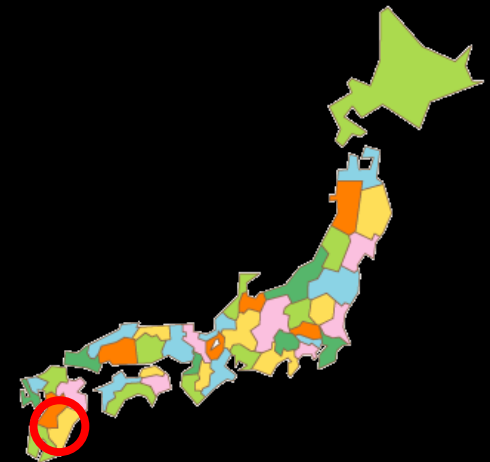# On-line PD system and PD Locator for XLPE Cables

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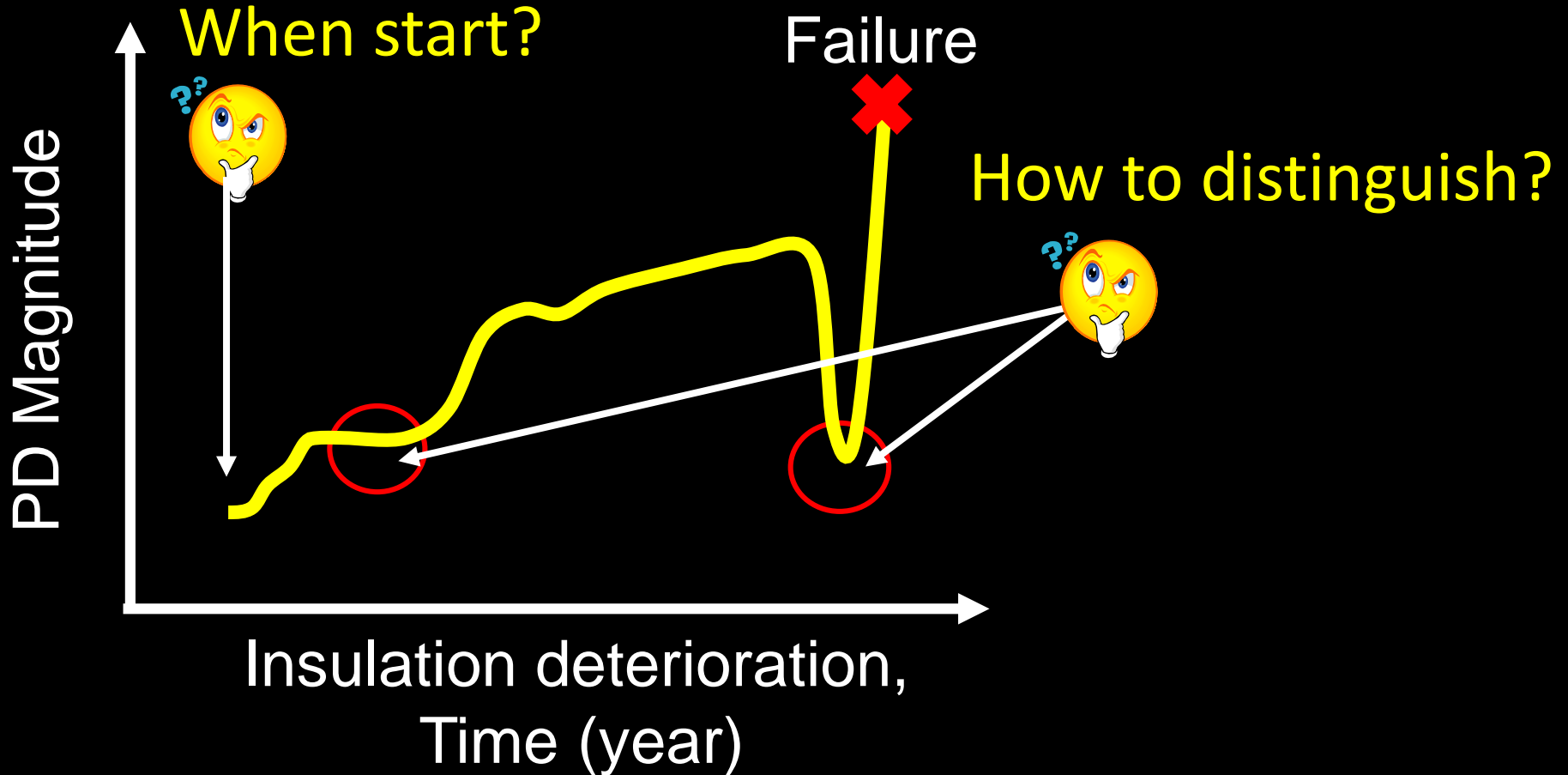K. Miyagawa
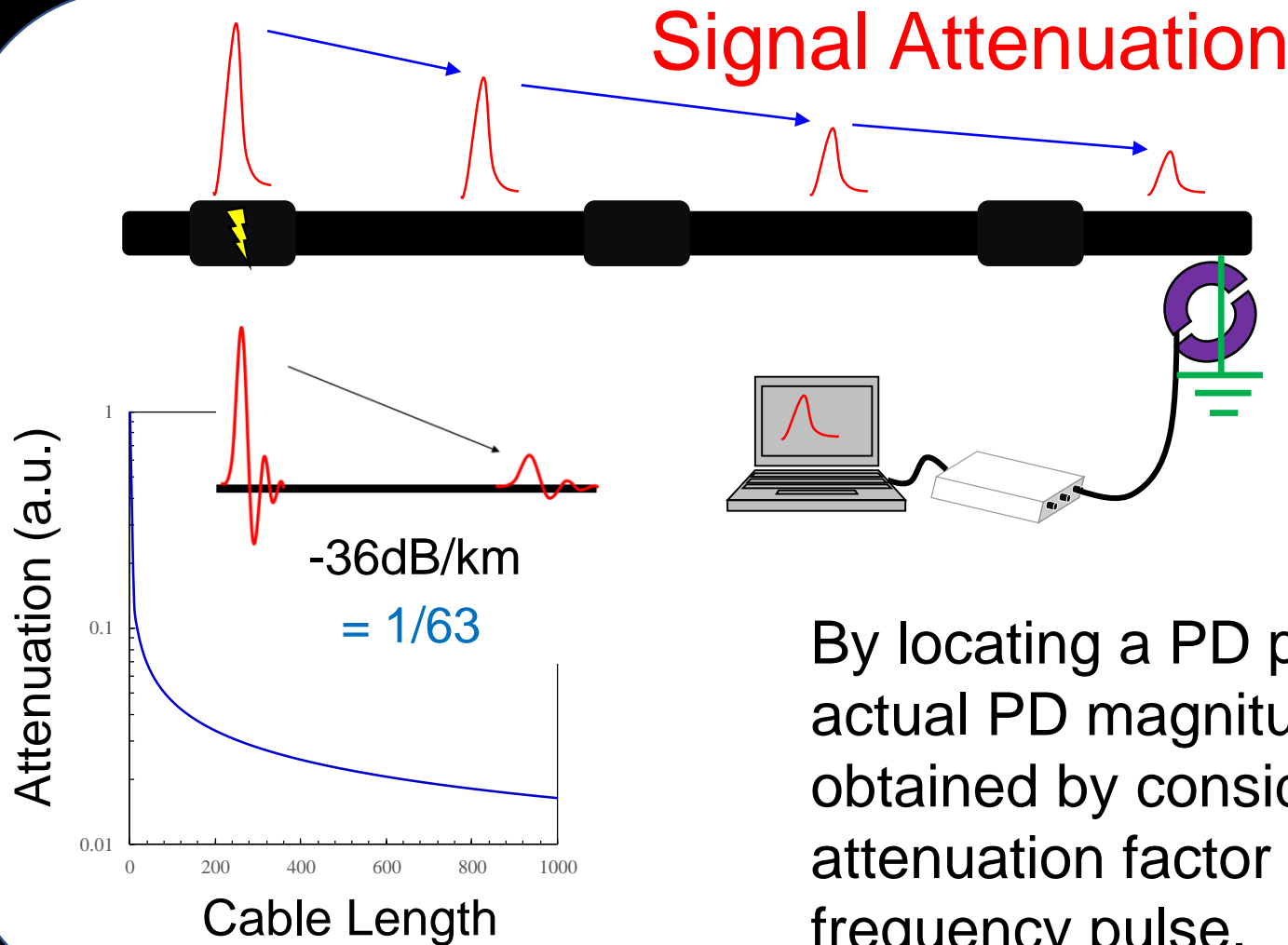Kyushu Electric Power Co., Inc

Contents

1. Motivation (1)

Measurement of PD in XLPE cable is useful because PD is a precursor to dielectric breakdown.

Necessity of 24h-PD Monitoring

When start?

Failure

How to distinguish?

PD Magnitude

Insulation deterioration, Time (year)

1. Motivation (2) Necessity of PD locating

PD pulse detected by a sensor doesn't refer the actual amplitude.

Signal Attenuation

-36dB/km
= 1/63

Attenuation (a.u.)

Cable Length

By locating a PD position, actual PD magnitude may be obtained by considering the attenuation factor of a high frequency pulse.

2.1 PD Monitoring

Cloud Computing

On-line PD Monitoring System (PDOM)

AD converter
>100MSS
(<10ns)

Current Sensor

Cable Joint

Field Site
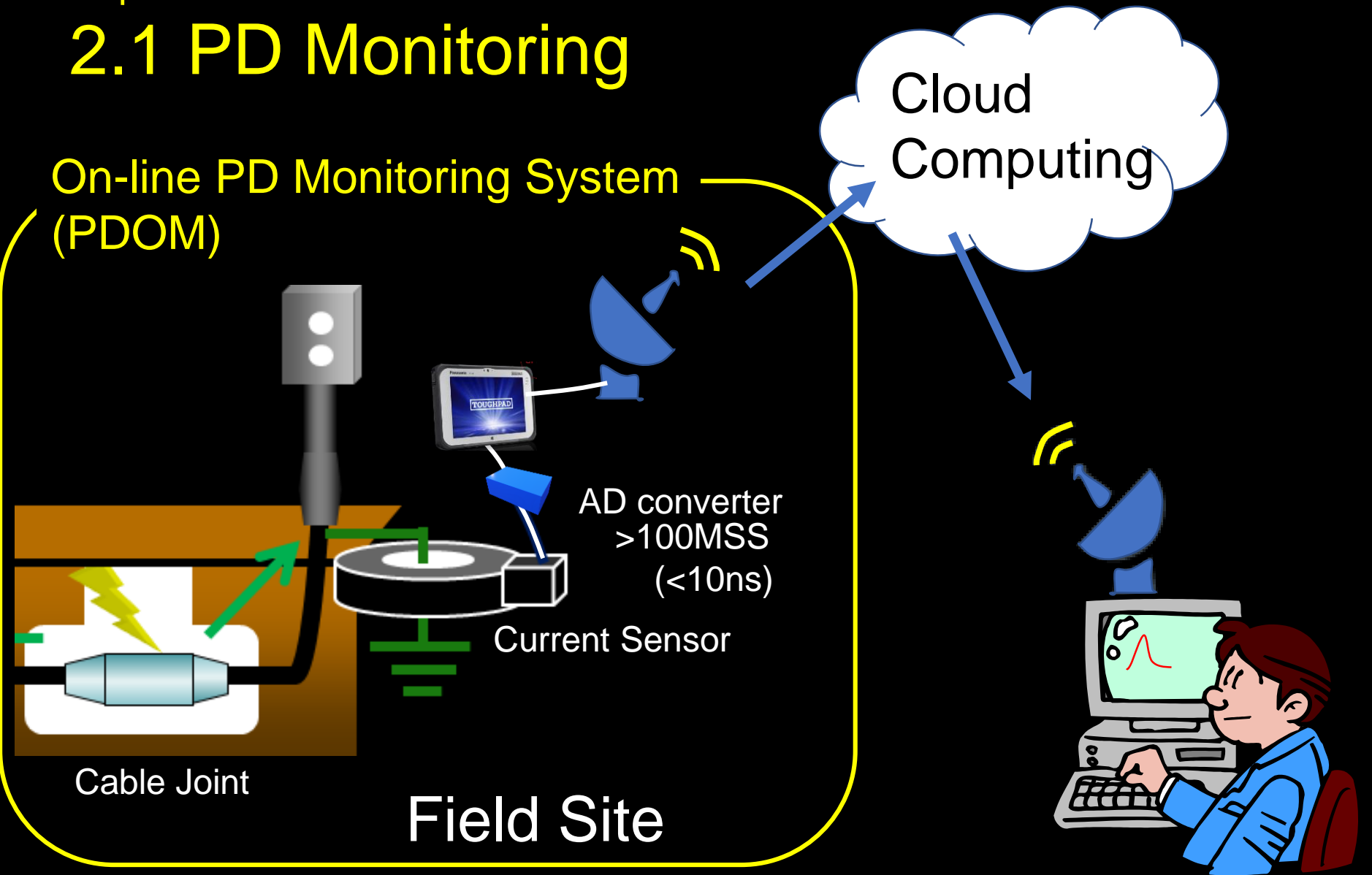
Arrangement & Data Transfer

SS

16m 7m 5m 91m

CT
(>1kHz)

AD converter

Tablet PC

PDOM U.

50-plotted-data (T=500ns)

Cloud

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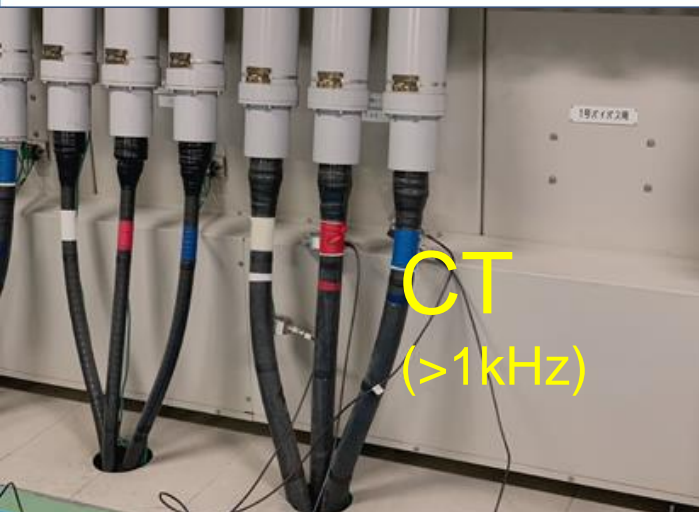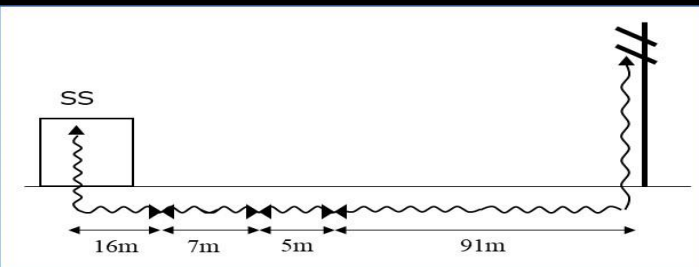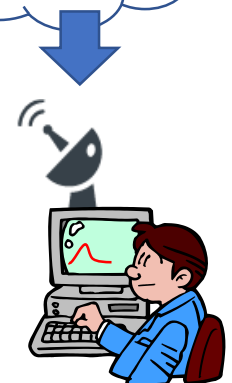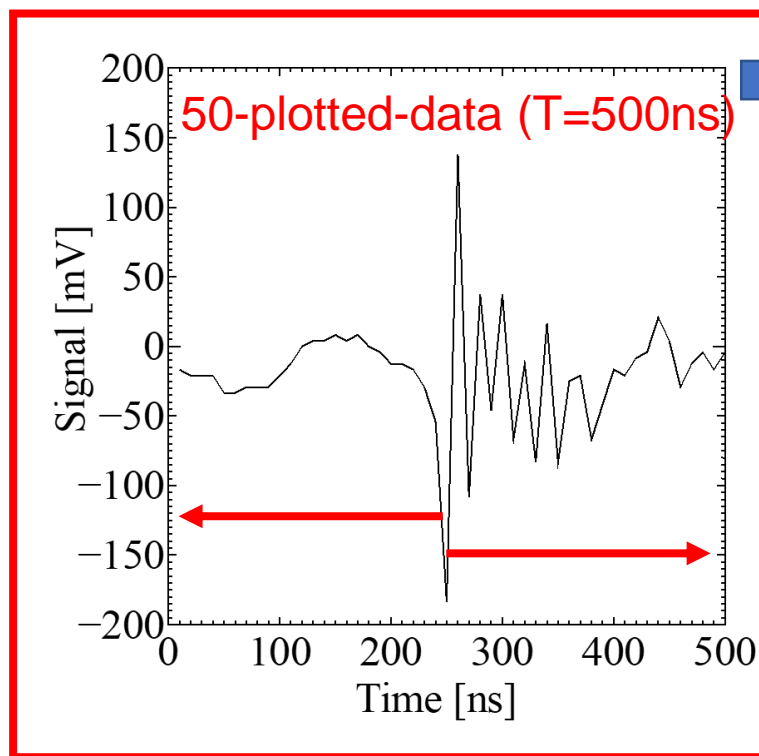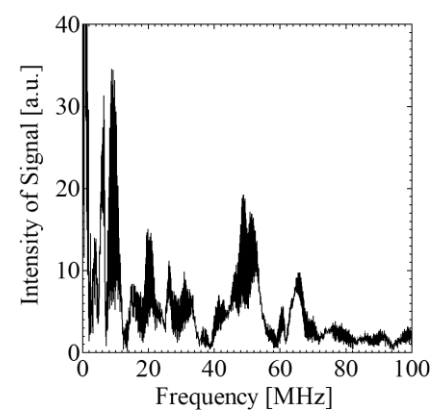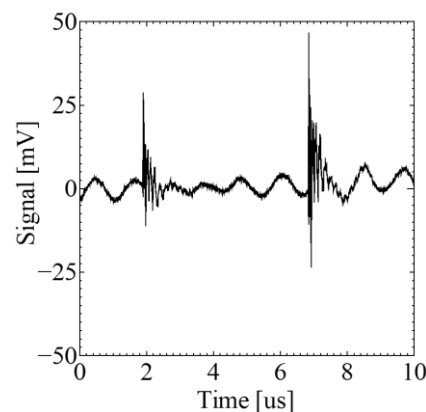
2.2 PD Locating
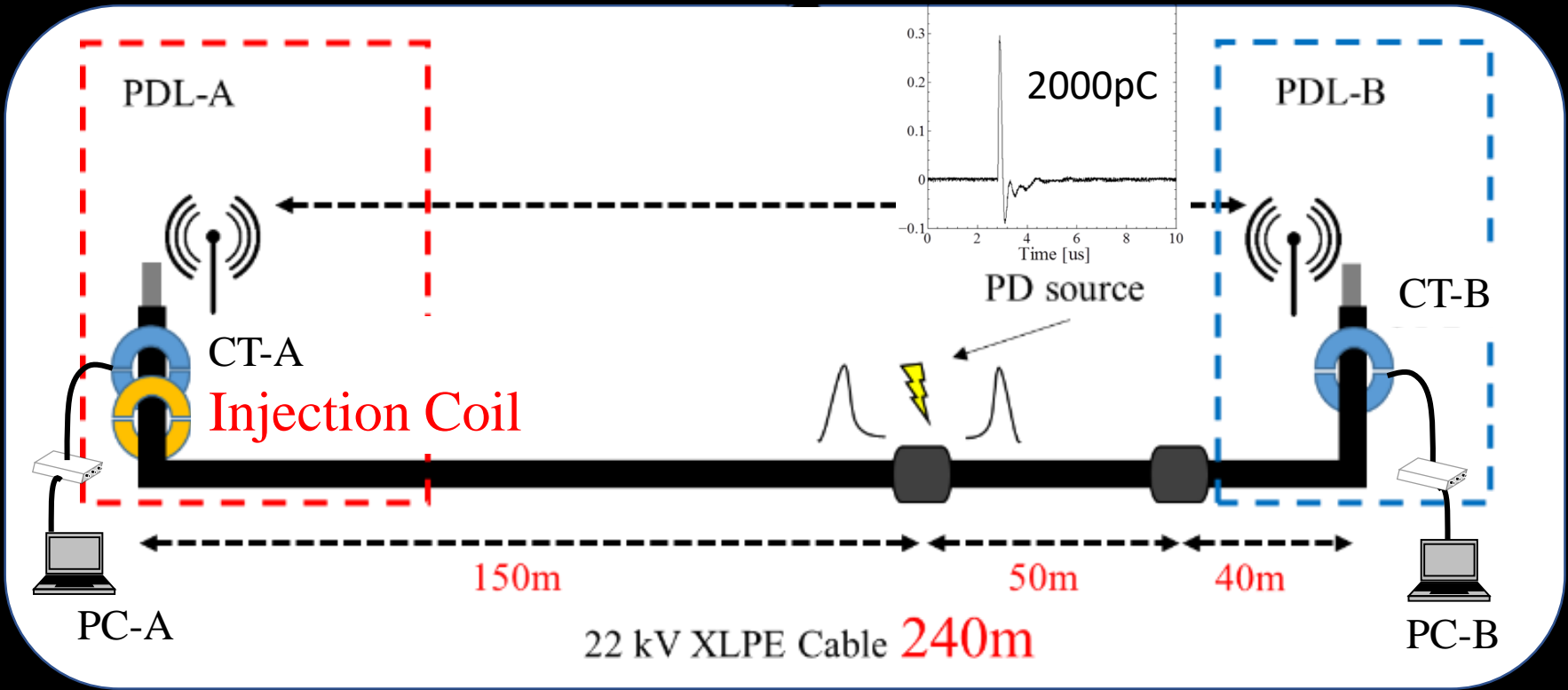
Key Player : Injection Coil

Measure Propagation Time ΔT of Pulse in Cable

How to locate PD?

(1) PC-A, PC-B receive 1 PPS signal from a GPS satellite
(2) The signal activates a signal control program in each PC.
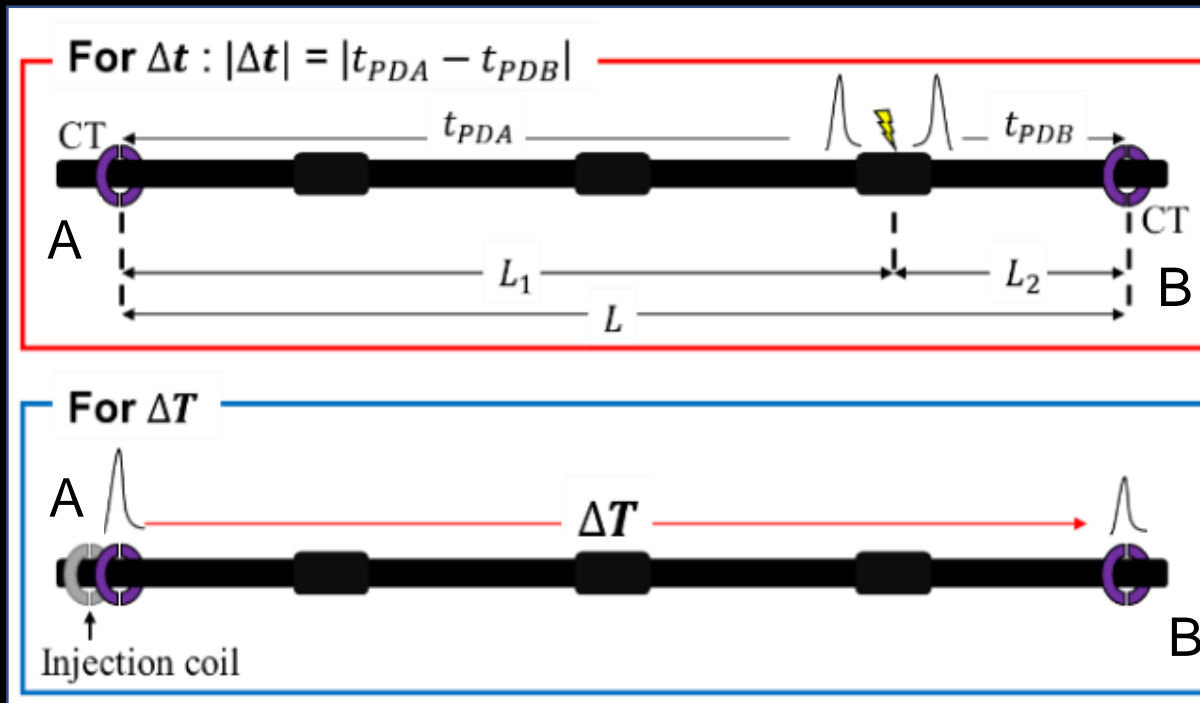(3) AD converters output signals at constant intervals,
    and control the internal and local time in PDL system.

For $\Delta t : |\Delta t| = |t_{PDA} - t_{PDB}|$

$$L = L_1 + L_2 \qquad (1)$$
$$L_1 = L \, (1 - \Delta t / \Delta T) \, / 2 \quad (2)$$
$$L_2 = L \, (1 + \Delta t / \Delta T) \, / 2 \quad (3)$$

When Sampling frequency of 100 MHz (=10ns),
the internal time in PCs is made by integrating time every
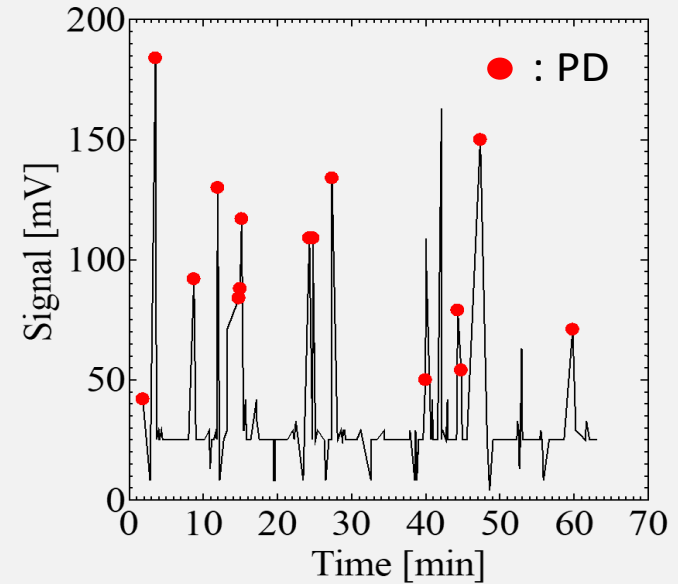10 ns from a signal of AD converter.

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3.1 PD Monitoring
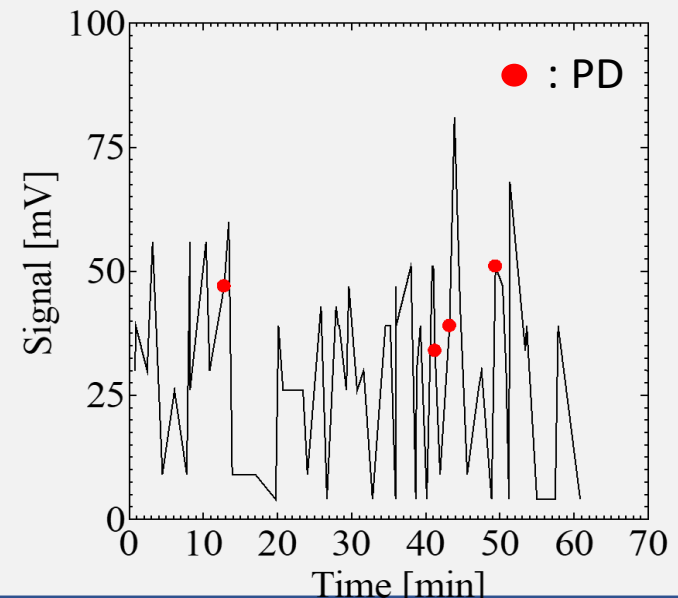

Phase 2 (Red)

Phase 1 (Blue)

PD-like signals are detected sporadically for 60 min, and occurrence frequency at phase 2 (Red) is higher than that at phase 1 (Blue).
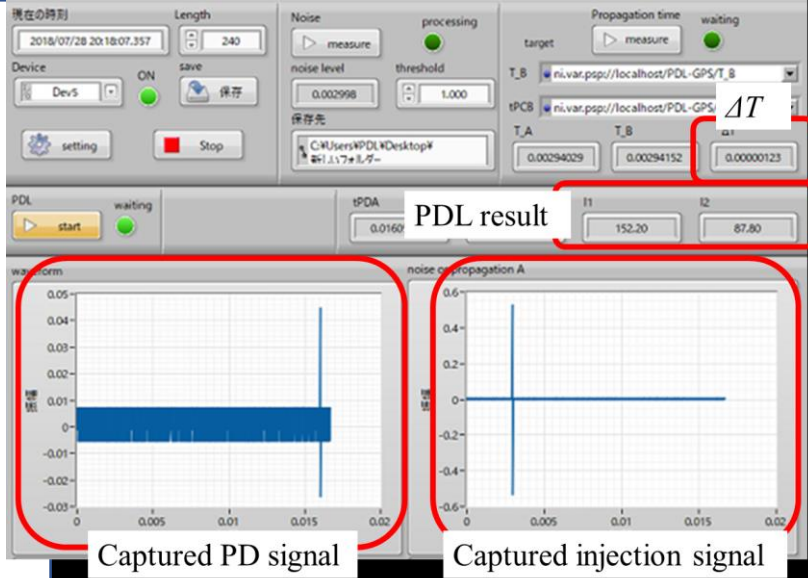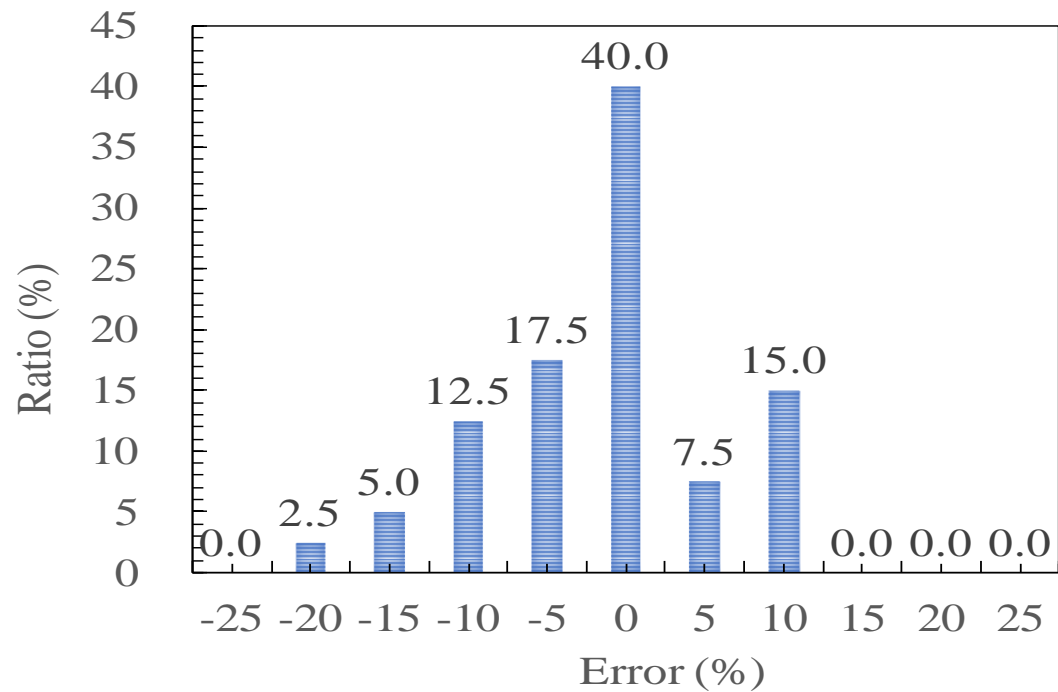
Phase 3 : None

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3.2 PD Locating

Locating accuracy of PDL in 40-times measurements.

Histogram — Error (%) vs Ratio (%): 0.0, 2.5, 5.0, 12.5, 17.5, 40.0, 7.5, 15.0, 0.0, 0.0, 0.0

Captured PD signal   Captured injection signal

PDL result
ΔT

Accuracy rate
less than 5%: 40.0%
less than ±15% :92.5%.

PDL-A   PDL-B
CT-A   CT-B
Injection Coil   PD
150m   90m
PC-A   PC-B

10
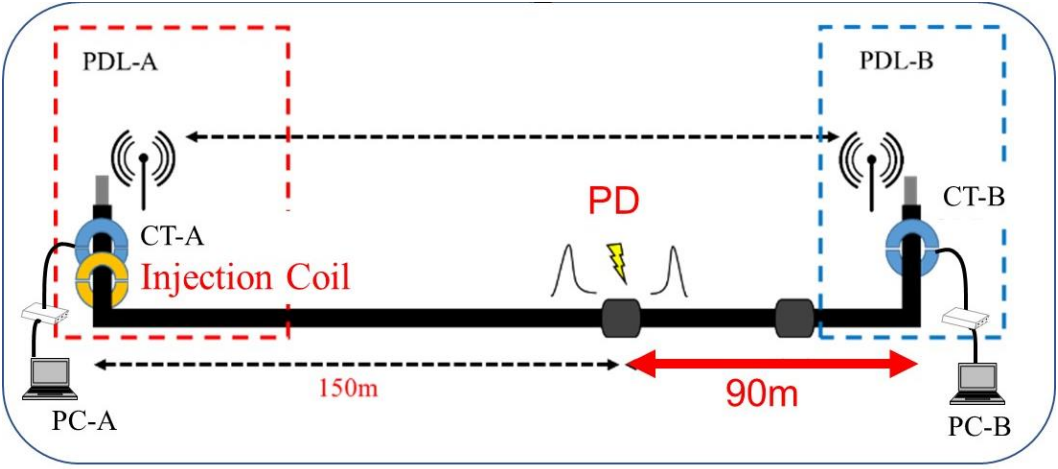
4. Conclusion

- ## PDOM System

 : A sampling frequency for data acquisition is 100 MHz, and we exchange on-site PD data through a cloud system.

  : we successfully measured PDs in the early stage of insulation deterioration of a XLPE cable in a field site.

- ## PDL System

  : PD locating is conducted by using the internal local time at positions A and B.

  : The obtained accuracy is good enough to identify the location of cable faults.

5. Future Work

16m   7m   5m   91m
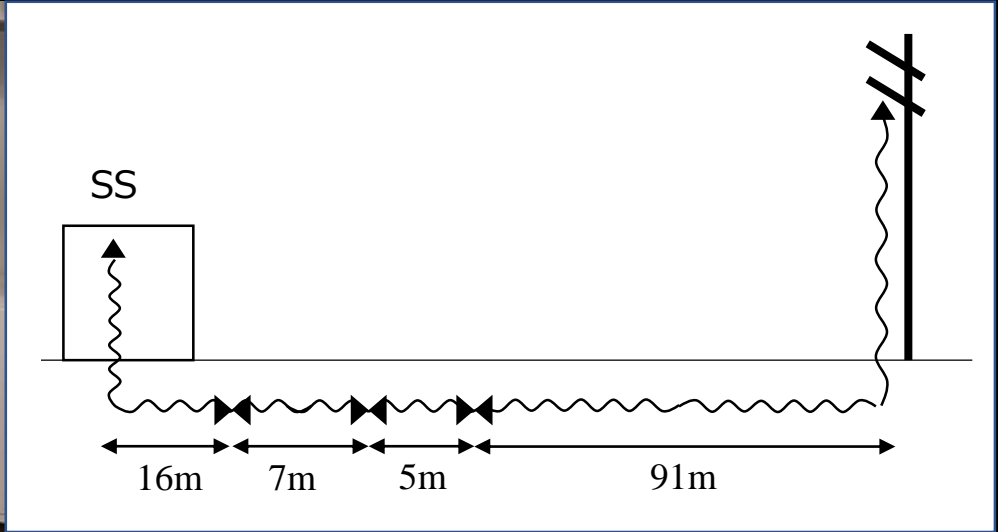
3 cable joints near substations within 30m.

Including a terminal cable portion, a PD position can be evaluated by using a PDL system.

When occurrence frequency of PD becomes high, PD locating will be conducted.