

**nwmo**

NUCLEAR WASTE  
MANAGEMENT  
ORGANIZATION

SOCIÉTÉ DE GESTION  
DES DÉCHETS  
NUCLÉAIRES

# Implementing Adaptive Phased Management 2014 to 2018

MARCH 2014



## *Correction*

On page 12, the fifth sentence of the first paragraph should read: "Based on current inventory projections, the underground repository requires a subsurface area in suitable host rock of about 2 kilometres by 3 kilometres."



# The NWMO is guided by five fundamental values:

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### » 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, Canada's plan for the safe, long-term care of used nuclear fuel. Adaptive Phased Management involves the development of a large infrastructure project that will include a deep geological repository and a 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 our 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 we receive through our engagement initiatives.

*Implementing Adaptive Phased Management 2014 to 2018* was released in draft for public review between September and December 2013. 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 available for review at [www.nwmo.ca](http://www.nwmo.ca).

The NWMO welcomes all suggestions and ideas about our work and how we can help you learn more about Adaptive Phased Management.

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# Executive Summary

The Nuclear Waste Management Organization (NWMO) is responsible for the long-term care of Canada's used nuclear fuel. *Implementing Adaptive Phased Management 2014 to 2018* describes our five-year work program.

Adaptive Phased Management, Canada's long-term plan for used nuclear fuel, is a management system and a 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, provincial and international regulatory standards and requirements for protecting the health, safety and security of humans and the environment.

The focus of the 2014 to 2018 period will be on siting and working with potentially interested communities as they move through the many steps of the siting process. For communities that move forward in the process, the NWMO will be ready to implement activities such as learning more, site evaluation and engagement. Twenty communities have successfully passed an initial screening and elected to advance to preliminary assessments (Step 3, Phase 1) of the site selection process. A narrowing down process has since taken place based on findings from the first phase of preliminary assessments. Currently, 15 communities continue to explore their interest in hosting Adaptive Phased Management, and Aboriginal peoples and communities in the surrounding area are progressively being engaged in learning and decision-making. We expect that the site selection process will advance over the five-year period such that the NWMO will have completed preliminary assessments to support identification of one or possibly two areas to proceed to site characterization (Step 4). The NWMO will continue to refine conceptual designs and postclosure safety assessments for a repository in both crystalline and sedimentary rock formations, and submit these to the Canadian Nuclear Safety Commission for a pre-project

review. 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.

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

- » Completing desktop preliminary assessments for communities that have passed an initial screening and elect to proceed in the site selection process;
- » Engaging the surrounding communities and Aboriginal peoples in learning and consideration of the project;
- » Based on the results of this work, identifying the communities with strong potential to be suitable for the project to progress with the next phase of work involving preliminary field studies and engagement of Aboriginal peoples and surrounding communities in order to establish a foundation to proceed to implement the project together;
- » Conducting this work collaboratively with the communities involved;
- » Completing preliminary field studies and assessments to support identification of one or two communities to progress to the detailed site characterization phase of work;
- » Designing and manufacturing physical prototypes of the used nuclear fuel container;
- » Establishing a container, engineering, and test facility for both the repository and transportation containers;
- » Completing an integrated review of microbiological processes that could occur within the repository environment;
- » Working with waste owners in planning for future transport of used nuclear fuel from the interim storage facilities where it is currently stored; and
- » Completing an update to the conceptual design and cost estimate for Adaptive Phased Management.

The plan for the next five years is organized along seven strategic objectives outlined in the following pages. This 2014 to 2018 strategic plan is a 'living' document that is regularly assessed, strengthened and redirected in the face of new information, advances in science and technology, insight from Aboriginal Traditional Knowledge, changes in societal values, and evolving public policy. Adaptive Phased Management will only proceed as quickly as Canadians, successful technology development and demonstration, and the regulatory authorities allow.

**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

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.
- » Implement collaboratively with Canadians the process for siting a deep geological repository for the safe, long-term management of used nuclear fuel in an informed, willing host community.
- » Refine and further develop the generic designs and safety cases for a repository for used nuclear fuel in both crystalline and sedimentary rock formations, and conduct technical research and development to ensure continuous improvement, consistent with best practices.
- » Ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.
- » Adapt plans for the management of used nuclear fuel in response to new knowledge, international best practices, advances in technical learning, insight from Aboriginal Traditional Knowledge, evolving societal expectations and values, and changes in public policies.
- » Maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.
- » Build and sustain an effective organization with the social, environmental, technical and financial capabilities for the safe, long-term management of Canada's used nuclear fuel.

# 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 are outlined below.

## **Building Sustainable Relationships**

The NWMO continued to engage with the many groups involved in the long-term management of Canada's used nuclear fuel at this early phase of work. 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 to incorporate Aboriginal Traditional Knowledge in the NWMO's work.
- » Continued to strengthen relationships with federal and provincial governments and to brief elected representatives about the project and the site selection process.
- » Supported initiatives designed to increase youth interest and participation in science, including Youth Science Canada, Shad Valley, the Science North School Outreach Program, and Scientists in School.
- » 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.

## **Collaboratively Implementing the Site Selection Process**

Working with communities, the NWMO continued to advance the site selection process. The NWMO:

- » Continued to support the formation of community liaison committees by Step 3 communities to facilitate learning in each community and to provide guidance in such areas as preliminary assessments and engagement with neighbouring communities.
- » Completed Phase 1 preliminary assessments (Step 3) in eight communities, four of which were identified for further study.
- » Continued to provide resources to communities to support reflection on their interest in the project and to facilitate dialogue and learning in the community about the project.
- » Continued to support community learning through facilitating visits to facilities where used nuclear fuel is currently stored on an interim basis, meetings and resources to contract independent expert advice.

**Optimizing Repository Designs and Further Increasing Confidence in Safety**

The NWMO's technical program continued research and development in the key areas of repository engineering, geoscience and repository safety. Research and development work is ongoing regarding the transportation of used nuclear fuel. The NWMO:

- » Maintained and advanced geoscientific research specific to the long-term behaviour and evolution of deep-seated, low-permeability groundwater systems in crystalline and sedimentary bedrock settings.
- » Worked collaboratively with Switzerland's nuclear waste management organization (Nagra) to develop copper coatings for repository containers using Canadian technologies developed by the National Research Council, the University of Ottawa, the University of Windsor, and the University of Toronto.
- » Prepared conceptual designs for the handling, transfer, loading, and sealing of used nuclear fuel containers.
- » Continued to collaborate with other nuclear waste management organizations in repository-related research activities at underground rock laboratories in sedimentary and crystalline rock formations.
- » Completed an illustrative postclosure safety assessment; the NWMO has now completed one in crystalline rock, the other in sedimentary rock.
- » Conducted analyses specific to the safe and secure transportation of used nuclear fuel, including work that resulted in a significant improvement in the neutron shielding performance of a conceptual used nuclear fuel transportation package.
- » Acquired the used nuclear fuel transportation package and upgraded the Canadian Nuclear Safety Commission licence for that package to current standards. A mobile transportation exhibit was developed and was taken to a number of events in communities involved in the site selection process and at a number of municipal conferences.

**Providing Financial Surety**

The NWMO, in compliance with the *Nuclear Fuel Waste Act*, continued to monitor the segregated funds whose sole purpose is to fund the implementation of the Deep Geological Repository and Centre of Expertise once a construction licence has been granted by the Canadian Nuclear Safety Commission, many years in the future. This included updating trust fund contributions to reflect the latest lifecycle cost estimates and trust fund balances.



### Adapting Plans

The NWMO engaged in continuous learning so as to be able to adapt its plans in response to new knowledge, international best practices, advances in technical learning, evolving societal expectations and values, changes in public policies and insight from Aboriginal Traditional Knowledge. The NWMO continued to work with specialists across Canada, as well as internationally. The NWMO:

- » Continued to solicit public input, including review of the NWMO's strategic objectives and implementation plan, so that evolving societal expectations are reflected in Adaptive Phased Management.
- » Continued to monitor any developments in reprocessing used nuclear fuel and report findings to the public on an annual basis.
- » Continued to partner with universities and other nuclear waste management organizations to keep abreast of the latest advances in the field.

### Ensuring 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 the organization's work through an Independent Technical Review Group, Advisory Council, and a forum of Aboriginal Elders.
- » Continued to update the Canadian Nuclear Safety Commission (CNSC) and seek feedback as part of the organization's agreement to obtain CNSC review of illustrative safety assessments for a used nuclear fuel repository in both crystalline and sedimentary rock formations.
- » Continued to report annually to the Minister of Natural Resources Canada, as required by the *Nuclear Fuel Waste Act*.

### Building and Sustaining a High-Performing Organization

The NWMO continued to enhance its staffing and contractor capability through a variety of initiatives, including research partnerships with universities, staff training and development, and investment in business systems and processes. The NWMO:

- » Supported the site selection process by continuing to recruit specialists in such areas as repository design and construction, environmental assessment, Aboriginal Traditional Knowledge, social research, ethics, finance, communications, and public engagement.
- » Opened community offices in Step 3 communities.
- » Continued to promote knowledge transfer to future generations by encouraging youth involvement in science and by providing financial support to graduate students through the Natural Sciences and Engineering Research Council's Industrial Postgraduate Scholarships Program.

# 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 NB Power<sup>1</sup>. 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<sup>2</sup>.

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 the NWMO’s recommendation to the Government of Canada are available on the NWMO website at [www.nwmo.ca](http://www.nwmo.ca).

In 2007, the Government of Canada, based on the NWMO’s recommendations, selected Adaptive Phased Management 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 Adaptive Phased Management will be regulated by the Canadian Nuclear Safety Commission (CNSC) under the *Nuclear Safety and Control Act* and its associated regulations.

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. In 2011, 2012 and 2013, many of the NWMO’s activities focused on working with communities that chose to become involved in the site selection process through the early steps of learning more about Adaptive Phased Management, the site selection process and the project.

The NWMO continues to build a multidisciplinary team with a range of experience in the fields of social research, technical research and development, public engagement, communications, finance and governance. We continue to collaborate with an extensive network of consultants, practitioners and academics from across Canada and around the world to ensure that our work benefits from the best available knowledge.

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 for construction of a proposed deep geologic repository (DGR) for the long-term management of low- and intermediate-level waste (L&ILW) from OPG-owned or -operated reactors. The NWMO has provided expertise in repository design and implementation to OPG’s project.

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<sup>1</sup> In 2004, through a transfer order, the Government of New Brunswick assigned responsibility for all aspects of the provincially owned nuclear generating assets to a new subsidiary corporation, NB Power Nuclear.

<sup>2</sup> 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. See glossary for more information about low and intermediate level waste.

# Regulatory Oversight of Adaptive Phased Management

All aspects of the NWMO's work will meet or exceed all applicable regulatory standards and requirements for protecting the health, safety and security of humans and the environment.

Implementation of a deep geological repository under Adaptive Phased Management 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.

Under section 26 of the *NSCA*, activities associated with a nuclear facility, such as preparing a site, construction, operation or decommissioning, can occur only in accordance with a licence issued by the CNSC. The Adaptive Phased Management repository will be subject to the CNSC's comprehensive licensing process, which covers the entire life cycle of the repository. This stepwise approach will require a licence for each phase of the repository life cycle. A licensing decision by the CNSC on a repository can be taken only after the successful completion of the environmental assessment process.

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

Although the CNSC is the main licensing authority, the CNSC 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.

Although Canada's constitutional division of powers confers the authority to regulate nuclear energy to the federal government, it does not exclude provincial and territorial authority to regulate related matters within their domain. All aspects of the NWMO's work will comply with all applicable provincial regulatory requirements. For example, some aspects of siting or construction of the project and the transportation of used nuclear fuel may be governed by provincial legislation:

- » Most provinces and territories include nuclear substances in legislation and regulations addressing the transportation of dangerous goods within that province or territory.
- » Provincial governments are responsible for protecting public health and safety, property and the environment within their borders, which often includes provincial emergency preparedness legislation.
- » Provincial governments are responsible for the regulation of resource exploration and/or extraction (e.g., drilling and underground mining) and Crown land management (e.g., disposition of provincial lands).
- » Provincial legislation requiring the assessment of potential environmental effects of an activity, plan or program may apply to some aspects of this work. Legislation governing endangered species, environmental protection, heritage protection or preservation, water resources protection, occupational health and safety, employment standards or labour relations may be relevant.
- » Various permits, licences and approvals will be required, and provincial policies and guidelines may be applicable at the site selection stage.
- » Municipalities, which derive their authority from provincial legislation, may have requirements such as permits, codes, standards and/or bylaws that also need to be addressed.

# 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. 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. Adaptive Phased Management 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*). The facility is to be sited in an informed, willing host community. 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.

Adaptive Phased Management 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 community
- » Opportunities for people and communities to be involved throughout the implementation process
- » Provision of optional temporary shallow storage at the central site, if needed<sup>3</sup>
- » 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 or take advantage of new technologies
- » Financial surety and long-term program funding to ensure the necessary money will be available for the long-term care of used nuclear fuel

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<sup>3</sup> 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.

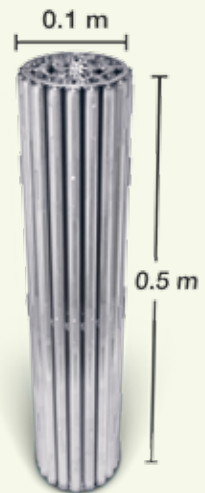
## Used Nuclear Fuel

Used nuclear fuel is a by-product of the generation of electricity by nuclear power plants. 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, and at Atomic Energy of Canada Limited's nuclear research sites in Whiteshell, Manitoba, and Chalk River Laboratories in Ontario.

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 containers have a minimum design life of 50 years. Although its radioactivity decreases with time, chemical toxicity persists and the used nuclear fuel will remain a potential health risk for many hundreds of thousands of years. For this reason, used nuclear fuel requires careful management.

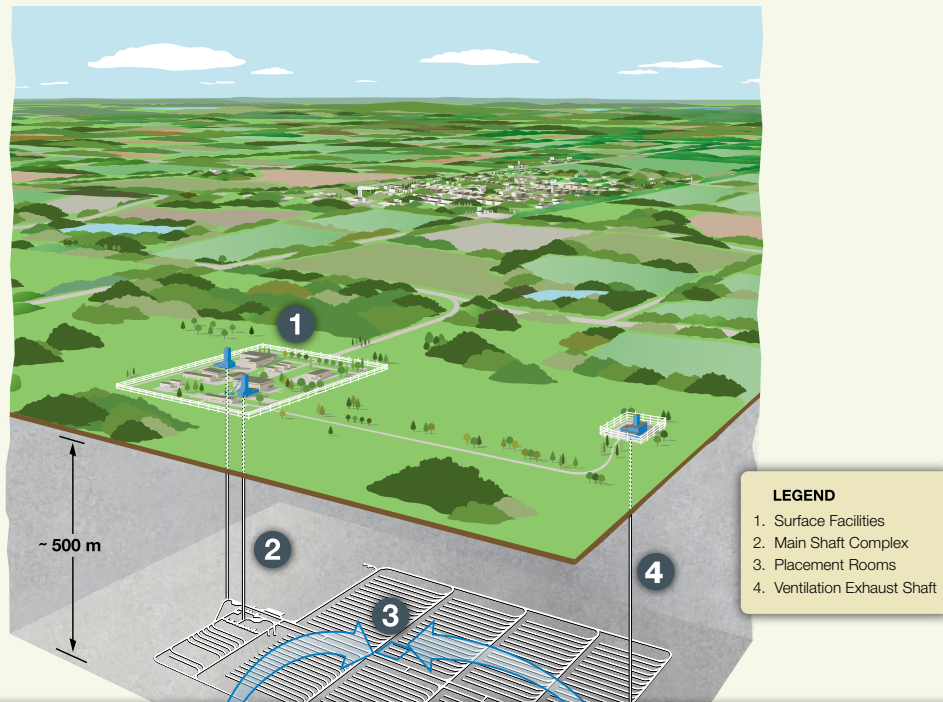
About 85,000 used nuclear fuel bundles are generated in Canada each year. Over 40 years, Canada's nuclear power program has produced over two million used nuclear fuel bundles. A small amount of used nuclear fuel, and components, is also created at research and development facilities operated by Atomic Energy of Canada Limited, 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 six 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 is available on the NWMO website at [www.nwmo.ca/technicalresearch](http://www.nwmo.ca/technicalresearch).

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.

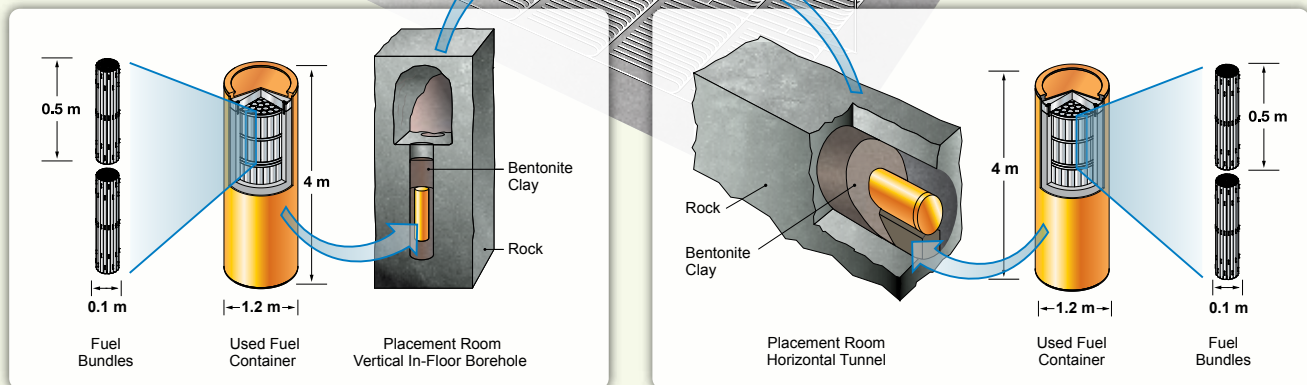


# The Project

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.



- LEGEND**
- 1. Surface Facilities
  - 2. Main Shaft Complex
  - 3. Placement Rooms
  - 4. Ventilation Exhaust Shaft



The containers will be placed in vertical boreholes drilled in the floor along the axis of a placement room, or placed horizontally within the confines of a placement room, depending on the nature of the rock and characteristics of the site.

## 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 (see diagram). The surface facilities require a dedicated surface area of about 600 metres by 550 metres for the main buildings and about 100 metres by 100 metres for the ventilation exhaust shaft. Land above the underground footprint that is not required for the surface facilities or to meet regulatory requirements could be available for other uses. Based on current inventory projections, the underground repository requires a subsurface area in suitable host rock of about 2 kilometres by 1 kilometre (375 hectares/930 acres). As well, regulatory or other requirements may limit activities in the immediate area surrounding the surface facilities.

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. Storage of this rock during operation of the facility is expected to require an area of about 700 metres by 700 metres, with a height between 3 metres and 6 metres. The area will include a storm water runoff pond, to collect and manage surface water. The excavated rock management facility is assumed to be located off-site. The location of the excavated rock would be selected in consultation with the community and surrounding region.

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. The containers will be placed in vertical or horizontal boreholes drilled into the rock and sealed with an effective sealing material such as bentonite clay.

The used nuclear fuel will be monitored and retrievable throughout all phases of implementation consistent with the direction from Canadians. Once the host community and the NWMO decide to close the site, the NWMO will backfill and seal the access tunnels, and seek the appropriate regulatory approvals prior to decommissioning. Following successful decommissioning, the NWMO will seek appropriate regulatory approvals for postclosure monitoring.

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 community.

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

For a fuller description of the project, please see *Description of Canada's Repository for Used Nuclear Fuel and Centre of Expertise* at [www.nwmo.ca/brochures](http://www.nwmo.ca/brochures).

## Transportation of Used Nuclear Fuel

Used nuclear fuel is currently safely stored in facilities licensed by the CNSC at 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. Depending on the location of the site, this may involve road, rail, or water transport, or a combination of the three. 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 Canadian Nuclear Safety Commission (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/brochures](http://www.nwmo.ca/brochures).

## Centre of Expertise

A centre of expertise will be established for the one or more communities in which a site has been selected for detailed evaluation (Step 4 of the site selection process). The centre will be located in or near the community, as determined with the community. 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, involving scientists and other experts in a wide variety of disciplines, including geoscience, engineering, and environmental, socioeconomic and cultural impact assessment.

The design details of the centre of expertise would be developed with the community, affected Aboriginal peoples 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 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.

Should the site ultimately be selected to host the deep geological repository, the centre of expertise would be expanded to include and support the construction and operation of an underground facility designed to confirm the characteristics of the site. The centre of expertise would become a hub for knowledge sharing across Canada and internationally.

## A Partnership Approach

The deep geological repository and centre of expertise will have a significant impact on any community and region 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. The used nuclear fuel will be placed in the facility over a period of three decades or more, and then monitored for an extended period of time prior to decommissioning.

The project will provide significant economic benefits. It offers direct employment for hundreds of people at the facility for many decades and many more indirect jobs in the host area and host province, with the opportunity to develop transferable skills and capacities. Implementation of the project will involve scientists, engineers, tradespeople and many others. The project may contribute to social and economic pressures that will need to be carefully managed to ensure the long-term health and sustainability of the community. For example, the potential influx of temporary construction workers may increase demand for social and physical infrastructure. To minimize social costs and help communities adapt to the opportunities and challenges of the project, the need for assistance, such as job training, affordable housing and infrastructure, would be examined.

Project implementation will require a long-term partnership among the community, Aboriginal peoples and surrounding communities, and the NWMO to ensure the project fosters well-being and sustainability of the area, consistent with its vision for the future. The project will only proceed with the involvement of the interested community, potentially affected First Nations and Métis peoples, and other communities in the surrounding area working in partnership to implement the project.



# Planning Priorities for 2014 to 2018

To guide implementation of Adaptive Phased Management, the NWMO established seven strategic objectives. The objectives identify program areas in the implementation of Adaptive Phased Management and the planning priorities for 2014 to 2018.

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 Adaptive Phased Management, 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 Adaptive Phased Management, to confirm support for the strategic direction and to invite suggestions on the associated work programs. The strategic objectives also provide the framework for the annual planning and reporting on our activities. The seven strategic objectives are briefly outlined in the table that follows.

In May 2010, the NWMO initiated a multi-year process for selecting an informed, willing community to host a national facility for the long-term care of used nuclear fuel.

Over the period 2014 to 2018, the NWMO will continue to implement the process to decide where to contain and isolate Canada's used nuclear fuel for the long term.

The site selection 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](http://www.nwmo.ca). The process is the product of a two-year dialogue with Canadians and is designed to guide the selection of an informed, willing host community.

The nine-step site selection process spans from communities learning about the project to construction and operation. The process is designed to be driven by the interest of communities, the progressively more detailed conduct of scientific and technical studies, and the involvement of surrounding communities and Aboriginal peoples. In the planning period, the NWMO will

## Strategic Objectives 2014–2018

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.
- » Implement collaboratively with Canadians the process for siting a deep geological repository for the safe, long-term management of used nuclear fuel in an informed, willing host community.
- » Refine and further develop the generic designs and safety cases for a repository for used nuclear fuel in both crystalline and sedimentary rock formations, and conduct technical research and development to ensure continuous improvement, consistent with best practices.
- » Ensure funds are available to pay for the safe, long-term management of Canada's used nuclear fuel.
- » Adapt plans for the management of used nuclear fuel in response to new knowledge, international best practices, advances in technical learning, insight from Aboriginal Traditional Knowledge, evolving societal expectations and values, and changes in public policies.
- » Maintain an accountable governance structure that provides confidence to the Canadian public in the conduct of the NWMO's work.
- » Build and sustain an effective organization with the social, environmental, technical and financial capabilities for the safe, long-term management of Canada's used nuclear fuel.

support communities and Aboriginal peoples in learning about the project and how long-term well-being or quality of life of the area might be fostered through participation in the project.

The NWMO is committed to reviewing and refining the process with Canadians, and in particular the communities involved in the site selection process, to ensure that it continues to meet needs and expectations. The NWMO is committed to stepwise decision-making and will only proceed to the next step after careful consideration and with the support of communities participating in the process.

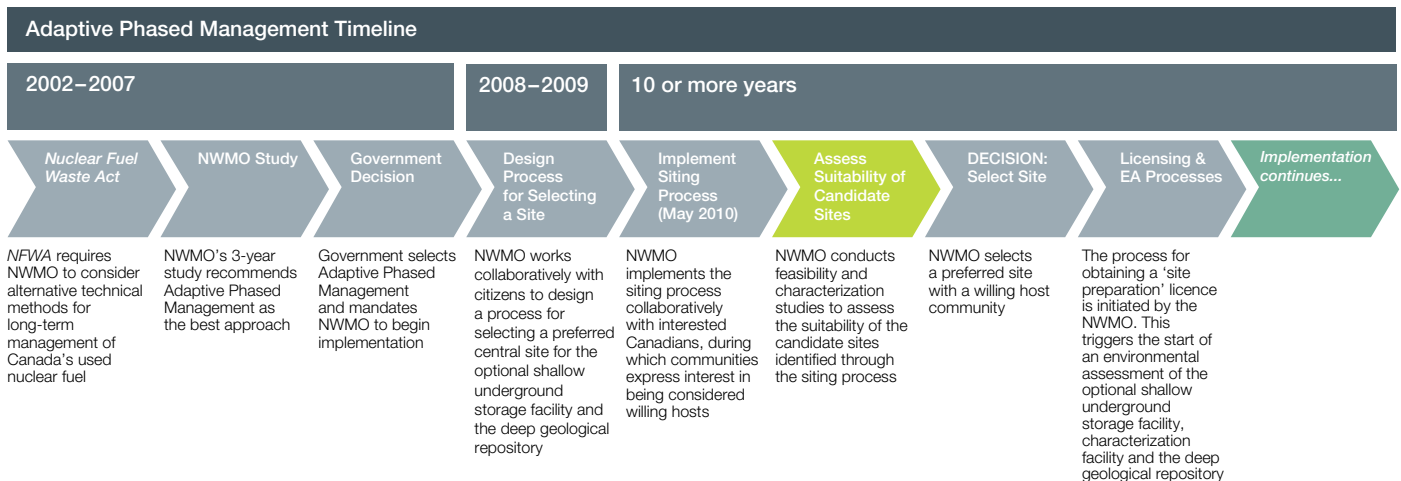
The NWMO will continue to build the organization to strengthen internal resources and capabilities, and support technical and social research programs to ensure continuous improvement and adaptation to new knowledge and best practices. The NWMO will continue to engage Canadians in these activities.

To ensure resources are available when required to manage requests for information and knowledge building, the NWMO has identified a number of milestones for the next five-year planning period.

These milestones include:

- » Completing desktop preliminary assessments for communities that have passed an initial screening and elect to proceed in the site selection process;
- » Engaging the surrounding communities and Aboriginal peoples in learning and consideration of the project;
- » Based on the results of this work, identifying the communities with strong potential to be suitable for the project to progress with the next phase of work involving preliminary field studies and engagement of surrounding communities and Aboriginal peoples in order to establish a foundation to proceed to implement the project together;
- » Conducting this work collaboratively with the communities involved; and
- » Based on the findings from preliminary field studies and assessments, identifying preferred site(s) to be the focus of the detailed site characterization phase of work.

Site selection for the Adaptive Phased Management Project is, by design, a community-driven process in which potentially interested communities decide to engage with the NWMO to learn more and explore their potential suitability to host the project. Progress through the site selection process will necessarily evolve on timelines shaped by communities rather than schedules prescribed by the NWMO. For planning purposes, the organization has set out activities for the next five years to ensure that the NWMO is in a state of readiness to advance program implementation as communities move forward through different phases of the site selection process. A breadth of work programs and activities are planned for 2014 to 2018 to ensure the organization is prepared for future phases of field investigations and detailed assessments, transportation planning, and refined repository design and safety case development.



## » Build Sustainable Relationships

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### **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.**

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 and will seek and respond to a diversity of views and perspectives. Interweaving of Aboriginal worldviews and knowledge systems with Adaptive Phased Management will strengthen the long-term management of used nuclear fuel. Our commitment to engagement and shared decision-making helps ensure that Adaptive Phased Management continues to respond to the values and concerns of Canadians. Building awareness and confidence in Adaptive Phased Management, and the NWMO as implementer, will continue throughout the planning period.

During the period 2014 to 2018, 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 together with affected Aboriginal peoples as holders of Traditional Knowledge, users of environmental resources and environmental stewards, to be active participants in the site selection process and to

share that knowledge with the NWMO 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 engagement, provision of information and dialogue.

Over the past several years, much of the NWMO's work has focused on developing plans, policies and processes collaboratively with Canadians to support the implementation of Adaptive Phased Management. Our engagement activities related to the broad Canadian public. As the siting phase of the implementation of Adaptive Phased Management progresses, the engagement program is evolving to focus more directly on the communities interested in hosting the project in the area, Aboriginal peoples 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 organization wishes to build long-term relationships with Aboriginal peoples that may be affected by the implementation of Adaptive Phased Management. 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 s.35 of the *Constitution Act* (1982). Understanding the nature of any impacts of the implementation of Adaptive Phased Management on Aboriginal rights, treaties and land claims and how Aboriginal peoples should be accommodated as a result of any impacts is an important component of the NWMO's work. The NWMO needs to ensure effective consultation with Aboriginal peoples and that all those affected have the opportunity for meaningful involvement. The NWMO acknowledges that the Crown has a legal duty to consult and accommodate and will support the Crown's work to meet its obligations. Through all stages of program implementation, the NWMO seeks to work with Traditional Knowledge holders to bring this important and necessary complement to the project.

## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Continue work to increase awareness among Canadians and Aboriginal peoples of Canada about Adaptive Phased Management, the site selection process and the NWMO;
- » Implement communications and media relations programs to help interested individuals and organizations understand Adaptive Phased Management;
- » Seek comment from interested individuals and organizations on the NWMO's plans and the implementation of Adaptive Phased Management;
- » Brief waste owners on plans for the implementation of Adaptive Phased Management so they may ensure their used nuclear fuel strategies are aligned with the implementation of Adaptive Phased Management;
- » Brief Canada's nuclear host communities about progress in implementing Adaptive Phased Management, including planning for eventual transportation of used nuclear fuel from their communities to the deep geological repository;
- » Develop and sustain relationships with communities that choose to engage in the site selection process, surrounding communities and Aboriginal peoples. This is expected to include working together in the conduct of studies;
- » Develop and sustain relationships with municipal associations to better understand local governments' points of view, and work with them to implement Adaptive Phased Management;
- » Develop and maintain relationships with the federal government, and provincial and local governments in nuclear provinces to help coordinate and support their roles in the implementation of Adaptive Phased Management;
- » Develop and maintain relationships with national, provincial and regional Aboriginal organizations, and keep them apprised of progress in the implementation of Adaptive Phased Management and the site selection process;
- » Continue to seek the advice of Elders and Aboriginal 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 affected Aboriginal peoples, including Traditional Knowledge holders, recognizing the diversity of cultures and languages, practices and approaches among Aboriginal communities; the identification of sacred areas; understanding traditional laws, practices and use of land; and protection of 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;
- » Build a multi-generational view of the long-term management of used nuclear fuel through engagement, education and outreach involving young Canadians, including Aboriginal youth;
- » Assess the effectiveness of the NWMO website and other communication vehicles to identify opportunities for improvement and make refinements;
- » Assess effectiveness of NWMO engagement activities and continue to make refinements; and
- » Continue to report publicly on the input that the NWMO receives and how this advice has been considered.

In 2014, the NWMO will:

- » Provide briefings and information upon request to interested individuals and organizations about Adaptive Phased Management and the site selection process;
- » Continue to support communities and regions as they explore their early interest in the project and the siting process, including facilitating engagement of third-party knowledge specialists to assist in community learning about the project; the form of support provided will be determined in collaboration with these communities;
- » Provide briefings and information to governments to support their participation in the implementation of the site selection process and to 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 (CANHC), 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 on interweaving Aboriginal Traditional 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, DVDs, exhibits and information kits to support the siting process and for a range of audiences;
- » Continue to implement the NWMO Corporate Social Responsibility Program;
- » Continue to develop and implement a NWMO education, outreach and capacity-building strategy for young Canadians and Aboriginal youth that incorporates both technical and social disciplines;
- » Continue to seek the perspective of Canadians with the use of web-based tools and other activities; and
- » Continue to participate in regional and national environmental initiatives.

## » Collaboratively Implement the Site Selection Process

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**The NWMO will implement collaboratively with Canadians the process for siting a deep geological repository for the safe, long-term management of used nuclear fuel in an informed, willing host community.**

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](http://www.nwmo.ca). Implementation of the process, including the selection of an informed and willing host community 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 humans and the environment, fairness and regulatory oversight. 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 *Steps in the Siting Process – At a Glance*, and the complete description of the siting process cited above). It is expected that individual communities 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 for communities. Preliminary assessments (feasibility studies) of potential sites will be done in partnership with communities as they come forward and express interest. A community may end its involvement in the process at any point up to and until the final agreement is signed. Over time, refinements to the siting process may be necessary as experience is gained, and the process is designed to be adaptive.

As communities advance in the site selection process, a more regional perspective becomes a focus. Work can proceed only with the involvement of affected Aboriginal peoples 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 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 Project together are beginning to emerge. This project will only proceed with the involvement of the interested community, affected Aboriginal peoples 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.

# Steps in the Siting Process – At a Glance

Getting Ready	<b>The NWMO publishes the finalized siting process, having briefed provincial governments, the Government of Canada, national and provincial Aboriginal organizations, and regulatory agencies on the NWMO's activities.</b> The NWMO will continue briefings throughout the siting process to ensure new information is made available and requirements which might emerge are addressed.
Step 1	<b>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.</b> Awareness-building activities will continue throughout the full duration of the siting process.
Step 2	<b>Communities identify their interest in learning more, and the NWMO provides detailed briefing. An initial screening is conducted.</b> At the request of the community, the NWMO will evaluate the potential suitability of the community against a list of initial screening criteria.
Step 3	<b>For interested communities, a preliminary assessment of potential suitability is conducted.</b> At the request of the community, the NWMO will conduct a feasibility study collaboratively with the community to determine whether a site has the potential to meet the detailed requirements for the project. Regional engagement will be initiated, and an initial review of transportation considerations will be conducted. Interested communities will be encouraged to inform surrounding communities, including potentially affected Aboriginal communities and governments, as early as possible to facilitate their involvement. Preliminary assessments are conducted in two phases: <b>Phase 1:</b> Desktop study and engagement; <b>Phase 2:</b> Field investigations and expanded engagement.
Step 4	<b>For interested communities, potentially affected surrounding communities are engaged if they have not been already, and detailed site evaluations are completed.</b> In this step, the NWMO will select one or more suitable sites from communities expressing formal interest for regional study and/or detailed multi-year site evaluations. The NWMO will work collaboratively with these communities to engage potentially affected surrounding communities, Aboriginal governments and the provincial government in a study of health, safety, environment, social, economic and cultural effects of the project at a broader regional level (Regional Study), including effects that may be associated with transportation. Involvement will continue throughout the siting process as decisions are made about how the project will be implemented. A centre of expertise will be launched in or near the community.
Step 5	<b>Communities with confirmed suitable sites decide whether they are willing to accept the project and propose the terms and conditions on which they would have the project proceed.</b>
Step 6	<b>The NWMO and the community with the preferred site enter into a formal agreement to host the project.</b> The NWMO selects the preferred site, and the NWMO and community ratify a formal agreement.
Step 7	<b>Regulatory authorities review the safety of the project through an independent, formal and public process, and if all requirements are satisfied, give their approvals to proceed.</b> The implementation of the deep geological repository will be regulated under the <i>Nuclear Safety and Control Act</i> 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. Regulatory requirements will be observed throughout all previous steps in the siting process. The documentation produced through previous steps, as well as other documentation that will be required for a licence application, will be formally reviewed by regulatory authorities at this step through an Environmental Assessment, and if this assessment is successful, then licensing hearings related to site preparation (and possible construction) of facilities associated with the project. Various aspects of transportation of used nuclear fuel will also need to be approved by regulatory authorities.
Step 8	<b>Construction and operation of an underground demonstration facility proceeds.</b> The NWMO will develop the centre of expertise, launched in Step 4, to include and support the construction and operation of an underground demonstration facility designed to confirm the characteristics of the site before applying to regulatory authorities for an operating licence. Designed in collaboration with the community, it will become a hub for knowledge-sharing across Canada and internationally.
Step 9	<b>Construction and operation of the facility.</b> The NWMO begins construction of the deep geological repository and associated surface facilities. Operation will begin after an operating licence is obtained from regulatory authorities. The NWMO will continue to work in partnership with the host community in order to ensure the commitments to the community are addressed throughout the entire lifetime of the project.

The business plan assumes that over the five-year period, some communities will elect to move through sequential steps of preliminary assessments and site evaluations. As communities advance in the site selection process, work will proceed together with the involvement of Aboriginal peoples and surrounding communities. The NWMO may select sites for detailed characterization by the end of the planning period. Work plans for the 2014 to 2018 period will ensure that 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. The NWMO will assist interested communities in engaging surrounding communities, the region, and provincial and Aboriginal governments, in a regional study of environmental, social, cultural and economic effects, and detailed site investigations. Involvement of regional representatives will help ensure that the broad 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 must work to assist provincial governments to become informed and ready to support community interest, and address inquiries about Crown land, and provincial regulations and approvals.

Throughout the siting process, the NWMO will support and assist communities to build understanding of Adaptive Phased Management and to address questions and concerns, including how used nuclear fuel will be contained and isolated from groundwater, people and the environment. The NWMO also supports communities to build understanding of how the project may help or hinder a community's ability to achieve its long-term plan; to engage citizens, surrounding communities and Aboriginal peoples; and to assess community willingness to host the project. Funding and resources will be provided to support interested communities as they work through each step. To assist communities in capacity building, the NWMO will provide funding and resources through

a program collaboratively developed with communities involved in the site selection process. As the siting process advances, funding and resources will also be provided to Aboriginal peoples and communities in the surrounding area.

As communities advance in their learning about the project and in the site selection process, understanding what would constitute a 'compelling demonstration of willingness' from a community, as required by the siting process, is an important question. Those in the surrounding area would also like to better understand the nature of their involvement. Working collaboratively with those involved in the siting process to articulate expectations in this area is an important objective during the planning period.

In the next few years, technical support to the siting process will focus on assessing the suitability of potential sites through geoscientific 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 support a narrowing down of potential siting areas, and potentially by the end of the planning period, support selection of a preferred location to be the focus of Step 4 detailed site characterization. The NWMO expects to be ready to begin detailed site evaluations on one or more sites by the end of the planning period. Detailed site characterization (Step 4) will include further geological investigations, safety assessments, environmental assessments, and social and economic impact assessments. This work will be planned and conducted, in collaboration with interested communities, Aboriginal peoples and surrounding areas. The application of Aboriginal Traditional Knowledge throughout this work is an important objective.

Transportation is an important consideration in the assessment of any site. 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 to the site from the locations at which it is currently stored. 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 the satisfaction of regulatory authorities, and citizens, before transportation of used nuclear fuel to the repository can begin. Work in this area will include engaging: regulatory authorities at all levels to understand their expectations; transportation experts and those working in the field to understand issues and concerns; nuclear station communities as they will be affected by any transportation plan; and communities along the transportation route as a large group with a shared interest to raise questions or concerns to be addressed in the process. Communication materials continue to be developed to support a new mobile exhibit and brochure, as well as DVDs, backgrounders and engagement activities, to respond to public and media concerns that are raised.

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 siting 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 to be able to safely contain and isolate used nuclear fuel for a very long period of time, the community must be informed and willing to host the facility, 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.

As we continue implementing the site selection process, we understand 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 (Step 3 in the Site Selection Process)**

In 2014, many communities are expected to be involved in preliminary assessments as part of Step 3 in the site selection process.

These studies are designed to assess, in a preliminary way, the suitability of a community and associated site(s) to host the project. These studies are an opportunity for the community and the NWMO to explore suitability together.

## **The Two Phases of Work**

Work will be conducted in two phases during the planning period with the opportunity for stock-taking by both the community and the NWMO at the end of each phase. Some communities with relatively low potential to be suitable for the project may be screened out of the process at the end of the first phase of work. By the end of the second phase of work, one or two communities or siting areas with strong potential to meet the requirements of the project may be selected for the next step in the site selection process: detailed studies over a three- to five-year period (Step 4). Resources are available to communities participating in the site selection process to cover costs associated with participation in the project throughout all phases of work.

Eight communities completed Phase 1 studies by the end of 2013, and four of these communities were selected to be the focus of more detailed Phase 2 studies. Other communities are continuing with their Phase 1 studies, and a subset of these may be identified for more detailed Phase 2 studies by the end of 2014.

## Studies Conducted

Phase 1 preliminary assessment studies involve work in a number of areas:

- » Geoscientific studies: Is there potential to find a suitable site in the community?
- » Engineering studies: Is there potential to safely construct the facility in the community?
- » Transportation studies: Is there potential for safe and secure transportation?
- » Environment and safety studies: Is there potential to manage any environmental effects and to ensure safety of people and the environment?
- » Social, economic and cultural studies: Is there potential to foster the well-being of the community and region and to lay the foundation for moving forward?

## Focus of Phase 2 Preliminary Assessments

Phase 2 is a continuation of Step 3 in the site selection process. The objective of the multi-year studies, dialogues and learning in Phase 2 is to guide the identification of the preferred location for the Adaptive Phased Management Project.

In order to select the preferred location, the NWMO will need to be: confident that a strong safety case can be developed for the project in that location; confident that the interested community could demonstrate willingness once all siting studies are completed; confident that we can build a strong partnership with local Aboriginal and non-Aboriginal communities; and confident that we can transport used fuel to the preferred location. At the end of Phase 2 assessments, a preferred location(s) will be identified as the focus of Step 4 detailed site evaluations. Step 4 studies may require three to five years to complete, and will support confirmation of the preferred location that would be the focus of a regulatory approval process led by the Canadian Nuclear Safety Commission.

Phase 2 assessments will build upon the learning from Phase 1 studies. The multi-year program of study and engagement will facilitate further learning, deepen understanding of the project and further explore potential suitability of the area being studied. This learning and reflection is broadened to include First Nations and Métis peoples in the area and surrounding communities. In this phase:

- » Technical evaluation of potentially suitable areas continues 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, secure long-term containment and isolation of used nuclear fuel. Activities will 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. Community members and those in the area will be engaged to help identify and refine the list of potentially suitable siting areas that would be socially acceptable.
- » Environment and safety evaluations will focus on specific areas guided by input from the interested community, Aboriginal peoples and surrounding communities. Field studies and discussions with the local community and Aboriginal peoples will build understanding of the environmental conditions of the areas being studied.
- » Potential transportation routes and mode(s) 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 assessments 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 community and with First Nations and Métis peoples and surrounding communities will be broadened to 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 in the community and area 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 the foundation to work together to implement the project. Engagement will explore the potential for these working partnerships to be established. An important outcome of Phase 2 will be to identify the terms under which a working partnership can be developed to implement the project. Phase 2 will also explore whether an implementation plan can be developed to ensure safety, align with expectations of the community and area, and be economically feasible.

Phase 2 assessments are expected to take three to four years to complete, and perhaps longer. Additional time may be required to support assessments to provide the confidence required to narrow down potential siting areas and select a preferred siting area. Not all communities that begin this phase of work will necessarily complete the full sequence of Phase 2 studies. Through regular stock-taking by the NWMO and the community as Phase 2 studies progress, a decision may be made part way through the work to conclude studies. This would be the case if studies at any point suggested the community does not have strong potential to meet the requirements of the project.

## Aboriginal Traditional Knowledge

Aboriginal peoples have a special relationship with the natural environment, and 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 range of factors that should be considered in field studies, social assessments, and assessing benefits and effects to be managed.

The NWMO will work together with Aboriginal communities in potential siting areas to respectfully apply Traditional Knowledge to both technical safety and community well-being aspects of the site selection process. Traditional Knowledge will also guide the NWMO's engagement with Aboriginal communities and local Elders, providing guidance on spiritual and cultural considerations, and developing and maintaining effective and meaningful relationships between generations and within and between communities. The NWMO expects that integrating Aboriginal Traditional 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 will be important to informing more detailed studies.

## Review by Geoscientific Review Group

Geoscientific studies are reviewed by the Adaptive Phased Management Geoscientific Review Group (APM-GRG), and their reports are published on the NWMO website at [www.nwmo.ca/sitingprocess\\_preliminaryassessments\\_apm-grg](http://www.nwmo.ca/sitingprocess_preliminaryassessments_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.

## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Continue work to explore technical safety considerations through illustrative postclosure safety assessments of the deep geological repository and preparation of generic used nuclear fuel transportation risk assessments, including disruptive scenarios;
- » Prepare for the development of emergency response preparedness plans;
- » Continue to support communities in developing capacity to consider their interest in the site selection process;
- » Continue to support communities in responding to the values-based requirements of the process, including appropriate engagement of citizens and transparency;
- » Continue to seek advice of municipal associations and Aboriginal organizations on materials and tools to support a community-driven siting process;
- » Continue to develop mobile exhibits and tools to support local and regional-based discussions of Adaptive Phased Management and siting;
- » Prepare generic options for transport of used nuclear fuel from interim storage sites to a long-term management facility to assess potential sites and transportation routes;
- » Refine and enhance approaches to assessing willingness;
- » Refine and enhance approaches to engaging Aboriginal peoples and those in the surrounding area in siting decision-making in the spirit of partnership;
- » Refine tools and methods for geoscientific assessment of candidate sites in both crystalline and sedimentary rock settings;
- » Provide engineering designs to support evaluation of candidate sites;
- » Provide preliminary environment and safety assessments to support evaluation of candidate sites;
- » Refine tools and methods for assessment of sites in terms of environmental, social, cultural and economic factors, including factors identified by Aboriginal Traditional Knowledge and traditional approaches to land use mapping and planning;
- » Refine tools and methods for informing and engaging citizens in decision-making;
- » Engage interested communities in more intensive learning about the project, and explore and help assess the extent to which the project might contribute to or detract from the well-being of the community;
- » Establish and sustain NWMO presence in communities that decided to enter the site selection process to provide information and support public engagement;
- » Explore the need to design and implement a property value protection program to support the implementation of the project, as has been requested by some communities;
- » Conduct preliminary assessments (Step 3 – Phase 1 Preliminary Assessment) collaboratively with the communities that pass initial screening and decide to proceed to Step 3;
- » Upon conclusion of Phase 1 work, identify a smaller number of communities eligible to be carried forward to next phase of work (Step 3 – Phase 2 Preliminary Assessment) and seek their agreement to proceed to the next phase of work;

- » Initiate and complete preliminary field investigations, and engage surrounding communities and Aboriginal peoples (Step 3 – Phase 2 Preliminary Assessment);
- » Upon conclusion of Phase 2 work, select siting area(s) to be the focus of detailed site characterization (Step 4) and seek agreement to proceed to the next phase of work;
- » Ensure readiness to begin detailed site evaluations (Step 4) and expanded regional studies in collaboration with communities;
- » Plan for future centres of expertise to support technical and social assessments and discussion of community well-being issues;
- » Identify preferred transportation modes and potential routes associated with each of these siting areas, and welcome existing nuclear station communities and communities along the transportation route as a large group with a shared interest to raise questions or concerns to be addressed in the process;
- » Conduct research on partnership and power-sharing frameworks for consideration in structuring of a formal agreement with the community, Aboriginal peoples and the area, once selected; and
- » Explore long-term knowledge transfer considerations, such as markers and archives, as part of international collaborative research efforts (Nuclear Energy Agency).

In 2014, the NWMO will:

- » Continue to refine a generic used nuclear fuel transportation risk assessment;
- » Work in partnership with communities as they proceed through the siting process;
- » Implement, support and further develop the *Learn More Program* for community capacity building to meet the needs of communities, surrounding areas and Aboriginal peoples;
- » Conduct preliminary desktop assessments upon request of interested communities with potentially suitable sites (Step 3 – Phase 1). Continue desktop work to assess geoscientific, engineering, transportation, and environment and safety factors, as well as potential to foster well-being of the community, Aboriginal peoples and surrounding area, including factors identified by Aboriginal Traditional Knowledge;
- » Conduct field studies upon request of interested communities with strong potential to meet the requirements of the project (Step 3 – Phase 2). Field studies will help advance the assessment of geoscientific, engineering, transportation, and environment and safety factors, as well as potential to foster well-being of the community, Aboriginal peoples and surrounding area, including factors identified by Aboriginal Traditional Knowledge;
- » Develop and implement local and regional outreach plans to deepen understanding of regional perspectives and build relationships in the broader area;
- » Continue to seek opportunities to engage First Nations and Métis peoples at the local and regional level through collaborative work with communities, Treaty organizations, and regional or provincial Aboriginal organizations involved in the siting area;
- » Continue to advance coordination and collaboration with provincial governments aimed at identifying mechanisms and processes to address provincial areas of interest;
- » Continue to develop communication materials to support learning and dialogue on the project description, the safety of the repository, and transportation considerations;
- » Continue to advance dialogue on transportation considerations with regulatory authorities at all levels of government, transportation experts and those working in the field;
- » Continue to seek advice from municipal associations regarding ways to communicate transportation plans and engage with communities that may be on a transportation corridor for used nuclear fuel; and
- » Continue review of experience and best practices with transportation of hazardous materials, including transportation of nuclear wastes in Canada and internationally to identify lessons that apply to Adaptive Phased Management.

## » Optimize Repository Designs and Further Increase Confidence in Safety

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**The NWMO will refine and further develop the generic designs and safety cases for a repository for used nuclear fuel in both crystalline and sedimentary rock formations, and conduct technical research and development to ensure continuous improvement, consistent with best practices.**

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 containment and repository performance to meet or exceed the regulatory expectations of the Canadian Nuclear Safety Commission (CNSC), the guidance of the International Atomic Energy Agency and the experience in other countries.

The NWMO's technical program supports Adaptive Phased Management in three key areas: siting, conceptual engineering design and costing, and safety assessment. Underlying work in these key areas is a base program in which technical program activities in geosciences, safety assessment, repository engineering, environmental sciences and regulatory affairs are carried out in Canada and with international partners to ensure that the best knowledge and understanding are being applied. 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 Adaptive Phased Management. The Plan incorporates feedback from the Independent Technical Review Group (ITRG). A strong technical program ensures that Adaptive Phased Management benefits from knowledge and innovation in the long-term care of used nuclear fuel from Canada and abroad, including Finland, France, Japan, Sweden, Switzerland, the United Kingdom and the United States. It also ensures that NWMO staff sustain the expertise required to implement the adaptive program.

As part of the Adaptive Phased Management technical program, the NWMO undertakes joint research projects with its counterparts in other countries, most notably those of Sweden (SKB), Switzerland (Nagra), Finland (Posiva) and France (Andra). Work includes testing and demonstration of repository engineering technology

and processes at underground research laboratories in Sweden (Äspö Hard Rock Laboratory) and Switzerland (Mont Terri), and geoscientific investigation of glacial processes. As well, the NWMO continues to participate in international projects with the European Commission and the Nuclear Energy Agency. These activities will ensure that the NWMO is employing best practices and continuing to learn during implementation of Adaptive Phased Management.

The NWMO is enhancing its technical program in engineering design and optimization. Over the next five years, physical prototypes of the long-lived repository containers will be designed and manufactured. This work is being undertaken in conjunction with Canada's universities and national research laboratories. It will incorporate the best available design practice and the state-of-the-art in manufacturing technologies, and demonstrate our ability to meet the rigorous engineering requirements of the repository environment. Further, a container engineering and test facility will be established for both the repository and transportation containers. This facility will be used to continue to investigate manufacturing technologies and for prototype testing. In the course of the conduct of preliminary assessment studies, potential routes and modes will be assessed and discussed. The NWMO will also 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. The optional temporary shallow storage at the central site component of Adaptive Phased Management is not expected to be required and is not a focus of work.

In order to support understanding and broad dialogue on 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.

## Going Forward

In the 2014 to 2018 time period, technical program activities will complete work to update repository designs and safety assessments, complete CNSC pre-project review in both crystalline and sedimentary rock, and begin a proof test plan to qualify a Canadian-engineered barrier system in advance of submission of site preparation and construction licences. Further studies, analyses and joint activities will continue with international partners to improve understanding of key processes and confidence in the safety case for a deep geological repository.

In the period 2014 to 2018, the NWMO will:

- » Complete CNSC pre-project reviews of postclosure safety assessments of a used nuclear fuel deep geological repository in crystalline and sedimentary rock;
- » Complete optimization study of repository container geometry and used nuclear fuel capacity;
- » Assess copper coating technology for repository containers;
- » Complete preliminary design, fabrication and testing of prototype repository containers;
- » Complete the update to the conceptual design and cost estimate for Adaptive Phased Management;
- » Complete an integrated review of the microbiological process that could occur within the repository environment in support of corrosion models;
- » Continue work to explore technical safety considerations through preparation of generic used nuclear fuel transportation risk assessments, including assessment of used nuclear fuel transportation modes;
- » 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;
- » Continue the NWMO's involvement in joint research activities and international programs at the Äspö Hard Rock Laboratory in crystalline rock in Sweden and at the Mont Terri Laboratory in sedimentary rock in Switzerland; and
- » Establish a prototype test facility for engineered barrier evaluations.

In 2014, the NWMO will:

- » Complete assessment of copper coating and welding technologies for repository containers;
- » Develop an engineered barrier test and demonstration facility;
- » Review alternative repository container emplacement technologies;
- » Investigate the manufacturing process for producing buffer materials;
- » Further investigate the potential for rail transportation of used nuclear fuel; and
- » Complete annual review of the NWMO's Adaptive Phased Management Technical Program by the ITRG.

## 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 the engineered barrier system is planned.

### Preparing for the Transportation of Used Nuclear Fuel

The NWMO's technical program includes planning for the transportation of used nuclear fuel in the future. This work includes testing and refinement of package design including consideration of 'beyond design basis' scenarios, development of transportation mode and route scenarios, and development of emergency management processes and plans including for the very unlikely event of a package failure.

### Health and Safety of the Public and Workers

The NWMO's repository design 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 has recently submitted generic safety assessments to the CNSC to illustrate our methodology for assessing long-term safety. We are continuing to apply and improve our safety assessment approach, considering both operational and long-term safety.



## » Provide Financial Surety

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### **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. 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 Adaptive Phased Management Project will be implemented in phases and spanning many decades. It has an estimated cost of \$16 billion to \$24 billion (2010 \$).

The NWMO completed a full update of these estimates in 2011. The updated cost estimate covers many decades of Adaptive Phased Management lifecycle activity for the deep geological repository and related transportation of used nuclear fuel. For planning purposes, a cost estimate for the deep geological repository and used nuclear fuel transportation system has been developed which assumes an inventory of 4.6 million used CANDU fuel bundles. The specific volume of Canada's used nuclear fuel to be placed in the repository will be agreed with the community using the best information available at the time and an open and transparent consultation process involving surrounding communities and others who are interested and potentially affected. The current estimated cost is \$21.2 billion (2010 \$), with a present value of \$7.7 billion

(2010 \$). These cost estimates include 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 eventual cost of this project may differ from these estimates, depending on a number of factors, including the location of the facility, surrounding infrastructure, the rock type and characteristics, the design of the repository, the volume of used nuclear fuel to be managed, and the period of extended monitoring following used nuclear fuel placement. The NWMO must estimate what costs can reasonably be expected to occur over the lifetime of the project, along with a contingency for unexpected events. The NWMO is committed to providing regular assessments on all these 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 Adaptive Phased Management 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 nuclear fuel that will need to be managed. The NWMO is committed to the prudent use of these resources.

## *The Nuclear Fuel Waste Act*

The planning, development and implementation of the Adaptive Phased Management 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 (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 that the trust funds are maintained securely and used only for the intended purpose.

As required by the *Nuclear Fuel Waste Act*, the Annual Report of the NWMO must outline the funding formula for the next fiscal year to ensure funds required to cover the full cost of implementation of Adaptive Phased Management 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.

## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Annually assess all factors that impact Adaptive Phased Management cost estimating and funding requirements;
- » Update the total cost estimate for Adaptive Phased Management no later than 2017;
- » Continue to publish the audited financial statements of the Members' nuclear fuel waste trust funds as they are provided by the financial institutions (see [www.nwmo.ca](http://www.nwmo.ca)), and provide updates to confirm that the waste owners are meeting their financial obligations;
- » Estimate and publish the financial implications of potential future scenarios of varying volumes of used nuclear fuel, when available; 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.

## » Adapt Plans

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### **The NWMO will adapt plans for the management of used nuclear fuel in response to new knowledge, international best practices, advances in technical learning, insight from Aboriginal Traditional Knowledge, evolving societal expectations and values, and changes in public policies.**

A fundamental tenet of Adaptive Phased Management is the ongoing incorporation of new learning and knowledge to guide decision-making. We are committed to re-evaluating decisions where warranted, maintaining the option to change course and being prepared to act on new knowledge or information. Developments throughout the implementation of Adaptive Phased Management may pose technical and ethical challenges. The NWMO's approach and response to these challenges will be critical to the success of Adaptive Phased Management.

The NWMO has identified five fundamental values – integrity, excellence, engagement, accountability and transparency – that inform all its work. A series of principles to guide the siting process, identified in dialogue with Canadians, further builds on this framework. Through regular engagement of citizens, specialists and potentially affected communities, the NWMO monitors, reviews, reports and discusses the challenges of Adaptive Phased Management 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. Through its ongoing participation in the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD), the NWMO regularly reports on its work and participates in an exchange of best international practices in such areas as safety case development, community-based site selection processes and citizen engagement. This includes participation in the OECD Nuclear Energy Agency's Radioactive Waste Management Committee, Integration Group on the Safety Case, and Forum on Stakeholder Confidence. The NWMO also participates in international research projects.

A program that is implemented over a long time will have many opportunities to improve safety and

performance, enhance effectiveness, build understanding, reduce uncertainty and address societal concerns. One of the strengths of Adaptive Phased Management is the incorporation of new learning and knowledge.

Developments in environmental and energy policies are particularly relevant to Adaptive Phased Management. 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 has a process for ongoing monitoring, review and discussion of the potential implications of these developments on the quantities and characteristics of used nuclear fuel that the NWMO may be asked to manage in the future. During the planning period, it is anticipated that industry plans to move forward with nuclear new build may result in requests for the NWMO to confirm its understanding of and readiness to address a range of used nuclear fuel types and volumes for long-term management. The NWMO will work closely with waste owners to stay abreast of industry plans for nuclear new build. The NWMO will work cooperatively with the industry to exchange plans, best practices and experiences in managing different types of radioactive waste in Canada. As in previous years, the NWMO will continue to keep a watching brief on any new technological developments in reprocessing used nuclear fuel. The NWMO will continue to engage Canadians to ensure continued alignment with values and expectations.

Consistent with the NWMO Transparency Policy and Engagement Procedure, the NWMO reports regularly on its progress in implementing Adaptive Phased Management and especially in response to the advice of Canadians and the changing external environment.

The NWMO also seeks formal opportunities, such as House of Commons Standing Committees, for open and transparent review of the implementation of Adaptive Phased Management at key milestones and decision points.

## Continuous Learning

One of the cornerstones of the Adaptive Phased Management program is a commitment to continuous learning from new developments and experience, and adapting and refining plans for all aspects of the long-term management plan for Canada's used nuclear fuel. The NWMO continually monitors and reviews international research, experience, activities and events for lessons learned and as an opportunity to reflect on whether refinements are needed to our plans.

In addition to its responsibility for implementing Canada's plan for the long-term management of used nuclear fuel, the NWMO is assisting Ontario Power Generation (OPG) in seeking regulatory approval for construction of a proposed deep geologic repository (DGR) for the long-term management of low- and intermediate-level waste from OPG-owned or -operated reactors. The NWMO has gained important learning and experience, which is being used to refine Adaptive Phased Management design and implementation. The NWMO also continues to learn from regulatory review processes for a repository for used nuclear fuel underway in Sweden.

Tragic events in Lac Mégantic in July 2013 have increased public discussion, including among Canadian municipalities, about transportation of goods along rail lines. The NWMO will seek to learn from this ongoing discussion.

## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Support the site selection process by furthering 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 Nuclear Energy Agency's Radioactive Waste Management Committee, Integration Group on the Safety Case and Forum on Stakeholder Confidence;
- » Continue to research citizen priorities and concerns relating to Adaptive Phased Management;
- » Build understanding of the interweaving of Aboriginal Traditional Knowledge and other assessment approaches into implementation;
- » Review and update the social and ethical framework and consider emerging and potential challenges;
- » Post research papers and the results of engagement activities on the NWMO website;
- » 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;
- » Publish a preliminary technical assessment of Generation III reactor (CANDU type and other) used nuclear fuel on deep geological repository design and safety;
- » Seek the input of Canadians on how the implementation of Adaptive Phased Management 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 Adaptive Phased Management in the future.

In 2014, the NWMO will:

- » Continue to advance the framework for preliminary assessments (feasibility studies, Step 3 – Phase 2) with advice and input from Aboriginal organizations, incorporating Aboriginal Traditional Knowledge provided by Aboriginal contractors and Traditional Knowledge holders;
- » Publish a review of developments in used nuclear fuel reprocessing and alternative used nuclear fuel management technologies; and
- » Publish an update on current and future potential inventories of used nuclear fuel quantities and types.

## » Ensure Governance and Accountability

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### **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 will be regulated under the *Nuclear Safety and Control Act (NSCA)* 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. A licensing decision by the Canadian Nuclear Safety Commission (CNSC) on an Adaptive Phased Management repository can only be taken after the successful completion of the environmental assessment process under the *Canadian Environmental Assessment Act*. All aspects of the NWMO's work will meet or exceed all applicable regulatory standards and requirements for protecting the health, safety and security of humans and the environment.

#### **MEMBERS**

Ontario Power Generation, NB Power 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 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 nine members of the Board of Directors, representing a range of perspectives from both within and outside the nuclear industry, including capabilities in ethics, 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.

In 2012, the Council's membership was renewed and included the appointment of a new member, Dr. Wesley Cragg, an internationally recognized expert in applied ethics. Current membership of the Advisory Council represents a broad range of expertise, including geosciences, nuclear engineering, strategic communications, business ethics, environment, medicine, political science and Aboriginal Traditional Knowledge. 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 Adaptive Phased Management site selection. As the NWMO's work leads to the selection of an informed and willing host community, and as affected Aboriginal organizations and 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 scientific disciplines, as well as expertise in Traditional Aboriginal Knowledge, as outlined in the *Act*.

## POLICIES AND PROCEDURES

Since 2010, the NWMO has maintained ISO 9001:2008 certification covering its quality management system for activities in support of site selection and development of repositories for the long-term management of nuclear waste. In addition, NWMO governance is designed to meet the requirements of CSA N286-12, Management System Requirements for Nuclear Facilities, as they apply to the development of a deep geological repository.

In 2012, the NWMO received certification that its health and safety governance is in compliance with CSA Z1000:2006 Occupational Health and Safety Management, and that its environmental governance is in accordance with ISO 14001:2004 Environmental Management Systems. Monitoring, auditing and management review activities to maintain these certifications will occur in 2014 and beyond.

## INDEPENDENT TECHNICAL REVIEW GROUP

The Board of Directors established the Independent Technical Review Group (ITRG) in 2008 to regularly review the NWMO's technical research program on used nuclear fuel. The ITRG conducts annual reviews to inform the Board and Advisory Council whether the NWMO technical program is based on credible scientific and technical approaches and methodologies; is consistent with international practices; and will broaden and advance the NWMO's technical knowledge to adequately support implementation of Adaptive Phased Management. The four members bring extensive internationally recognized expertise in the technologies associated with nuclear waste geological repository projects acquired through experience in Canada, the United Kingdom, Sweden and Switzerland. Members of the ITRG are appointed by the NWMO Board on a three-year basis. Appointments were recently renewed for another three-year term. The members are profiled on the NWMO website. Reports of the group are also published on the NWMO website.

## PEER REVIEWS

The NWMO will continue to seek opportunities for peer review of its work and to invite independent comment. The Geoscientific Review Group, 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 Adaptive Phased Management. 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 contribute to Canada's reporting at the 2015 convention as part of the delegation led by the CNSC.

## Triennial Report

The *Nuclear Fuel Waste Act* sets out very specific reporting requirements for the triennial reports. Triennial reports were issued in 2011 and 2014, and the next triennial report will be issued in 2017. The triennial reports include:

- a)** a summary of [the NWMO's] 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;
- 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);
- c)** its budget forecast for the next five fiscal years to implement the strategic plan;
- 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
- e)** the comments of the Advisory Council on the matters referred to in paragraphs *a)* to *d)*.



## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Convene regular meetings of NWMO Members, Board of Directors, Board Committees and Advisory Council;
- » Coordinate annual reviews of the NWMO's technical program by the Independent Technical Review Group, and publish the reports of the Review Group;
- » Conduct assessments and audits of internal governance to maintain and achieve certifications to management system standards for quality, safety and environmental management;
- » Interact with the CNSC on Adaptive Phased Management in the pre-licence application period consistent with the terms of the service agreement that identifies the CNSC's early involvement in the Adaptive Phased Management Project prior to submission of a licence application. These areas include the CNSC participating in community or other meetings to provide information on the regulator's role, identifying regulatory requirements for a repository and providing regulatory review of conceptual Adaptive Phased Management safety assessments;
- » Report to Canadians on its progress in implementing Adaptive Phased Management. 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 second triennial report in March 2014 and 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, the Advisory Council, and the Independent Technical Review Group and their reports;
- » Report internationally on progress for the long-term management of Canada's used nuclear fuel at the 2015 meeting of the *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*; and
- » Undertake membership review, and make appointments to the Advisory Council to ensure members bring a broad range of expertise.

## » Build and Sustain a High-Performing Organization

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### **The NWMO will build and sustain an effective organization with the social, environmental, technical and financial capabilities for the safe, long-term management of Canada's used nuclear fuel.**

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. The NWMO must have access to a sufficient and sustainable number of trained and skilled personnel. This requires investment in the organization to ensure resource capacity, capability, expertise, and sound administrative and management policies and practices, that provide a foundation for operations and demonstrate commitment to staff development.

The NWMO has a strong set of skills and competencies resident in its current staff. It will be important to ensure this expertise is retained and further developed over the years to come. The long time frames associated with management of used nuclear fuel give rise to the additional priority of intergenerational knowledge management. Qualified human resources will be required to support program implementation and operations spanning decades. 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.

We will require expertise and capabilities in a range of fields, including, but not limited to, repository design and construction, environmental assessment, socio-economics, ethics, finance, public engagement, Aboriginal Traditional Knowledge, siting, information management and waste management technology. Investment in human resources, skills training and networks of specialists will be important to build and sustain a capability for inquiry, assessment and decision-making to support the implementation of Adaptive Phased Management. These specialists will be critical to implementing the siting process, developing host community interest and partnerships, and undertaking the technical and socio-economic site investigations.

As the NWMO proceeds with the implementation of Adaptive Phased Management and builds partnerships to facilitate this implementation, capacity at the local and regional levels to participate in the implementation of the deep geological repository and associated facilities will become a critical component of the larger organization required to implement Adaptive Phased Management. Capacity building at the local and regional level will be important.

## Going Forward

In the period 2014 to 2018, the NWMO will:

- » Continue to grow and develop its staffing and contractor capability through initiatives, such as focused recruitment campaigns when appropriate, alliances with appropriate educational institutions, development of third-party expertise, training and development programmes, and succession planning;
- » Continue to foster NWMO values in activities and processes to grow and develop its staffing and contractor capability, including Aboriginal cultural training; and communication about corporate history, approaches, and ethical and social framework;
- » Continue to invest in business systems and processes throughout the business planning period to support the growing organization;
- » Continue to ensure hiring plans include recruitment of recent university graduates as well as those with appropriate graduate degrees, to support maintenance of institutional memory and the transfer of information to future generations;
- » Take into account future needs for regionally based staff and local information offices to support the site selection process in communities electing to enter the process; and
- » Continue to work with potential host communities and regions to build capacity to participate in the site selection process, and ultimately for the host community and region to participate in the implementation and operation of the deep geological repository and associated facilities through NWMO staff support and provision of a funding and resources program.

# The Road Ahead

The NWMO invites all Canadians and Aboriginal peoples of Canada to stay involved in Adaptive Phased Management 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.

Adaptive Phased Management will proceed as expeditiously as Canadians, successful technology demonstration and the regulatory authorities allow. Implementation of the site selection process for the deep geological repository for used nuclear fuel has begun. This community-led process is supported by the resources and work programs described in this plan.

# 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 nuclear 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 nuclear 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 as an option, should it be needed, to provide a contingency in the event of unplanned circumstances.

**Retrievability** is the ability to remove the used nuclear fuel from where it has been placed. Retrievability is an important component of Adaptive Phased Management 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 to take advantage of new technologies which may emerge in the future; for instance, technologies which might reduce the hazard associated with used nuclear fuel over the long term.

**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 nuclear waste.

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