NUCLEAR *facts*

How is used nuclear fuel managed?

THE FUEL FOR CANDU NUCLEAR POWER REACTORS IS IN THE FORM OF BUNDLES OF TUBES CONTAINING PELLETS OF URANIUM OXIDE. THE BUNDLES ARE INSERTED INTO AND REMOVED FROM THE REACTOR BY REMOTELY OPERATED FUELLING MACHINES. TYPICALLY A BUNDLE WILL RESIDE IN THE REACTOR FOR ABOUT TWO YEARS.

When the fuel is removed from the reactor it looks much the same as when it was put in. However, there is a very important difference. New CANDU fuel bundles are so slightly radioactive that they can be picked up safely and carried by hand. When the fuel is discharged from the reactor it is highly radioactive and cannot be handled directly.

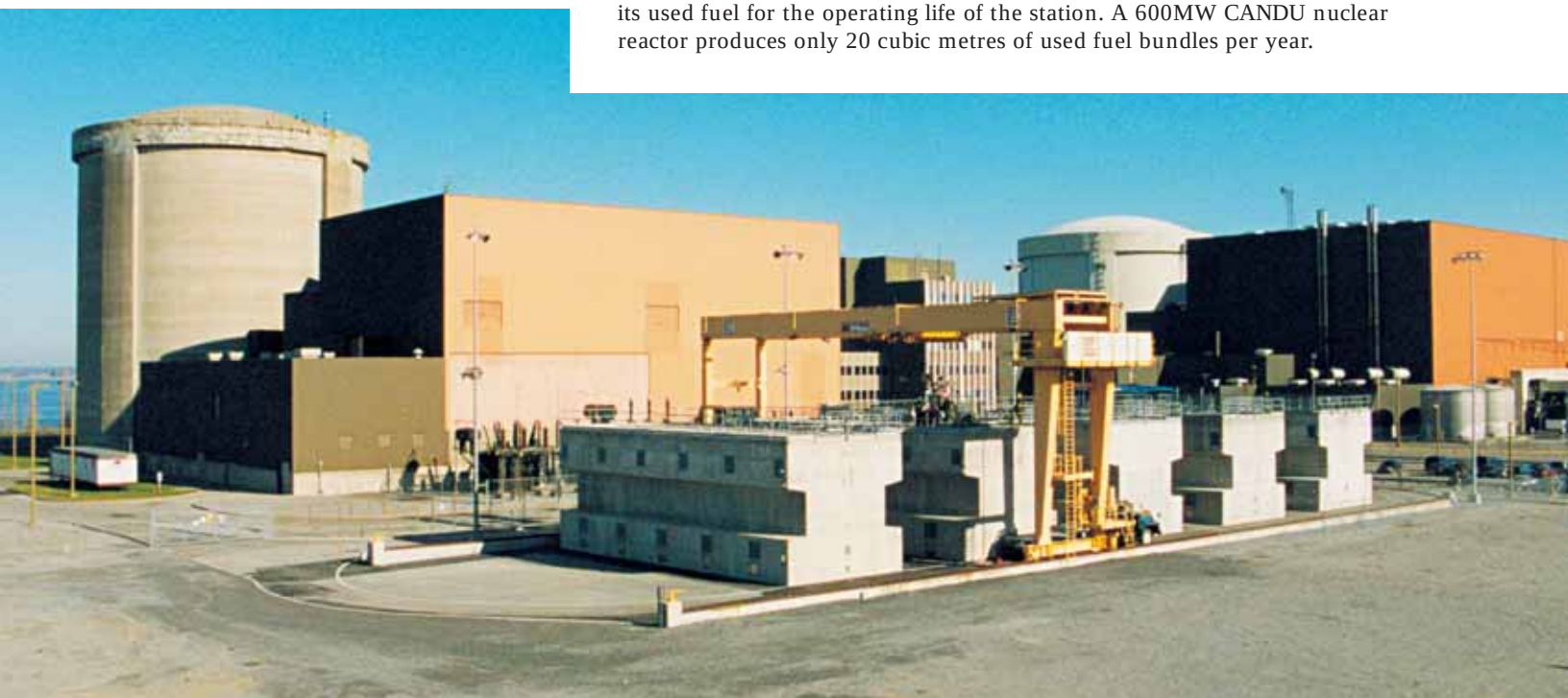
Used fuel is sometimes referred to as "high-level nuclear waste." This is something of a misnomer since only a very small portion of the used fuel is waste; radioactive by-products of the fission process. The bulk of the used fuel contains a large energy potential that could be harnessed by recycling.

Used nuclear fuel is perceived by some to be uniquely hazardous. However, like many non-radioactive but toxic materials that require permanent isolation, the potential hazard can be eliminated by careful isolation and management.

How do we currently manage used fuel?

Used fuel from nuclear generating stations in Canada is stored on-site. Similarly, that from the research reactors of Atomic Energy of Canada Limited is stored at that company's Chalk River Laboratories. When the fuel first exits the reactor it is placed in water-filled bays. Water cools the fuel and shields the radiation. After several years in the bays, when the radioactive fission products have largely decayed and the associated heat generation has diminished, the used fuel can be transferred to dry storage on-site, typically large concrete cylinders. There is enough space at each nuclear generating station to store all its used fuel for the operating life of the station. A 600MW CANDU nuclear reactor produces only 20 cubic metres of used fuel bundles per year.

Used nuclear fuel is stored in concrete containers, as shown here at Gentilly in Quebec.



Who pays for used fuel management?

The cost of on-site storage of used fuel is included in the total operating costs of the station, reflected in the electricity rate we pay. The proposed *Nuclear Fuel Waste Act* (which was introduced to Parliament in April 2001 as *Bill C-27*) would require the utilities operating nuclear power plants to form a Waste Management Organization to deal with long-term management and also to establish a trust fund to cover all future costs.

What are the alternatives to on-site storage?

There are a number of alternatives to on-site storage for the long-term management of used nuclear fuel. One method would be to gather all used fuel in a central place and store it in concrete canisters on or near the surface. To ensure the continuing security of this method, the canisters would need to be monitored on an ongoing basis as they are now at reactor sites. Permanent isolation is another method considered by nations with nuclear power programs. This method would not rely on long-term human supervision but on passive safety. A number of such options are being examined in several countries. These options include isolation in granite, in salt domes and other solid rock formations. Finland and Sweden are proceeding with the development of geologic disposal facilities for their used nuclear fuel.

What is an isolation vault?

Extensive research and testing was carried out by Atomic Energy of Canada Limited (AECL) on a concept for permanent disposal of used fuel in a vault deep in stable granitic rock in the Canadian Shield. As part of this research, AECL constructed its Underground Research Laboratory (URL) near the town of Lac du Bonnet in Manitoba, to demonstrate the conceptual designs for isolation and storage of spent fuel. A single vault could hold all the used fuel arising from 100 years of operation of all existing Canadian nuclear generating stations. Many sites can be found in the Canadian Shield that would meet the geological requirements established by Canadian and international scientists for the safe isolation of high-level nuclear waste. Many of the rock formations in the Canadian Shield have been in place for two billion years.

Is permanent isolation safe?

A federal Environment Assessment Panel (sometimes referred to as the Seaborn Panel after its chairman) examined the concept for an isolation vault described above. In its report issued in 1998, the Panel found the safety of the concept had been adequately demonstrated from a technical perspective but that there were questions about public acceptability.

A number of uranium ore bodies in the world provide valuable evidence about geological containment. The Oklo deposit in Gabon, the Koongara in Australia, and Cigar Lake in Saskatchewan are some of the best known examples. The Cigar Lake deposit has been buried under porous, wet sandstone for more than a billion years, yet has retained its radioactive components so well there is no trace of them at the surface.

Longterm Care of Canada's Used Nuclear Fuel

The Nuclear Waste Management Organization (NWMO) was established in 2002 to develop with Canadians a management approach for the long term care of Canada's used nuclear fuel. In 2007, the Government of Canada selected the NWMO's recommended approach, Adaptive Phased Management. The NWMO is now responsible for collaboratively implementing the plan with Canadians.

Adaptive Phase Management features:

- Centralized containment and isolation of used nuclear fuel in a deep geological repository in a suitable rock formation.
- Continuous monitoring with the potential for retrieval for an extended period of time.
- An informed and willing host community.
- Ongoing public engagement.

Used nuclear fuel will remain safely stored at Canadian nuclear reactor sites until the design, siting, environmental assessments, licensing, site-specific R&D, transportation systems, confirmation of site suitability, final design, safety analysis and decision to construct are completed.

Citizens will be engaged in decision-making at every stage of implementation.

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