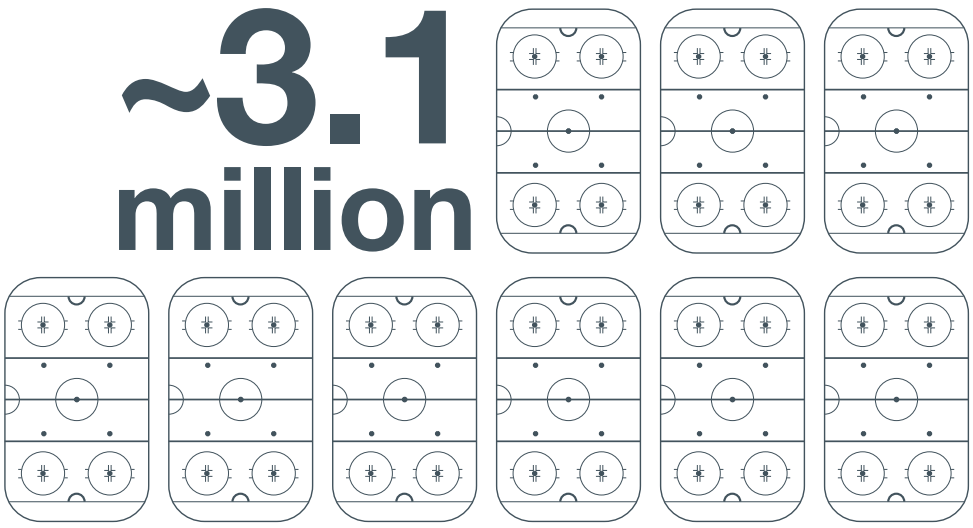
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

What is used nuclear fuel?

For decades, Canadians have been using electricity generated by CANDU nuclear power reactors in Ontario, Quebec and New Brunswick. Used nuclear fuel is a byproduct of this process.

Currently, used nuclear fuel is safely stored on an interim basis at existing reactor sites in Canada. The current storage method is safe, but temporary.

Through the *Nuclear Fuel Waste Act* (*NFWA*), the Government of Canada assigned responsibility for the safe, long-term management of Canada's used nuclear fuel to the Nuclear Waste Management Organization (NWMO). We led the development of a long-term plan, called Adaptive Phased Management (APM), that is based on the values and priorities of Canadians and Indigenous peoples and that aligns with international best practices. We are now implementing that plan.

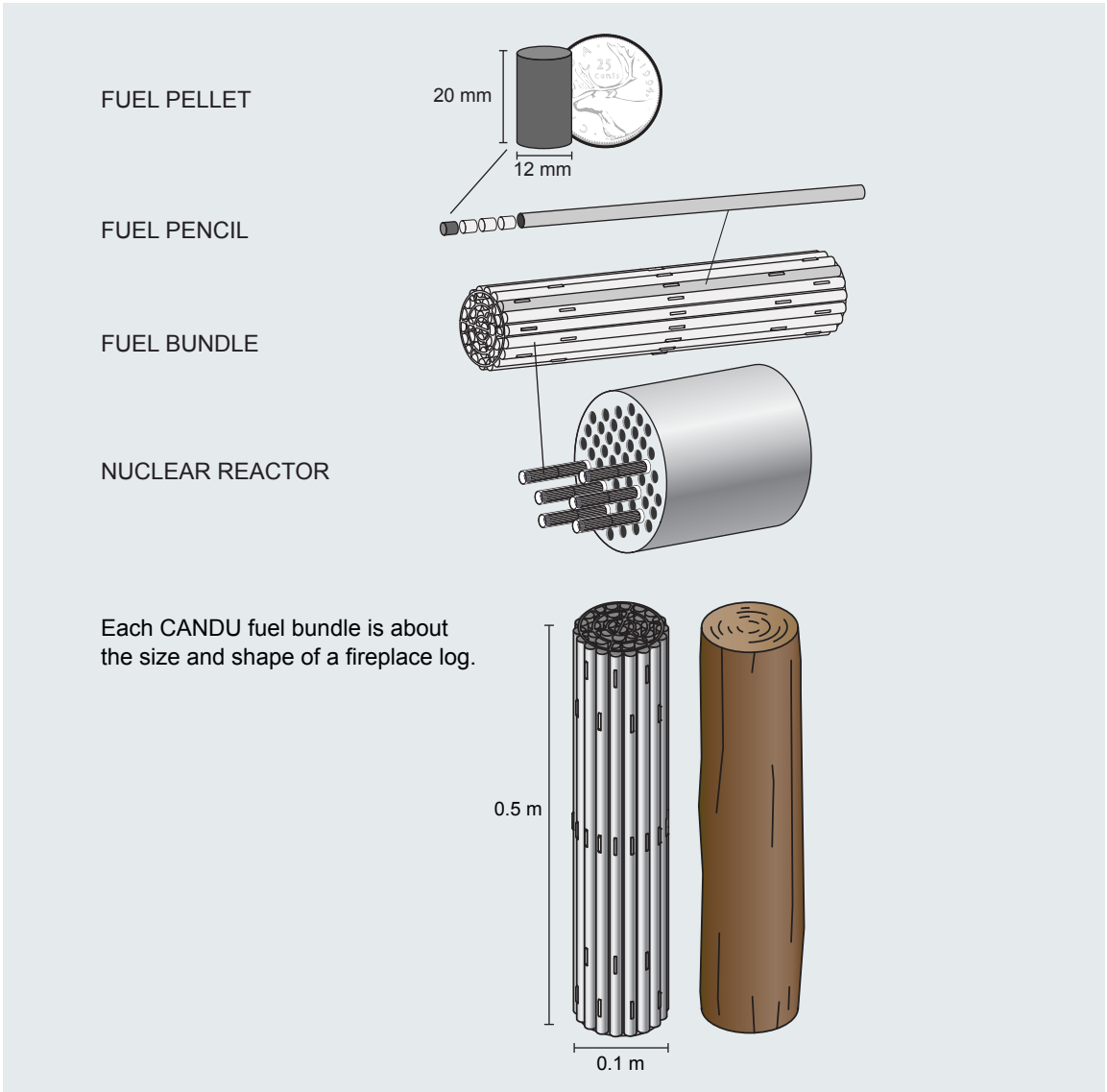


As of June 30, 2021, there are about 3.1 million used CANDU nuclear fuel bundles in Canada. If stacked like cordwood, all this used nuclear fuel could fit into about nine hockey rinks from the ice surface to the top of the boards. At the end of the planned operation of Canada's existing nuclear reactors, the number of used CANDU nuclear fuel bundles could total up to about 5.5 million.

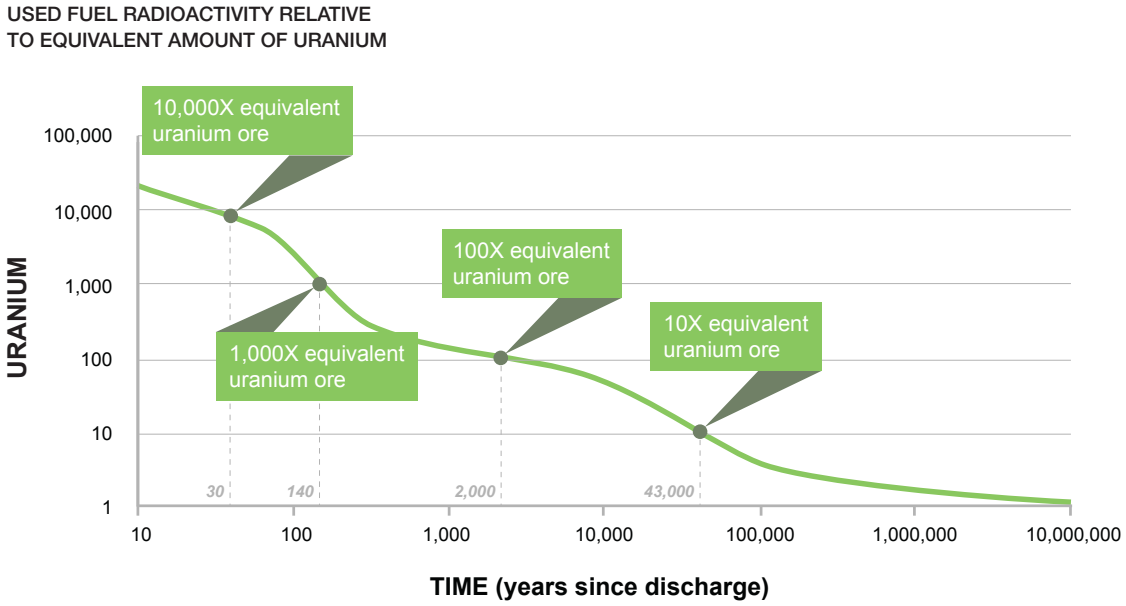
CANDU nuclear fuel

Canadian used nuclear fuel is not a liquid or a gas – it is a stable solid. Under Canadian and international regulations, it is not classified as a flammable, explosive or fissile material.

CANDU nuclear fuel consists of uranium dioxide (UO_2) made from natural uranium. During fabrication, UO_2 powder is pressed into solid pellets and then baked into a ceramic form. The ceramic pellets are placed inside a tube made of a zirconium-tin alloy, with the completed assembly called a fuel element or fuel pencil. These fuel pencils are welded together into bundles the shape and size of a fireplace log. Each CANDU fuel bundle is about 0.5 metre long, has a diameter of about 0.1 metre, contains about 20 kilograms of uranium, and has a total mass of about 24 kilograms.



Radioactive decay over time in used CANDU fuel



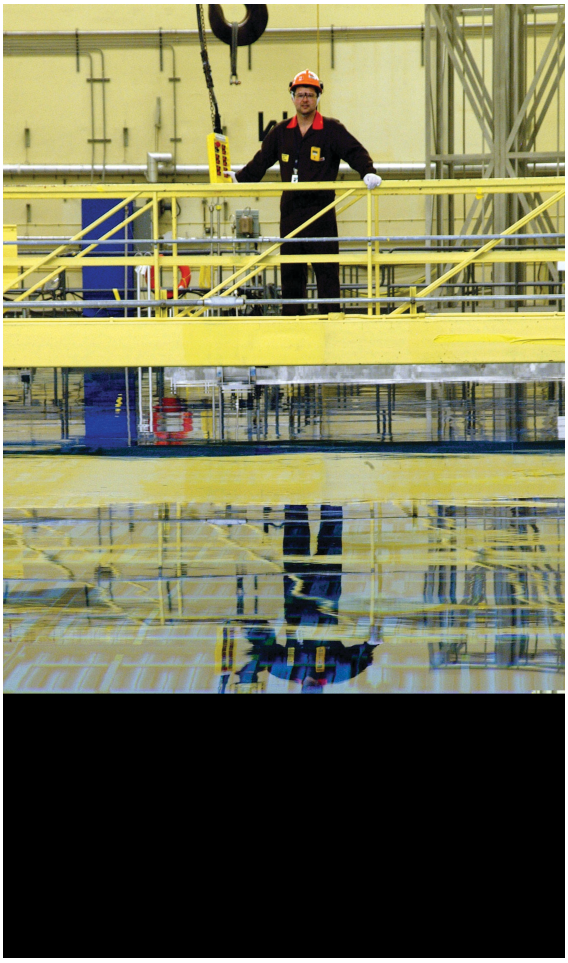
Although its radioactivity level decreases rapidly with time, residual radioactivity (together with some chemical toxicity) persists, and the used fuel remains a potential health risk for many hundreds of thousands of years.

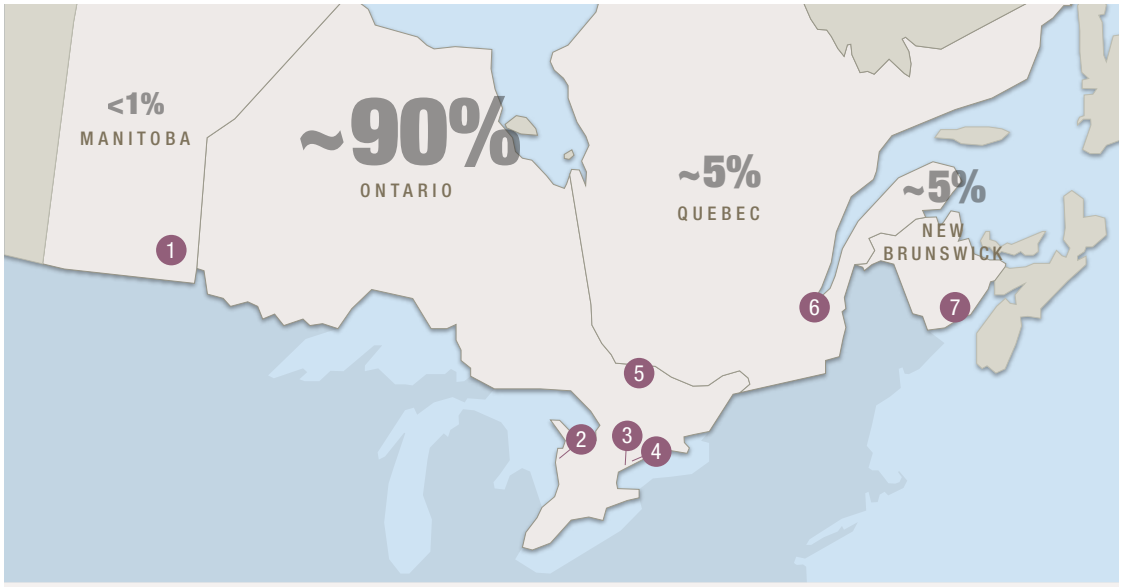
When CANDU fuel is removed from the reactor at the end of its useful life, it is considered a waste product. Used fuel is highly radioactive and requires careful management. Although its initial radioactivity level decreases rapidly with time, residual radioactivity (together with some chemical toxicity) persists, and the used fuel remains a potential health risk for a very long period of time.

It will take about one million years for the radioactivity level to reach about that of an equivalent amount of natural uranium.

How used nuclear fuel is stored today

When used nuclear fuel bundles are removed from a reactor, they are placed in a water-filled pool to reduce their heat and radioactivity. After seven to 10 years, the bundles are placed in dry storage containers, silos or vaults. Dry storage is a proven technology that has been in use around the world since the 1980s.





● **Interim storage facilities**

1. Whiteshell Laboratories, Man.
2. Bruce Nuclear Generating Station, Ont.
3. Pickering Nuclear Generating Station, Ont.
4. Darlington Nuclear Generating Station, Ont.
5. Chalk River Laboratories, Ont.
6. Gentilly Nuclear Generating Station, Que.
7. Point Lepreau Nuclear Generating Station, N.B.

Used nuclear fuel is safely stored near or at the sites where it is produced in facilities licensed by the national regulator – the Canadian Nuclear Safety Commission. There are also small quantities of used research and development fuels in licensed facilities at Atomic Energy of Canada Limited's Canadian Nuclear Laboratories.

Canada has a robust regulatory framework that governs the handling of used nuclear fuel. Used nuclear fuel is carefully managed and shielded at all times to ensure that no one is exposed to an unshielded bundle.

What is the long-term plan for used nuclear fuel?

Canada's plan, known as Adaptive Phased Management (APM), is both a technical method (what we plan to build) and a management system (how we will work with people to get it done).

The end point of the technical method is the centralized containment and isolation of Canada's used fuel in a deep geological repository in an area with suitable geology and informed and willing hosts.

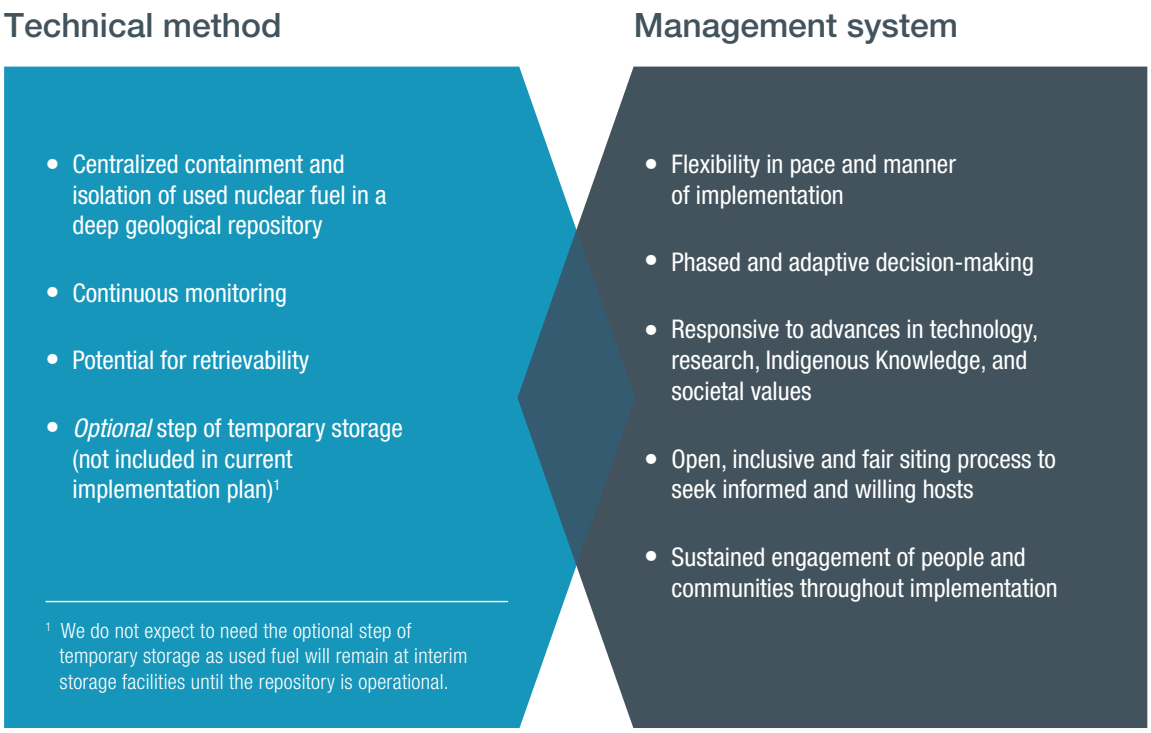
APM also involves the development of a transportation system to move the used fuel from the facilities where it is currently stored to the new site.

The management system involves realistic, manageable phases, each marked by explicit decision points. It allows for flexibility in the pace and manner of implementation, and fosters the sustained engagement of people and communities throughout its implementation.

APM is also designed to meet rigorous safety standards throughout all aspects of its design and implementation.

Canada's plan emerged from dialogue with Canadians, Indigenous peoples and experts, and best meets the key priorities considered important by citizens. It was selected as Canada's plan by the federal government in June 2007.

The plan is consistent with the long-term management approach adopted by other countries with nuclear power programs, such as Finland, Sweden, Switzerland, the United Kingdom and France.



How much used nuclear fuel will be managed?

The *NFWA*, which was passed by the Government of Canada in 2002, requires the NWMO to manage all used nuclear fuel produced in Canada. This includes the used fuel bundles that exist now and those produced in the future, including those created using new or emerging technologies.

Currently, Canadian reactors produce about 90,000 used CANDU fuel bundles per year. If Canada's existing reactors operate to the end of their planned current lives, including planned refurbishments,

the inventory of used fuel that will need to be managed in the facility could be about 5.5 million bundles, depending on future operating experience.

The NWMO's deep geological repository will need to be large enough to contain and isolate the inventory of used fuel from nuclear plants in Canada. Canada's plan was developed for managing Canada's used nuclear fuel. No foreign used fuel will be placed in the repository.

In the future, decisions about nuclear power generation made by provincial governments, nuclear plant operators and regulators may result in a larger inventory and perhaps different types of used fuel. For instance, the lives of existing reactors might be extended through additional refurbishment. Provincial governments may also decide to build new nuclear plants. For example, the government of Ontario and Ontario Power Generation have recently announced plans for a new Small Modular Reactor (SMR) to be constructed by the late 2020s.

There is also an active research sector exploring other new technologies such as fuel reprocessing and other types of advanced reactors. Canada's plan will be implemented over many decades, and a fundamental tenet of our approach is incorporating new knowledge and adapting to new technology. The NWMO is committed to working with key stakeholders to ensure future fuel types and inventory can be safely accommodated. We actively encourage organizations developing new concepts to work with us to identify the types of fuel waste that may result.

No matter the source of the fuel, safety will always be our top priority.

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