

## HYDRO HALL OF FAME

# Petty Harbour: Bringing Hydroelectricity to an Island Community

*The 5.3-MW Petty Harbour Hydroelectric Development — commissioned in 1900 — was the first hydro plant built in the Canadian province of Newfoundland. The project still operates today, accounting for approximately 4 percent of Newfoundland Power's annual generation. This plant is the most recent inductee to Hydro Review's Hydro Hall of Fame.*

By John G. Evans and Ian R. Kerr

The geography of the area surrounding the 5.3-MW Petty Harbour Hydroelectric Development in Petty Harbour, Newfoundland, Canada, is largely unchanged since the time of the plant's construction at the turn of the century. The terrain surrounding the town consists of high rocky cliffs with prominent bedrock outcrops. The small fishing community lies on a cove off of the North Atlantic Ocean, about 12 kilometers south of St. John's, the oldest city in North America. Petty Harbour, which lies on Newfoundland's Avalon Peninsula, is perhaps best known as the scene of the 1977 movie *Orca: The Killer Whale*.

But while the area remains much the same, the role of the 2003 Hydro Hall of Fame inductee has changed. The

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plant's original purpose was to supply power to St. John's electric street railway system. It has continually operated since its commissioning in 1900 and today annually furnishes 18 gigawatt-hours of electricity to customers of Newfoundland Power Inc., a wholly owned subsidiary of Fortis Inc. That accounts for approximately 4 percent of the utility's generation.

The project was one of the first hydroelectric plants in Canada and the first hydroelectric plant in Newfoundland. It was constructed in conjunction with the St. John's street railway system. (The system's initial 8 kilometers of rails were completed in December 1899, when four streetcars served the city's population of approximately 31,000.)

The hydroelectric plant and the St. John's street railway system were the ideas of Robert G. Reid, owner of the St. John's Street Railway Company, and G.H. Massey, chief engineer for Reid's company. Reid was a Scottish civil engineer who had arrived in Canada in 1871. He established successful contracting and railway businesses in central Canada, and by 1890, reputedly, was a millionaire. Reid built the Newfoundland Railway, but a year before its completion in 1897, he had already turned

his sights to the city of St. John's.

In 1896, the Newfoundland government awarded Reid the rights to build and operate the St. John's street railway system and to construct the Petty Harbour hydroelectric plant to supply its power. The government also authorized Reid's company to sell any surplus electricity produced by the plant to corporations or individuals for power, light, or heating purposes.

When built, the plant had the second largest capacity in Canada, next in size to the DeCew Falls No. 1 plant near Niagara Falls, Ontario, Canada.<sup>1</sup>

The project's primary water source is an upstream 21.8 million-cubic-meter storage reservoir called Bay Bulls Big Pond — created by a 6-meter-high dam on Raymond's Brook (one of the tributaries of the Petty Harbour River). In 1921, the storage volume increased to 35 million cubic meters as a result of an approximate 3-meter increase in the height of the dam. Since 1976, this reservoir also has served as one of the major water supplies for the St. John's metropolitan area.

The waterworks included an open wooden flume and rock tunnel, which conveyed water from the forebay reservoir to the penstock. A surge tank installed during refurbishment/reconstruction of the project in 1926 remains in service today. Another interesting feature of the plant is the location of the powerhouse in the middle of town. Aside from the penstock, the powerhouse appears to be merely another commercial building in the community.

Equipment designer A.C. Rice initially specified a 1,400-kW early Francis-type turbine and a 550-volt, three-phase generator. The plant began operation in 1900 with a staff of eight to ten employees. Today, one person staffs the plant on a





The Petty Harbour Hydroelectric Development began operation in 1900 to supply power to the St. John's electric street railway. When the railway began service, four streetcars served a population of about 31,000.



The high rocky cliffs with prominent bedrock outcrops surrounding the 5.3-MW Petty Harbour Hydroelectric Development in Petty Harbour, Newfoundland, Canada, remain largely unchanged since this photo was taken at the turn of the 20th century.

part-time basis as a result of remote control capability and the fact that the plant no longer is as critical to service reliability as it was in the past.

The plant is named for the community of Petty Harbour, known in 1500 as "Petite Harbour," a seasonal base for the

Basque fishery. English adventurers moved in during the next century and prevailed in a conflict with Portuguese fisherman in 1618, when the area was known as "Petyte Harbour." During the 1600s, pirates used the harbor as a base and hiding place, and in 1637 an attempt

at English settlement there failed. By 1664, however, the area's name had been anglicized as "Petty Harbour." Settlement continued despite attacks from the French and discouragement from migrant fishermen who destroyed settlers' houses each season. By the mid-

## Technical Information

### Petty Harbour Hydroelectric Development

#### General Information

*Location:* Petty Harbour (approximately 12 kilometers south of St. John's, Newfoundland, Canada)  
*Owner:* Newfoundland Power Inc. (a Fortis Company)  
*Capacity:* 5.3 MW  
*Average Yearly Output:* 18 gigawatt-hours  
*Head:* 57.9 meters  
*Average Streamflow:* 5.6 cms  
*On-Line:* 1900  
*Original Design:* G.H. Massey, A.C. Rice  
*Original Construction:* Reid Newfoundland Company

#### Equipment:

**Turbines (3)**  
*Unit 2* (originally installed in 1900): Victor type (early Francis turbine) 1.4 MW  
 Manufactured by Stillwell, Bierce & Smith Vaile Co.  
*Replaced in 1908 with:* Horizontal Francis 1.57 MW  
 Manufactured by Voith  
*Unit 1* (originally installed in 1902): Inward-flow Girard type (impulse turbine) 1.4 MW  
 Manufactured by Stillwell, Bierce & Smith Vaile Co.  
*Replaced in 1912 with:*

Horizontal Francis  
 1.57 MW  
 Manufactured by Voith

*Unit 3* (installed in 1926): Horizontal Francis 2.05 MW  
 Manufactured by Armstrong Whitworth  
**Generators (3)**

*Unit 2* (installed in 1900): 3-phase, 60 Hertz, 550 volts  
 Manufactured by Westinghouse  
*Replaced in 1926 with:* 3-phase, 60 Hertz, 2,300 volts  
 Manufactured by General Electric  
*Unit 1* (installed in 1902): 3-phase, 60 Hertz, 550 volts  
 Manufactured by Westinghouse  
 Rewound in 1926 to 2,300 volts  
*Unit 3* (installed in 1926): 3-phase, 60 Hertz, 2,300 volts  
 Manufactured by General Electric

#### Construction

**Powerhouse**  
 48.8 meters long by 7.3 meters wide by 4.9 meters high  
 Masonry construction

#### Penstock

*Original:* 1,057 meters long, 2.4-meter by 2.4-meter cross-section wooden flume

112.2 meters long, 2.4-meter by 2.4-meter cross-section rock tunnel  
 115.2 meters long, 2-meter-diameter steel penstock

#### Replacements:

1926: 975-meter-long, 2.3-meter-diameter wood stave penstock

1953: Steel penstock (surge tank riser) replaced with 2.3-meter-diameter steel pipe

1999: Lower 740.7 meters of penstock replaced with 2.3-meter-diameter steel pipe

#### Intake Structure

Concrete with steel gate and lift (integral to forebay dam)

#### Dams and Reservoirs

##### Forebay

In 1900, rockfill with timber facing

In 1926, concrete gravity

Steel anchors added in 1992

9.1-meter maximum height

##### Bay Bulls Big Pond

Zoned earthfill (rebuilt 1998-1999)

Concrete outlet conduit

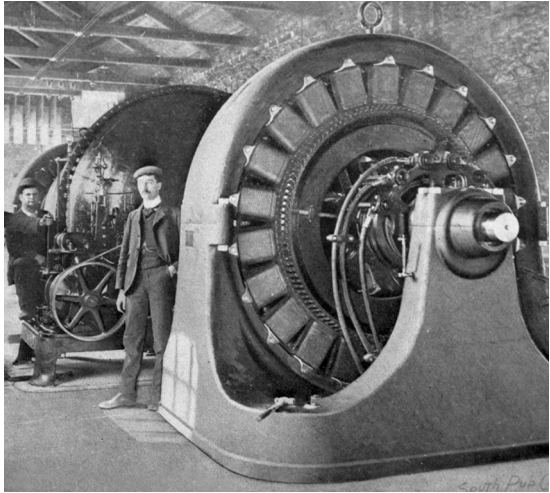
##### Cochrane Pond

Earthfill with concrete overflow spillway and timber crib outlet

##### Tailrace

Unlined canal excavated in rock

137 meters long



Petty Harbour's original turbine and generator operated from 1900 to 1926.

1800s, Irish and English were counted among the town's population of 747.

When the Petty Harbour project began in 1898, it brought alternate employment, as well as relatively inexpensive electricity. Soon after the project began operation, however, the owners realized that the growing demand for electricity — particularly during the drier summer months — exceeded the plant's ability to generate power. By 1907, the company was supplying electricity to 20,500 city lights compared to just 9,000 in 1901. As well, commercial and industrial operations in the city began converting their use of gas engines in favor of electricity.

To respond to the exploding demand for electricity, the plant owners installed a second unit in 1902. This unit had the same capacity as the original, but was of a different design. The new unit was an impulse wheel with an outward-flow

Girard-type runner and a unique governor arrangement linked to the unit's main gate valve.

In 1908, the original turbine was replaced with a 1.57-MW horizontal Francis turbine that used 50 percent less water and had greater capacity and efficiency. In 1912, the owners replaced the second turbine-generator unit to help meet the ever-increasing demand. Further increases in production were achieved in 1918 when, to alleviate summer water shortages, an additional watershed was diverted from the Manuel's River system to form a 2.3-million-

cubic-meter reservoir at Cochrane Pond.

The St. John's Street Railway Company operated the plant until 1926, when the company sold it to Newfoundland Light and Power — the predecessor to the current owner, Newfoundland Power. In response to the continued growth in demand for electricity, the new owner made major upgrades, which were designed by Montreal Engineering Company (currently part of AMEC), to all aspects of the project. Refurbishment/reconstruction included rewinding the generator that was installed in 1912 and adding a third turbine-generator. In 1981, the utility again upgraded Units 2 and 3 by replacing the runners and wicket gates to improve efficiency.

In 1978, the plant was entered in the Canadian Engineering Heritage Record, and tourists frequently visit due to its

scenic location and historic value. In addition to its role as a generating station, the plant and its operator also collect rainfall and streamflow data for publication by Environment Canada, a Canadian federal government department.

While the plant's current role is small relative to total provincial electricity needs, it still is one of the larger plants in Newfoundland Power's generation network of 23 small hydroelectric developments. Newfoundland Power and Fortis Inc. recognize that small hydro can be an environmentally friendly form of power generation and, therefore, continue to investigate potential sites throughout North and Central America. (The newest of Newfoundland Power's plants — the 6-MW Rose Blanche plant located on the province's southwest coast — was commissioned in 1998.) Despite the Petty Harbour plant's age and less significant role today, there is every reason to expect this plant to continue operation for the foreseeable future. ■

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#### Note

<sup>1</sup>Osborne, Bob, "DeCew Falls No. 1: Part of Canada's Hydroelectric Heritage," *Hydro Review*, Volume XVII, No. 6, November 1998, pages 42-44.