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Restraining the migration of HV cables in duct

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Contrary to standard practice in Europe and elsewhere in North America, on Hydro-Quebec's underground high-voltage system the HV cables are installed in individual ducts for each phase. The major drawback of this practice is that the cables are free to move within the confinement of the ducts and at the manholes. These movements are incited principally by: i) the difference in level between the manholes; ii) the vibrations induced by road traffic; iii) the cyclic thermal expansion of the cables.

Two harmful effects are associated with the migration of cables from "upper" manholes towards "lower" manholes: the curvature increase for the cable and for expansion loop in "lower" manholes and the straightening of the expansion loop in "upper" manholes.

The probability of a failure in cable insulation, especially for oil-impregnated paper insulation, or a fatigue rupture in the metal sheath of the cable, increases substantially if the radius of curvature of the expansion loops is too small. On the other hand, straightening of the expansion loop rises mechanical solicitations of the joints, and the risk of their failure.

This paper deals with the development, the validation and the installation on Hydro-Quebec's underground high-voltage network of special devices that restrain the migratory movements of the cable between the manholes.

These devices are installed in the manholes, at the exit from and/or at the entrance to the cable duct. The principle of two inverted cones is exploited in order to create a progressive restrain applied to an advancing cable. Several cycling testes in the laboratory confirmed the performance of such a solution, before its first use on an existing 120-kV underground line.