

## «ADM-9» - the Acoustic Monitoring System of High-Voltage Equipment Insulation by Partial Discharges

The «ADM-9» monitors the insulation condition of:

- HV cables' terminations and joints;
- GIS and switchgears of different types;
- HV oil-filled equipment (power and measuring transformers, breakers, etc).



«ADM-9» (Acoustic PD Monitor) is used for on-line condition monitoring and defect location in high-voltage equipment insulation. «ADM-9» system operation is based on the method of PD measuring and analyzing, which is has high sensitivity for defect location in different types of insulation.

The acoustic sensors of «ADM-9» system are installed on the surface of the equipment near the monitored insulation zone. Usually these are the grounded or isolated surfaces of the equipment, without high potential. When installing the sensors, special means are used for providing good contact between the acoustic sensor and the surface of the object.

### The Features of «ADM-9».

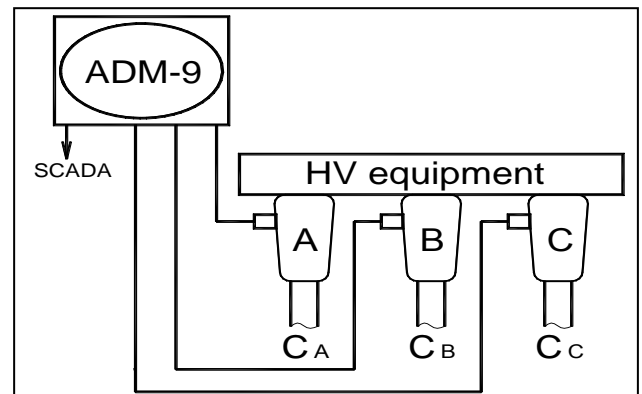
The use of «ADM-9» system allows solving the most important problems of equipment condition diagnostics, that directly affects the HV equipment operation.

- «ADM-9» measuring device can monitor PD activity in 8 different locations of the equipment, remote from each other at a distance of up to 30 meters.
- Due to the function of synchronic signal measuring by several channels, «ADM-9» can locate the PD source inside the HV equipment.
- On the basis of the measured data the system gives the diagnostic reports and the recommendation for the further equipment operating.

### The Monitoring of HV Cable Terminations.

The acoustic sensors of «ADM-9» can be used for terminations condition monitoring, and for joints condition monitoring, if there is such a need and opportunity (there should be power supply in the monitored zone). The measurement zone of the acoustic sensors is usually not more than  $\pm 1$  meter because of the acoustic signal attenuating along the cable, that's why these sensors are not used for cables insulation condition monitoring.

The acoustic sensors of «ADM-9» are installed on the body of the monitored termination, or if it is impossible, on the open part of the cable near the termination. There should be good acoustic contact between the sensor and the termination surface.



The measured acoustic PD pulses are processed and analyzed in «ADM-9», and for each channel the signal is formed proportional to PD intensity («PDI»), which consider the quantity and amplitude of PD pulses. The information and the diagnostic reports about insulation condition are transmitted to SCADA.

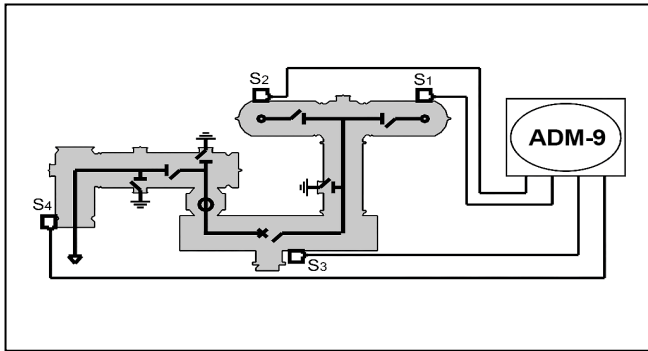
### PD Monitoring in GIS Insulation.

The most effective mean of PD measuring in the GIS insulation is the use of the monitoring systems with UHF sensors. In this case the best UHF sensors are the electromagnetic antennas installed inside the GIS by the manufacturer.

In the field, the electromagnetic sensors are installed on the surface of the isolators, which are located between the parts of GIS, can be used. But in several types of GIS there is no possibility to install the external electromagnetic antennas, because there are metal rings.

If there aren't any build-in electromagnetic antennas, and there is no possibility to install the external electromagnetic antennas, the only way of PD measuring is the use of the external acoustic sensors.

The acoustic sensors are installed in the most critical zones, where the insulation defects can appear, or there are free particles, or carburized tracks can develop. An acoustic sensor can monitor the zone of around 2-3 meters in GIS, because PD pulses attenuate quickly in gas environment. That is why quite a number of acoustic sensors should be used for GIS monitoring.



The advantage of «ADM-9» use for GIS monitoring is that the condition of the cable terminals, connected to the GIS, can be monitored.

For monitoring of MV switchgear, the acoustic sensors are installed inside each cell on the cable termination, or as a free acoustic microphone in the cell.

### PD Monitoring in Power Transformers

«ADM-9» is used for PD measuring and analyzing inside the tanks of oil-filled high-voltage equipment – power and measuring transformers, breakers, etc.

Due to the good acoustic properties of the oil, one acoustic sensor can monitor a big volume of the oil insulation inside the tank. It is possible, if there are no metal elements of transformer on the ways of the pulses.

While choosing the places for the most efficient acoustic sensors installation, the two reasons should be taken into account.

1. The acoustic sensors should be installed as close as possible to those insulation zones inside the tank, where the defects accompanied by partial discharges can appear.

2. There should be the possibility of defect location inside tank by the standard triangulation methods. The defect location is based on analyzing the time of one PD pulse arrival to several acoustic sensors. The nearer is the sensor to the defect zone, the earlier is the PD pulse measured by the sensor.

For defect location by PD inside the tank, the signals from all the «ADM-9» acoustic sensors are measured synchronically, which allows assessing the difference in the time of arrival of the acoustic signals, and calculating the coordinates of the defect inside the transformer tank.

### The Delivery Set of «ADM-9»

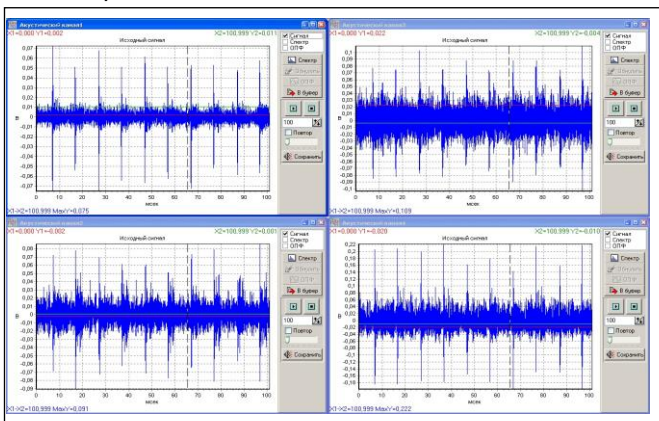
The delivery set of «ADM-9» for PD insulation monitoring is:

- «ADM-9» measuring device in protective enclosure;
- A set of the acoustic sensors for PD measuring;
- Coaxial cables for sensor connection 15 meters long for one sensor
- Manual on CD.
- «iNVA» software for PC.

### «ADM-9» External Interfaces

«ADM-9» external interfaces are:

- RS-485 isolated interface.
- Ethernet for the measuring device connection to the local network and data upload to «iNVA» by fiber optic
- USB for PC connection.



### The «ADM-9» Specification

Parameter	Value
The number of measured channels	9
Rated voltage, kV	Up to 500
PD pulse frequency, kHz	30÷300
Discharge value, pC	20÷100000
PC interface	RS-485, Ethernet
Supply voltage, V AC/DC	90÷260
Temperature range, °C	-40÷+60
Device dimensions, mm	280*260*110
Device weight, kg	2,0