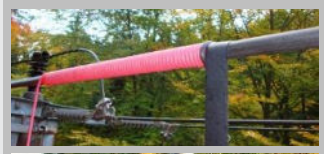
SUCCESS CASE 12.2024

Indication of Partial Discharges

FAILURE DETECTION SYSTEM ON MEDIUM VOLTAGE INSULATED OVERHEAD LINES




THE CHALLENGE

CEZ Distribuce operates approximately 300km of **insulated medium voltage (MV) overhead lines** in forest clearings. This type of line has the advantage of a narrow protective zone and the ability to operate even when vegetation comes into contact with the phase conductors. However, the disadvantage of insulated lines is the **difficulty in detecting the fall of branches or trees onto these conductors**. In such cases, there can be an **immediate or gradual degradation of the conductor insulation or breakage of the conductor**, which can result in their fall to the ground with the subsequent **risk of electric shock**. The goal of the *Indication of Partial Discharges* (iPD) project was to develop, install, and deploy into regular operation a system that would successfully detect the aforementioned conditions.

THE SOLUTION

iPD consists of the following components: sensors of partial discharge activity, a capacity divider, and a measuring, communication and evaluation unit. The sensors used are single-layer coils wound on the surface of the conductor, creating capacitive coupling with the individual phase conductors, which enables the **recording of voltage waveforms and the transmission of partial discharge signals**. These sensors measure partial discharge activity within the insulation of individual phase conductors. The measured values are then processed by the PeakClassifier application, which evaluates the probability of fault in the range of 0 to 100%, with real values falling within the interval <0;1>.

A typical fault detected by iPD can be divided into three stages to present to the dispatcher:

- Beginning of the fault (e.g. a tree branch fell on the conductor, start of the degradation, number of peaks 26 – probability 20%).
- Ongoing fault (increased number of contacts, number of peaks 32, probability 80-100%).
- End of fault (line back in normal operation, number of peaks 0, probability 0%).

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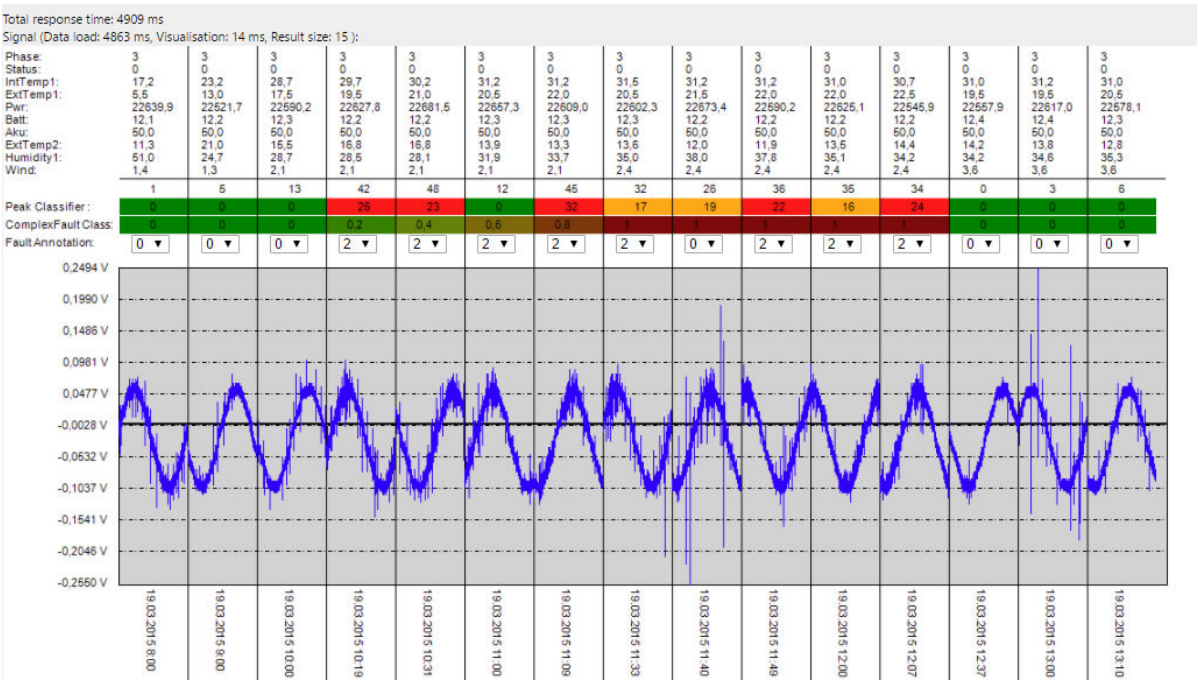
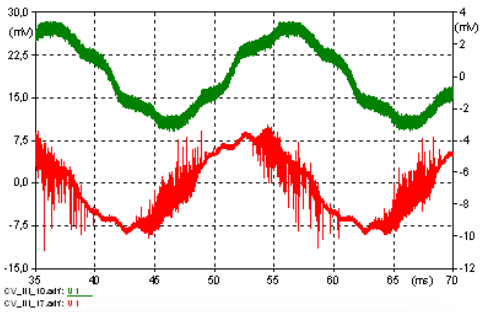
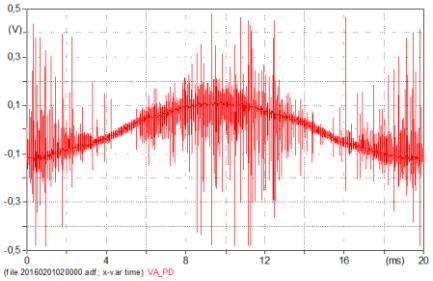


Measured signal in Volts and classification of the probability of failure.

MAIN ACHIEVEMENTS

Following the iPD pilot verification, the detectors were put into full operation. CEZ Distribuce is **successfully operating 20 fault detectors**. As other Distribution System Operators (DSOs) in the Czech Republic showed interest in the detector an additional 30 iPD units were also deployed into full operation by them.





Top pictures: Example of signal (green without fault, red with fault),
Bottom pictures: typical fault cause (fallen tree branch) and result (damaged insulation).

KEY SUCCESS FACTORS

A key activity for the successful development of iPD was the **precise and prompt evaluation of every non-standard pattern in the measured values**. This was made possible by frequent physical monitoring by patrolling the line route. Only this type of control allows distinguishing disruptive signals from actual branch contacts or conductor breaks and thus **ensuring sufficient reliability of the fault detector**.

WAY FORWARD

The existing fault detectors provide a relatively robust solution but, apart from the sensors, also require capacitive dividers, a remote terminal unit equipped with a communication card and SIM, and a sufficiently powerful power module. The Technical University of Ostrava is currently working on the **development of a "light" version of the fault detector**. This is a low-power solution that would communicate to and rely on the nearest fault detector and which could be installed using live-line techniques.