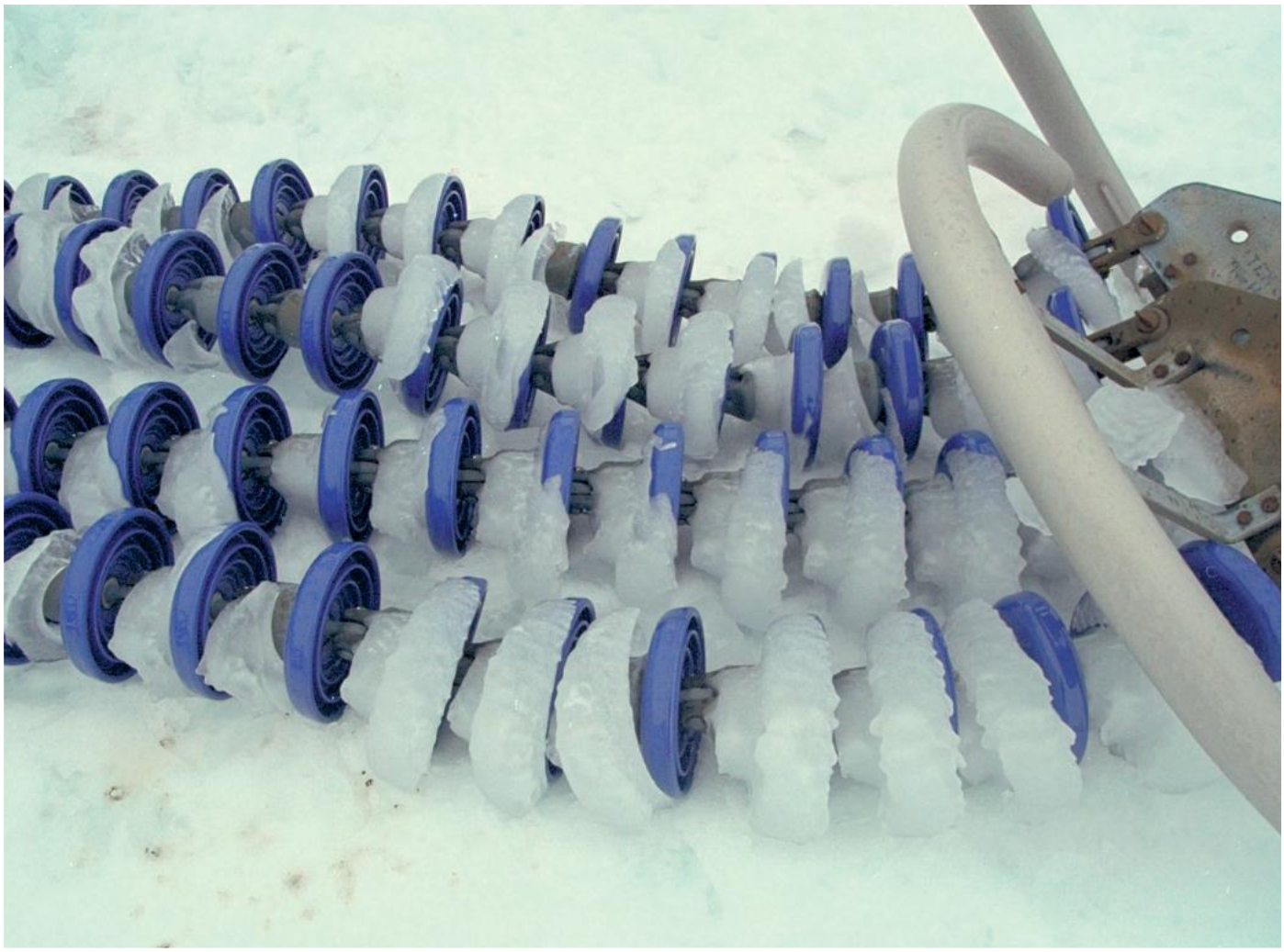
GE
Grid Solutions

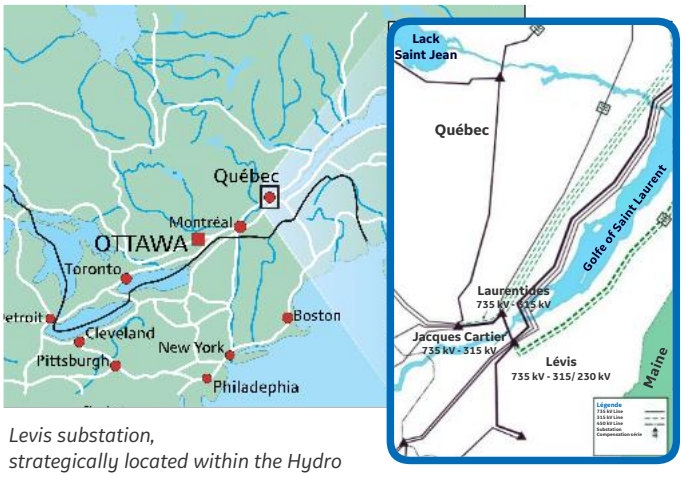
HVDCice™

The World's First HVDC de-icing equipment for Canada's Hydro-Québec

When a leading North American utility lost a large section of its transmission system due to an ice storm, it needed to find an efficient and economical solution to ensure that the situation never happened again.



Imagination at work



Levis substation, strategically located within the Hydro Quebec transmission network

Bolded lines are de-iced lines

The North American ice storm of January 1998 left 1.4 million Hydro-Québec customers in the dark for up to five weeks.

Customer Challenges

In 1998, the Québec region of Canada was hit by one of the worst ice storms in recorded history. While the eastern part of Canada was used to being affected by ice storms, this one was so severe that the weight of the ice literally pulled down 600 kilometres (370 mi) of high voltage transmission lines and 735 kV towers as well as 3,000 kilometres (1,900 mi) of medium and low voltage distribution lines. The situation left millions of people in the Montreal area without electricity, some for several weeks. This cost the utility millions of dollars to repair.

If this situation reoccurred, Hydro-Québec had to be equipped to ensure a minimum number of lines remained available to supply essential services to large cities like Montreal and Québec. However, they could not justify installing a de-icing system that would sit idle for the majority of the year. It had to be a dual purpose system that could somehow be adapted to the existing system and transmission lines.

Hydro-Québec's power network includes approximately 32,000 kilometres of transmission lines and over 500 high voltage substations connected to the neighboring grids at 18 different points, making these connections and lines an important link in the Canadian and North American power grid.

The idea was to find a way to effectively and efficiently combine a high voltage de-icing system with a system that could improve the network's stability and voltage control. Several proposals were considered but GE's solution was the most appropriate to meet Hydro-Québec's technical and functional specifications.

The Solution

GE designed the world's first combined HVDC-based de-icing and Static Var Compensator (SVC) system.

The system is flexible enough to be switched from SVC mode to de-icing mode in less than one hour. When not de-icing, the system functions as a reactive power compensator.

The de-icing is achieved by permitting the flow of high intensity direct current into the transmission lines. The heat produced melts and detaches the ice from the cables.

The process itself is simple. The lines must be disconnected at the substation level and isolated from the grid. The system will be switched to de-icing mode to allow the high intensity direct current to flow through the already isolated transmission line and melt the ice. Once the ice has melted - which takes between 30 minutes and a few hours depending on the thickness of the ice and the length of the line to be de-iced - the transmission line is reconnected to the grid, which takes approximately 30 minutes.

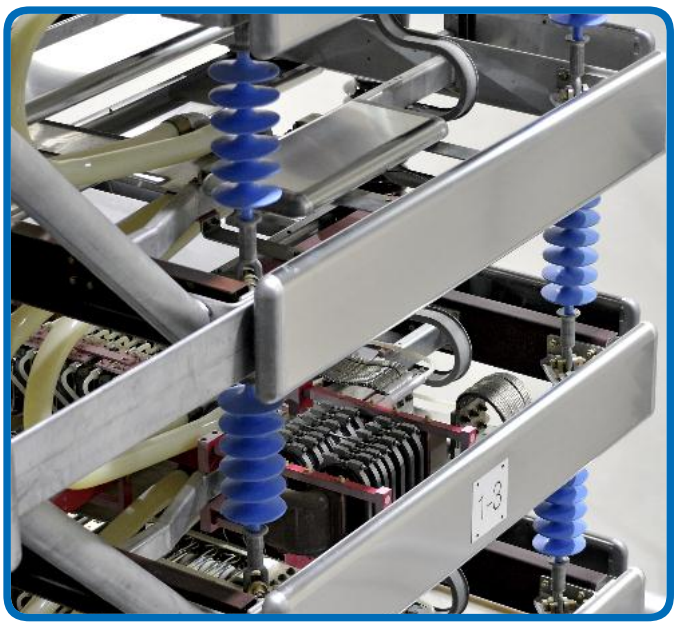
As it is a planned switch, transmission power can be re-routed to other lines, thus avoiding load interruption - even short term ones.

GE's system, which has the capability to protect approximately 600 kilometers of transmission lines, was operational in the Fall of 2007.

Appropriately named HVDCice™, the system generates up to 7,200 A of direct current in the transmission lines. The HVDCice system is implemented at the Lévis substation, a major connection point for the transmission lines of the Province.

Aerial view of Levis De-icer valve hall and var compensation equipment

The static reactive power compensator comprises the same equipment which is automatically reconfigured in the form of a TCR (Thyristor Controlled Reactor) to which a TSC (Thyristor Switched Capacitor) is added. The combined equipment makes a classic Static Var Compensator (SVC). The control system is based on GE' s Series V controller.



H400 thyristor valves

The system improves the power stability and voltage control of the 315 kV and 735 kV transmission networks in the metropolitan region of Quebec.

This was a turnkey contract for a transmission line de-icer of 310 MW power, convertible to a stability and voltage controller by providing reactive power to the network in the range of +250 Mvar / -125 Mvar.

Key Benefits

HVDCice™ is the first system of its kind in the world. The project demonstrates innovative uses for existing solutions that help our customers ensure a secure, efficient supply of energy.

The system is cost effective as it has dual functionality. The system serves as reactive power compensator and when required can be switched to de-icing mode within an hour.

HVDCice™ could be applied in areas of the world that experience severely cold ice storms and where the need for innovative equipment design with low electrical losses can be effectively integrated into the system to ultimately make existing equipment more efficient.

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Picture of cables broken by ice - Source: ShutterStock

Imagination at work