TECHIMP
Italy

TECHIMP **MV SWITCHGEARS** CASE STUDIES

LIST OF CASE STUDIES

- 33kV MV Switchgear – PD investigation
- 15kV MV Switchgear – On-line PD Test
- 15kV MV Switchgear – On-line PD Test

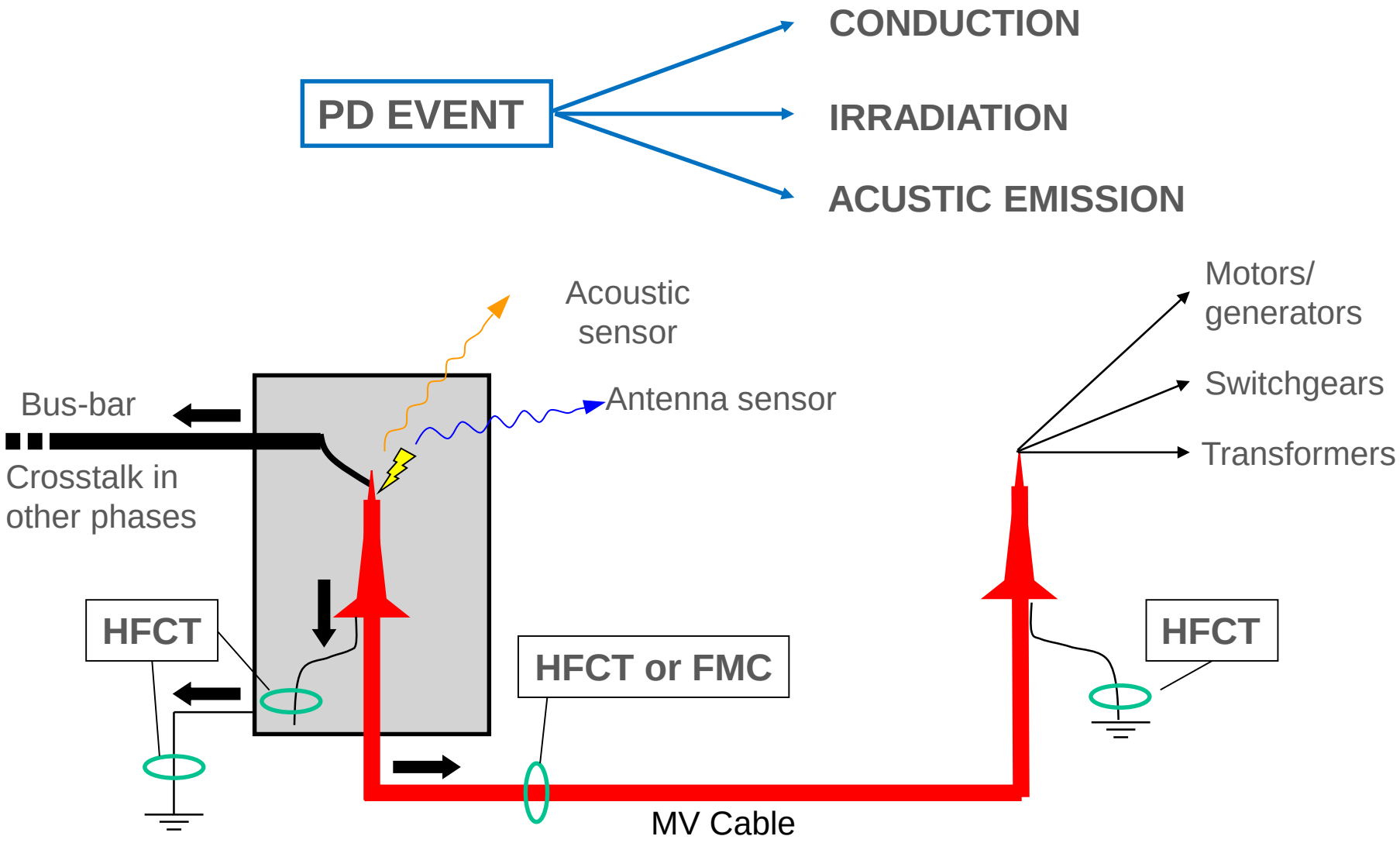
TECHIMP SpA

LOCATION	**FAR EAST**
EUT	**MV SWITCHGEARS**
RATED VOLTAGE	**33 kV**
INSULATION	
LENGTH	
VINTAGE	
TYPE OF TEST	**ON-LINE**
PD SENSOR	**VARIOUS**

CASE STUDY

PD detection in switchgear using conventional detectors provides simply an information about PD levels (in mV or dB).

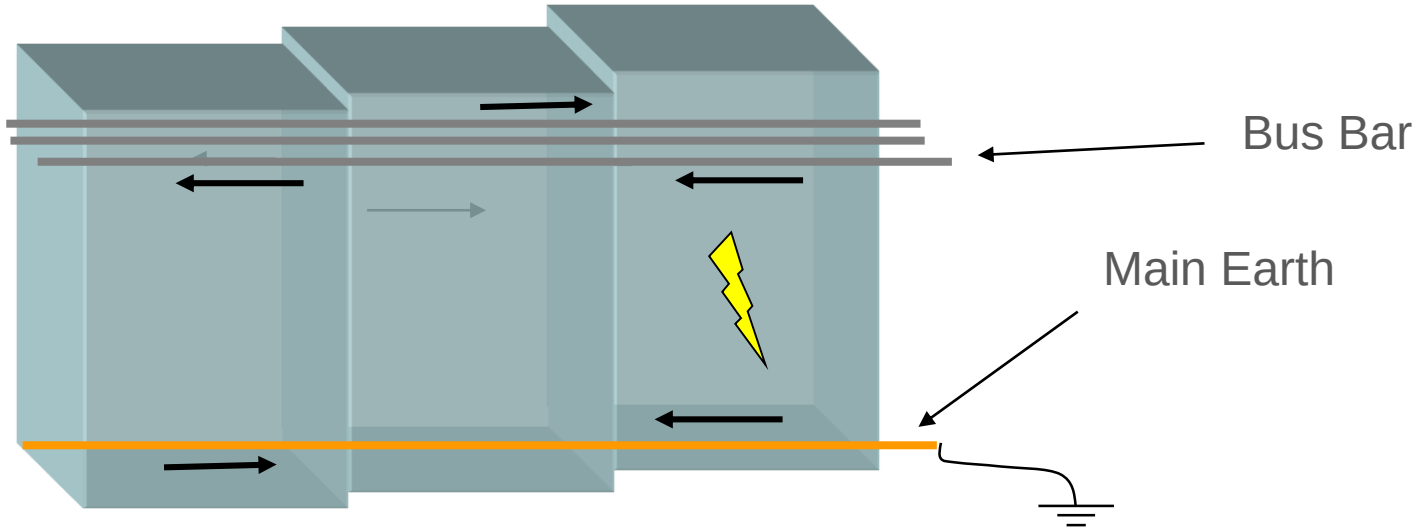
Propagation of PD event



PD measurement setup

PD pulses propagation along contiguous SWITCHGEARS:

- PD pulses propagate along switchgear line-up through the **BUS BARS** and the common main earth



PD phenomena occurring inside **one cabinet** may be **detected in all the cabinets** as an effect of the propagation along the switchgear line-up.

Different PD source location = Different Time/Frequency information

PD Source **Localization** carried out resorting to **UWB detectors**!

PD measurement setup

- **HFCT:** installed around cable ground lead or directly around cables. Monitoring of PD activities within both switchgears and cables

- **FMC:** tied to the cable. Monitoring of PD activities within both switchgears and cables

- **TEV jumper sensors:** across switchgear openings. Monitoring of PD activities inside switchgears

PD measurement setup

Different PD activities lead to different degradation rates within the insulation system

IDENTIFICATION is required!

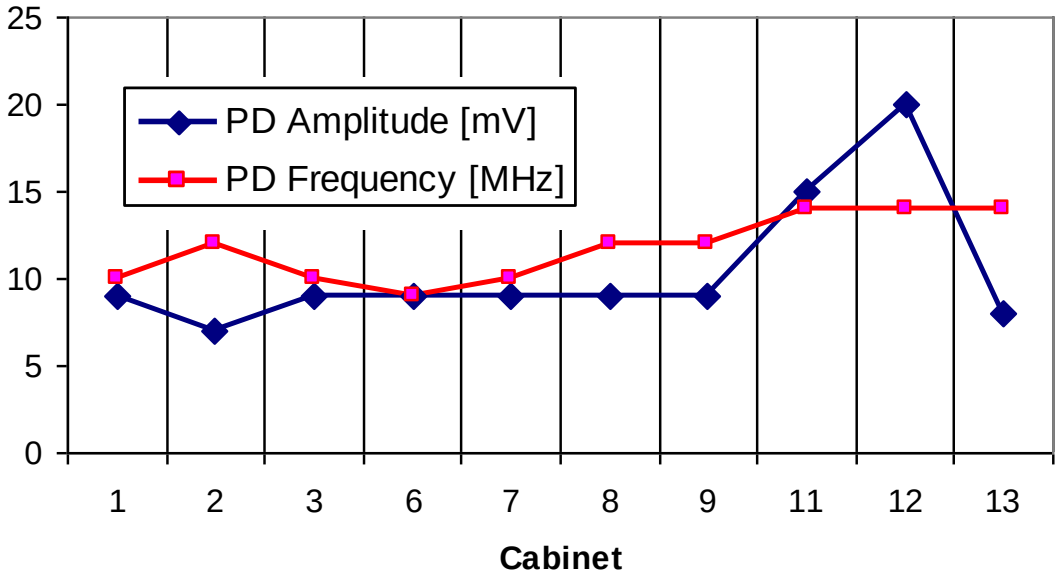
TYPE OF DISCHARGE	LOCATION	EFFECTS	DEGRADATION RATE
Corona PD	Free air volume due to metallic protrusions	Ozone attacks polymeric insulation	**LOW**
Surface PD	Cable terminations	Tracking	**MEDIUM**
Internal PD	Within insulation material	Fast material degradation	**HIGH**

PD measurement setup

Large number of Switchgear interconnected

PD pulse generated inside one switchgear can propagate in the contiguous cabinets

PD Amplitude/Frequency attenuation along the line-up can be evaluated to localize the defect, but after PD sources IDENTIFICATION!



PD measurement setup

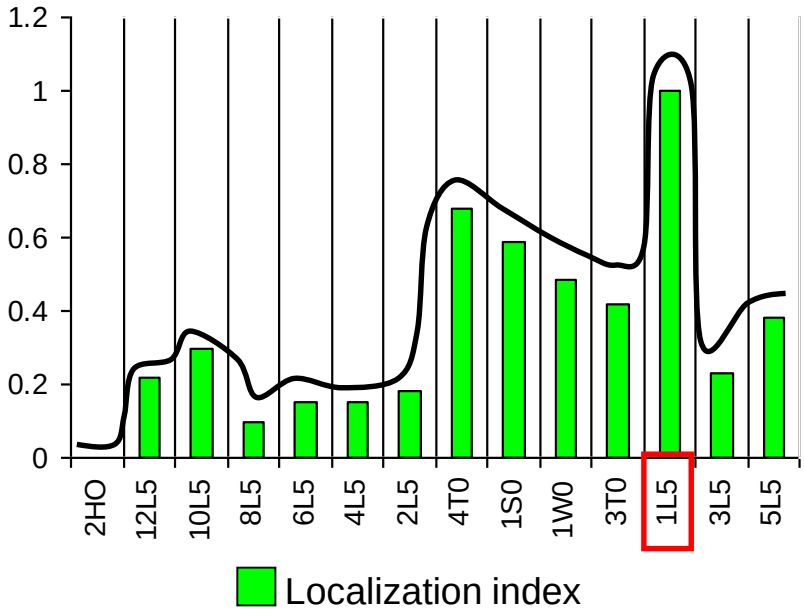
Localization Index

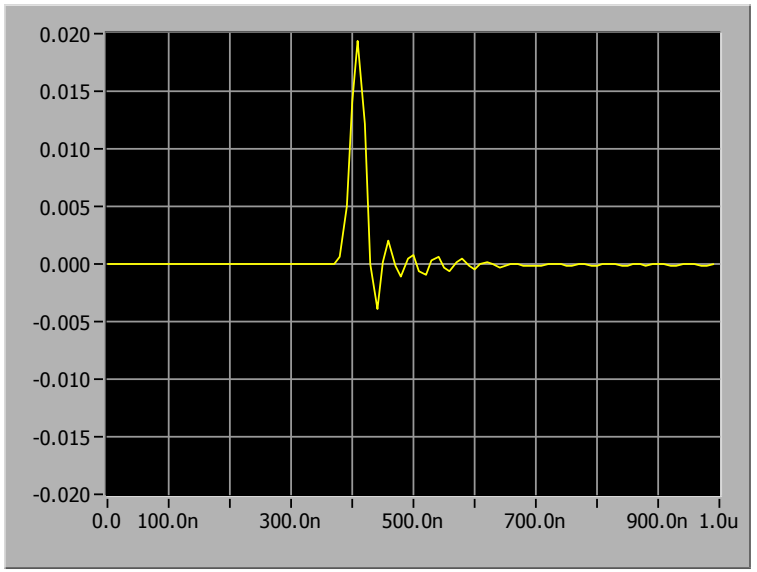
$$L_I = q \cdot F$$

Amplitude Frequency

Equivalent frequency is obtained:

$$F = \sqrt{\int_0^{\infty} f^2 \left|\tilde{S}(f)\right|^2 \mathrm{d}f}$$



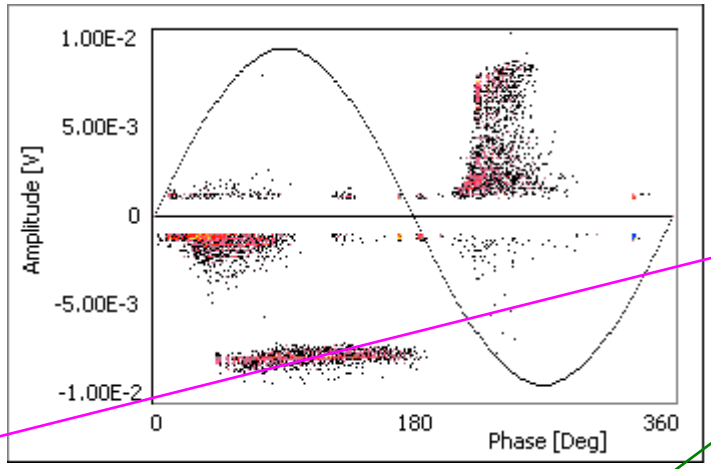


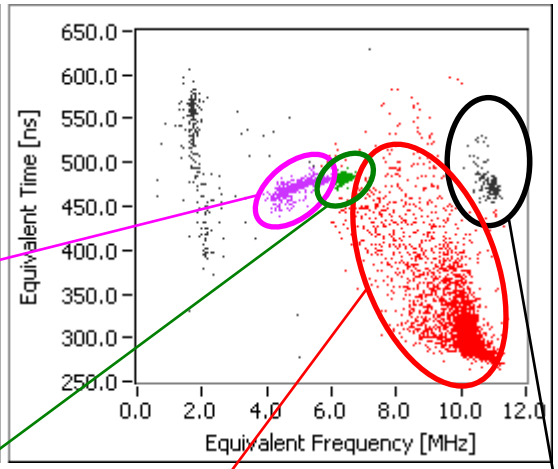
PD Sensors

PD measurement results

2HO	12L5	10L5	8L5	6L5	4L5	2L5	4T0	1S0	1W0	3T0	1L5

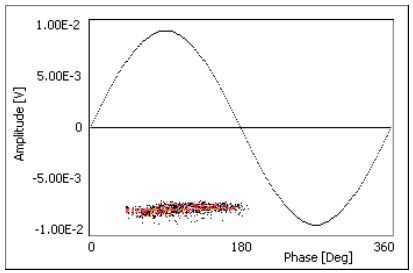
Entire Pattern



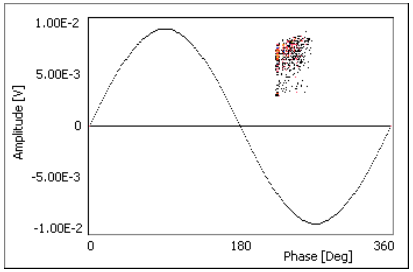


T-F Map

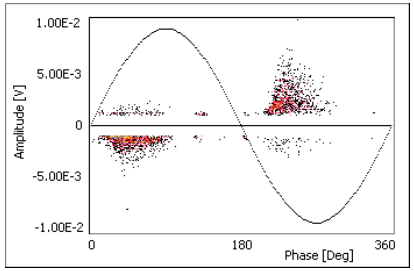
Corona PD



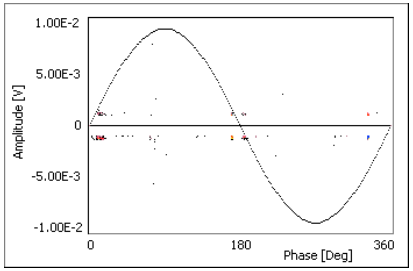
Corona PD



Interface PD cable termination



Disturbance



PD measurement results

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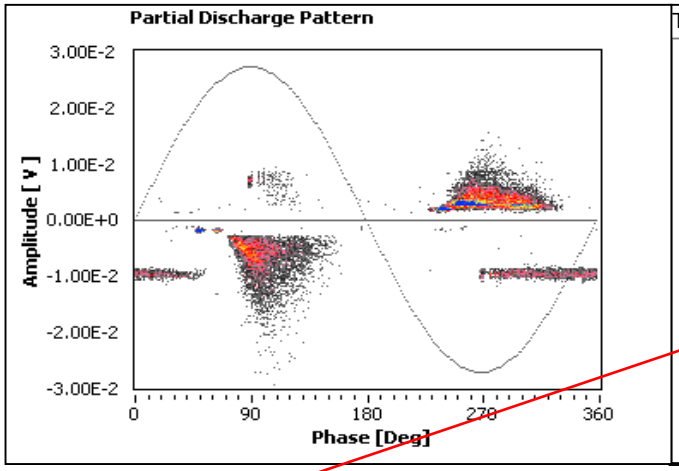
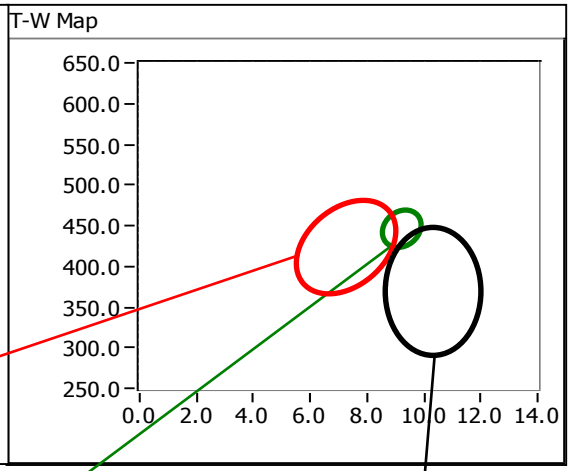
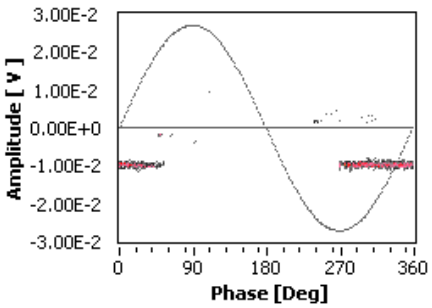
Entire Pattern



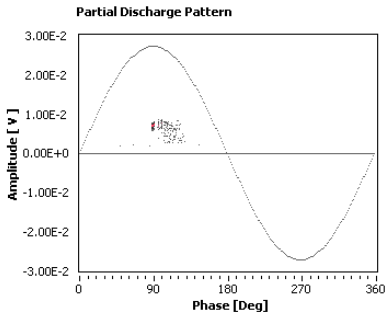


T-F Map

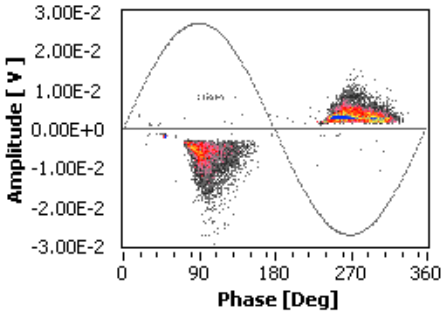
Corona PD



Corona PD

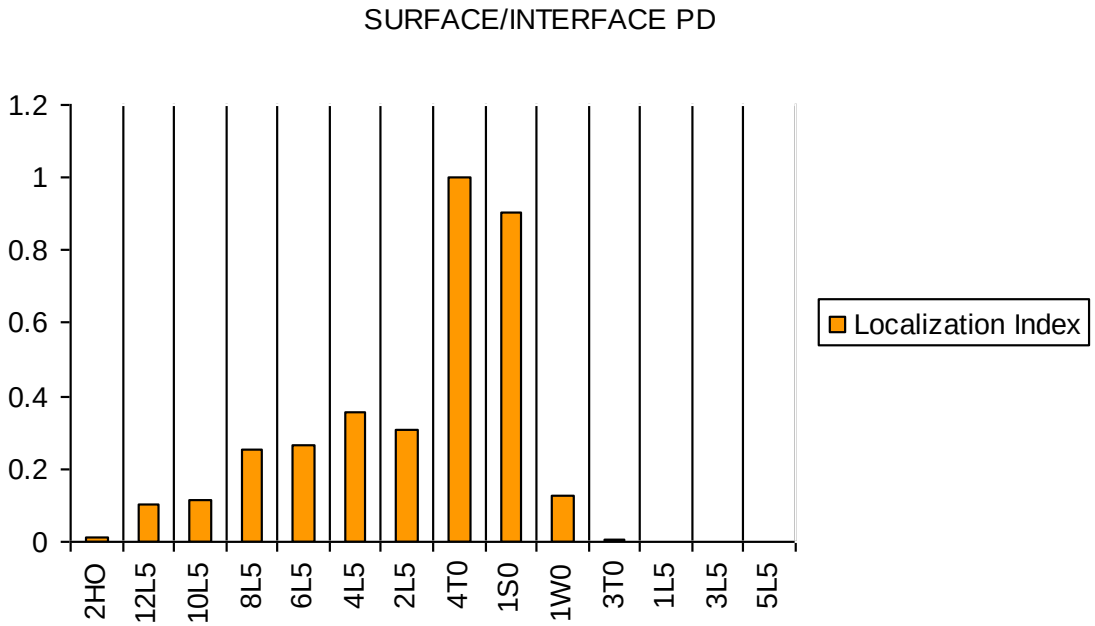


Interface PD cable termination



Localization of the surface phenomenon

The surface PD phenomenon were detected propagating along the switchgears.
"Amplitude-frequency-repetition rate" analysis highlighted that the source is located in switchgear 4T0.

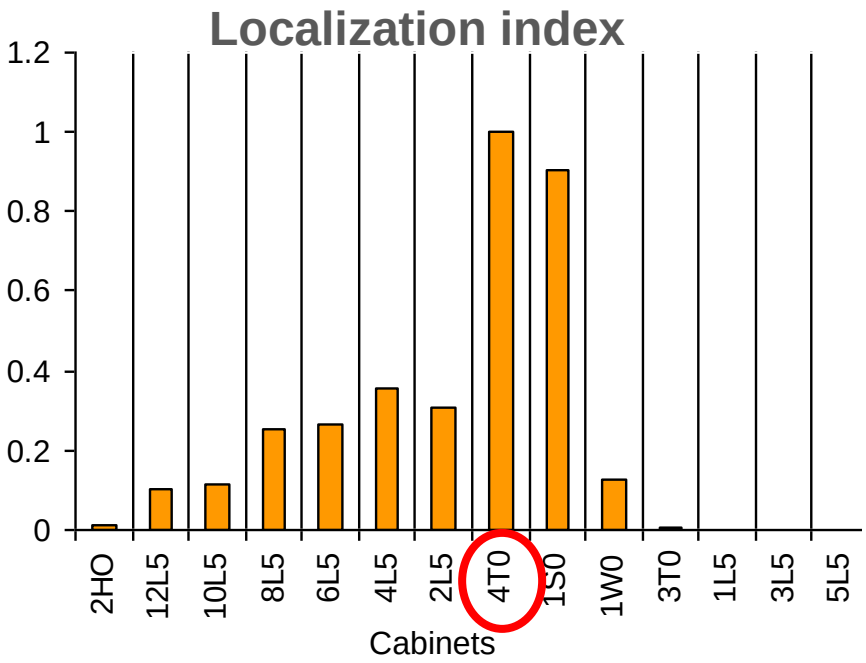


Another measurement was suggested in order to monitor the Amplitude trend of PD activity in panel 4TO within 3 months.

The utility did not performed the suggested measurement and, after 4 month, Panel 4TO had a failure.

PD measurement results

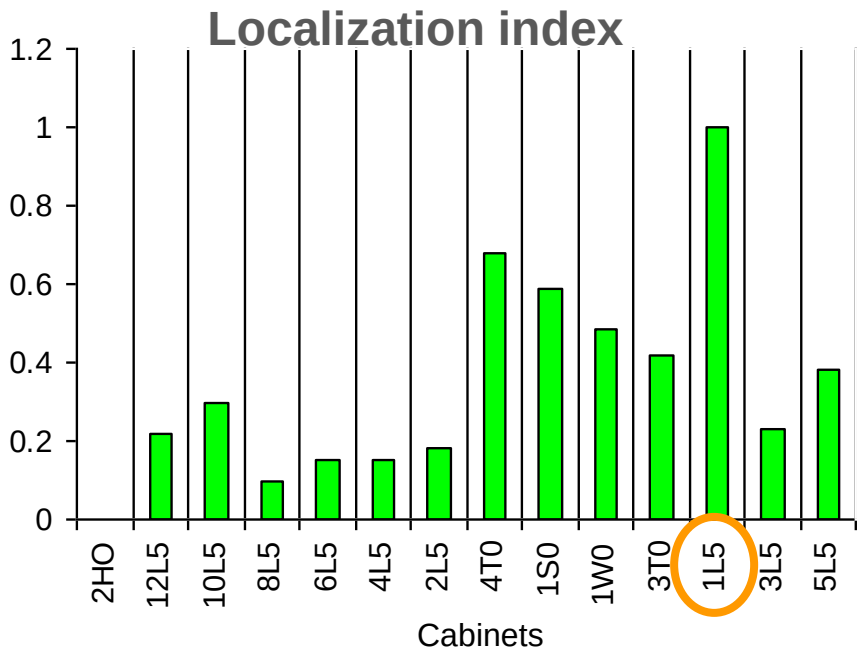
Interfaces PD Cable Termination



INTERFACE PD

LOCALIZED IN PANEL 4T0

Corona

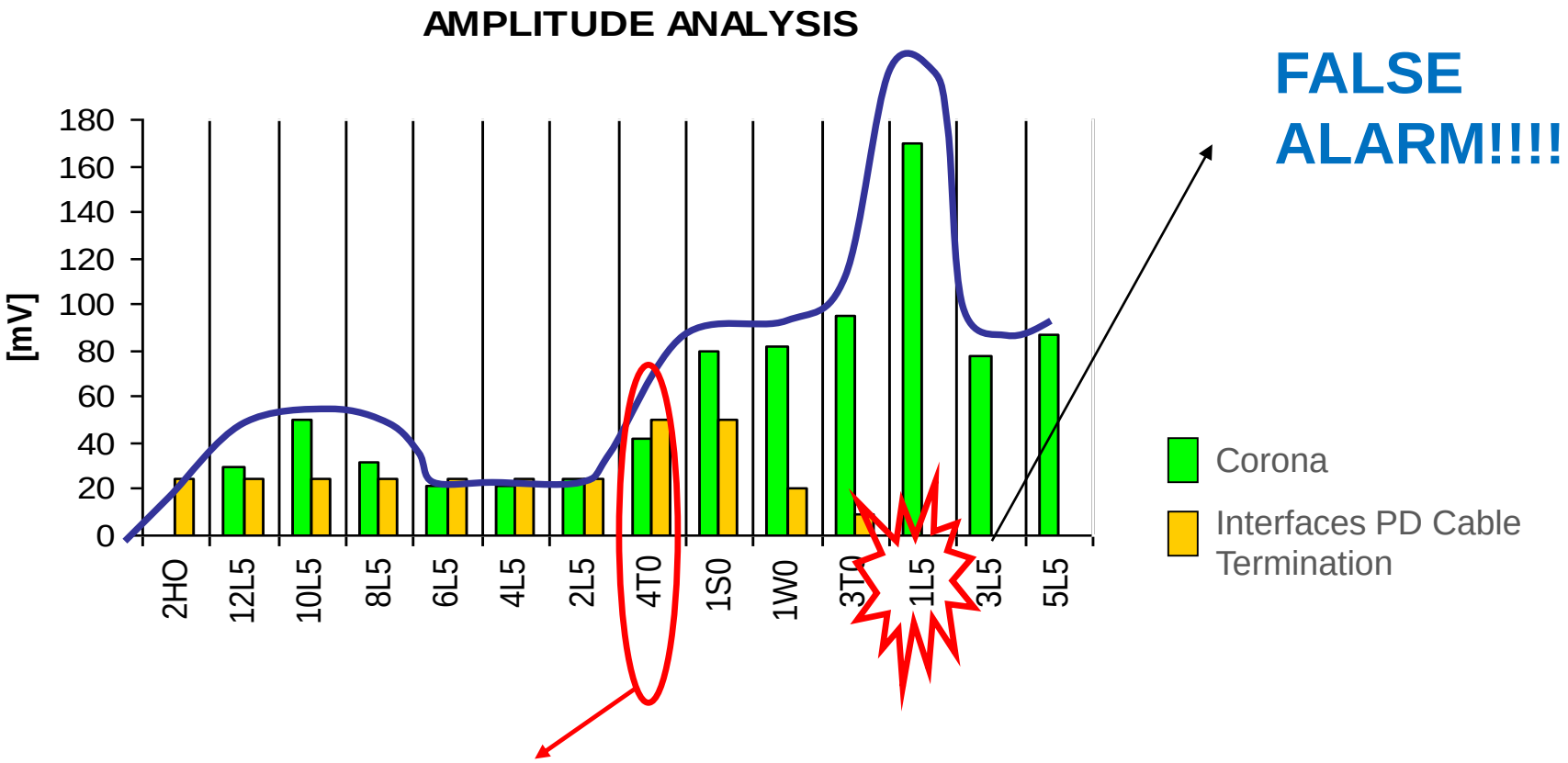


CORONA PD

LOCALIZED IN PANEL 1L5

PD measurement results

PD INFERENCE BASED ONLY ON MAGNITUDE MAY LEAD TO FALSE ALARMS



PD measurement results

- PD activity in Panel 4TO was 50 mV high! The PD source was identified as a interface PD in cable termination! The panel had a failure four months after the measurement!

- Another PD activity was detected in panel 1L5.

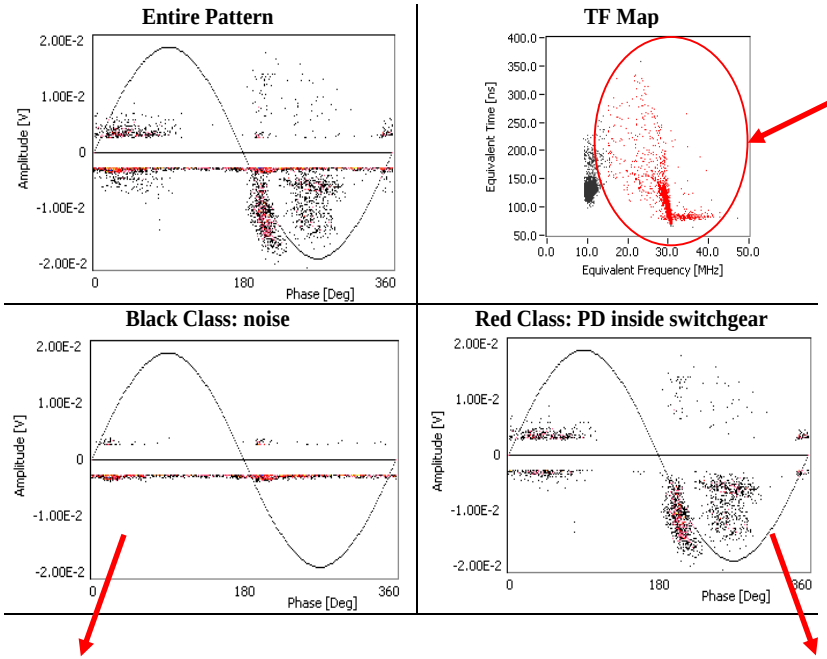
  It was 160 mV high! The PD source was identified as a CORONA. The panel is still on service.

LOCATION	**EUROPE**
EUT	**MV SWITCHGEARS**
RATED VOLTAGE	**15 kV**
INSULATION	
LENGTH	
VINTAGE	
TYPE OF TEST	**ON-LINE**
PD SENSOR	**VARIOUS**

CASE STUDY

Two PD measurement sessions performed on both cables and switchgear

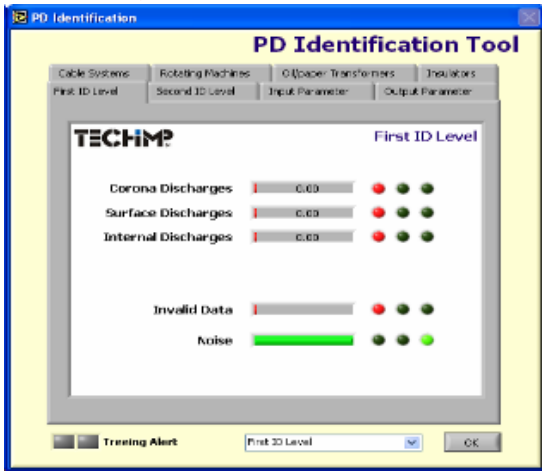
PD detection through HFCT on cables ground lead

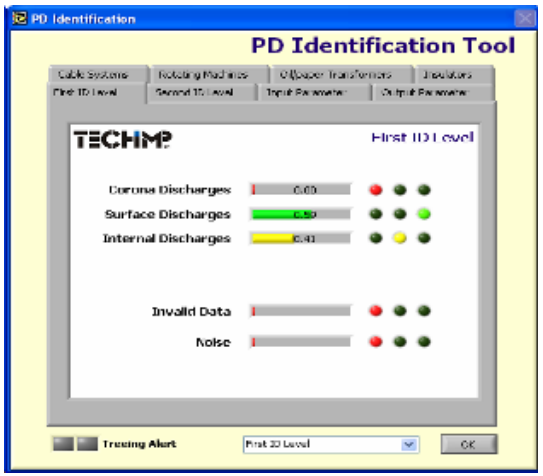


PD activity in HIGH frequency region

PD source close to the measurement system

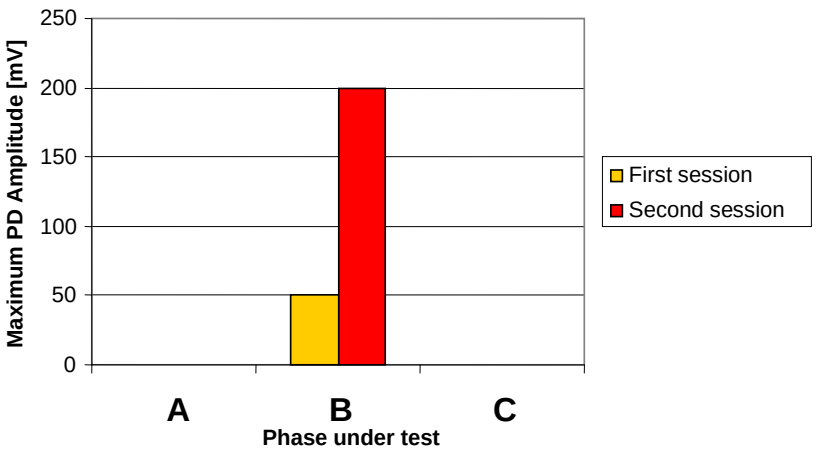
Second measurement suggested after three months





Internal/Surface defect in cable termination

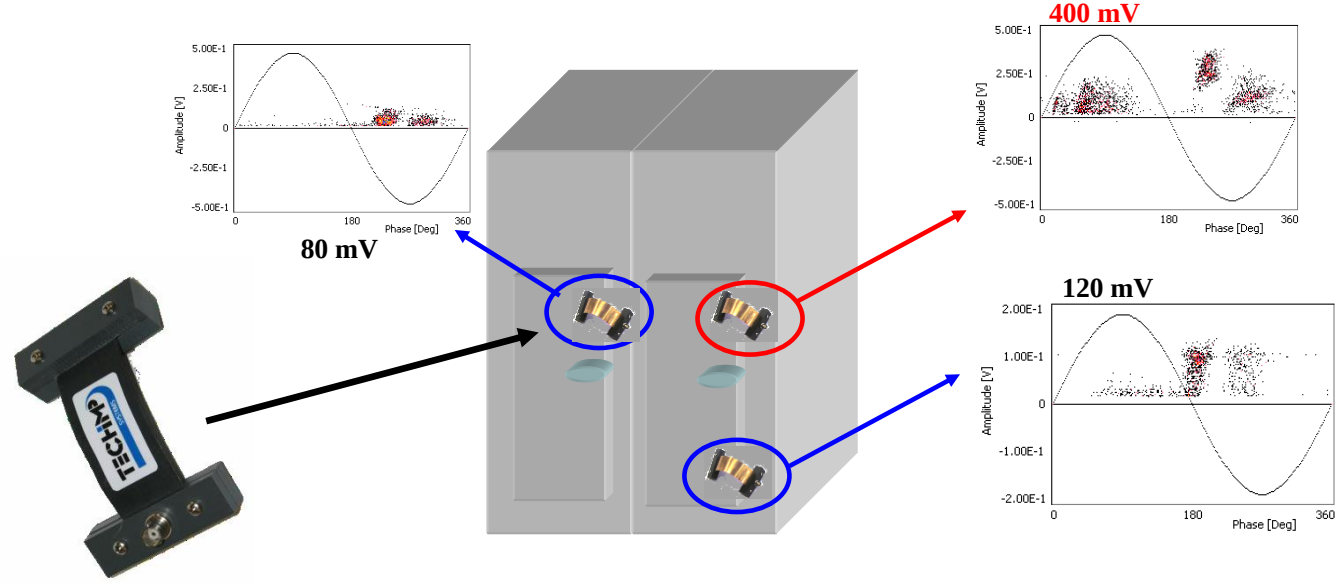
PD detection through TEV jumper sensor



Second measurement result after three months: PD activity strongly increased!

Cable Termination Replacement was suggested!

TEV Jumper can record internal PD and it is very selective regarding this kind of phenomenon



TECHIMP SpA

LOCATION	**FAR EAST**
EUT	**MV SWITCHGEARS**
RATED VOLTAGE	**15 kV**
INSULATION	
LENGTH	
VINTAGE	
TYPE OF TEST	**ON-LINE**
PD SENSOR	**VARIOUS**

CASE STUDY

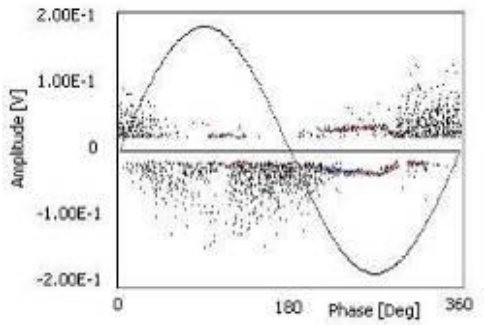
PD measurement sessions performed on MV switchgear.

PD measurement results

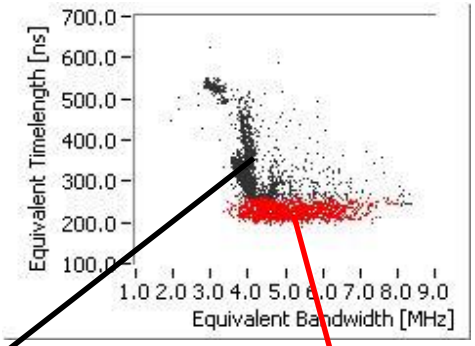
PD investigation through Antenna Sensor:

- Antenna sensor is very sensitive for **corona and surface discharges**

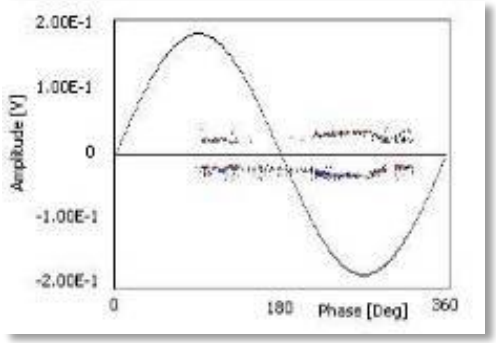
Entire pattern



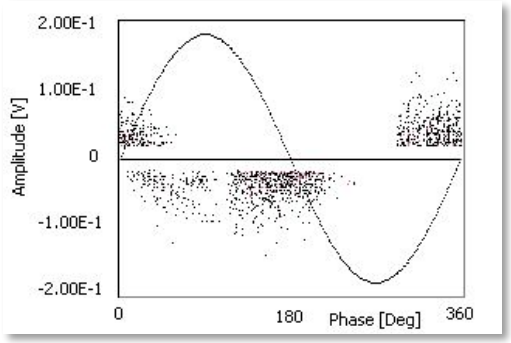
Classification map



External disturbances



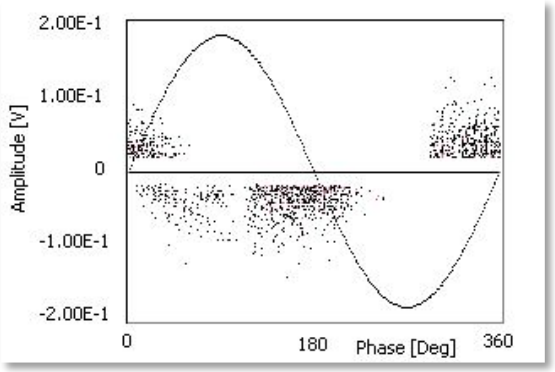
Surface

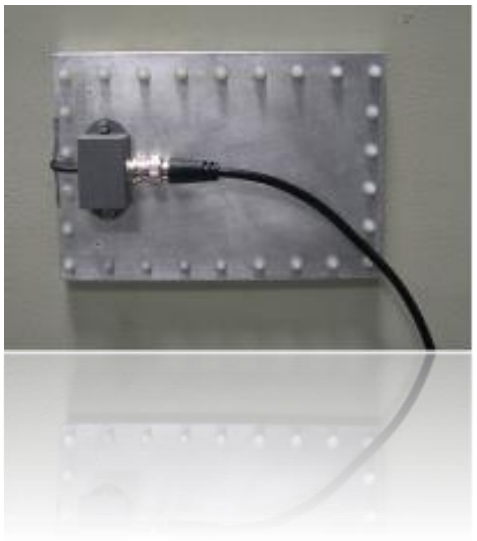


Red phenomenon can be better analyzed separating the surface activities.

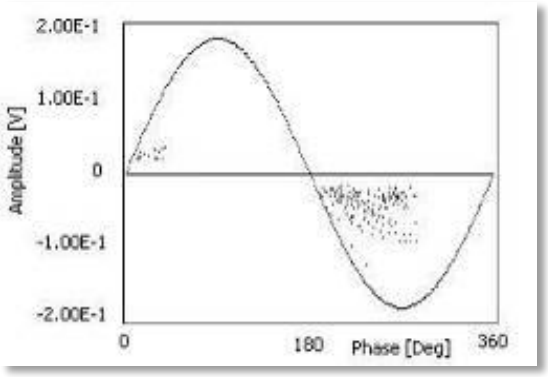
PD measurement results

Pattern relevant to entire Surface phenomenon





Surface on phase 2



Surface on phase 1