

# Refurbishment of Gently-2 Nuclear Power Plant

Nuclear power is a reliable, efficient, safe and GHG-free source for meeting global energy needs. Gently-2, Québec's only nuclear power plant, has been producing high-quality power for 25 years. With an installed capacity of 675 MW, it produces 5 TWh a year, equivalent to the power consumption of more than 270,000 households, or 3% of Hydro-Québec's total generated output.



## Project description

Gently-2 power plant was commissioned in 1983, and nuclear power plants of its type have a service life of approximately 30 years. Based on numerous technical, economic and safety studies, Hydro-Québec has determined that it is economically and environmentally preferable to refurbish the existing facilities rather than to decommission the plant. The refurbishment project is therefore designed to extend the life of a facility with a proven reliability and safety record.

The same studies also served to determine the exact nature of work required. All work will be carried out in accordance with appli-

cable industry regulations. The project will include the preparation of detailed work procedures and will be submitted to a strict quality assurance program.

The project has two parts: **the refurbishment of Gently-2** and **the construction of a Solid Radioactive Waste Management Facility (SRWMF)**, which together will extend the plant's service life until 2040.

## Keeping the community informed

Hydro-Québec publishes annual plant operations and environmental monitoring reports.

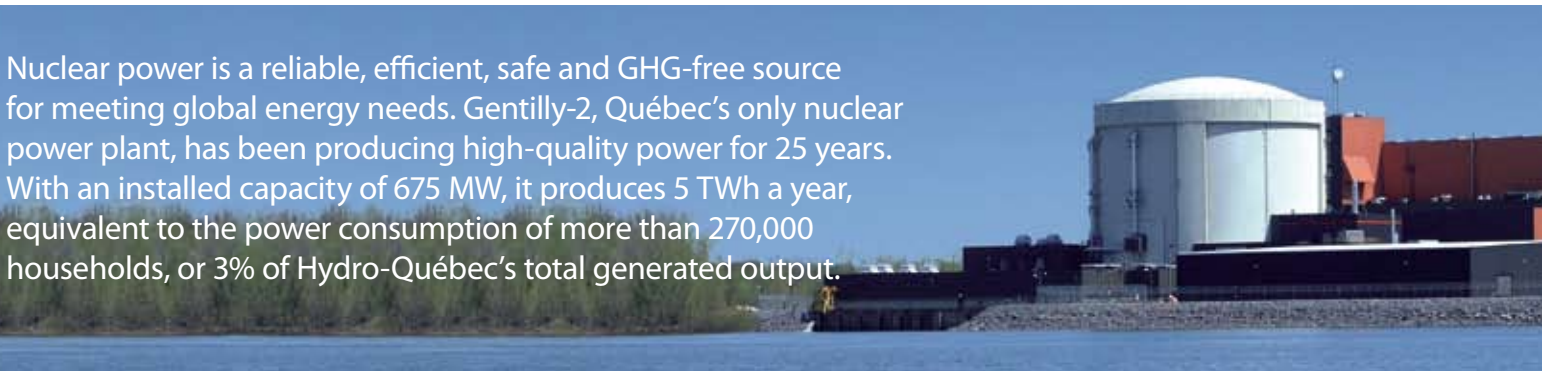
As part of the draft-design phase, the community has been kept informed since 2003 through information and discussion panels, public consultation campaigns, information bulletins, articles in regional newspapers and a Web site. In addition, public hearings on the project's environmental impact assessment were held.

The utility will also introduce communication initiatives for the refurbishment project to facilitate discussion and continue to disseminate information.

## Economic benefits

Operation of Gently-2 nuclear power plant represents a major contribution to the economies of the Mauricie and Centre-du-Québec regions. It provides more than 800 jobs and generates regional direct spinoffs of about \$100 million a year. Furthermore, the power plant's presence has led to the development of high-calibre nuclear expertise in these regions, which is being transmitted by recognized Québec colleges and universities.

The refurbishment project itself will create economic spinoffs of \$600 million in Québec, including \$200 million regionally. The plant refurbishment alone will create some 800 jobs over a 20-month period. Hydro-Québec will set up a committee to maximize the regional economic impact of the refurbishment and to facilitate communication with local business representatives.





## Protecting human health

### *Living near a nuclear power plant*

For more than 25 years, Gentilly-2 power plant has been managed and maintained to eliminate risks to the health and physical integrity of employees, the environment and the public.

Residents' average exposure to radiation from the plant's radioactive waste is estimated to be 200 times less than their exposure to the radiation from natural sources to which we are all exposed on a daily basis.

### *Working at Gentilly-2*

At Hydro-Québec, employee health and safety is of paramount importance.

More than 800 people work at Gentilly-2 on a daily basis. All personnel adhere to a strict, safety-oriented operational framework that emphasizes individual commitment and teamwork to ensure the protection of public health and the environment.

The safety of employees responsible for plant operation and refurbishment is managed according to all applicable standards, regulations and laws, as well as the principle of keeping radiation risk "as low as reasonably achievable" (ALARA).

The same safety measures apply to employees of contractors working on the site, who are also required to attend applicable training sessions on subjects such as radiation protection and health and safety.

## Protecting the environment

Environmental protection is one of Hydro-Québec's constant concerns.

The environmental impact assessment filed by the utility in 2004 was accepted by the Canadian Nuclear Safety Commission (CNSC) and Québec's Ministère du Développement Durable, de l'Environnement et des Parcs (MDDEP). The impact assessment led to an environmental monitoring and follow-up program for each phase in the construction of the Solid Radioactive Waste Management Facility (SRWMF) and for the plant refurbishment project.

Once the construction and refurbishment are completed, the environmental monitoring program currently in force at the power plant will be applied to the facility as a whole.

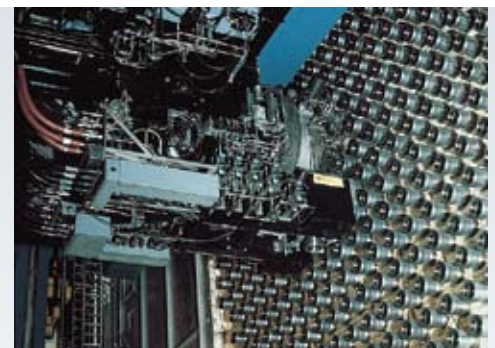
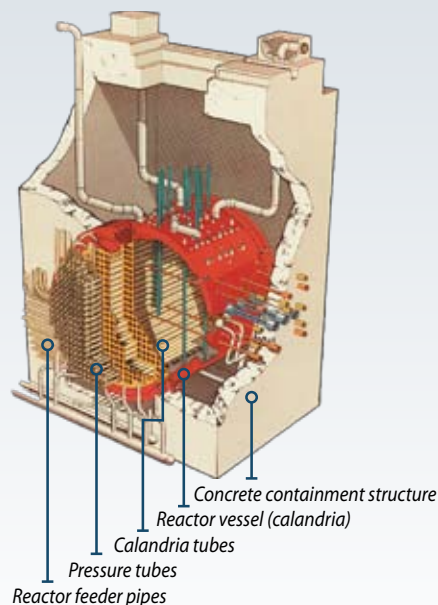
## Project steps

### *Power plant refurbishment*

Engineering and procurement will begin in 2008. The project will start in 2011 for a return-to-service in late 2012. The main steps in the project are as follows.

#### **Removal of fuel bundles**

Prior to refurbishing the reactor, a remotely controlled robot will remove the 4,560 fuel bundles and place them in the storage pool. This is a routine procedure: during normal operations, an average of 20 bundles are replaced daily at Gentilly-2.



Reactor face

#### **Reactor component refurbishment**

A remotely controlled device will also be used to replace the 380 pressure and calandria tubes, while the 760 reactor feeder pipes will be removed using a technique tested and proven at Point Lepreau.

## Important lessons:

### Refurbishment of New Brunswick's Point Lepreau Power Plant

In December 2006, seven Gentilly-2 employees joined the New Brunswick Power team at Point Lepreau Power Plant. This facility being similar to Gentilly-2, the Hydro-Québec staff will gain pertinent experience during the refurbishment activities there. This experience will be very helpful in the planning and execution of the Gentilly-2 refurbishment project. The Point Lepreau refurbishment started in March 2008 and will be completed in fall 2009.

## Government approvals

### Provincial

2004	BAPE public hearing held under the Environment Quality Act
2007	SRWMF* phase 1 construction approvals received
2008	SRWMF* phase 1 operating licence granted

### Federal

2006	Canadian Nuclear Safety Commission (CNSC) public hearing on SRWMF construction and power plant refurbishment
2007	SRWMF* phase 1 construction approvals received from CNSC
2008	Modified CNSC operating licence received permitting operation of SRWMF* phase 1
2010	CNSC operating licence renewal request, which will specify the post-refurbishment return-to-service conditions for Gentilly-2

\*Hydro-Québec will submit a new request to provincial and federal authorities for the construction and operation of SRWMF phases 2, 3 and 4.

## Cost

Gentilly-2 refurbishment cost	\$1.9 billion
Post-refurbishment cost of generation	7.2 ¢ / kWh



Control room

### Other systems

Various types of work will be done to meet recent nuclear safety standards. This will include replacing equipment in the two shut-down systems, adding reactor trip parameters, automating part of the Emergency Core Cooling system and installing new valves. A new filtering ventilation discharge system will also be installed in the reactor building.

### Computer replacement

The two computers connected to the control panels of the plant's systems will be replaced.



Phase 1 of the Gentilly-2 SRWMF, constructed in 2007 and 2008

### Solid Radioactive Waste Management Facility (SRWMF)

Effective and safe management of radioactive waste is an everyday component of operating a nuclear power plant.

Phase 1 (2007–2008) of SRWMF construction will meet current operational needs for low- and medium-level radioactive waste storage.

Phase 2 (2009–2010) will be used to store waste produced during refurbishment of the plant.

Phases 3 and 4 will meet storage needs as long as the plant remains in operation.



Generating unit and moisture separator-reheaters

### Generating unit and related systems

Work on the generating unit will consist in replacing the generator rotor windings and the moisture separator-reheaters. In addition, the two turbine low rotors and diaphragms must be replaced and adjustments made to the turbine base plate.



## Hydro-Québec: Clean, renewable energy

Hydro-Québec is Canada's largest electric utility and one of the world's leading producers of clean, renewable and safe energy. With 97% of its output generated by water, Hydro-Québec is responsible for less than 1.5% of all greenhouse gases emitted by Canadian electric utilities.

As avenues for fulfilling its commitment to sustainable development, the company is focusing on energy efficiency, technological innovation and the continued development of renewable energy sources. In this connection, between now and 2015, Hydro-Québec will bring a significant amount of wind power onto its grid—up to 10% of its total installed capacity.

Nuclear energy is another efficient way to meet global energy needs without greenhouse gas emissions.

Because Gentilly-2 power plant does not depend on precipitation or wind, it adds diversity to Hydro-Québec's generating fleet and therefore increases the security of Québec's energy supply. In addition, as a reliable and non-intermittent source of power located close to major centres in the St. Lawrence River valley, it contributes to the stability and reliability of the Hydro-Québec transmission system.

### For more information

About Gentilly-2 power plant:  
[http://www.hydroquebec.com/generation/classics/nuclear/gentilly\\_2](http://www.hydroquebec.com/generation/classics/nuclear/gentilly_2)

About the Gentilly-2 refurbishment project:  
<http://www.hydroquebec.com/gentilly-2>

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## Nuclear energy: A global trend

Nuclear energy is found worldwide in both industrialized and developing economies. Used in 31 countries, it represents 16% of global electricity production. Many European countries rely heavily on nuclear power, including France (80%) and the United Kingdom (22%). In the United States, nuclear energy accounts for 19% of generated output. According to the International Atomic Energy Agency (IAEA), several dozen plants will be added worldwide in the next 20 years.

In Canada, 16% of all electricity is nuclear-based and produced with CANDU technology, which makes use of our abundant natural uranium. Many countries using this technology have opted to refurbish existing power plants instead of closing them and building replacements. In South Korea, refurbishment of the Wolsong 1 plant is currently in the planning stages. In Canada, three refurbishment projects are underway: at the Point Lepreau power plant in New Brunswick and at two reactors in Ontario's Bruce A nuclear complex. Québec's Gentilly-2 power plant will soon be added to the list.

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