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### 120 kV cable installation at Beauharnois Power Station

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The restoration of Beauharnois Power Station required the construction of two new SF<sub>6</sub> substations and fifty-six (56) - 120 kV XLPE insulated cable circuits to transport the generated power of 1673 MVA. The cable project involved the installation of more than 42 kilometers of 120 kV XLPE insulated cables as well as 168 outdoor and 168 SF<sub>6</sub> terminations.

The XLPE cables were manufactured by Pirelli in Canada and France while the terminations were manufactured in Italy. Newly designed dry type SF<sub>6</sub> terminations were used, thus reducing the need for periodic inspection and preventive maintenance.

Type tests were successfully carried out at Pirelli laboratories in Italy to qualify the XLPE insulated cables and terminations for this particular project. These included heating cycles under voltage, HVAC and Hot Impulse tests. A special short circuit test was also carried out at IREQ (Hydro-Québec) to ascertain mechanical integrity of the interface between the cable termination and the GIS metallic enclosure.

Various installation techniques were used for the 36 cable circuits connecting the 120 kV outdoor transformers to the substations as well as for the 20 cable circuits connecting the substations to the overhead transmission lines. Fire resistant fiberglass ducts and stainless steel conduits in trefoil arrangement in air were used. To integrate the cables into the east side substation, duct banks and aluminum trays as well as a special overhead cable gallery and a vertical shaft were needed.

The ampacity calculations for the various cable configurations including a complex arrangement of 66 high voltage cables in the same duct bank were performed using the finite element analysis technique. Two optimized copper conductor sizes were established; 380 mm<sup>2</sup> for the cables between the thirty six outdoor transformers and the new SF<sub>6</sub> substation and 1600 mm<sup>2</sup> for cables between the substations and the overhead transmission lines.

The commissioning tests performed included jacket tests, conductor resistance and cable capacitance measurements, HVAC tests as well as acoustical resonance measurements.

A Distributed Temperature Sensor (DTS) unit connected through fiber optic cables, installed along the cable circuits, enables Real Time Condition Monitoring. The conductor temperature is calculated using a thermal model, developed in-house, that takes into consideration the cables and their environment.