Risk Committee
Toronto, Ontario

The accompanying notes to the financial statements are an integral part of this financial statement.

Statement of operations
year ended December 31, 2016

	2016	2015
	$	$
Revenue		
Member cash contributions received (Note 4)	61,122,670	66,762,580
Non-member cash contributions received	586,071	411,744
	61,708,741	67,174,324
Change in deferred capital contributions (Note 6)	(331,601)	(263,623)
Change in long-term deferred member contributions (Note 5c)	(854,038)	(450,640)
Change in member contributions receivable (Note 5a)	1,495,064	(8,539,840)
Change in deferred/payable member contributions (Note 5b)	(39,485)	55,860
Total contribution revenue (Note 11)	61,978,681	57,976,081
Interest income (Note 11)	8,646	12,761
Total revenue	61,987,327	57,988,842
Expenses		
Adaptive Phased Management		
Staffing and administration	25,293,545	24,467,493
Siting process	14,463,059	10,988,186
Design and development safety case	13,006,750	9,799,624
Building relationships	1,664,096	3,760,874
Governance structure	583,149	527,084
Adapting to change	259,624	216,874
	55,270,223	49,760,135
Deep Geologic Repository		
Regulatory review stage	1,710,714	2,930,513
Design stage	858,918	1,180,238
Staffing and administration	1,549,719	1,721,944
	4,119,351	5,832,695
Lifecycle Liability Management		
Contract services	119,062	141,067
Staffing and administration	1,231,232	1,197,382
	1,350,294	1,338,449
Amortization	1,247,459	1,057,563
Total expenses (Note 11)	61,987,327	57,988,842
Excess of revenue over expenses for the year	-	-

The accompanying notes to the financial statements are an integral part of this financial statement.

Statement of changes in net assets
year ended December 31, 2016

	2016	2015
	$	$
Net assets, beginning of year	8,200,354	1,581,154
Excess of revenue over expenses for the year	-	-
Remeasurements during the year:		
Deferred pension asset	(2,237,000)	2,341,000
Other post-employment and pension benefits liability	(799,400)	4,278,200
Net assets, end of year	5,163,954	8,200,354

Statement of cash flows
year ended December 31, 2016

	2016	2015
	$	$
Operating activities		
Cash received from contributions	61,708,741	67,174,324
Interest received	8,646	12,761
	61,717,387	67,187,085
Cash paid for salaries and benefits, materials and services	(59,756,688)	(68,805,209)
	1,960,699	(1,618,124)
Investing activity		
Purchase of capital assets (Note 3)	(1,532,365)	(1,421,009)
Net increase (decrease) in cash	428,334	(3,039,133)
Cash, beginning of year	1,915,785	4,954,918
Cash, end of year	2,344,119	1,915,785

The accompanying notes to the financial statements are an integral part of these financial statements.

1. Description of organization

The Nuclear Waste Management Organization ("NWMO") is a not-for-profit corporation without share capital, established under the *Canada Corporations Act*, 1970 ("the Act"), as required by the *Nuclear Fuel Waste Act* ("*NFWA*"), 2002, which came into force November 15, 2002.

The *NFWA* requires electricity-generating companies which produce used nuclear fuel to establish a waste management organization. In accordance with the *NFWA*, the NWMO established an Advisory Council, conducted a study and provided recommendations on the long-term management of used nuclear fuel to the Government of Canada. The results of the study and the recommendations were submitted in November 2005. As part of the long-term mandate, the NWMO is now responsible for implementing Adaptive Phased Management ("APM"), an approach selected by the Government of Canada to address the management of used nuclear fuel.

The NWMO formally began operations on October 1, 2002. Its founding members are Hydro-Québec, NB Power Nuclear, and Ontario Power Generation Inc. ("Members") – which are Canadian companies that currently produce used nuclear fuel as a byproduct of electricity generation.

Pursuant to a Membership Agreement, cost sharing of APM costs has initially been done based on the number of fuel bundles produced as of June 30, 2006, adjusted to account for the assumed timing of transfer of used fuel to the repository. At the Board of Directors' meeting on June 11, 2014, the date used for the calculation of the number of fuel bundles was changed to June 30, 2013, effective for cost sharing of APM costs beginning January 1, 2015.

In addition to the above mandate, effective January 1, 2009, the NWMO entered into two new agreements with Ontario Power Generation Inc. ("OPG") to expand its operations to provide project management services for Phase 1 of OPG's Low and Intermediate Level Waste Deep Geologic Repository ("DGR"), and certain provision costing and accounting services relating to nuclear Lifecycle Liability Management ("LLM").

Effective February 1, 2011, the NWMO entered into an Engineering, Procurement and Construction Management Agreement for the DGR Phase 2 (design) and Phase 3 (construction) services with OPG. The design services cover detailed engineering, geoscience characterization, environmental and safety assessment, community engagement, and regulatory affairs. Phase 3, the construction services, is pending government approval, as well as both parties – OPG and the NWMO – mutually agreeing to proceed with this service.

2. Significant accounting policies

Basis of presentation

The financial statements of the NWMO are the representations of management prepared in accordance with Canadian accounting standards for not-for-profit organizations set out in Part III of the Chartered Professional Accountants Canada ("CPA Canada") Handbook using the deferral method of reporting restricted contributions. The significant accounting policies adopted by the NWMO are as follows:

2. Significant accounting policies (continued)

Reporting controlled and related entities
The investment in the controlled enterprise is reported using the equity method (Note 4).

Capital assets
Capital assets are recorded at cost. Amortization is provided for on the straight-line basis over their estimated useful lives as follows:

Office building	15 years
Furniture and office equipment	7 years
Transport and work equipment	7 years
Vehicles	5 years
Computer equipment and software	3 years
Leasehold improvements	Initial lease term plus one renewal period

Income tax
The NWMO is a not-for-profit organization, and pursuant to section 149(1)(1) of the *Income Tax Act*, is not subject to income tax.

Revenue recognition
Contributions received from members are treated as restricted contributions, and as such, they are not recognized as revenue until associated costs have been incurred. Any excess or shortfall of member contributions is recorded as deferred revenue or member contribution receivable, respectively.

Contributions used for the purchase of capital assets owned by the NWMO are deferred and amortized into revenue at the rate corresponding with the amortization rate of the related capital assets.

Pension and other post-employment benefits
The NWMO's post-employment benefit programs include a contributory defined benefit registered pension plan, a defined benefit supplementary pension plan, and other post-employment benefits, including group life insurance, health care and long-term disability benefits. The NWMO has adopted the following policies with respect to accounting for these post-employment benefits as per CPA Canada Handbook Part III, Section 3463, effective January 1, 2014:

(i) The NWMO accrues its obligations under pension, supplementary pension plan, and other post-employment benefit ("OPEB") plans. The defined benefit obligation for pension is determined using the projected benefit method pro-rated on service and are measured based on the actuarial valuation prepared for funding purposes (but not one prepared using a solvency, wind up, or similar valuation basis). Under this method, the benefit costs are amortized over the average remaining service period of active employees as indicated in Note 7. For other unfunded plans such as supplementary pension plan and OPEB, a similar accrual method is used and the benefit obligations are measured based on the actuarial valuation for accounting purposes. Remeasurements and other items for the period are recorded through net assets.

(ii) The obligations are affected by salary levels, inflation, and cost escalation of specific items (e.g., dental and health claims). Pension and OPEB costs and obligations are determined annually by independent actuaries using management's best estimate assumptions. The discount rate used by the NWMO in determining projected benefit obligations and the costs for the NWMO's pension plan is based on the funding valuation on a going concern basis, while other employee benefit plans' discount rates are based on representative AA corporate bond yields in effect at the end of the year.

(iii) Pension fund assets are valued using market-related values for the purposes of determining actuarial gains or losses and the actual return on plan assets. The plan's assets consist of investment grade securities. Market and credit risk on these securities are managed by the plan by placing plan assets in trust and through the plan investment policy.

Research and development

Research and development costs are charged to operations in the year incurred.

Foreign currency translation

Monetary assets and liabilities denominated in foreign currencies are translated into Canadian currency at the year-end exchange rate. Any resulting gain or loss is reflected in staffing and administration expenses. Transactions in foreign currencies throughout the year have been converted at the exchange rate prevailing at the date of the transaction.

Financial instruments

Financial instruments include cash, accounts receivable, and accounts payable and accrued liabilities.

Financial assets and financial liabilities are initially recognized at fair value when the NWMO becomes a party to the contractual provisions of the financial instrument. Subsequently, all financial instruments are measured at amortized cost. Financial assets measured at amortized cost are assessed at each reporting date for indications of impairment. If such impairment exists, the asset is written down and the resulting impairment loss is recognized in the statement of operations.

Related party transactions

Related party transactions are recorded at the exchange amount.

Use of estimates

The preparation of financial statements in conformity with Canadian generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, disclosures of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the reporting period. Due to the inherent uncertainty in making estimates, actual results could differ from those estimates. Accounts requiring significant estimates include pension and other post-employment benefits, certain accrued liabilities and amortization which is based on the estimated useful life of the capital assets.

3. Capital assets

			2016	2015
	Cost	Accumulated amortization	Net book value	Net book value
	$	$	$	$
Land	10,000	-	10,000	10,000
Computer equipment and software	3,545,519	2,667,014	878,505	1,236,817
Furniture and office equipment	2,312,550	1,847,147	465,403	412,354
Leasehold improvements	2,234,099	2,002,377	231,722	533,861
Office building	1,166,393	38,880	1,127,513	-
Transport and work equipment	1,150,194	184,850	965,344	436,685
Vehicles	374,231	264,272	109,959	183,266
Construction in progress	-	-	-	643,861
	10,792,986	7,004,540	3,788,446	3,456,844

Construction in progress relates to an office building which was completed in 2016.

Capital asset additions totalling $212,041 (2015 – $165,345) have been excluded from the statement of cash flows as they remain unpaid at year-end. During 2016, capital asset additions totalling $165,245 (2015 – $265,170) have been included in the statement of cash flows as they were accrued at December 31, 2015, and paid in 2016 (2015 – accrued at December 31, 2014, and paid in 2015).

4. Related party transactions, balances and other information

Transactions and balances not otherwise disclosed separately in the financial statements are as follows:

			2016	2015
	APM	LLM/DGR	Total	Total
	$	$	$	$
Transactions during the year				
Member contributions received				
Ontario Power Generation Inc.	52,975,000	4,065,498	57,040,498	62,446,580
New Brunswick Power	2,010,000	-	2,010,000	2,069,000
Hydro-Québec	2,072,172	-	2,072,172	2,247,000
	57,057,172	4,065,498	61,122,670	66,762,580

The NWMO set up a wholly owned subsidiary in Saskatchewan to purchase mineral exploration rights in support of the APM siting process. This subsidiary was incorporated on March 27, 2013, with share capital, under the *Canada Business Corporations Act*. The subsidiary company purchased certain mineral exploration claims for $5,000 funded by $1 in share capital and a $4,999 interest-free loan from the NWMO. This wholly owned subsidiary was dissolved, effective July 29, 2016, with the mining rights surrendered to the Crown at zero value and the interest-free loan of $4,999 forgiven by the NWMO.

5. Member contributions receivable and deferred/payable member contributions

The NWMO receives contributions from its members and is solely funded through their contributions. The contributions received from the members are restricted in nature, and thus revenue is recognized when qualifying expenses are incurred. Amounts received in advance of qualifying expenses are recorded as deferred member contributions. Commitments for contributions which have not been received by the NWMO are recorded as contributions receivable when the amount is determinable and the ultimate collection is likely. Information in this note includes amounts related to Atomic Energy of Canada Limited.

(a) Member contributions receivable

Member contributions receivable are made up of the following:

	2016	2015
	$	$
Ontario Power Generation	7,064,239	5,583,884
New Brunswick Power	201,628	200,967
Hydro-Québec	14,048	-
	7,279,915	5,784,851

(b) Deferred/payable member contributions

Deferred/payable member contributions are made up of the following:

	2016	2015
	$	$
Atomic Energy of Canada Limited	168,011	117,697
Hydro-Québec	-	10,829
	168,011	128,526

(c) Long-term deferred member contributions

Long-term deferred member contributions represent amounts received or receivable to fund various employee future benefits as follows:

	2016	2015
	$	$
Deferred pension asset	36,848,322	36,726,610
Other post-employment benefits	(20,034,868)	(17,915,794)
Pension and other post-employment benefit liabilities – short term (Note 7)	(300,000)	(115,000)
Less remeasurements and other items in net assets	(5,163,954)	(8,200,354)
	11,349,500	10,495,462

(d) Continuity of deferred member contributions

The continuity of deferred member contributions is as follows:

	2016	2015
	$	$
Balance, beginning of year		
Deferred/payable member contributions – current	128,526	184,386
Deferred member contributions – long term	10,495,462	10,044,822
	10,623,988	10,229,208
Contributions received	61,708,741	67,174,324
Contributions receivable	7,279,915	5,784,851
Contribution revenue recognized	(61,978,681)	(57,976,081)
Amounts received previously recognized	(5,784,851)	(14,324,691)
Change related to capital contributions	(331,601)	(263,623)
	11,517,511	10,623,988
Balance, end of year		
Deferred/payable member contributions – current	(168,011)	(128,526)
Deferred member contributions – long term	11,349,500	10,495,462

6. Deferred capital contributions

	2016	2015
	$	$
Balance, beginning of year	3,456,844	3,193,221
Contributions for the purchase of capital assets	1,579,061	1,321,186
Less amortization into revenue	(1,247,459)	(1,057,563)
Balance, end of year	3,788,446	3,456,844

7. Pension and other post-employment benefit plans

Effective January 1, 2009, the NWMO offers certain benefits to employees and retirees. A brief overview of these benefit plans is set out below:

(a) Registered pension plan

The registered pension plan is a contributory defined benefit plan covering most employees and retirees. The Plan is funded, and fund assets include pooled funds that are managed by a third party. The benefit costs and assets related to this plan are recorded in the NWMO's financial statements.

(b) Supplementary pension plan

The supplementary pension plans are defined benefit plans covering certain employees and retirees. The plan is unfunded.

(c) Other post-employment benefit plans

These other post-employment benefit plans provide medical, dental, and group life insurance coverage for certain groups of full-time employees who have retired from the NWMO.

The most recent actuarial valuations in accordance with CPA Canada Handbook Section 3463 of the registered pension plan, other post-employment benefit plans and supplementary pension plan were performed as at December 31, 2015, December 31, 2014, and December 31, 2013, respectively. The liability as at December 31, 2016, is based on an extrapolation of the previous valuations.

A funding valuation, which was completed for the pension plan as of January 1, 2016, reported a surplus of $34.3 million on a going concern basis and a surplus of $0.3 million on a solvency basis.

The significant actuarial assumptions for benefit obligation and costs adopted in estimating the NWMO's accrued benefit obligations are as follows:

	Registered pension plan		Supplementary pension plan		Other post-employment benefit plans	
	2016	2015	**2016**	2015	**2016**	2015
	%	%	**%**	%	**%**	%
Discount rate at the beginning of the period	**6.0**	6.0	**4.2**	4.1	**4.2**	4.1
Salary schedule escalation rate	**3**	3	**3**	3	**-**	-
Rate of cost of living increase	**2**	2	**2**	2	**-**	-
Rate of increase in health-care cost trend	**-**	-	**-**	-	**5.9**	5.3
Discount rate at the end of the period	**5.75**	6.0	**4.0**	4.2	**4.0**	4.2
Average remaining service life for employees	**13 years**	13 years	**13 years**	13 years	**12 years**	15 years

Information for the NWMO's pension and post-employment benefits, including long-term disability ("LTD") is as follows:

	Registered pension plan		Supplementary pension plan		Other post-employment benefit plans	
	2016	2015	2016	2015	2016	2015
	$	$	$	$	$	$
Changes in accrued benefit obligation						
Accrued benefit obligation, January 1	(51,299,000)	(47,375,000)	(4,812,400)	(4,451,200)	(13,218,394)	(15,653,394)
Current service cost	(1,945,000)	(1,781,000)	(319,000)	(309,000)	(807,000)	(1,205,000)
Interest cost	(3,182,000)	(2,940,000)	(231,000)	(209,000)	(584,000)	(686,000)
Employee contribution	(1,017,000)	(955,000)	-	-	-	-
Benefits paid	1,241,000	692,000	153,100	74,000	283,226	131,000
Net actuarial gain (loss)	(2,444,000)	1,060,000	(145,400)	82,800	(654,000)	4,195,000
Accrued benefit obligation, December 31	(58,646,000)	(51,299,000)	(5,354,700)	(4,812,400)	(14,980,168)	(13,218,394)
Changes in plan assets						
Fair value of plan assets, January 1	88,025,610	79,105,570	-	-	-	-
Expected return on plan assets	5,327,712	4,819,040	-	-	-	-
Benefits paid	(1,241,000)	(692,000)	-	-	(283,000)	(131,000)
Net actuarial gain (loss)	207,000	1,281,000	-	-	-	-
Employer contribution	2,158,000	2,557,000	-	-	283,000	131,000
Employee contribution	1,017,000	955,000	-	-	-	-
Fair value of plan assets, December 31	95,494,322	88,025,610	-	-	-	-
Funded status						
Fair value of plan assets	95,494,322	88,025,610	-	-	-	-
Accrued benefit obligation	(58,646,000)	(51,299,000)	(5,354,700)	(4,812,400)	(14,980,168)	(13,218,394)
Accrued benefit asset (liability)	36,848,322	36,726,610	(5,354,700)	(4,812,400)	(14,980,168)	(13,218,394)
Short-term portion	-	-	(150,000)	(19,000)	(150,000)	(96,000)
Long-term portion	36,848,322	36,726,610	(5,204,700)	(4,793,400)	(14,830,168)	(13,122,394)
	36,848,322	36,726,610	(5,354,700)	(4,812,400)	(14,980,168)	(13,218,394)
Components of cost recognized						
Current service cost	1,945,000	1,781,000	319,000	309,000	807,000	1,205,000
Interest cost on accrued benefit obligation	3,182,000	2,940,000	231,000	209,000	584,000	686,000
Expected return on plan asset	(5,327,712)	(4,819,040)	-	-	-	-
Cost recognized	(200,712)	(98,040)	550,000	518,000	1,391,000	1,891,000

7. Pension and other post-employment benefit plans (continued)

An amount of $300,000 (2015 – $115,000) that is included in accounts payable and accrued liabilities is part of the total $20,334,868 (2015 – $18,030,794) accrued benefit liability at the end of the year for the supplementary pension and other post-employment benefits/LTD plans.

The pension and other post-employment benefit costs recognized are included in the respective expense categories in the statement of operations.

Sensitivity information related to the other post-employment benefit plans is as follows:

	2016	2015
	$	$
Effect of 1% increase in health-care cost trends on		
Accrued benefit obligation	3,543,000	2,940,000
Service cost and interest cost	389,000	585,000
Effect of 1% decrease in health-care cost trends on		
Accrued benefit obligation	(2,635,000)	(2,217,000)
Service cost and interest cost	(281,000)	(417,000)

The supplementary pension plan is unfunded and is secured by a Letter of Credit of $7,896,300 (2015 – $5,810,500) issued by OPG.

8. Deferred lease inducements

	2016	2015
	$	$
Tenant inducements	461,757	461,757
Less accumulated amortization	(435,528)	(386,040)
	26,229	75,717

9. Guarantees

In the normal course of business, the NWMO enters into agreements that meet the definition of a guarantee.

(a) The NWMO has provided indemnities for various agreements. Under the terms of these agreements, the NWMO agrees to indemnify the counterparty for various items, including, but not limited to, all liabilities, loss, suits, and damages arising during, on or after the term of the agreement.

(b) The NWMO indemnifies all directors, officers and employees acting on behalf of the NWMO for various items, including, but not limited to, all costs to settle suits or actions due to services provided to the NWMO, subject to certain restrictions.

The nature of these indemnification agreements prevents the NWMO from making a reasonable estimate of the maximum exposure due to the difficulties in assessing the amount of liability which stems from the unpredictability of future events and the unlimited coverage offered to counterparties. Historically, the NWMO has not made any payments under such or similar indemnification agreements, and therefore, no amount has been accrued with respect to these agreements.

The NWMO also arranged a standby Letter of Credit issued by OPG to secure its supplementary pension plan (Note 7).

10. Operating leases

The NWMO has entered into a number of leases for office premises which expire at various dates up to June 30, 2027.

The estimated annual minimum payments over the initial term of these leases up to their expiration are as follows:

	$
2017	951,755
2018	924,935
2019	937,058
2020	971,970
2021	990,764
Thereafter	5,689,384
	10,465,866

11. Segment reporting

The NWMO has two reportable segments as follows:

- Federal mandated program (APM);
- Other direct services outside its mandated programs, which include DGR and LLM for OPG, with service contracts which became effective January 1, 2009, and February 1, 2011.

Segment information is as follows:

	APM		DGR/LLM		Total	
	2016	2015	2016	2015	2016	2015
	$	$	$	$	$	$
Contribution revenue	56,385,974	50,728,815	5,592,707	7,247,266	61,978,681	57,976,081
Interest income	7,789	10,661	857	2,100	8,646	12,761
Total revenue	56,393,763	50,739,476	5,593,564	7,249,366	61,987,327	57,988,842
Amortization of capital assets	1,123,541	979,340	123,918	78,223	1,247,459	1,057,563
Operating cost	55,270,222	49,760,136	5,469,646	7,171,143	60,739,868	56,931,279
Total cost	56,393,763	50,739,476	5,593,564	7,249,366	61,987,327	57,988,842
Expenditure for capital assets	1,575,136	1,292,703	3,925	28,483	1,579,061	1,321,186

The allocation of the common service costs to each function of the above segment is based on direct staff in each function.

12. Government remittances

Accounts payable and accrued liabilities include the following amounts with respect to government remittances:

	2016	2015
	$	$
Goods and Services Tax/Harmonized Sales Tax ("GST/HST")	705,900	739,700
Less GST/HST receivable	(368,762)	(357,387)
Net GST/HST payable	337,138	382,313
Workplace Safety and Insurance Board premiums payable	-	758
	337,138	383,071

REPORT OF THE ADVISORY COUNCIL

Advisory Council to the NWMO

Mr. Wayne Robbins
Chairman of the Board of Directors
Nuclear Waste Management Organization
22 St. Clair Avenue East, 6th Floor
Toronto, ON M4T 2S3

February 2017

Dear Mr. Robbins,

On behalf of the Advisory Council to the Nuclear Waste Management Organization (NWMO), I am pleased to submit our comments for inclusion in the NWMO's *Triennial Report 2014 to 2016*.

We provide comments as required of the Advisory Council under sections 8 and 18 of the *Nuclear Fuel Waste Act*.

Respectfully submitted on behalf of members of the Advisory Council,

The Honourable David Crombie
Advisory Council Chair

Copy: NWMO Advisory Council:

- Dr. David R. Cameron
- Mr. Joseph Cavalancia
- Dr. Dean Jacobs
- Ms. Diane M. Kelly
- Ms. Eva Ligeti
- Dr. Derek H. Lister
- Dr. Dougal McCreath
- Mr. Donald Obonsawin
- Ms. Linda Thompson

Table of Contents

1. Introduction and Background

This report fulfils the requirement in the *Nuclear Fuel Waste Act* (*NFWA*) that the Advisory Council (Council) must comment every three years on the process and findings of the Nuclear Waste Management Organization (NWMO).

Section 1 provides an overview of the mandate, approach and framework that we developed for the purpose of evaluating the NWMO's work. Section 2 provides a summary of our activities over the past three years and our evaluation of the work the NWMO has undertaken during that time period. Section 3 includes comments and recommendations on the NWMO's plans for future work as described in its implementation plan, *Implementing Adaptive Phased Management 2017 to 2021*. Finally, section 4 provides our reflections on the NWMO's work to date, observations on international experiences with nuclear waste management, and some conclusions about consent and partnership.

1.1 *Nuclear Fuel Waste Act* (*NFWA*) Requirements

As required by the *NFWA*, the NWMO Board of Directors established the Advisory Council in 2002. The *NFWA* specifies that the membership of the Council should reflect a broad range of scientific and technical disciplines related to the management of nuclear fuel waste, as well as expertise in public affairs, social sciences and Indigenous Knowledge [1]. Since 2002, several members have left the Council, and several new members have been appointed (see boxes). The Honourable David Crombie continues to serve as Chair, and the Council members are profiled in chapter 12 (*Advisory Council*). The Council is required by the *NFWA* to comment every three years on the previous three years of NWMO activity. These independent statements on the NWMO's work, which include observations on the results of the NWMO public consultations and analyses of any significant socio-economic effects of the organization's activities, are published in the NWMO's triennial reports, beginning with the 2010 report. The Council is also obliged to comment on the organization's five-year strategic plans and budget forecasts. The Council comments are submitted to Canada's Minister of Natural Resources and made public at the same time.

Advisory Council – Current Members	
David Crombie, Chair	2002-ongoing
David R. Cameron	2002-ongoing
Joseph Cavalancia	2015-ongoing
Dean Jacobs	2015-ongoing
Diane M. Kelly	2015-ongoing
Eva Ligeti	2002-ongoing
Derek H. Lister	2002-ongoing
Dougal McCreath	2008-ongoing
Donald Obonsawin	2002-ongoing
Linda Thompson	2015-ongoing

Advisory Council – Former Members	
Marlyn A. Cook	2008-2015
Helen Cooper	2002-2008
Wesley Cragg	2012-2015
Gordon Cressy	2002-2008
Frederick Gilbert	2002-2015
Rudyard Griffiths	2008-2011
Michel R. Rhéaume	2010-2015
Daniel Rozon	2002-2009

[1] The NWMO has replaced the term "Aboriginal Traditional Knowledge" with "Indigenous Knowledge" in order to provide a more accurate and comprehensive perspective.

1.2 Relationship With the NWMO

The Advisory Council follows the development of the NWMO's plans and activities closely, and provides ongoing counsel and advice. We generally meet four times a year. The Chair works with staff to set the agenda. At our meetings, staff members make presentations on the NWMO's work, and the Council asks questions, requests more information, raises issues, considers the NWMO's work, and provides advice. We hold an in-camera session at the end of most of our meetings when we deliberate without the presence of NWMO management or staff. The Council Chair provides a report to NWMO Board meetings to ensure a comprehensive exchange of information. Council members and the NWMO Board of Directors usually meet once a year for an exchange of views.

In order to fulfil our legislated reporting requirements, the Advisory Council provides written comments on the NWMO's work. Previous comments were provided in the following documents:

- The NWMO's Final Study Report, *Choosing a Way Forward – The Future Management of Canada's Used Nuclear Fuel* (*2005*)
- The NWMO's *Triennial Report 2008 to 2010, Moving Forward Together* (*2010*)
- The NWMO's *Triennial Report 2010 to 2013, Learning More Together* (*2013*)

In addition, several Council members have presented papers[2] about the NWMO's work at international conferences:

- *Canada's Approach to the Management of Used Nuclear Fuel: the Role of the Advisory Council to the Nuclear Waste Management Organization* by David Crombie and Derek H. Lister for the 15th Pacific Basin Nuclear Conference, Sydney, Australia, 2006.
- *Managing Used Nuclear Fuel in Canada – Challenges Ahead as a Repository Site is Sought* by David Crombie, Derek H. Lister and Daniel Rozon for the 16th Pacific Basin Nuclear Conference, Aomori, Japan, 2008.

The Council's activities are summarized on a yearly basis for inclusion in the NWMO Annual Report. The NWMO also documents the actions taken by the organization in response to our advice. They are recorded in tracking matrices, which are posted on the NWMO's website[3].

1.3 Evaluation Framework

In order to fulfil our obligations to provide an independent review of the NWMO's work, we developed criteria for evaluation. In developing these criteria, we considered the mandate and mission of the NWMO, and paid particular attention to the experience and recommendations of the Seaborn Panel[4] and to the NWMO's Ethical and Social Framework.

[2] www.nwmo.ca/advisorycouncil
[3] Tracking matrices are available at www.nwmo.ca/advisorycouncil.
[4] The Seaborn Panel was a Canadian Environmental Assessment Agency panel chaired by Blair Seaborn between 1989 and 1998. The Panel examined the disposal concept for used nuclear fuel management proposed by Atomic Energy of Canada Limited. See section 2.8 at www.nwmo.ca/studysocialethical.

Advisory Council Evaluation Criteria

In 2005, the Advisory Council developed a statement – *How the Advisory Council of the Nuclear Waste Management Organization Intends to Fulfill its Mandate*[5]. The statement included four evaluation criteria (comprehensiveness, fairness and balance, integrity, and transparency) to provide a basis for our assessment of the NWMO's work.

In 2010, 2013 and 2016, to reflect the evolution of the NWMO's work, we updated these criteria and continue to use them in our work:

1. **Comprehensiveness.** In fulfilling its mandate, are all available reasonable alternative approaches and the experiences of other organizations and jurisdictions being effectively evaluated and taken into account by the NWMO? In answering this question, we consider the views of the Adaptive Phased Management-Geoscientific Review Group (APM-GRG), the Council of Elders and Youth, and the Municipal Forum. We also evaluate how effectively the understanding and knowledge that the NWMO continues to acquire is being integrated into its work at all levels and the work of its agents and contractors.
2. **Fairness and balance.** Is there fairness and balance in the siting process such that adequate consideration is given to diverse points of view, including minority perspectives?
3. **Integrity.** Is the NWMO fulfilling its mandate with openness, honesty, and consistency, and is it allowing adequate and meaningful opportunities for public and stakeholder participation and engagement? In answering this question, we consider how effectively the NWMO responds to public input and respects participating individuals, communities, and organizations, and their diverse perspectives, concerns, and values.
4. **Transparency.** Are the plans, timetable, activities, and decisions of the NWMO clearly communicated to the public, and is information shared with citizens, stakeholders, and partners in a timely fashion so that they can participate effectively?
5. **Technical strength.** Does the NWMO have the human resources required to address the engineering and scientific dimensions of site characterization, repository design and safety assessment? Equally, does the NWMO have the human resources necessary to ensure the accurate understanding of the societal and Aboriginal dimensions of the site selection process, as well as the delineation and evaluation of alternative transportation corridors? Included in this aspect of our assessment is ensuring that adequate provision is made for skilled personnel required at the local level to meet the short- and long-term needs and interests of all the communities involved in the site selection process.
6. **Financial capacity.** Does the funding formula adequately reflect the costs of the APM of Canada's nuclear waste? Has the NWMO identified and accommodated all key factors and uncertainties associated with the cost estimates such as the amount and type of used fuel to be managed, the geology of the site and the rate of return on contributed funds? Are cost estimates being kept up-to-date, and are financial contributions being adjusted to reflect these estimates?
7. **Culture of learning.** Is the NWMO actively pursuing new ideas and perspectives, and applying its learning – regarding science, technology, Indigenous Knowledge, history, ethics, sociology, and culture – in a responsive way? Has the NWMO incorporated the lessons learned from international experiences and the Ontario Power Generation's (OPG) project to develop a deep geologic repository for low- and intermediate-level waste? Is new knowledge being absorbed by its own staff, shared adequately with its partner organizations, and reflected adequately in all aspects of the work and activities of the organization?

In this triennial report, we report our assessment of how effectively the NWMO is carrying out its mandate when viewed in light of these criteria.

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[5] *How the Advisory Council of the Nuclear Waste Management Organization Intends to Fulfill its Mandate* is available at www.nwmo.ca/ACMandate.

2. 2014-2016 Activities

The primary purpose of this section is to provide the Advisory Council's comments on the work of the NWMO during 2014 to 2016. But first, in section 2.1, we provide some context for these comments by summarizing our process and activities during that time period. In section 2.2, we provide our evaluation of the NWMO's work.

2.1 Overview of Advisory Council Activities: 2014-2016

During 2014 to 2016, the Council held four formal meetings each year and was kept informed about NWMO activities between meetings. Council meetings included progress reports from the NWMO and discussions of current activities and plans under development. We discussed correspondence that had been received from outside parties. At the Council's request, NWMO staff provided regular updates and assessments of potential risks to the NWMO's work that might result from internal or external socio-political, technical and organizational factors. We held four additional, full-day working sessions in fall 2016 and a conference call in early 2017 to discuss the contents of this triennial report. At our request, formal records of our meetings and copies of papers by Council members are posted on the NWMO website [6]. Summaries of our work are published regularly in the NWMO's annual reports [7].

Advisory Council Meetings – February 2014 to January 2017

- February 3, 2014
- May 27-28, 2014
- September 15, 2014
- November 25, 2014
- February 9, 2015
- May 27, 2015
- September 21, 2015
- December 1, 2015 (includes meeting to exchange views with Board of Directors)
- February 10, 2016
- May 31, 2016
- September 8, 2016 *
- September 26, 2016
- September 27, 2016 *
- October 27, 2016 *
- November 29, 2016 (includes meeting to exchange views with Board of Directors)
- November 30, 2016 *
- January 4, 2017 (conference call)

* Working sessions to prepare Triennial Report

[6] Records of Advisory Council meetings are available at www.nwmo.ca/advisorycouncil.
[7] The NWMO's annual reports are available at www.nwmo.ca/reports.

In addition, the Council welcomed several guests to our meetings to make presentations, followed by discussions that helped inform our work:

- Dr. Dan Longboat, Director of the Indigenous Environmental Studies Program, Trent University, spoke to the Council about the origins of Aboriginal laws and systems of governance based on consensus (February 3, 2014).
- The Honourable Bob Rae discussed with the Council and NWMO management his experience with the Ring of Fire project, and in particular Aboriginal engagement (May 27, 2014).
- Chief Isadore Day from Serpent River First Nation (SRFN) discussed perspectives on Aboriginal Governance and Indigenous Law (February 9, 2015).
- Dr. Peter Kaiser, Chair of the APM-GRG, presented a review of the NWMO's geoscientific preliminary assessments being conducted as part of Step 3 of the site selection process (December 1, 2015).
- Dr. Michael Stephens, a member of the APM-GRG, gave a presentation to the Advisory Council (November 29, 2016).

2.2 Advisory Council Comments on the NWMO's Activities: 2014-2016

The Advisory Council's comments on the NWMO's work during the 2014 to 2016 period are provided below for the following areas of focus:

1. Building Sustainable Relationships
2. Site Selection Process
3. Adaptive Phased Management (APM) Technical Program
4. Transportation
5. Environment
6. Financial Surety
7. Planning and Governance
8. Regulatory Framework

Where relevant, we also provide commentary on the NWMO's responses to the recommendations in our previous Triennial Report (2013).

2.2.1 Building Sustainable Relationships

A key element of the work of the Advisory Council during 2014 to 2016 was to track and evaluate the NWMO's continued engagement with the many groups involved in the long-term management of Canada's used nuclear fuel, including potential host communities, First Nation and Métis organizations and communities, municipal associations, federal and provincial governments, and young Canadians. An overview of our discussions on building sustainable relationships is provided below under the following headings:

- Ethical and Social Framework
- Recognition Programs
- Multi-Generational Engagement
- First Nation and Métis Engagement
- Skills Training and Capacity Building

Ethical and Social Framework

In 2004, the NWMO approved an Ethical and Social Framework as recommended by a Roundtable on Ethics. In 2011, the Ethical and Social Framework was reviewed by a group of ethics practitioners, and several suggestions were made. An important conclusion was that "the underlying focus of the framework as it is currently articulated is out of date. That being the case, the NWMO might want to consider updating the framework by bringing the questions to focus more clearly and specifically on the siting process now underway and which is expected to be central to the work of the NWMO for at least the next 15 years."

In our previous Triennial Report 2011-2013 (section 3.1), the Council recommended that:

- "The NWMO update the Ethical and Social Framework to increase its relevance to the site selection phase of the Adaptive Phased Management process;" and
- "The NWMO consider options for independent evaluation of its work, using the questions in the Ethical and Social Framework, commencing at the end of Phase 1 of Step 3."

The NWMO has not fully acted on these recommendations. However, the organization reports that it has worked to express and put the Ethical and Social Framework into action throughout its plans, programs and communications materials. For example, programs that recognize communities and acknowledge Aboriginal contributions are a reflection of this approach. In addition, for each new phase of work, the NWMO reports that it begins with the question: how should this work be conducted consistent with the principles enshrined in the Ethical and Social Framework? The development of the Transportation Planning Design is a recent example of this thought process. The organization has also implemented a program of annual independent assessments of a major component of its work: the engagement program.

Recognition Programs

The Council provided advice on the NWMO's programs for recognizing the important contributions of municipalities and First Nation and Métis organizations and communities. The Council initially had some concerns about these programs, but they have been well-executed and have enabled communities that have not proceeded to the next phase of work to feel that their time and contributions were appreciated.

Three programs were established and implemented:

- Recognizing Community Leadership in Preliminary Assessments: Phase 1
- Acknowledging Aboriginal Contributions in Preliminary Assessments: Phase 1
- Recognizing Communities in Preliminary Assessments: Phase 2

Multi-Generational Engagement

In our last Triennial Report, the Council emphasized that one of the unique features of the APM Project is that it spans many generations, today and in the future. In particular, it is important to recognize that the youth of today will be the decision-makers of tomorrow and must be engaged in the process. We recommended that the NWMO place a high priority on multi-generational engagement by developing and implementing a detailed work plan to integrate youth involvement and capacity building throughout the APM Project.

The NWMO has developed a multi-faceted approach to youth engagement, as demonstrated in the organization's Triennial Report 2014-2016 in the section *Involving Youth in the Project*. In addition, the NWMO posts an annual update on its plans and activities related to youth engagement on its website at www.nwmo.ca/youthengagement.

These documents show how the NWMO has reached out to youth and students in Aboriginal and municipal siting communities to build understanding of the APM Project and ensure that they are part of the dialogue. This has involved a variety of activities that should contribute to building sustainable relationships. For example:

- The NWMO has hired two summer students each year to participate in the Design and Construction Group.
- Some municipalities and Aboriginal communities participating in the site selection process have engaged summer students, with support from the NWMO.
- Youth members are participating on many of the community liaison committees.
- The NWMO has provided support for a number of youth conferences and gatherings with Aboriginal communities and organizations.
- NWMO staff members deliver presentations to school, college and university classes.
- The NWMO Council of Elders and Youth has introduced a focus on youth involvement. Youth members were appointed and have active roles in co-chairing and participating in the meetings.
- The NWMO sponsors initiatives that help young people develop science related skills, and supports municipalities in hiring students for activities related to APM.
- Through research contracts to universities, graduate students are introduced to the NWMO's activities and technical projects.

First Nation and Métis Engagement

During 2014 to 2016, the Council continued to advocate and provide advice on ways to build solid relationships with First Nation and Métis organizations and communities. For example, we emphasized that First Nation and Métis issues are evolving both legally and politically. This requires an unprecedented level of attention, flexibility and responsiveness to changing expectations. Indigenous communities expect meaningful involvement, integration of Indigenous Knowledge, and opportunities for lasting social and economic benefits from the project. We have observed major progress by the NWMO in this area over the past three years. For example, the NWMO has designed the siting process to provide communities with time to learn about APM and fully consider its implications. The NWMO has also been working carefully with communities and organizations to understand the breadth and scope of engagement required. This has included updates of economic modelling of employment and wealth creation opportunities. Near-term benefits such as local procurement are also being incorporated. The NWMO Aboriginal Relations Group was expanded.

In the Council's last Triennial Report, we recommended that the NWMO provide more details on how Indigenous Knowledge, cultural values, law, and spirituality will be integrated in the next five years of work. The Council provided input into the NWMO's Indigenous Knowledge Policy, which was released in 2016[8]. We note that some of the other activities during the past three years included:

- The NWMO includes Indigenous Knowledge as input alongside the technical and social aspects of site selection. This includes the involvement of Elders, trappers, hunters, fishers, and other knowledge keepers in each siting area.
- The NWMO has begun to meet with communities regarding their protocols with respect to sharing knowledge.
- The NWMO continues its process of gaining understanding of traditional laws through meetings with knowledge holders. All NWMO staff and contractors who have contact with Aboriginal communities receive Aboriginal awareness training.

Other topics of discussion between the Council and NWMO management over the past three years included the relationships and interactions among municipalities and the surrounding First Nation and Métis communities, engagement of individual treaty organizations, and the involvement of women's organizations in Aboriginal communities. We also discussed ways to use the planned traditional land use studies in the site selection study areas to support opportunities for collaboration and partnership with municipalities and other Aboriginal communities in the broader region.

[8] The Indigenous Knowledge Policy may be found at www.nwmo.ca/IndigenousKnowledge.

Skills Training and Capacity Building

The NWMO briefed the Council on its plans for skills training and capacity building in siting study areas. The Council agreed with the current focus on science, math, and the environment, and suggested some additional areas that might be included such as:

- Social responsibility
- Ecosystems and monitoring
- Leadership training
- Engineering
- Trades

The Council also noted that education is helpful for creating a lasting, positive impact in a community, even if that community is not ultimately selected for APM.

2.2.2 Site Selection Process

Since 2010, the NWMO has been working collaboratively with interested communities to select a site where Canada's used nuclear fuel can be safely and securely contained over the long term. During the 2014 to 2016 period, the NWMO continued narrowing its focus to areas with strong potential to host the facility. Field studies and expanded engagement activities are now underway in the vicinity of nine of the original 21 communities that requested preliminary assessments. For more details, please see chapter 6.2 (*Collaboratively Implementing the Site Selection Process*) of the NWMO's Triennial Report.

During 2014 to 2016, the Council continued to seek further information and provide advice on various aspects of the site selection process. We discussed findings from technical and social preliminary assessments. We reviewed reports on fieldwork, as well as on engagement activities with municipal, First Nation and Métis communities in each study area. We supported the use of contractors from local and Aboriginal communities wherever feasible. We also emphasized the importance of ensuring that contractor selection will provide both high quality and consistency of approach across the study areas.

The Council was pleased to see that fieldwork included the interweaving of science with Indigenous Knowledge, as community members worked closely with the NWMO in geoscience mapping and surveys. We inquired about the involvement of Aboriginal communities to ensure that fieldwork does not impact on culturally sensitive areas. The NWMO reported that community workshops with local First Nation and Métis groups, NWMO staff and contractors are held in each study area to discuss such matters as walking the land to conduct geological and environmental mapping, incorporation of Indigenous Knowledge and development of protocols.

The Council noted that when borehole drilling starts, local communities and the NWMO may experience increased attention from interests beyond the local community. We emphasized that it will be important to provide adequate information to meet the needs of both the local and broader communities. We also suggested that local communities should be well-prepared for any increased attention they may receive. The NWMO is incorporating these considerations in its communications programs, in its work on local capacity building, and in the scheduling of borehole drilling activities.

The Council discussed preparations for further narrowing down of study areas. We advised that the site ultimately selected for the project should be one in which communities share the NWMO's core corporate values. We cautioned the NWMO to recognize the varying capacities of communities in the study areas and assist them in building local capacity where necessary. The NWMO responded that this advice will be considered in the next round of Phase 2 dialogues and assessments.

The NWMO briefed the Council on the project of the Canadian Nuclear Laboratories (CNL) to create a near-surface disposal facility for its low-level radioactive waste. We advised the NWMO to keep informed about plans associated with the CNL facility because they may have implications for public engagement around the NWMO's site selection and transportation work.

2.2.3 Adaptive Phased Management (APM) Technical Program

During 2014 to 2016, the Council received regular updates on the technical program. Our discussions focused on safety and included such specifics as the new testing facility for container transportation and storage, the shaft sealing program, the manufacturing and composition of the bentonite buffer, the weld crush test, the ability to withstand future glaciation, the testing of container integrity, container development and materials, container costs, container emplacement options, and the construction of the buffer box.

As issues around alternative methods for the disposal of used nuclear fuel continue to arise, we found the NWMO's *Watching Brief on Reprocessing, Partitioning and Transmutation* to be an effective resource for considering the adaptive nature of the NWMO's work. We suggested it might be worthwhile for the NWMO to have the watching brief validated by other independent sources.

Throughout the past three years, the Council has observed the NWMO's involvement in international conferences and study visits. We noted that the NWMO's work is attracting considerable international interest from countries seeking to learn from the Canadian example. The organization also recruited individuals with international expertise to review and assess its own work through the Independent Technical Review Group (ITRG – now disbanded; see also section 3.6) and the APM-GRG. This work has been very valuable in support of the credibility of the NWMO's work. We emphasized that the attention to technical safety must continue to be complemented by the application of a strong ethical framework in order to ensure sustained progress with site selection and implementation of APM in Canada.

We congratulate the NWMO on several recent awards. The organization received the Canadian Nuclear Society's 2015 Innovative Achievement Award for its engineered-barrier system design, a groundbreaking contribution to the storage of used nuclear fuel in Canada. Two NWMO staff members received awards at the 18th International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM 2016) held in fall 2016 in Japan. Yang Sui, a design engineer for used nuclear fuel transportation at the NWMO, was awarded the Aoki prize for best overall presentation at the conference for his work on an advanced combustion and computational fluid dynamics modelling framework – a system that he is developing to determine the performance of transportation packages in severe accident scenarios involving fires. Ulf Stahmer, a senior engineer at the NWMO, won an award for best poster for his concept to improve communications about radiological doses in terms of flight-time equivalents.

2.2.4 Transportation

In the Council's last Triennial Report, we recommended that the NWMO move quickly to involve Canadians and Aboriginal peoples in a comprehensive dialogue about all potential transportation modes and routes. We suggested that this process should be designed to probe public perceptions and concerns regarding transportation and gather suggestions for ways to address them. In response, the NWMO introduced a new strategic objective focusing on transportation work and engagement plans in its implementation plan, *Implementing Adaptive Phased Management*, beginning in fall 2014. The NWMO also developed a discussion document to serve as a foundation for advancing dialogue on transportation planning for APM[9]. Transportation continues to form part of annual engagement and discussion in the communities, with first responders and at conferences, assisted by the mobile transportation exhibit.

The Council encouraged the NWMO to undertake an analysis of potential radiation exposure to the public and drivers in the transportation system. We were pleased to see the NWMO's publication on this topic, *Assessing Radiological Dose to Members of the Public and Workers during UFTP Transportation*[10].

During 2014 to 2016, the Council continued to provide advice to the NWMO on transportation, addressing such matters as the timing and approach for engaging communities potentially affected by transportation routes. We urged the NWMO to continue its focus on both the social and technical considerations associated with transportation.

2.2.5 Environment

In our last Triennial Report, the Council recommended that the NWMO provide more information about how the organization plans to incorporate environmental considerations in its next five years of work. We suggested that the NWMO should consider ways to contribute to environmental sustainability and an environmentally attuned culture for the host communities, as well as in the NWMO's own operations. This would allow the organization to move beyond regulatory compliance and harm-avoidance to contribute environmental benefits throughout its plans, actions and partnerships.

Over the past three years, the NWMO has initiated Phase 2 environmental desktop studies in areas that are participating in the site selection process. The initial work included a review of available information – including natural features, ecological land classification, sensitive species habitat and sustainability, terrestrial habitat, and aquatic habitat – for the study areas. Based on this information, field activities are being planned and initiated to verify and further refine the information. This information will assist in the assessment of potential surface constraints and potential mitigating options for environmental management. The NWMO reports that Indigenous Knowledge is being collected in parallel with the environmental investigations and will complement the assessment of potential impacts resulting from planned field activities. The Council emphasized that in addition to collecting information, it is important to work with knowledge holders to understand, appreciate and use Indigenous Knowledge. The NWMO will also develop initial baseline monitoring requirements for each of the areas under further investigation.

[9] See www.nwmo.ca/transportationplanning.
[10] Available at www.nwmo.ca/PublicandWorkerSafety.

The NWMO has indicated that environmental sustainability opportunities will be informed by the initial environmental assessments and will be identified during the design process. The Council has suggested that the NWMO should demonstrate how it will be a leader in promoting environmental sustainability throughout its work. For example, in repository design and development, this may include innovative approaches to a range of considerations, including energy sources, energy efficiency, stormwater, materials, habitats, effluents, and emissions. We believe that local environmental priorities should be identified through discussion with potential host communities, beginning as early as possible.

2.2.6 Financial Surety

The Council receives financial reports from the NWMO on a regular basis. They show that the NWMO regularly updates projected costs and continues to ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.

2.2.7 Planning and Governance

During 2014 to 2016, the Council continued to provide advice on the NWMO's business and implementation plans. For example, in February 2015, we engaged in a detailed strategic planning session with NWMO management that contributed to the NWMO's siting timelines, which were published in the 2016-2020 Implementation Plan. In September 2015, we provided suggestions for the wording of the Phase 2 siting objectives for safety and partnership, particularly with respect to the interweaving of Indigenous Knowledge. We also emphasized the importance of being explicit about the time frames being addressed because long-term safety will be a fundamental area of interest to the public.

The Advisory Council reviewed drafts of the NWMO's implementation plan, *Implementing Adaptive Phased Management 2017 to 2021*, raised questions and made a number of suggestions. Additional comments are provided in section 3 of this report.

In the Council's 2013 Triennial Report, we expressed concerns about the uncertainty regarding the amount and type of used fuel that may be generated in the future, beyond that from existing nuclear facilities. We noted that this creates potential risks to the NWMO's work and influences the NWMO's ability to effectively plan for the long-term management of Canada's nuclear fuel wastes. We recommended that the NWMO prepare a "road map" showing the political, regulatory and consultation processes associated with the amount and type of used nuclear fuel to be managed. The NWMO reviewed with the Council the steps in the approval process, and how it continues to work with relevant provincial and federal government agencies on the details of the regulatory approvals and licensing requirements.

The NWMO reviewed its transparency policy during 2014 to 2016. The Council provided suggestions for clarification that were incorporated in the update before posting on the NWMO website in December 2016 [11].

[11] www.nwmo.ca/policies

The Council discussed the Centre of Expertise planned for the eventual repository site and the potential scope of its activities. The NWMO confirmed that the centre will support technical demonstration and site characterization work; will be a hub for visits by local residents, as well as interested people from across Canada and other countries; and will be designed with guidance from the local community.

In the Council's 2013 Triennial Report, we recommended that the NWMO undertake a systematic review of the lessons learned from experience with the OPG project for a deep geologic repository for low- and intermediate-level waste. The NWMO provides regular updates on the OPG project to the Council, providing an opportunity to discuss lessons learned with the Council and consider their implications for the APM Project for high-level waste.

2.2.8 Regulatory Framework

Implementing Adaptive Phased Management 2017 to 2021 includes a section on Regulatory Oversight of Adaptive Phased Management. APM is a complex process that will require regulatory approval from the Canadian Nuclear Safety Commission, Transport Canada, various provincial agencies, and municipalities.

The Council observed that experience with the OPG project for low- and intermediate-level waste demonstrates some of the uncertainties associated with the regulatory framework for APM. The recent decision to require evaluation of alternative sites is a key example. Another issue is that the *Canadian Environmental Assessment Act* (*CEAA*), 2012, is currently under review, and a new *CEAA* is expected in 2018. The Council emphasized the importance of a robust regulatory framework to help address political and public pressures on the APM process. We noted that the Order in Council received by the NWMO in 2007 selected the NWMO's recommendation of APM. The NWMO's recommendation of APM was based on considerable analysis and planning that should be recognized as a contribution to the regulatory process.

The Council noted that the NWMO's work is currently focused on Ontario, where the deep geological repository will be located. When the NWMO begins to engage in more specific discussions with Quebec, New Brunswick and Manitoba regarding the transportation of their used nuclear fuel, it will also need to address the regulatory requirements of those provinces.

3. Implementing Adaptive Phased Management 2017 to 2021

In this section of our report, we review the August 2016 draft of the NWMO's five-year implementation plan, *Implementing Adaptive Phased Management 2017 to 2021*, and provide comments and recommendations for future work. The plan is available in chapter 10 (*Implementing Adaptive Phased Management 2017 to 2021*) of this Triennial Report. The NWMO's plan is structured around the organization's eight strategic objectives. We discussed the following topics for specific focus in this section:

1. Ethical and Social Framework
2. Multi-Generational Engagement
3. Indigenous Engagement
4. Environment
5. Safety and Feasibility
6. Independent Program Review
7. Transportation
8. Partnership
9. Knowledge Management

3.1 Ethical and Social Framework

The NWMO states that in the period 2017 to 2021, in order to continue to adapt plans, it will "continue to implement the Ethical and Social Framework and refine as appropriate." The Council agrees that this is a very important aspect of the organization's work. In section 2.2.1 of this report, we note that the NWMO commissioned a review of the Ethical and Social Framework in 2014. The review concluded that the NWMO is taking its ethical responsibilities very seriously and made some suggestions to strengthen the organization's work in that regard. The Council agrees with that assessment, and we continue to believe that the NWMO should update the Ethical and Social Framework to increase its relevance to the current site selection phase of the APM process.

The Council would also like to see the NWMO refer to the Ethical and Social Framework more consistently and explicitly demonstrate how it is being used. In the spirit of APM, it would be worthwhile to undertake a regular review of how the NWMO has applied the Ethical and Social Framework in its work and make the findings publicly available. We also suggest that the NWMO consider the suggestion from the review to provide support to communities to help them understand the Ethical and Social Framework and how it can be put into practice during the site selection process. In addition, as the NWMO works more closely with First Nation and Métis communities, it should seek to understand and apply the ethical and social values that are embodied in their cultures.

The Advisory Council recommends that the NWMO make the application of the Ethical and Social Framework more explicit in all its implementation plans and triennial reports.

The Advisory Council recommends that the NWMO consider providing support to communities to learn about the Ethical and Social Framework, strengthen it and explore how it can be put into practice during the site selection process.

The Advisory Council recommends that the NWMO seek to understand and apply the ethical and social values that are embodied in the First Nation and Métis communities in the siting study areas.

The Advisory Council recommends that the NWMO, in consultation with the Council, conduct a review of the application of the Ethical and Social Framework every three years, as part of the triennial report process. Based on the outcome of these reviews, the NWMO should refine the Ethical and Social Framework if necessary to reflect the needs of each stage of the organization's work.

3.2 Multi-Generational Engagement

In the NWMO's plans for building sustainable relationships, the organization recognizes that "engagement of 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." In the period 2017 to 2021, the organization intends to "increase youth awareness and understanding of the project and capacity for future decision-making as required by APM." The Council emphasizes the importance of this work, given the multi-generational nature of the APM Project, spanning not only seven generations into the future, but many more. We suggest that it would be worthwhile for the NWMO to undertake periodic evaluation of progress towards the desired outcomes of its youth engagement work.

The Advisory Council recommends that the NWMO develop an evaluation system for its youth engagement program, based on desired outcomes and measurable goals.

3.3 Indigenous Engagement

In the period 2017 to 2021, the NWMO indicates that it will continue to deepen and strengthen its relationships with First Nation and Métis communities and organizations. We note that the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and the Truth and Reconciliation Commission of Canada (TRC) create an important and evolving context for the NWMO's work and need to be taken into account. We believe that the NWMO's work with Indigenous communities is exemplary and represents an excellent illustration of the "adaptive" aspect of APM. It is noteworthy that the NWMO is working with Indigenous communities to develop new practices, in advance of government direction on these matters.

During the past three years, the NWMO has developed several programs that are carefully tailored to the needs and interests of Indigenous communities. Examples include the program to acknowledge early Aboriginal participation in the APM Project, and the Aboriginal Partnerships Resources Program. We encourage the organization to ensure that engagement initiatives with Indigenous communities continue to be developed in consultation with those communities and with sufficient time and resources to ensure a full and mutual exchange of knowledge and ideas.

3.4 Environment

The NWMO's website emphasizes that "our priority is protecting people and the environment," and one of the NWMO's objectives for the long-term management of used nuclear fuel is "to ensure that environmental integrity is maintained over the long term." To achieve this objective, the NWMO states that it "is committed to meeting or exceeding all applicable regulatory standards and requirements for protecting the health, safety, and security of people and the environment." The NWMO developed an Environment Policy in 2014 that provides guidance for the NWMO to continually improve its environmental performance.

The Council believes that although these statements provide a sound framework for the NWMO to meet its environmental obligations, the organization would do well to adopt a much broader perspective on environmental sustainability in the form of a Statement of Corporate Environmental Responsibility. This would include (1) the way that the NWMO conducts itself as an organization (e.g., office management and policies for events and travel), and (2) planning for environmentally sustainable approaches to developing and operating the deep geological repository and the transportation system. The statement might include such topics as carbon footprint, biodiversity conservation, recycling, waste and water management, renewable energy, resource conservation, greener supply chains, and Leadership in Energy and Environmental Design.

The NWMO is demonstrating leadership and innovation in its social well-being, corporate social responsibility, and engagement work, well beyond any legislated requirements. The Council thinks the organization should pay similar level of attention to the environment. The NWMO should strive to rank among the best corporations in the world in adopting a comprehensive approach to environmental sustainability in all aspects of its work. This will be expected by environmental non-governmental organizations, and should be part of the NWMO's efforts to build trust and confidence. It should be seen as a commitment that flows logically from a multi-generational perspective, as required by the Ethical and Social Framework.

The NWMO's commitments to First Nation and Métis communities and organizations will also require a broad and long-term understanding and respect for the land and Mother Earth.

The Advisory Council recommends that the NWMO undertake a scan of best practices for environmental sustainability in related industries (e.g., nuclear projects and waste management in other countries; other types of energy projects; and mining, pipelines and large-scale industrial projects in small and/or remote communities).

The Advisory Council recommends that the NWMO develop a Statement of Corporate Environmental Responsibility.

3.5 Safety and Feasibility

The NWMO continues to work towards demonstrating the safety and feasibility of repository and engineered-barrier design. Here we provide several observations and recommendations for this work.

3.5.1 Testing Program

Over the next five years, the NWMO will test physical prototypes of the long-lived repository containers for used nuclear fuel. The organization will also continue to conduct testing of used fuel transportation containers. We believe that this is a topic that requires frequent communication with the public and stakeholders to ensure transparency and confidence in the work, and we note that the NWMO states that it will prepare communications in plain language to explain and report on this work.

3.5.2 Learn More Program

In our Triennial Report in 2013, we recommended that additional specialists in radiation protection such as a health physicist and a medical doctor specializing in nuclear medicine should be involved in the *Learn More Program* to provide increased information about the health implications of the transportation and management of used nuclear fuel. The NWMO has not fully acted on this recommendation, but the Council notes that it contracted third parties to conduct studies such as *Assessing Radiological Dose to Members of the Public and Workers during UFTP Transportation*. In addition, some community liaison committees have taken action to include members from health disciplines and people with experience in nuclear and related areas, where available. The Council still believes it is important to ensure that potential host communities are well-informed about the health effects of radiation in the environment.

The Advisory Council recommends that the NWMO increase its efforts to ensure that potential host communities are provided with reliable information regarding the effects of low doses of radiation on human health.

3.5.3 Safety Assessments

In the period 2017 to 2021, the NWMO plans to "maintain and improve safety assessment models, including groundwater flow, containment release and transport, and coupled thermal-hydraulic-mechanical processes." This work, particularly the investigation of how groundwater moves in deep geological environments and how groundwater may interact with nuclear waste containers, is critically important to the public and should be communicated accordingly.

The Advisory Council recommends that the NWMO develop a plain language communication package regarding groundwater flow and interactions with nuclear waste containers in deep geological settings.

3.5.4 Participatory Safety Analyses

The Seaborn Panel report included the following key conclusion concerning safety of the nuclear fuel waste disposal concept that had been developed by the Atomic Energy of Canada Limited (AECL): "From a technical perspective, safety of the AECL concept has on balance been adequately demonstrated for a conceptual stage of development, but from a social perspective, it has not" (Executive Summary, page 2). The Panel also defined seven elements that it considered necessary parts of safety. One of these was that in order to be considered safe, a concept for managing nuclear fuel wastes must be judged, on balance, to "be based on thorough and participatory scenario analyses."

This element was defined in more detail in chapter 6 of the Seaborn Panel report [12], leading to the following conclusion: "Open and well-publicized public participation in defining extreme events of concern, and the methods used to analyze them, will be a prerequisite for gaining broad acceptance that public safety has been thoroughly considered" (page 70).

The Council believes that the advice of the Seaborn Panel is still relevant today, and we emphasize the importance of working with the public and potential host communities to ensure that their concerns are addressed. This should include identification and analysis of potential scenarios and solutions so that technical safety and social safety are clearly linked within the APM Project.

The Advisory Council recommends that the NWMO develop a participatory approach to engage the public and potential host communities in identifying, analyzing and addressing safety concerns.

[12] The Seaborn Panel report is available at www.ceaa-acee.gc.ca/default.asp?lang=En&n=0B83BD43-1&xml=0B83BD43-93AA-4652-9929-3DD8DA4DE486&offset=1&toc=show.

3.6 Independent Program Review

The NWMO introduced a new strategic objective in 2015 to guide its work on continuously improving technical knowledge by contributing to and learning from best practices in Canada and other countries. The Council supports this objective and observes that independent reviews of this work are essential to shaping public perceptions, building trust and reinforcing the NWMO's international reputation.

For example, the APM-GRG is composed of five internationally recognized experts with experience that is relevant to the siting of deep geological repositories in both crystalline and sedimentary rock formations. The group reviews the NWMO's work to ensure that site evaluations are conducted in a consistent and traceable manner using best international practices.

Another review body, the ITRG completed its mandate in 2013. The ITRG's role was to provide oversight and advice to the NWMO Board on the adequacy and preparedness of the APM technical program to support future activities. However, as the technical program advances and becomes increasingly specialized, the NWMO has decided to arrange independent reviews of its work by assembling groups of experts on an as-needed basis. An example of such independent review was the 2016 Corrosion Peer Review, which is posted on the NWMO website [13].

The Council recognizes that the NWMO is meeting high standards for peer review for specific aspects of its work. However, we are concerned that there is no comprehensive review mechanism at present. There is a risk that the NWMO may not identify all the aspects of its work that need review and that some aspects of the NWMO's work will not receive the attention they deserve.

The Advisory Council recommends that the NWMO consider establishing additional mechanisms, including independent experts with international experience, to provide periodic, comprehensive evaluation of scientific and technical aspects of the APM Project and make the results publicly available.

3.7 Transportation

Implementing Adaptive Phased Management 2017 to 2021 (chapter 10) indicates that transportation will be an increasingly important aspect of the NWMO's work over the next five years. The plan outlines technical studies, regulatory approvals, public attitude research, best practice reviews, and communications needs associated with this work. We observe that the transportation work will take the NWMO beyond Ontario – where most of its efforts have been focused to date – to the other provinces where spent nuclear fuel has been generated (Quebec, New Brunswick and Manitoba). It will be important to re-engage Canadians across the country, as well as in these specific provinces, in discussions about perceptions and concerns, and to provide information about safety and other issues.

[13] The 2016 Corrosion Peer Review may be found at www.nwmo.ca/NWMOCopperCorrosionProgramReview.

3.8 Partnership

In *Implementing Adaptive Phased Management 2017 to 2021*, the description of Canada's plan for used nuclear fuel includes a short section, entitled *A Partnership Approach*. It states that "the 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." The Council observes that this statement reflects that the NWMO's thinking and understanding has evolved over the past three years. The willing host concept has expanded to include supportive and inclusive partnerships with multiple communities in the siting area. This reflects a deeper understanding of the complexities of each siting study area with respect to such factors as decision-making authority, economic benefits and land ownership.

In the description of the plans for *Assessing Site Suitability in 2017 to 2021*, the NWMO describes the kinds of partnerships needed for the project to proceed. It recognizes that the community that initiated the process, nearby First Nation and Métis communities, and nearby municipalities may all participate in the APM Project in various ways, depending on their roles, needs and perspectives.

The Advisory Council recommends that the NWMO explain, in its communications with the public and communities in the siting study areas, how its understanding of the willing host concept has been enhanced to include supportive and inclusive partnerships.

3.9 Knowledge Management

One of the Council's criteria for evaluating the NWMO's work addresses the culture of learning (see section 1.3). We have observed that the organization continually seeks out new information and perspectives and incorporates these learnings into its work. We also note that the long time frame, complexity and intergenerational nature of the APM Project inevitably bring about changes in corporate structure, management systems and personnel. We believe it would be worthwhile to investigate ways to ensure that knowledge is well-managed and made accessible to personnel engaged in different aspects of the project throughout successive phases of work.

The Advisory Council recommends that the NWMO review best practices in related industries and consider developing its own knowledge management system.

4. Reflections on Consent and Partnership

In this section, we provide our reflections on the APM Project being undertaken by the NWMO, in conjunction with a review of international experiences and lessons learned from other countries. These reflections lead to some conclusions about the relationship between consent and partnership, and our affirmation that the APM Project is being designed and implemented as a socio-technical endeavour that includes careful attention to both social acceptability and technical feasibility.

4.1 Adaptive Phased Management (APM) in Canada

Implementing Adaptive Phased Management 2017 to 2021 signals the evolution of the NWMO's thinking and understanding that APM will require multiple partnerships with various communities and organizations. This reflects the readiness and ability of the NWMO to learn from its experiences and adjust according to new understandings gained from working with interested communities and organizations in the study areas. We believe this is a good time to reflect on the development of the NWMO's engagement work to this point, and to think about how it will continue to evolve, consistent with APM.

The *NFWA*, 2002, that led to the creation of the NWMO was a response to the conclusions of the Seaborn Panel, which investigated the work undertaken by AECL to develop a solution for Canada's nuclear waste. The Panel stated that although the AECL concept demonstrated safety from a technical perspective, it was not shown to have broad public support. In particular, it cited the lack of an ethical and social framework and absence of demonstrated support from Aboriginal peoples.

These concerns were paramount in the initial phase of the NWMO's mandate to study approaches for the safe, long-term management of used nuclear fuel and to recommend a preferred approach to the Government of Canada. The Government accepted the NWMO's recommendation for APM, an approach that had emerged from a three-year dialogue with both specialists and the general public.

As described on the NWMO website, "APM is both a technical method and a management system. The end point of the technical method is the centralized containment and isolation of Canada's used fuel in a deep geological repository in an area with suitable geology and an informed and willing host. APM also involves the development of a transportation system to move the used fuel from the facilities where it is currently stored to the new site. The management system involves realistic, manageable phases, each marked by explicit decision points. It allows for flexibility in the pace and manner of implementation, and fosters the sustained engagement of people and communities throughout its implementation. APM is also designed to meet rigorous safety standards throughout all aspects of its design and implementation."

The work undertaken by the NWMO from the inception of the APM Project has exemplified the five fundamental values embedded in APM: integrity, excellence, engagement, accountability, and transparency. Here are some selected examples from the plan, *Implementing Adaptive Phased Management 2017 to 2021*.

- The NWMO continues to invite "all Canadians and Aboriginal peoples of Canada to learn more and become involved in the management of Canada's used nuclear fuel."
- One of the milestones for the next three years of work is to "conduct this work collaboratively with the communities involved, including First Nation and Métis communities in the area, and surrounding communities in order to establish a foundation to proceed in partnership to implement the project."
- The NWMO's first strategic objective is to "build sustainable, long-term relationships with interested Canadians and Aboriginal peoples of Canada, and involve them in setting future directions for the safe, long-term management of used nuclear fuel. Continue to adapt plans for the management of used nuclear fuel in response to evolving societal expectations and values, insight from Indigenous Knowledge, and changes in public policies."
- The second strategic objective is to "implement collaboratively with communities the process to select a site suitable for locating the deep geological repository and Centre of Expertise in a safe location in an area with an informed, willing host."
- Under *A Partnership Approach*, the NWMO states that it will "work with the interested community, First Nation and Métis communities in the area, and surrounding communities to harness the economic benefits associated with the project in a manner that will directly and positively contribute to the well-being of not only the interested community, but also other communities within the surrounding area, and as much as possible, drive future growth, capabilities and expertise that will sustain the community over time."

The Council has observed the NWMO's careful and collaborative approach to the site selection process over the past decade. It started with the goal of seeking an informed and willing host community. The NWMO website states "the host community, the local geographic community in which the facility is to be located, must be informed and willing to accept the project. The local community must have an understanding of the project and how it is likely to be impacted by the project. As well, the local community must demonstrate that it is willing to accept the project."

The NWMO's approach is that communities must take the initiative to enter the process. As detailed on the NWMO's website, 22 communities initially stepped forward to learn more about APM, and 21 of them requested preliminary assessments. Based on the results of work completed to date, nine communities remain engaged in the site selection process. The NWMO is now embarking on field investigations in these areas, as well as preliminary discussions about transportation routes from the sources of used nuclear fuel to the chosen site.

We observe that as the NWMO has learned more about the communities in the siting study areas, it has become apparent that the geography of jurisdiction and land ownership is complex, involving many players that will need to participate in APM in ways that meet their economic, social and cultural needs. We also observe that as the NWMO proceeds to consult on safe, secure and socially acceptable transportation plans, it will be critical to ensure that all Canadians, especially those communities that lie within potential transportation routes, have ample opportunities to learn and provide feedback.

4.2 Lessons From International Experiences

In order to assist us in reviewing the NWMO's work, we keep abreast of nuclear waste management activities in other jurisdictions. A recent report by the US Nuclear Waste Technical Review Board (NWTRB) provided an instructive analysis of experiences around the world with processes for selecting sites for deep geological repositories [14]. The NWTRB presented a historical analysis of 24 examples in 10 countries in which implementers attempted to find a repository site. Six national programs remain on track (including Canada, but not including the United States). In Finland, France and Sweden, the implementers are moving beyond site selection by seeking or preparing to seek approval from their regulatory authorities to construct a facility.

The NWTRB report investigates the respective roles and relationships of two filters in the site selection process: the technical suitability filter and the social acceptability filter. These investigations show that passing potential sites through the social acceptability filter has proved to be a major challenge in most of the countries that have launched siting initiatives. For example, in France during the late 1980s, demonstrations shut down the waste management program. At about the same time in Sweden, public opposition to surface-based testing forced the implementer to reconstruct its siting process. In the United States, the Department of the Environment cancelled the program to find a site for a second repository because of intense public reaction. In Germany, the presumptive, but controversial, choice of Gorleben as a repository site paralyzed that country's efforts to dispose of its high-level waste and spent nuclear fuel for several decades.

Implementers have learned from their experiences. The NWTRB found that a common response is to focus on locations where there is potential for positive effects or where the influence of negative effects is low. This strategy can lead to consideration of economically underdeveloped areas, such as Carlsbad, New Mexico, or the Meuse/Haute-Marne area in eastern France. It may also lead to places that are already hosting nuclear facilities, such as West Cumbria in England, the area around the Olkiluoto reactor site in Finland, and the municipalities where the Oskarshamn and Forsmark reactor sites are located in Sweden.

Another response to the need to obtain social acceptability is to recognize the value of seeking community engagement early in the process. For example, the NWTRB notes that in Sweden, the municipalities gave permission for the implementer to carry out site-specific investigations, but retained near-absolute authority to prevent the government from issuing a licence to construct a repository. In France, communities in the Meuse/Haute-Marne area formally volunteered to host an underground research laboratory. In Canada, the NWMO issued invitations for communities to express an interest and learn more about APM. In addition, as discussed in section 3.3 of this report, the NWMO's work is characterized by a broad, respectful and informed approach to Indigenous engagement. This is being undertaken in the context of the UNDRIP, as well as a national movement towards reconciliation of First Nation and Métis peoples in response to the TRC.

The NWTRB concludes that at least two conditions must be met for a consent-based siting process to succeed. First, the process must accommodate national political norms about how power is distributed between the central government on the one hand and local/state/regional/tribal governments on the other. In Scandinavian societies, allocating strong powers to municipalities is a long-standing tradition. However in most other nations, decision-making authority is more strongly vested in the national level of government, making it challenging to create processes that incorporate local consent.

[14] The US NWTRB report *Designing a Process for Selecting a Site for a Deep-Mined, Geologic Repository for High-Level Radioactive Waste and Spent Nuclear Fuel, 2015*, is available at www.nwtrb.gov/reports/siting_report_summary.pdf.

A second requirement for successfully implementing a consent-based siting process, according to the NWTRB, relates to the behaviour of the implementer. Those responsible must be widely seen as trustworthy and committed to operating in a transparent manner. Trust can help to make an implementer's actions less contentious. For example, when tough trade-offs have to be made, how interested and affected parties interpret the implementer's conduct becomes critical. If the reservoir of trust is full, they are more likely to accept the implementer's actions, especially if the rationale for the decision is transparent.

Trust is also essential to help people accept the complex technical arguments inherent in the siting process. As the NWTRB observes, such arguments may be open to differing, even incompatible, interpretations that can be difficult to resolve. If the implementer has demonstrated its trustworthiness, those parties are more likely to accept its assessment.

The NWTRB also makes some interesting observations about the relationships between the technical suitability and social acceptability filters. For example:

1. Sites for which technical suitability can be demonstrated by relatively simple analyses may face fewer challenges passing through the social acceptability filter.
2. The order in which a site passes through the technical and social filters may reflect a judgment about which poses the greatest challenge and runs the greatest risk of failure.
3. The content and wording of site suitability criteria can influence public perception of the trustworthiness of the implementer.
4. Public attitudes towards nuclear power can profoundly affect the siting process in some countries.
5. Informed consent of a community to host a deep geological repository requires extensive underground site characterization.

These international experiences illustrate that the road to consent for nuclear waste management is a rocky one that can be easily diverted or blocked. We believe that the adaptive approach taken by the NWMO – combining safety and technical excellence with a strong Ethical and Social Framework – provides a strong foundation to avoid the types of hazards and risks illustrated by the examples above.

4.3 Conclusions

In conclusion, we observe that the NWMO's success to date is based in large measure on adherence to its five fundamental values: integrity, excellence, engagement, accountability, and transparency. This has ensured an inclusive, patient and thorough approach to the organization's research and engagement activities. Feedback from the public and communities has been used by the NWMO to continually adapt both itself as an organization and its plans for the various aspects of its work. The process began with a collaborative approach to finding an informed and willing host community. It has evolved to incorporate an understanding that consent must be complemented by participation in meaningful and mutually beneficial partnerships.

The NWMO has a strong track record of addressing both the technical and social aspects of APM, laying the groundwork for building productive and trusting partnerships with host communities over the long term. In order for the NWMO to implement the APM Project successfully, the ideals of informed willing consent, partnership, trust, and transparency, and the use of an ethical framework to guide decision-making will continue to be paramount.

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