

# Small Modular Reactors: Managing Used Fuel

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The Nuclear Waste Management Organization (NWMO) is responsible for implementing Canada's plan for the safe, long-term management of used nuclear fuel – including that created using new or emerging technologies.



Canada has been using CANDU nuclear reactors to generate electricity for more than half a century. Used nuclear fuel is a by-product of this process. In the future, new nuclear technologies and decisions about nuclear power generation made by governments, operators and regulators may also result in different types of used fuel.

Canada's plan, known as Adaptive Phased Management (APM), requires used nuclear fuel to be contained and isolated in a deep geological repository. This approach is consistent with international best practice for managing high-level radioactive waste.

## **Small Modular Reactors**

In Canada, there is an active research sector exploring new technologies such as small modular reactors (SMRs), fuel reprocessing and other types of advanced reactors.

We encourage organizations developing new concepts to work with us to identify the types of fuel waste that may result.

SMRs may provide an alternative to large-scale nuclear reactors. They could come with less up-front capital costs, simpler designs and could run with fewer workers. They could also be purchased and constructed in a modular way. They may even generate less long-lived, high-level waste requiring management in a deep geological repository.

## Adapting to New Knowledge

Canada's plan will be implemented over many decades, and a fundamental tenet is incorporating new knowledge. We will adapt plans in response to advances in technical learning and international best practices, ongoing public input, Indigenous Knowledge, changes in public policy and evolving societal expectations and values.

We encourage organizations developing new concepts to work with us to identify the types of fuel waste that may result. The planning to accommodate this material will take time, and starting early will ensure we are prepared to manage all of Canada's used nuclear fuel when the repository begins operating.

The specific amount and type of used fuel to be placed in the repository will be agreed with host communities using the best information available and through an open and transparent process. Regulatory review processes and approvals, which are required by law before the facility can be constructed and operated, will be based on an agreed fuel inventory and will also involve an open and transparent consultation process.

## The NWMO and Used Nuclear Fuel

The NWMO was established as a not-for-profit organization in 2002 in accordance with the *Nuclear Fuel Waste Act (NFWA)* to manage all of Canada's nuclear fuel waste. Today, a comprehensive process is well underway to identify a suitable repository site with an informed and willing host. We expect to identify a preferred site by about 2023.

## Ensuring Safety

Fuel waste will need to meet certain criteria to ensure the NWMO can accept it and meet all safety requirements.

### » Physical requirements

Waste forms in the repository must be a durable, solid material that will not react chemically or release radionuclides rapidly should they come into contact with groundwater. For waste forms not considered durable, the waste owner would be responsible for converting them into a durable waste form before we could accept them for management in the repository.

Waste forms in the repository must be a durable, solid material.

### » Characterization requirements

To accept fuel waste for management in the repository, we will need detailed information about characteristics such as physical, chemical and elemental composition, radionuclides, handling information and the length of time since it was removed from the reactor.

» **Repository requirements**

Once we have sufficient information about new types of fuel to be managed, we will determine potential impacts to repository designs. For example, new types of fuel may need to be packaged and arranged differently than current design concepts allow.

» **Transportation requirements**

The waste form must be transportable to the repository site, ideally fitting into a standard NWMO transport package. If not, there would be incremental costs to develop and license an appropriate transport package. There must also be an acceptable route to safely move the waste to the repository.

### **Costs for Waste Owners**

The implementation of Canada's plan is funded by Canada's major owners of used nuclear fuel. Each waste owner makes annual deposits to trust funds to ensure the money needed over the life of the project is available by the time construction begins. These contributions are based on the number of used CANDU fuel bundles each member is expected to generate.

The *Nuclear Fuel Waste Act* considers the potential for new market entrants, and the government-approved formula used to determine funding for APM anticipated this eventuality.

For emerging technologies, the NWMO would provide a fee for service at fair and reasonable costs to determine the long-term management requirements and associated costs for the resulting fuel wastes. If a new technology is deployed and there is a new fuel waste owner, the NWMO would determine

the long-term costs and establish the appropriate funding mechanism for accommodating these wastes.

Waste owners are responsible for interim storage of their used fuel waste until the repository is in place. They are also responsible for managing other types of waste, such as low- and intermediate-level waste or radioactive medical waste. This approach is consistent with Canada's radioactive waste policy framework.

“...the *NFWA* requires the NWMO to provide its services to new waste owners for managing nuclear fuel waste over the long-term at a fair and reasonable cost.”  
Minister of Natural Resources, April 2009, in letter approving funding formula.



NUCLEAR WASTE  
MANAGEMENT  
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SOCIÉTÉ DE GESTION  
DES DÉCHETS  
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