

Insulated Conductors Committee
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New Technique for Fault Location in Underground Medium Voltage Cable

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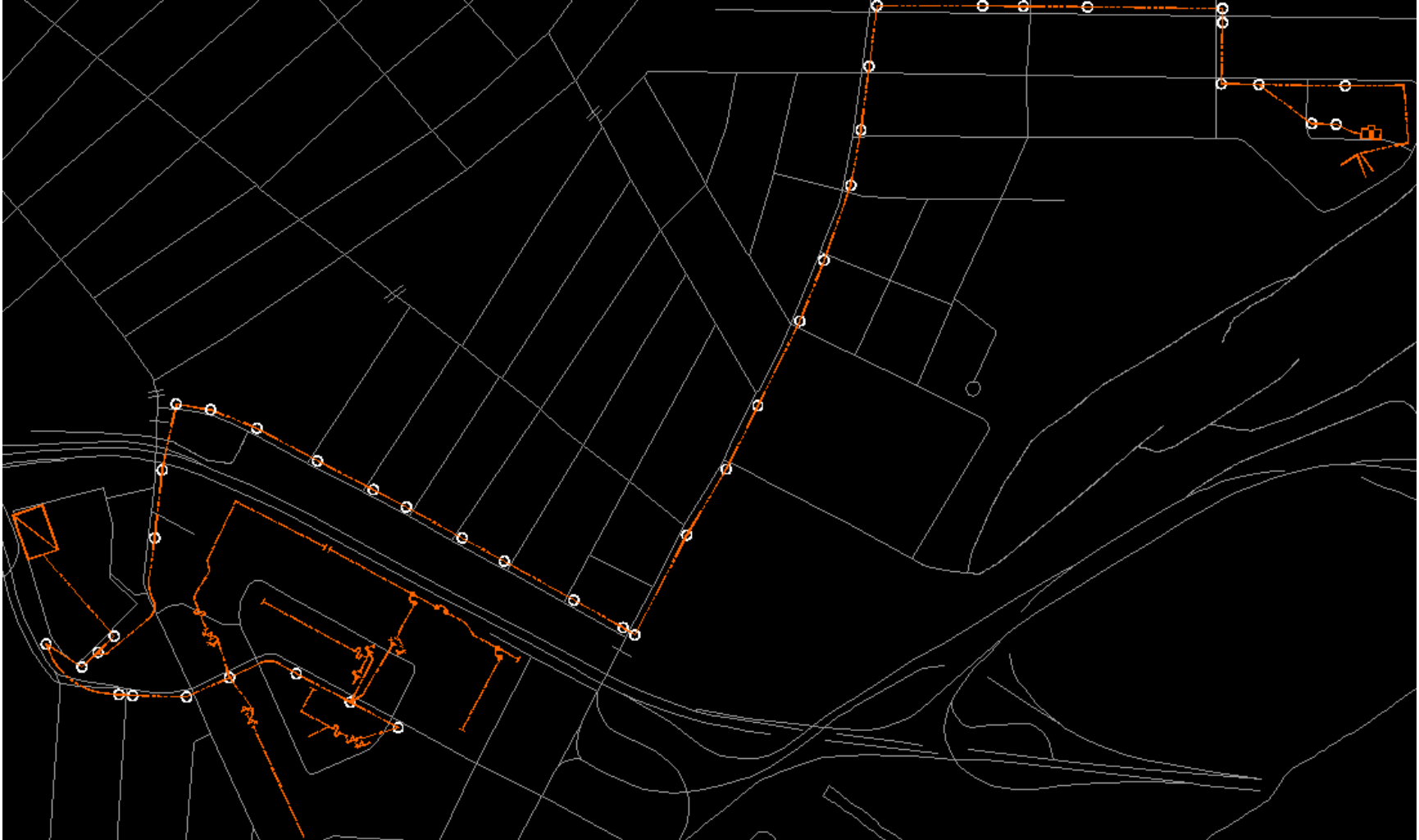
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Background

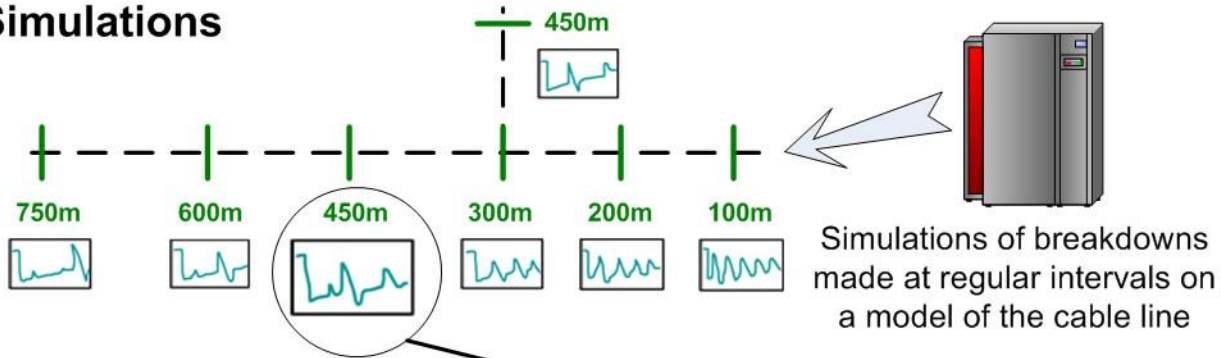
- **Underground cables:**
 - Hydro-Québec : 10,300 km of medium voltage underground cable (12kV & 25 kV)
 - Over the past 2 years : 150 in service faults & 100 faults during dielectric tests per year
 - **Traditional fault location methods :**
 - **Thumper and electro-magnetic detector:** location time is variable, planning is difficult, excessive use can damage cables;
 - **TDR :** needs signal interpretation, is difficult to use with multiple branches on the line.
 - **New idea :** comparing simulations and in-situ measurement of a fault in response to a voltage surge in order to pinpoint the fault on a schematic map.
 - **Expectations :** high reduction in the use of the thumper, quick and stable location time, no result interpretation.
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Example of Feeder Map



Principles

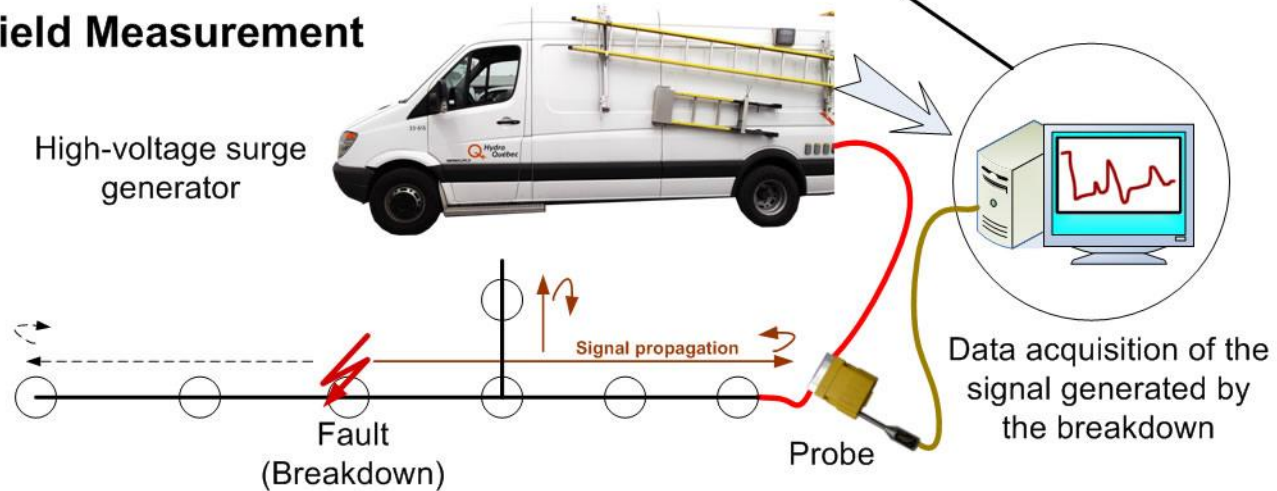
Simulations



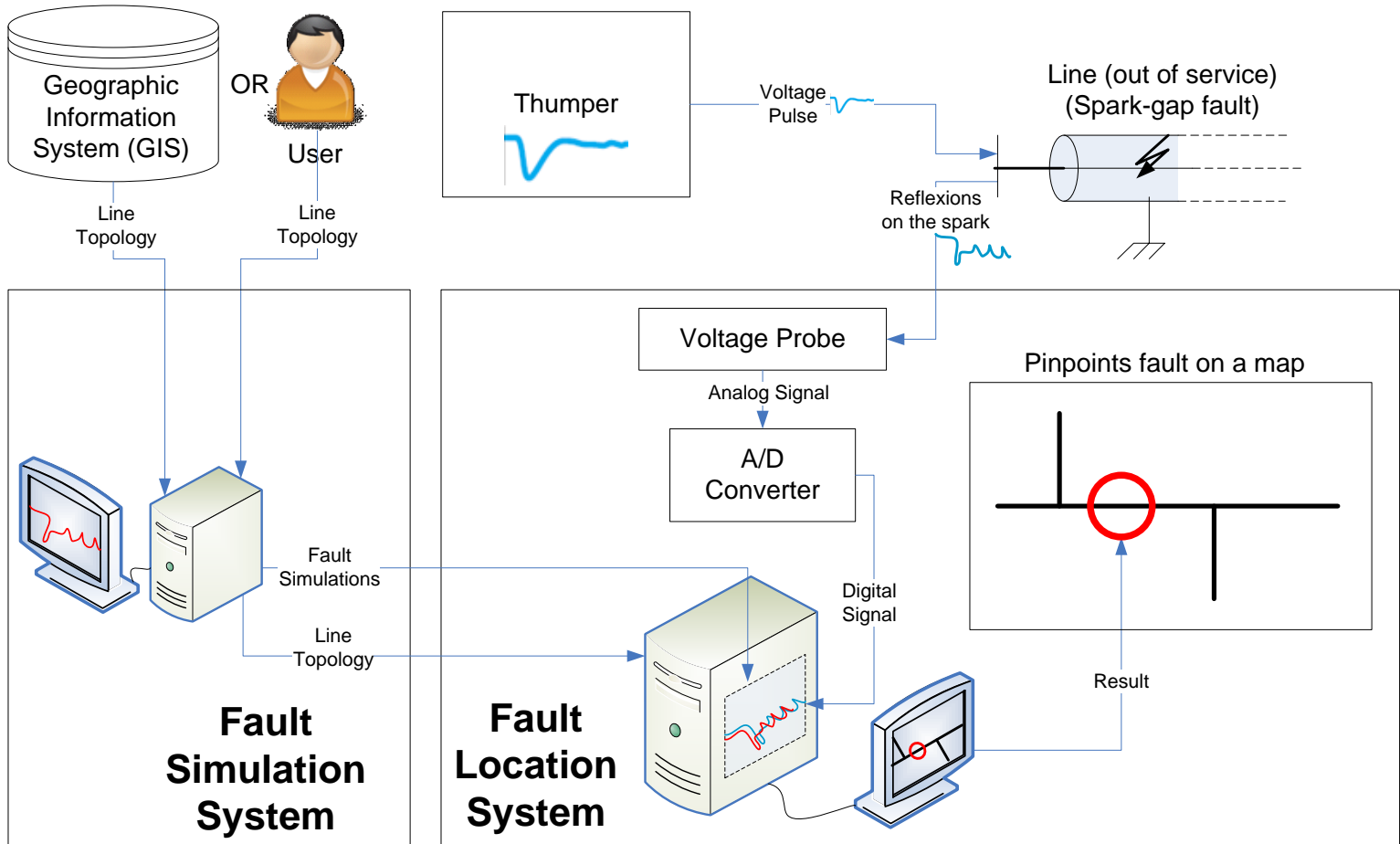
The simulation corresponding to a distance of 450m on the main branch gets the « best match » with the measurement

The fault is located

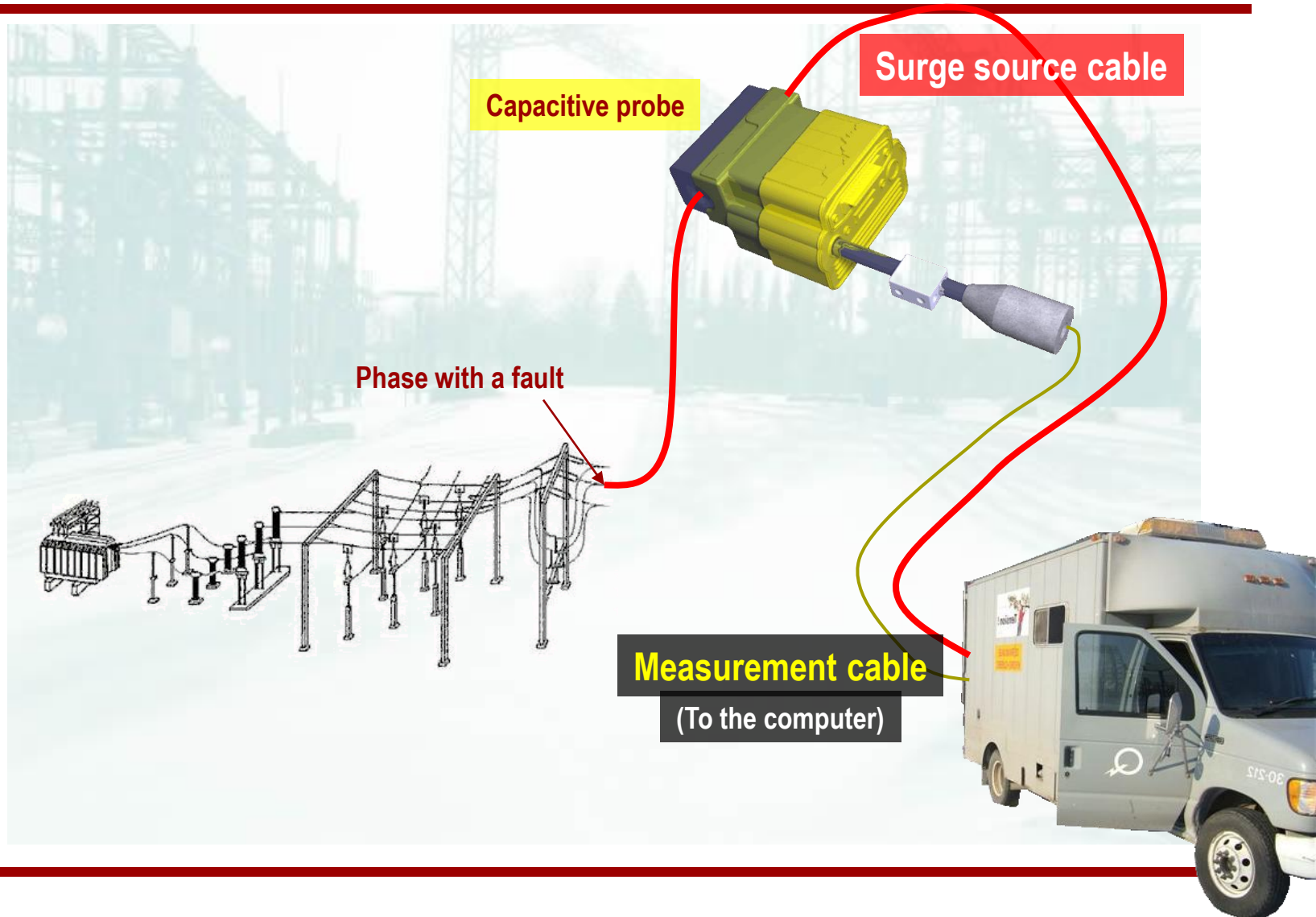
Field Measurement



Technical Overview

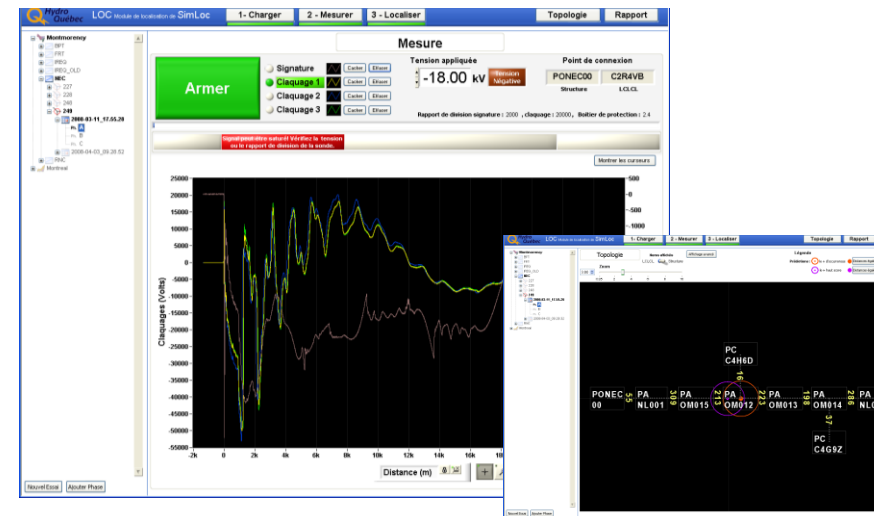
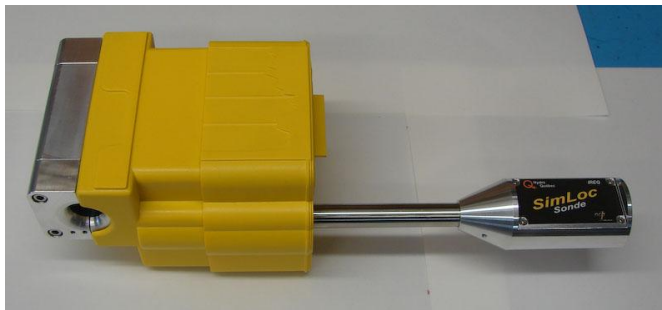


Equipment



Equipment (next)

- The breakdown signal must be read by a probe with a high attenuation (from 1/2000 to 1/20000).
- IREQ as developed its own capacitive probe :



- The rest of the equipment consist of:
 - A protection equipment that isolates the computer from an accidental high voltage that could occur on the probe side (made by IREQ)
 - A 100Mhz A/D acquisition card in a computer
 - A graphical interface software that performs the signal acquisition, the localization and the display of the result on a schematic map.

Application



ICC2010_lores.wmv

(click on above file name to play the movie)

Field results

- In Québec, 60% of the underground network is located in two major areas : Montréal and Québec City (about 6000 km).
- **Québec City** (Average cable line length: 5.2 km) :
 - Statistics based on 148 locations made between 2007 and 2010

Distance of prediction from real fault :	Exact manhole (or cable span)	0 to 1 manhole (or cable span)	0 to 2 manholes (or cable spans)
% of success :	64%	82%	89%

- **Montréal** (Average cable line length: 2.8 km, with several branches) :
 - Statistics based on 28 locations made in 2009 and 2010
 - **86% of success** (0 to 2 manholes distance)
-

Results

- The new fault location system is currently installed in all Hydro-Québec tests vehicles over the province of Quebec.
 - A 11 months test period in Quebec City has lead to an estimated 3700 hours reduction on fault-location when compared to traditionnal methods.
 - Personal training is easier : The new fault location technique is a « 1-2-3 steps » method without signal interpretation.
 - Requires very few high-voltage surge pulses, which minimizes potential detrimental effects on the cable.
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New technique for fault location

- **THANK YOU !**

- **Questions ?**

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Cable Electrical Model for Simulations

