

## «CDM-15/P» System for Periodic Monitoring of 6-10 kV Cables Insulation

The advantages of on-line monitoring for cable systems, as against regular tests in off-line mode (on the offline equipment), are well known. These are high efficiency and quick diagnostic reports, especially important for operation of cables and joints with cross-linked polyethylene insulation (XLPE), as defects developing time in XLPE cables is usually less than the standard time between two tests.



To equip a large number of distribution substations with the systems of continuous monitoring of all 6-10 kV cables at one time is often a big problem for a company, principally of economic nature, as it requires rather large investments.

An alternative way for effective monitoring of cables may be to use a portable system for periodic monitoring, which can consistently be installed on a variety of cable systems for a certain interval of time, usually one or two days.

**«CDM-15/P» System (Cables Diagnostics Monitor, 15 Channels, Portable)** is for periodic monitoring of cable insulation condition of up to 15 cables in combined cable assembly (switchgear) under voltage.

«CDM-15/P» monitors the power cables insulation, joints and terminations, using the method of measurement and analysis of partial discharges, which has the highest possible sensitivity for the defects diagnosis of insulation of any type.

### The advantages of «CDM-15/P» system for periodic monitoring:

- The system simultaneously monitors up to 15 cables connected in one place.
- The cable parameters are not measured once, but are monitored during a certain time interval, and in most critical operating conditions.
- As the system can be connected to energized cables, the time between measurements can be as long as desired.
- If necessary, the system of periodic monitoring can be installed on-line on the most important or critical cables for a longer period of time.

### «CDM-15/P» implements the following diagnostic functions:

- Continuous monitoring of power cable insulation by measuring and analyzing PD level and PRPD. It specifies the type of the insulation defect, analyzes its level and the risks for further exploitation.
- Automatic location of insulation defects in joints and cables, detected by the system due to partial discharges. This important diagnostic function is

unique as it makes possible to test cables on-line, under voltage.

### Periodic On-Line Monitoring of Cables.

«CDM-15/P» is designed to operate in automatic mode. The built-in memory volume is enough for storage of PD measurements data for quite a long time. When the specified time is out, all the data is transmitted via USB to the

computer, where it is stored and further processed.

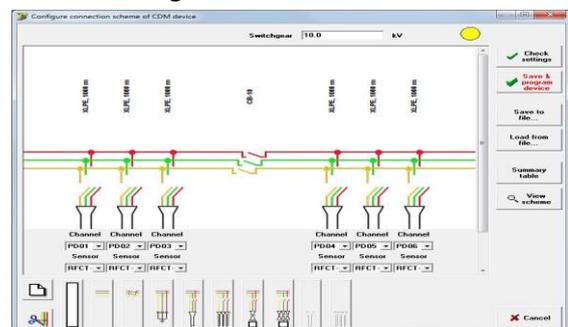
The on-line diagnostics of the monitored cables' insulation condition are done in the device, in real time, with built-in algorithms. If the critical threshold is surpassed then red LED switches on at the device cover. The program automatically generates the condition reports of all the cables on the base of the monitoring results.

### The optimal technology for starting up the periodic cables monitoring is described below:

«RFCT-7» («RFCT-1») PD sensors are pre-installed on all cables, which are supposed to be monitored, as well as on grounding conductors of terminations. The signal cables from all the sensors are taken to the cable terminal box, which provide easy and secure access for the diagnostic staff.

«CDM-15/P» with short coaxial cables is on-line connected via the cable terminal box to the required cables, and then partial discharges in insulation are measured within the required time period.

If the PD sensors have not been pre-installed on the cables, they will have to be installed directly before the measurement. In some cases, this can be done on energized cables, as the applied PD sensors are split-core and are easily mounted on a grounding conductor (busbar) of the cable shield. If it is dangerous to do, power has to be switched off while sensors are being installed.



Using «CDM-15/P» in automatic mode requires pre-forming of the "configuration" of the monitored cables (switchgear). This configuration is created on computer and is downloaded into the device before monitoring.

The circuit configuration is created with special program which allows drawing cabling diagrams and sensors installation points quickly and efficiently.

For this purpose, all the data required for defective cable detection, its condition estimation, specifying the insulation defect type and its danger is entered.

### «CDM-15/P» Basic Algorithms.

The most difficult problem of measuring the partial discharges in power cables is noise rejection as the noises decrease the monitoring systems sensitivity tenfold or even hundredfold.

To solve the problem of detecting defects at early stages of development, «CDM-15/P» has a number of the most modern means for external noise rejection. They include the following algorithms:

- Analysis of PD pulses generation time and the supply voltage phase.
- «Time of arrival», i.e. noise rejection by the time of pulses arrival from different cables, time-resolved of a few nanoseconds.
- Amplitude «noise rejection» of discharges to avoid pulses induced from adjacent cables.
- Analysis of each pulse's frequency characteristics to separate the random noise pulses from the repetitive PD pulses.

The second important task for built-in algorithms is identifying the type of cable insulation defect, i.e., its danger. The built-in «PD-Expert» system allows not only automatic partial discharges' assessment but also specifying the defect type in cable insulation. «PD-Expert» is even able to distinguish several similar defects at different locations in one cable.

«CDM-15/P» has the function of defect place location in cable. The partial discharge pulse generated in insulation defect point is used as the probe pulse. If the line has no pulses of sufficient amplitude, the "external noise" pulses can be used as probe ones. The built-in «on-line» reflectometer even more expands diagnostic capabilities of the system.

### «CDM-15/P» Delivery Set

The standard supply includes three similar transport cases for:

- Measuring device,
- PD sensors,
- Signal cables 15 meters long.

The following PD sensors are supplied:

- «RFCT-7» sensors, 12 pieces;
- «RFCT-4» sensors, 2 pieces;
- «TEV's» sensors, 2 pieces.



«RFCT-7» is split-core sensor with a 34\*34 mm inner window. The sensors measure partial discharges in conductors which have power current up to 1000 A. They are specially designed for cable insulation monitoring systems.

If the grounding conductor (busbar) size does not allow using «RFCT-7» sensor, you can use split-core «RFCT-4» sensor with a 67 mm-diameter window.

«RFCT-5» partial discharge sensors (23 mm inner diameter) are quick-detachable high-frequency clamp meters.

On preparatory stage, if the cables are planned to be equipped with fixed sensors output to the cable terminal box, it is a good practice to use the lowest price «RFCT-1» sensors (22 mm inner diameter).

If «CDM-15/P» is to monitor the busbar insulation, it is necessary to use special «CC» coupling capacitors, which are installed on the two sides of the busbar. The design of coupling capacitors allows using them as busbar post insulators.

### «CDM-15/P» Specifications

Parameter	Value
Number of monitored cables	Up to 15
Operating voltage, kV	> 3
Length of monitored lines, km	≤ 4
Pulses frequency, MHz	0.5 ÷ 15.0
Pulse quantity, pC	20 ÷ 100000
Inaccuracy in calculating the defect point	±1% of cable length
PC interface	USB
Power Supply, AC / DC, V	90 ÷ 260
Operating temperature, °C	-40 ÷ +60
Transport case dimensions, mm	520*435*230
Full weight of the system, kg	25