



**Moving Forward Together:**  
Overview of Canada's Plan for  
the Long-Term Management  
of Used Nuclear Fuel

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**nwmo**

NUCLEAR WASTE  
MANAGEMENT  
ORGANIZATION

SOCIÉTÉ DE GESTION  
DES DÉCHETS  
NUCLÉAIRES



## Invitation to Learn More

The Government of Canada selected Canada's plan for the long-term management of used nuclear fuel in June 2007. The approach, called Adaptive Phased Management, involves the development of a large infrastructure project in an informed and willing host community. The Nuclear Waste Management Organization (NWMO) is federally mandated to implement this project and is beginning the multi-year process for selecting an informed and willing community to host this national facility.

The plan calls for the construction of a deep geological repository to safely and securely contain and isolate Canada's used nuclear fuel.

This multi-billion-dollar project will also involve the creation of a centre of expertise for technical, environmental and community studies. It will become a hub for national and international scientific collaboration, and it will generate thousands of jobs in a host region and hundreds of jobs in a host community for many decades.

The NWMO is providing an opportunity for interested individuals, organizations and communities to learn more about Canada's plan for the long-term management of used nuclear fuel, the activities of the NWMO, and the process it will use to select an informed and willing community to host this project. Communities that express interest in learning more are not obliged to participate in the site selection process.

To learn more about this important initiative, please contact:

**Jamie Robinson**

Director, Communications

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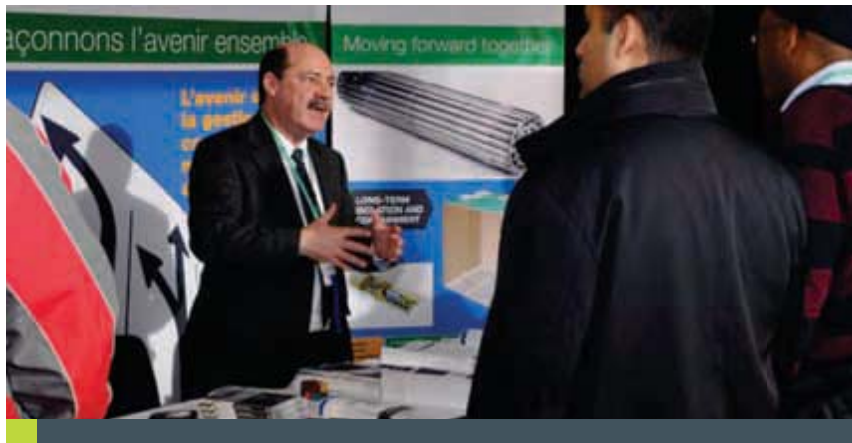
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## **>> What is Used Nuclear Fuel?**

For decades Canadians have been using electricity generated by nuclear power reactors in Ontario, Quebec and New Brunswick. We have produced just over 2 million used fuel bundles.

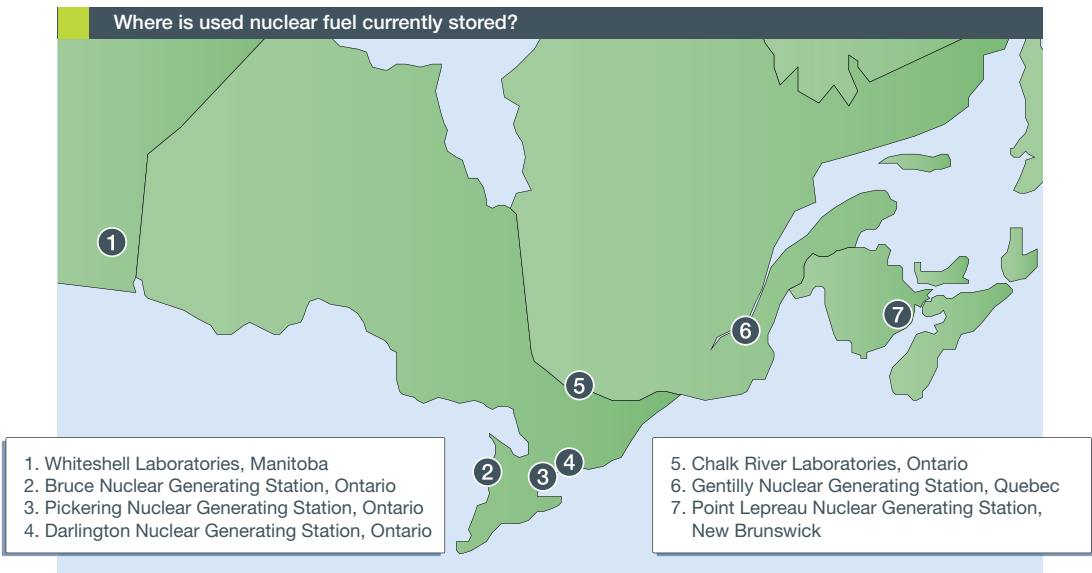
When used nuclear fuel is removed from a reactor, it is considered a waste product, is radioactive and requires careful management. Although its radioactivity decreases with time, chemical toxicity persists and the used fuel will remain a potential health risk for many hundreds of thousands of years.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

Canada's used nuclear fuel is now safely stored on an interim basis at licensed facilities at nuclear reactor sites in Ontario, Quebec and New Brunswick, where it is generated, and at Atomic Energy of Canada Limited's (AECL) nuclear research site in Manitoba and Chalk River Laboratories in Ontario.

Like many other countries with nuclear power programs, Canada is planning for the future. Canadians have emphasized that safety and security are the top priority now and in the future, and that this generation must assume active responsibility for putting in place a plan for the long-term stewardship of used nuclear fuel. Ensuring the long-term, safe and secure management of used nuclear fuel for the protection of people and the environment is an important responsibility we all share.



Used fuel bundles from Canada's CANDU nuclear reactors are approximately 0.5 metre long and weigh about 24 kilograms.



Used nuclear fuel dry storage containers at Ontario Power Generation's Western Waste Management Facility

## **Canada's Plan**

On June 14, 2007, the Government of Canada selected Adaptive Phased Management as Canada's plan for protecting both people and the environment over the very long time in which used nuclear fuel must be managed.

Adaptive Phased Management enables our generation to proceed in a deliberate and collaborative way to establish the foundation for the safe and secure stewardship of Canada's used nuclear fuel for the long term.

The plan requires that used nuclear fuel be contained and isolated in a deep geological repository in a suitable rock formation. A fundamental tenet of this plan is the incorporation of learning and knowledge at each step, to guide a process of phased decision-making. The plan builds in flexibility to adjust the plan if needed.

### **Adaptive Phased Management involves:**

- » Centralized containment and isolation of used nuclear fuel in a repository deep underground in a suitable rock formation;
- » Moving to this goal through a series of steps and clear decision points, which can be adapted over time as may be required;
- » Providing opportunities for people and communities to be involved throughout the implementation process;
- » Allowing for optional temporary shallow storage at the central site, if needed;
- » Ensuring long-term stewardship through continuous monitoring of used fuel;
- » Maintaining the 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 that may be developed; and
- » Providing financial surety and long-term program funding to ensure the necessary money will be available for the long-term care of used nuclear fuel.

Adaptive Phased Management was developed in dialogue with Canadians to reflect features considered important by citizens. It is consistent with the programs that have been developed in many other countries with nuclear power programs, such as Sweden, the United Kingdom, Finland and France. As a plan for the future, Adaptive Phased Management charts a course for the safe, secure long-term management of used nuclear fuel, in line with best international practice and the expectations of Canadians.





## Project Description

This large, high-technology project involves the construction of a deep geological repository and a national centre of expertise in an informed and willing host community.

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 will consist of a network of placement rooms for the used fuel (see diagram on next page).

Used nuclear fuel will be loaded into specially designed and certified containers at the reactor sites and will be transported to the repository site where it will be repackaged in corrosion-resistant containers for placement in the repository. The containers will be lowered through a shaft and transported underground to one of many placement rooms. The containers will be placed in vertical or horizontal boreholes drilled into the rock. They will then be sealed using bentonite clay, a proven-effective sealing material.

The used fuel will be monitored throughout all phases of implementation. It will also be retrievable at all times. The access tunnels and shafts will be backfilled and sealed only when the community, the NWMO and regulators agree that it is appropriate, and long-term monitoring will then be implemented.

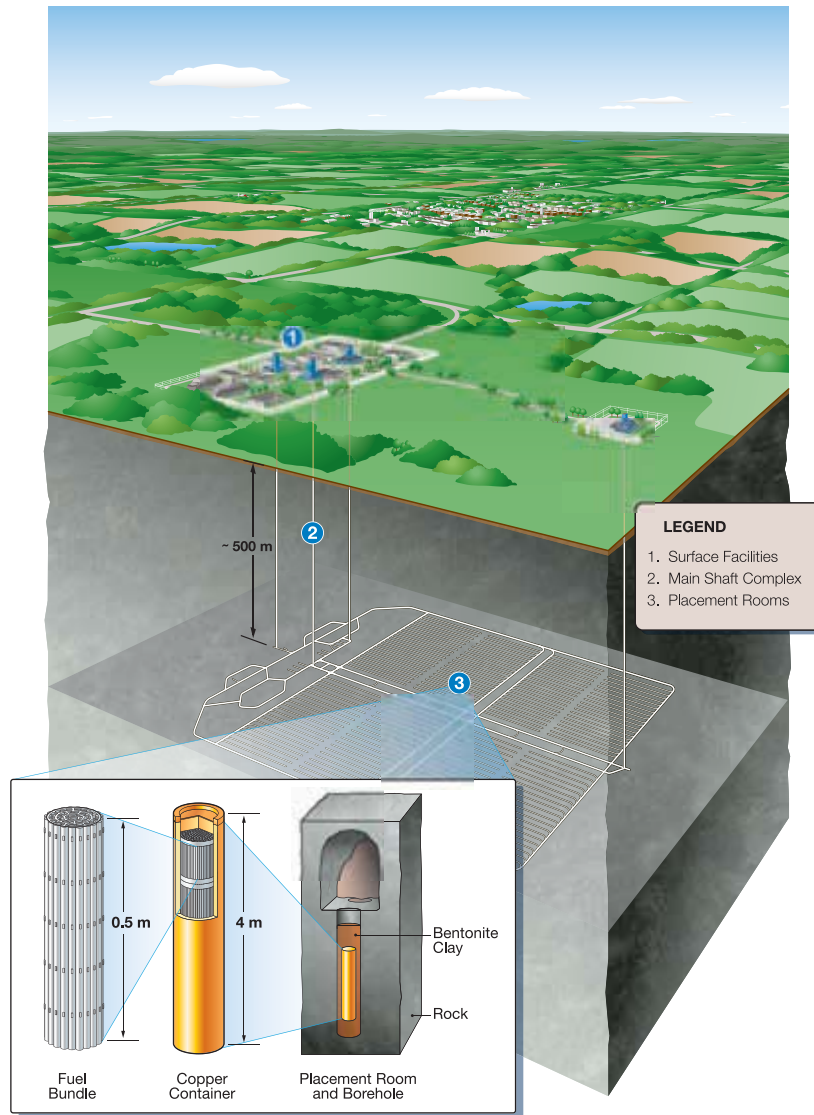
All aspects of the project, including the transportation of used fuel from the interim storage facilities to the repository, will be highly regulated by the Canadian Nuclear Safety Commission (CNSC) during the entire life cycle of the facility – from site preparation to construction, operation and decommissioning. The project will meet strict regulatory criteria to protect the health, safety and security of Canadians as well as the environment, and respect Canada's international commitments on the peaceful use of nuclear energy.

A centre of expertise for technical, environmental and community studies will be created at or near the site. It will become a hub for national and international scientific collaboration.

This multi-billion-dollar project will generate thousands of jobs in a host region and hundreds of jobs in a host community for many decades. It will be implemented through a long-term partnership involving the community, the larger region in which it is located and the NWMO, in a way that fosters the long-term well-being of the community.



- » This project requires a dedicated surface area of about 100 hectares (250 acres) for the surface buildings and associated facilities. As well, there may be a need to limit activities in the immediate area surrounding the surface facilities in order to meet regulatory or other requirements.
- » The underground repository requires a subsurface area in suitable host rock of approximately 2.5 kilometres by 1.5 kilometres (375 hectares/930 acres) at a depth of about 500 metres. The NWMO would need to have rights to the land above the underground repository, although alternative uses would be considered, with the community, for portions of this land.



## **Selecting a Site**

The process for identifying an informed and willing host community for a deep geological repository for the long-term management of used nuclear fuel in Canada is designed to ensure, above all, that the site which is selected is safe and secure and meets the highest scientific, professional and ethical standards.

Reflecting the guidance we received from Canadians, the process is built on a set of principles that reflects the values and priorities of Canadians on this issue. The process also contains a number of steps that these Canadians told us need to be part of the decision-making process to ensure it is an appropriate one for Canada. The process builds upon the best knowledge and experience within Canada and internationally.

### **GUIDING PRINCIPLES – OVERVIEW**

#### **Focus on safety**

- » Safety, security and protection of people and the environment are first and foremost.
- » All regulatory requirements will be met and, if possible, exceeded.
- » The best available knowledge will inform the process.

#### **Select an informed and willing host community**

- » The host community must be informed and willing to accept the project.
- » Communities will only be considered for this project if they willingly enter the process.
- » Communities that decide to participate have the right to end their involvement at any point up to and until a final agreement is signed.

#### **Foster the long-term well-being of the host community**

- » The host community has a right to benefit from the project.

#### **Involve those who are potentially affected**

- » The questions and concerns of surrounding communities and those on the transportation route must be addressed.
- » The NWMO will involve all potentially affected provincial governments.

#### **Respect Aboriginal rights, treaties and land claims**

- » The siting process will respect Aboriginal rights and treaties and will take into account unresolved claims between Aboriginal peoples and the Crown.

**STEPS IN THE PROCESS – AT A GLANCE**

The process is designed to be flexible and adaptive to allow individual communities to proceed at a pace and in a manner that reflects their needs and preferences.

Getting Ready	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.
Step 1	The NWMO initiates the siting process with a broad program to provide information, answer questions and build awareness among Canadians about the project and siting process.
Step 2	Communities identify their interest in learning more and request that an initial screening be conducted.
Step 3	For interested communities, a preliminary assessment of potential suitability is conducted.
Step 4	For interested communities, potentially affected surrounding communities are engaged if they have not been already, and detailed site evaluations are completed.
Step 5	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.
Step 6	The NWMO and the community with the preferred site enter into a formal agreement to host the project.
Step 7	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.
Step 8	Construction and operation of an underground demonstration facility proceeds.
Step 9	Construction and operation of the facility.

The guiding principles and steps in the process are described in more detail in *Moving Forward Together: Process for Selecting a Site for Canada's Deep Geological Repository for Used Nuclear Fuel*, available on the NWMO website or by request.



## **Protecting People and the Environment**

Any site that is selected to host this facility must be able to safely contain and isolate used nuclear fuel for a very long period of time. Any site selected will need to address scientific and technical siting factors that will acknowledge precaution and ensure protection for present and future generations.

The ability of a deep geological repository to safely contain and isolate used nuclear fuel relies on the form and properties of the waste, the human-made or engineered barriers placed around the waste, and the natural barriers provided by the host rock formation in which the repository will be located.

The site will be evaluated through a series of progressively more detailed scientific and technical assessments, beginning with desktop studies, and progressing with field studies, and finally detailed site characterization. These assessments will be used to develop a robust safety case for the review, and if appropriate, approval of regulatory authorities.

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, the guidance of the International Atomic Energy Agency and experience in other countries with nuclear waste management programs.

Key safety-related questions such as the following will be addressed:

- » Are the characteristics of the rock at the site appropriate to ensuring the long-term containment and isolation of used nuclear fuel from humans, the environment and surface disturbances caused by human activities and natural events?
- » Is the rock formation at the site geologically stable and likely to remain stable over the very long term in a manner that will ensure the repository will not be substantially affected by geological and climate change processes such as earthquakes and glacial cycles?
- » Are conditions at the site suitable for the safe construction, operation and closure of the repository?
- » Is human intrusion at the site unlikely, for instance through future exploration or mining?
- » Can the geologic conditions at the site be practically studied and described on dimensions that are important for demonstrating long-term safety?
- » Can a transportation route be identified or developed by which used nuclear fuel can safely and securely be transported to the site from the locations at which it is stored?



## **Community Well-Being**

Beyond ensuring safety, the NWMO's commitment to any host community and region is that its long-term well-being or quality of life will be fostered through its participation in this project.

The project will be implemented in a way that fosters the long-term well-being or quality of life of the community and region in which it is implemented. Depending on the community's vision for itself, this may include elements relating to:

- » economic health
- » the environment
- » safety and security
- » cultural dimensions
- » spiritual dimensions
- » social conditions
- » enhancing opportunities for people and communities

The project offers significant employment and income to the host community, region and province. However, with a project of this size and nature there is the potential to contribute to social and economic pressures that must be carefully managed. The NWMO will work with potentially interested communities, and their surrounding regions, as part of a long-term partnership to identify a plan to foster the well-being of the community through the implementation of the project.

The NWMO will work with the community to identify the processes and supports the NWMO will need to put in place to ensure the project helps foster well-being. The NWMO will work with the community to consider the effects of the project on factors such as:

- » Health and safety of residents and the community
- » Sustainable built and natural environments
- » Local and regional economy and employment
- » Community administration and decision-making processes
- » Balanced growth and healthy, livable community
- » Ability to avoid ecologically sensitive areas and locally significant features
- » Availability of physical infrastructure required to implement the project
- » Ability of the community, and the social infrastructure it has in place, to adapt to changes resulting from the project
- » Availability of routes (road, rail, water) and associated infrastructure to transport used fuel from existing storage facilities to the repository site, or potential to put these in place
- » NWMO resources required to put in place physical and social infrastructure needed to support the project

## Who We Are

The Nuclear Waste Management Organization (NWMO) was established in 2002 by Ontario Power Generation Inc. (OPG), Hydro-Québec and New Brunswick Power Corporation in accordance with the *Nuclear Fuel Waste Act (NFWA)* to assume responsibility for the long-term management of Canada's used nuclear fuel.

The NWMO is staffed by a team of professionals with a wide range of experience and skills, which include social, ethical and technical research, public engagement, finance and governance. The organization works with an extended group of consultants, practitioners and academics from across Canada and internationally to ensure that its work benefits from the best available research and experience.

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.**





The NWMO is guided by five fundamental values:

- » **Integrity** We will conduct ourselves with openness, honesty and respect for all persons and organizations with whom we deal.
- » **Excellence** We will pursue the best knowledge, understanding and innovative thinking in our analysis, engagement processes and decision-making.
- » **Engagement** We will seek the participation of all communities of interest and be responsive to a diversity of views and perspectives. We will communicate and consult actively, promoting thoughtful reflection and facilitating a constructive dialogue.
- » **Accountability** We will be fully responsible for the wise, prudent and efficient management of resources, and be accountable for all our actions.
- » **Transparency** We will be open and transparent in our process, communications and decision-making, so that the approach is clear to all Canadians.

The management of used nuclear fuel involves very long time frames, complex technical questions, and challenging social and ethical considerations. The NWMO has worked hard to listen to Canadians and is committed to continuing an open, transparent dialogue as we move ahead to implement Canada's approach for the long-term care of used nuclear fuel.





## FAQs

### **What is Canada's plan for the long-term management of used nuclear fuel?**

In 2007, the Government of Canada selected Adaptive Phased Management as the plan for safeguarding the public and the environment over the very long time in which Canada's used nuclear fuel must be managed. The cornerstone of this plan is containment and isolation of Canada's used nuclear fuel in a deep repository constructed in a suitable geological formation, in an informed, willing community. The plan will be implemented over many years through a process of phased and adaptive decision-making, guided by citizen engagement and the most advanced knowledge and expertise.

### **What are other countries doing?**

Internationally, countries are at different stages of designing or implementing their long-term management plans for used nuclear fuel. Canada's plan for a multiple-barrier system based on a deep geological repository is consistent with programs that have been developed in many other countries with nuclear power programs such as Sweden, Finland, France and the United Kingdom.

### **What facilities will be constructed?**

This national infrastructure project will involve the development of a deep geological repository with placement rooms for used nuclear fuel, approximately 500 metres underground. Supporting this repository will be an underground demonstration facility, surface buildings and a centre of expertise that will become a hub for national and international scientific collaboration.

### **How much land is required?**

The project will require a dedicated surface area of about 100 hectares (250 acres) for the surface buildings and associated facilities. The underground repository itself will require a subsurface area in suitable host rock of approximately 2.5 kilometres by 1.5 kilometres (375 hectares/930 acres) at a depth of about 500 metres.

### **What are the transportation requirements?**

Used nuclear fuel will be transported from the interim storage facilities where it is produced and safely managed now to the centralized site of the deep geological repository. Depending on the location of the site, this may involve the use of road, rail or water transport, or a combination of these modes, which are used widely today internationally. Transportation of this material will need to meet stringent requirements of Transport Canada and the Canadian Nuclear Safety Commission.

### **How will people and the environment be protected?**

A multiple-barrier system will safely contain and isolate the used nuclear fuel. The repository and containers for used fuel are designed to provide multiple engineered barriers using robust, corrosion-resistant materials. A further barrier is provided by the host rock in which the repository is built. The geology provides the principal barrier between the used fuel containers and the surface environment. Many years of investigation will be involved in demonstrating that the geology in that location meets strict technical safety requirements. Once placed in the repository, the used nuclear fuel will be monitored and retrievable.

### **How will the project be regulated?**

The project will be subject to a thorough and comprehensive regulatory review process to ensure that it is implemented in a manner that protects the safety of people and the environment, now and in the future. The Canadian Nuclear Safety Commission will review and assess the project and site locations, and ultimately will be responsible for issuing licences authorizing the project to proceed to different phases of its life cycle development. The Government of Canada, through Natural Resources Canada, monitors the NWMO on an ongoing basis to ensure compliance with the *Nuclear Fuel Waste Act*.

#### **How was the site selection process developed?**

The process of site selection for the deep geological repository reflects the ideas, experience and best advice of a broad cross-section of Canadians who participated in dialogues conducted over a two-year period. Thousands shared their thoughts with the NWMO on what an open, transparent, fair and inclusive process for making this decision would include. The NWMO has also drawn on experiences and lessons learned in site selection processes in Canada and other countries.

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#### **Has the NWMO identified some communities as potential hosts for the project?**

No. The NWMO will be seeking an informed and willing community to host the project. The project will not be imposed on any community. Communities that are interested in learning more about the NWMO, Adaptive Phased Management and the deep geological repository for used nuclear fuel are invited to contact the NWMO. Communities that express interest in learning more are not obliged to participate in the site selection process.

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#### **Has the NWMO ruled out certain areas?**

No. Many areas in Canada have the potential geological formations to safely and securely contain the used nuclear fuel. Detailed surface and subsurface investigations will be needed to confirm whether a specific site is in fact suitable. These detailed assessments will be undertaken on sites in communities that come forward with potential interest in hosting the project.

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#### **What are the benefits for a community and region that host the project?**

The project will be implemented through a long-term partnership involving the community, the larger region in which it is located and the NWMO. It is important that it be implemented in a way that will help foster long-term well-being and sustainability. The development and operations of the facilities will generate thousands of jobs in the host region and potentially hundreds of jobs in a host community for many decades.

#### **How will the project be funded?**

The *Nuclear Fuel Waste Act* requires that the planning, development and implementation of the project be 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 *Act* requires these 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 *Act* requires the NWMO to maintain a funding formula and establish the amount of deposits to trust funds required by each company on an annual basis.

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#### **How can I learn more about Canada's plan for the long-term management of used nuclear fuel?**

The NWMO is providing opportunities for interested individuals, organizations and communities to learn more about Canada's plan for the long-term management of used nuclear fuel, the activities of the NWMO, and the process it will use to select an informed and willing community to host this project. Communities that express interest in learning more are not obliged to participate in the site selection process.

To learn more about this important initiative, please contact:

#### **Jamie Robinson, Director, Communications**

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