

Continuous PD Monitoring of MV and HV Cable Systems.

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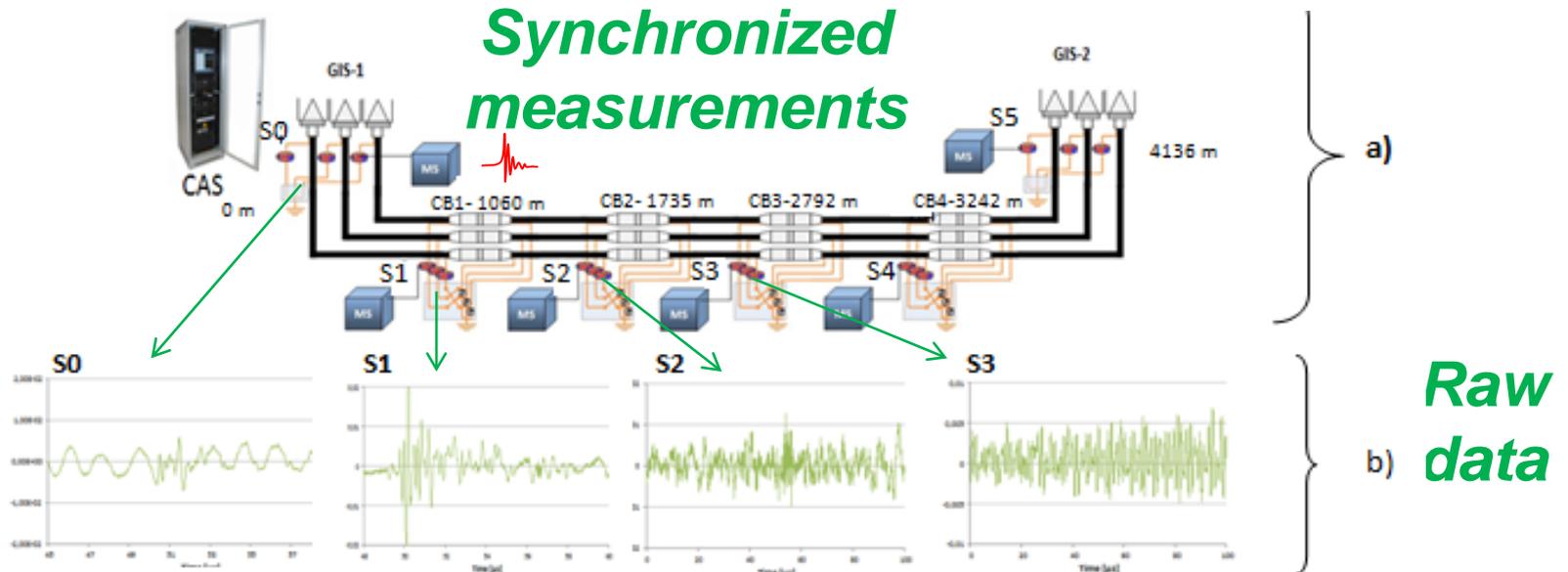
- What is the measuring frequency range to be used ?
- What is the maximum distance between sensors ?
- What is the alarm criterion to be used ?

What is the measuring frequency range to be used ?

What is the maximum distance between sensors ?

Practical example of PD monitoring.

- A continuous PD monitoring system was installed in a new 45 kV cable system of 4136 m length, composed by four cross bonding splices and two cable terminations.
- A CAS placed at the substation GIS-1 synchronizes the acquisition of the six MS units (S0, S1, S2, S3, S4, and S5). Each Sensor $S_i = 3$ HFCT units

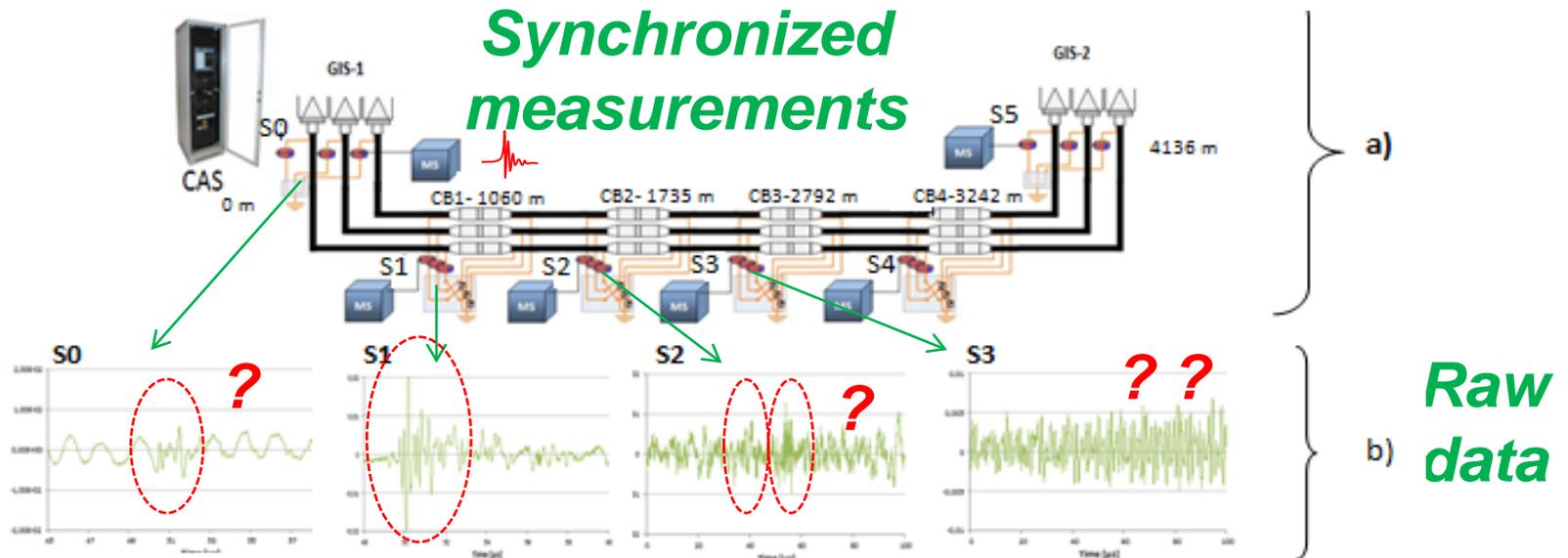


What is the measuring frequency range to be used ?

What is the maximum distance between sensors ?

Practical example of PD monitoring.

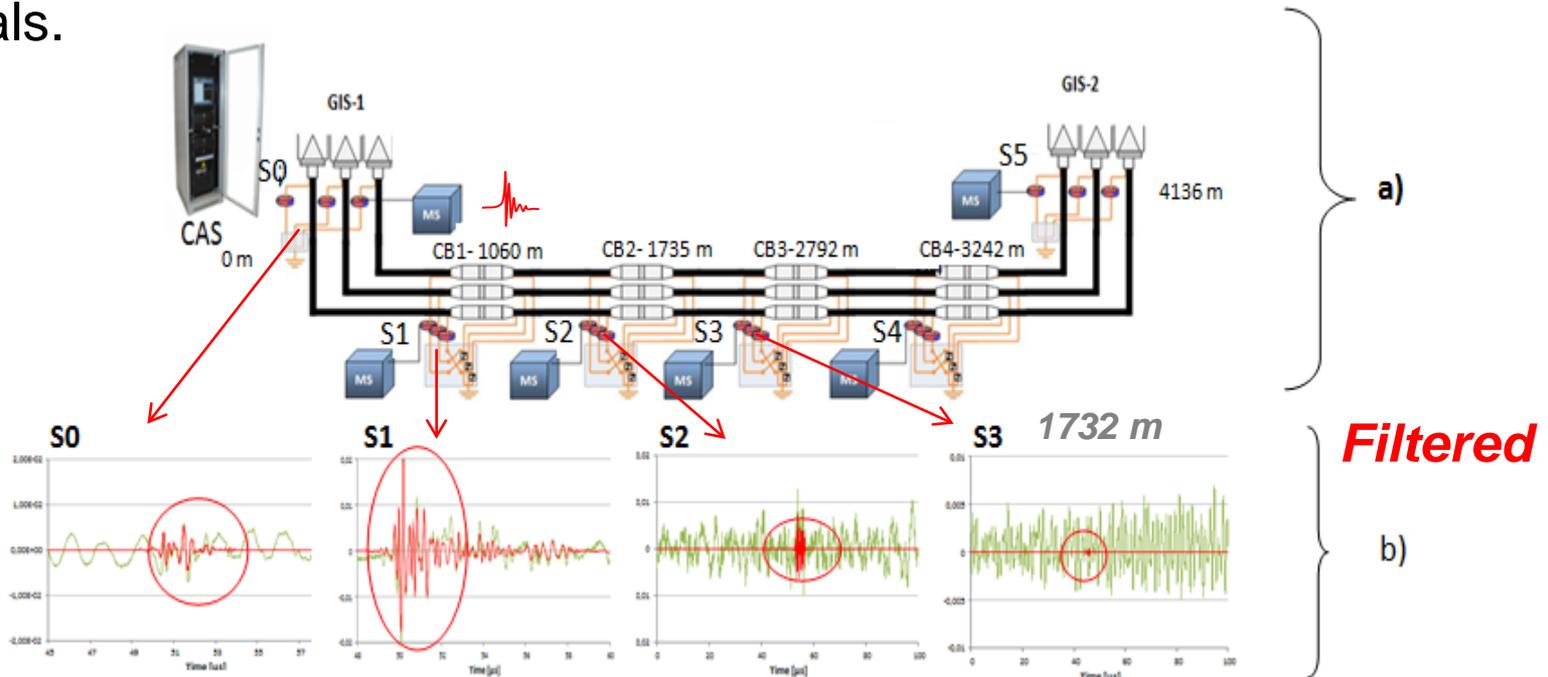
- The CAS removes the noise and performs the signal processing to locate PD sources and to analyze the PD evolution of the PD sources detected.
- 35 days after installation, PD pulses were detected: S0 S1, S2 and S3



What is the measuring frequency range to be used ? What is the maximum distance between sensors ?

Practical example of PD monitoring.

- A filtering tool on the basis of wavelet transform allows a good identification of PD signals.



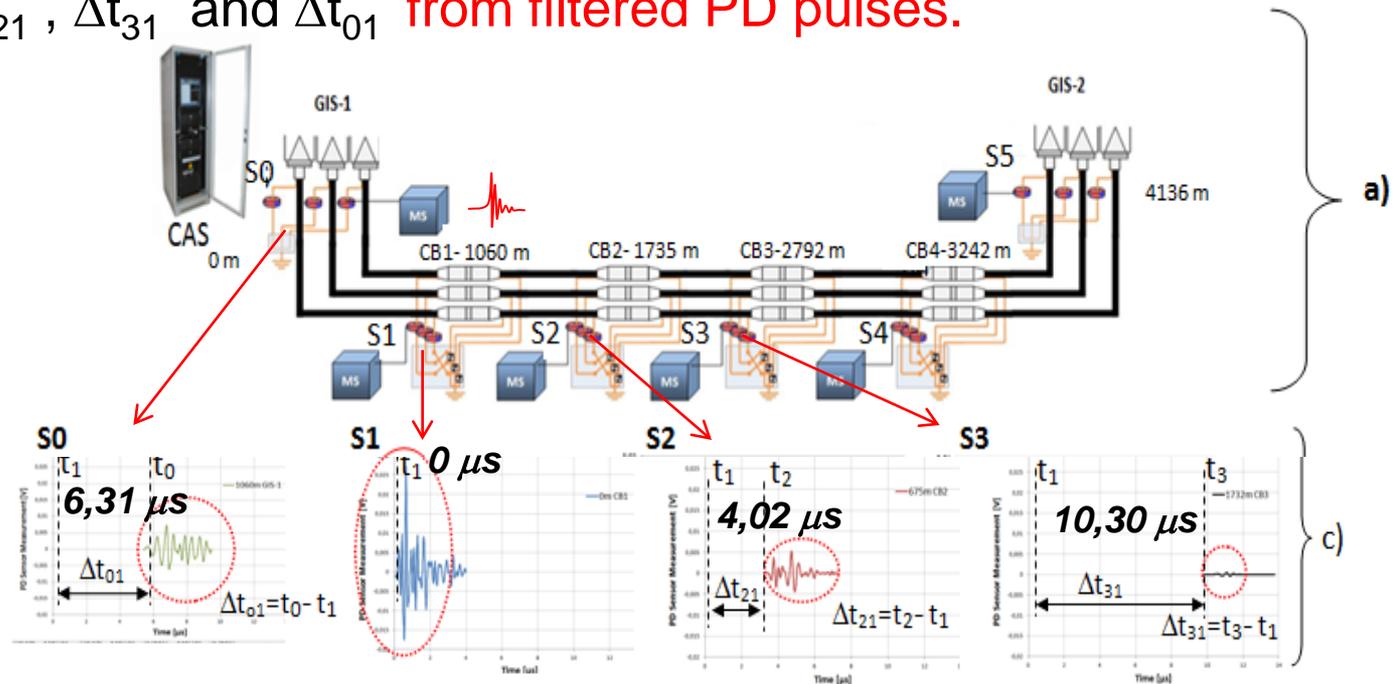
What is the measuring frequency range to be used ?

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Practical example of PD monitoring.

- PD location by means of time delays of **arrival times** of PD pulses:

Δt_{21} , Δt_{31} and Δt_{01} from filtered PD pulses.



What is the measuring frequency range to be used ?

What is the maximum distance between sensors ?

Practical example of PD monitoring.

Propagation speed = 168 m/ μ s (performed in a calibration test)

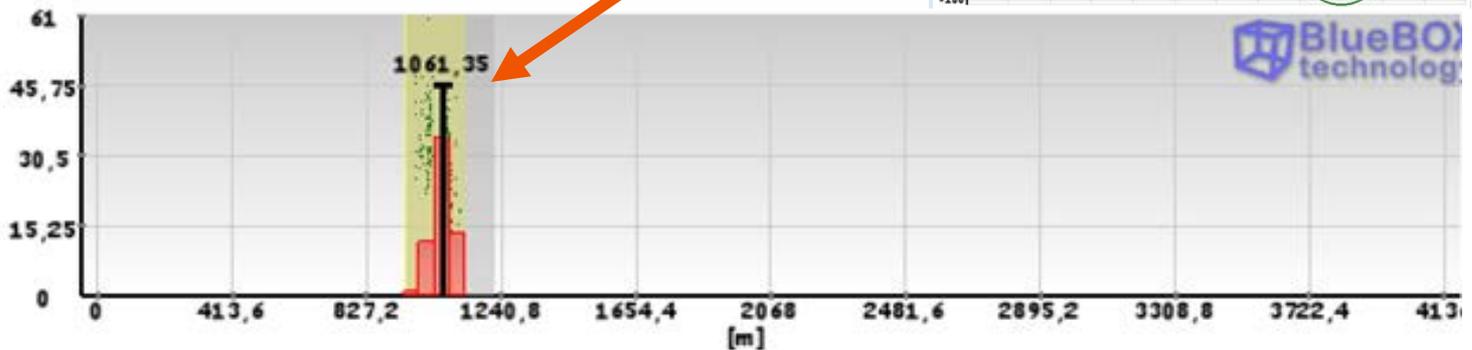
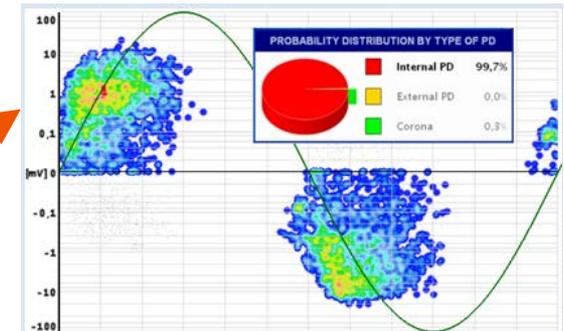
PD Mapping is determined using complementary information:

$$d = d(\Delta t_{21}, \text{speed})$$

$$d = d(\Delta t_{01}, \text{speed})$$

$$d = d(\Delta t_{31}, \text{speed})$$

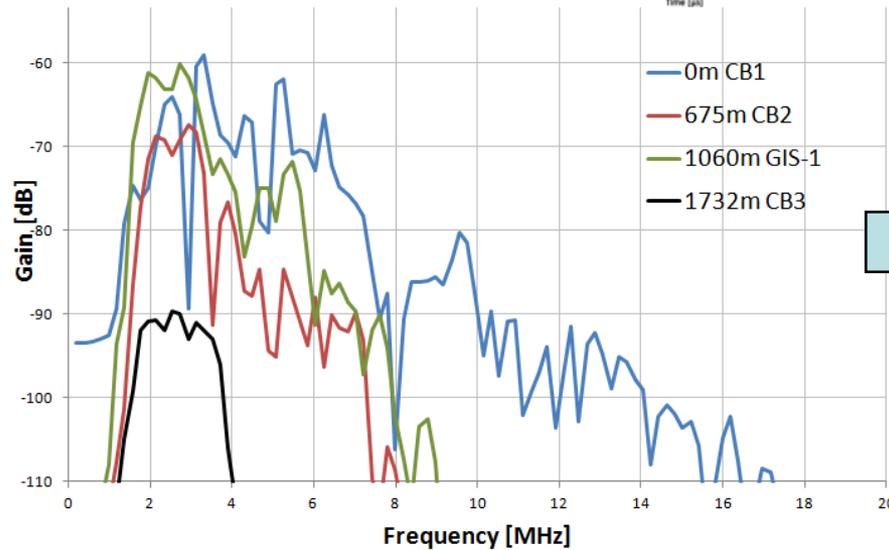
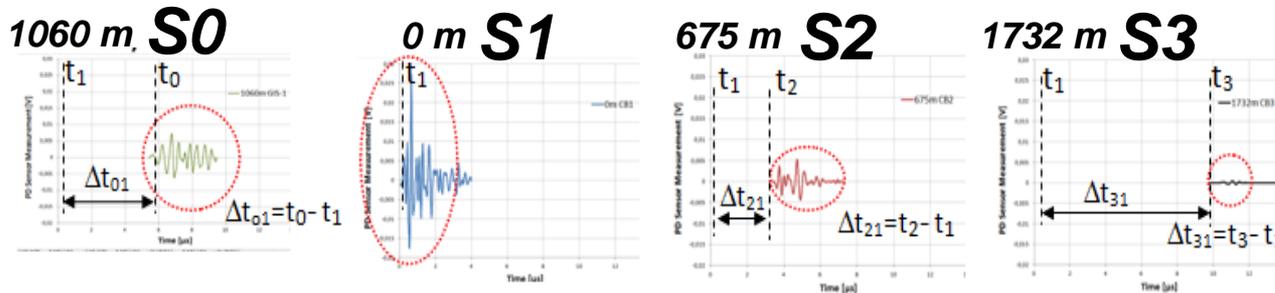
CB1 $d = 1060$ m



What is the measuring frequency range to be used ? What is the maximum distance between sensors ?

Practical example of PD monitoring.

Frequency spectrum of same PD pulse detected at S0, S1, S2 & S3



$$f_m = 1 - 20 \text{ MHz}$$

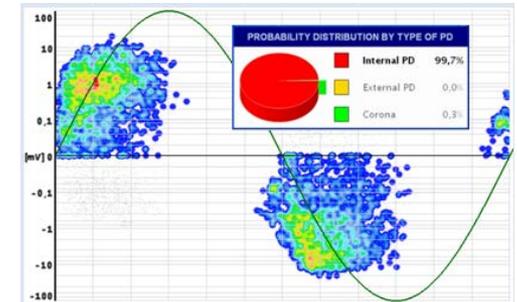
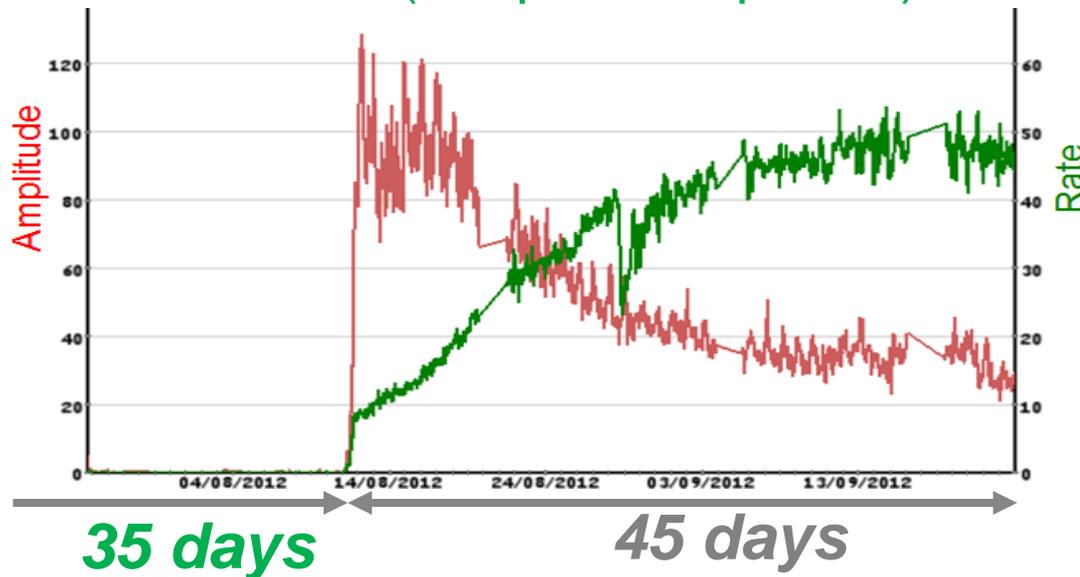
$$f^* = 1 - 7 \text{ MHz}$$

$$d = 1,7 \text{ km}$$

What is the alarm criterion to be used ?

Practical example of PD monitoring.

- Location
- Phase resolved PD pattern
- PD Amplitude Evolution ↑
- And PD Rate (PD pulses / period) ↑



CONCLUSIONS ABOUT PD MONITORING

1- What is the PD measuring method to be used ?

- $f_m > 1\text{MHz}$ (**NO IEC 60270**) HFCT + **Filtering**
- **Synchronized** PD measurements: **PD Location**

2- What is the measuring frequency range to be used ?

1- 20 MHz / (**1- 7 MHz**) Enough

3- What is the maximum distance between sensors ?

- Depends on **filtering tools**: Power filtering: $d_{\text{max}} \sim 2 \text{ km} / 8 \text{ km}$

4- What is the alarm criterion to be used ?

- Phase resolved PD pattern / Location / **Evolution of PD**
Amplitude and **Rate**

***THANK YOU
FOR YOUR ATTENTION***

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