# PRELOCATING AND PINPOINTING FAULTS ON UNDERGROUND MEDIUM VOLTAGE CABLES: REVIEW OF HYDRO-QUEBEC'S EXPERIENCE

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## ABSTRACT

*This paper presents a review of the experience with the SimLoc fault location method developed by Hydro-Québec and deployed in 2011 on the utility's underground distribution system. The SimLoc method helps prelocate faults on de-energized medium-voltage cables for lines up to several kilometres long. This paper also presents the development of the new CoLoc tool that is designed to pinpoint a cable fault location.*

## KEYWORDS

Fault location, medium voltage, cable, prelocating, pinpointing, thumper, underground, manhole

## INTRODUCTION

In January 2009, Hydro-Québec Distribution gradually rolled out a new cable fault location system named **SimLoc** (for **Simulation and Location**) [1]. This system was developed at Hydro-Québec's research institute, IREQ. The goal was to reduce average fault location time and the training workers required to perform the task. The challenge was to locate faults on long lines with many branch lines. The purpose was also to reduce the number of pulses (generated by the thumper) on the cable.

The SimLoc method (Figure 1) consists of simulating thumps at regular distances along the line, measuring an actual thump on the line, comparing the simulations with the measurement and identifying the best match, which corresponds to a unique point on the line and indicates the location of the fault.

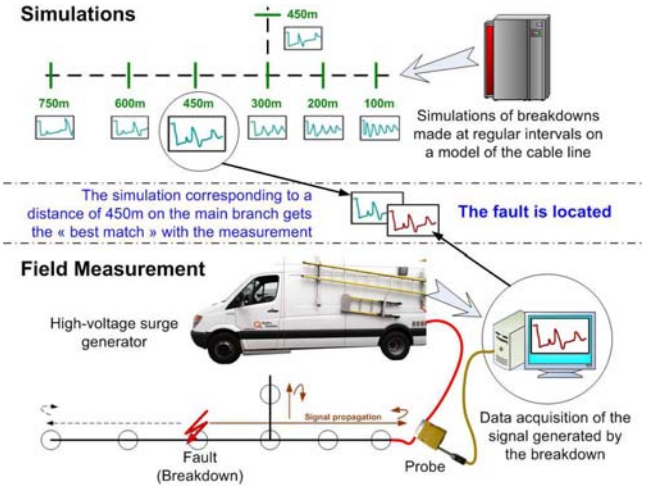


**Figure 1 - Diagram of the method**

On Hydro-Québec's underground system, almost all the cables run through buried conduits between two manholes. When there is a fault on a run, the latter must be removed and entirely replaced. A fairly low level of precision is thus sufficient for locating a fault: it is enough to know that the fault is located between two manholes that may be several dozen metres or a few hundred metres apart.

SimLoc has now been used for more than five years and its fault location success rate ranges from 50% to 85%, depending on the line configurations. The 15% to 50% unsuccessful locations are related to specific conditions or configurations that will be explained in this paper. Lines with a high rate of success will be referred to as "normal lines" and lines with a low rate of success as "complex lines."

SimLoc should be considered more as a fault prelocating tool rather than a pinpointing tool [2] [3]. Prelocating consists in determining as precisely as possible the location of, or distance to, a fault from a measurement point at the end of the line. To increase the efficiency of its fault location system, Hydro-Québec decided in February 2011 to mandate its research institute to develop a new tool to help locate faults that could not easily be located by SimLoc and to help confirm the location of a fault. The name of this pinpointing tool is **CoLoc** (for **Confirmation of Location**).

## TOPOLOGY OF UNDERGROUND DISTRIBUTION LINES

Hydro-Québec Distribution has over 4,000 underground distribution lines with 12,000 km of 12-kV and 25-kV medium-voltage underground cables. More than 200 lines are over 10 km long and most have branch lines. The system is almost entirely comprised of duct banks containing bare concentric neutral cables with 28-kV XLPE or TR-XLPE insulation. The province of Quebec is separated into six service areas in terms of distribution line groupings (Figure 2).


**Figure 2 – Province of Quebec's service areas for the underground distribution lines**