Spot check for partial discharges in a matter of minutes

Online partial discharge testing without interrupting operation

Distribution network operators use partial discharge testing to determine the condition of their cable routes and to detect hidden faults at an early stage. As this measurement typically requires the route to be switched off (at least for a short time), network operators usually only employ this method on part of their cables. A new accessory from Baur now makes it possible to check for partial discharges in a matter of minutes without having to switch anything off. This means that more cables can be tested for partial discharges, and offline measurement for the verification and pre-location of partial discharges can be limited to those routes that indicate abnormalities during the online check.

Up until now, network operators have had two options for testing medium voltage cables for partial discharges: using offline measurement or using online measurement, where the signals are transmitted via ring-shaped inductive couplers. For system critical cables, e.g. in the case of islanding, this online measurement is often permanently installed to facilitate monitoring. To perform a temporary measurement, however, the route must be briefly taken out of operation in order to attach the inductive couplers around the cable end. This is very time consuming and makes partial discharge testing disproportionately expensive for some cable routes. In extreme cases, switching off cable routes to attach the sensors is not possible or is only possible with difficulty, and online measurement under voltage is only permitted if extensive safety measures are implemented, as the switchgear must be opened to perform the measurement.

Direct connection to the VDS sockets

A new accessory for the portable Baur liona measuring device makes it possible to measure partial discharges in cables and switchgear in three phases during network operation – within a short time and without switching anything off. The accessory in question is the VDS PD coupler, which allows the measuring device to be connected to the switchgear VDS sockets (**Figure 1**) and makes partial discharges detectable, even if they occur several kilometres away from the measurement point.

Connecting to the VDS sockets is by no means a new idea, but it previously only enabled identification of partial discharges in the switchgear or the immediate vicinity, as the signals of partial discharges that are further away are

Source: Baur GmbH

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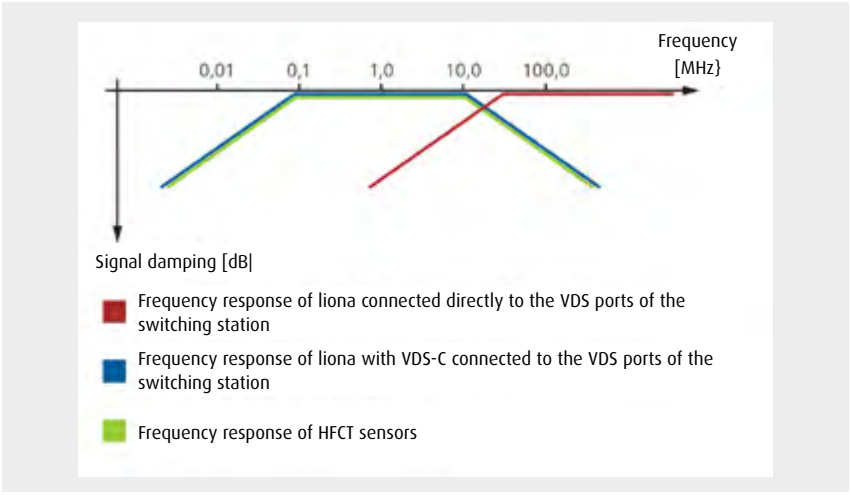
Figure 1: Connection of the partial discharge measuring device to the switchgear VDS sockets of a wind farm

suppressed by the high-pass character of the measurement setup. To enable detection of partial discharges that are further away, the frequency response of the measurement setup is adjusted by the VDS PD coupler (**Figure 2**) and is almost identical to that of the Baur inductive couplers (the HFCT sensors). This means that even cables several kilometres long can be checked for partial discharges during operation, with the check being performed from the switchgear via the VDS sockets. In addition, a sync channel allows the measurement to be synchronised with the measured phase, so that the partial discharges can be displayed according to the correct phase.



Source: Baur GmbH

Figure 2: When the partial discharge measuring device is connected directly to the switchgear VDS sockets, the high-pass characteristic (red line) prevents the detection of partial discharges that are further away. The VDS PD coupler produces a frequency response (blue) similar to that of inductive couplers (green), so signals from partial discharges that are kilometres away can also be evaluated.

Comparable accuracy of measurement results

The new VDS PD coupler has already demonstrated its qualities in a number of field tests. The tests were primarily

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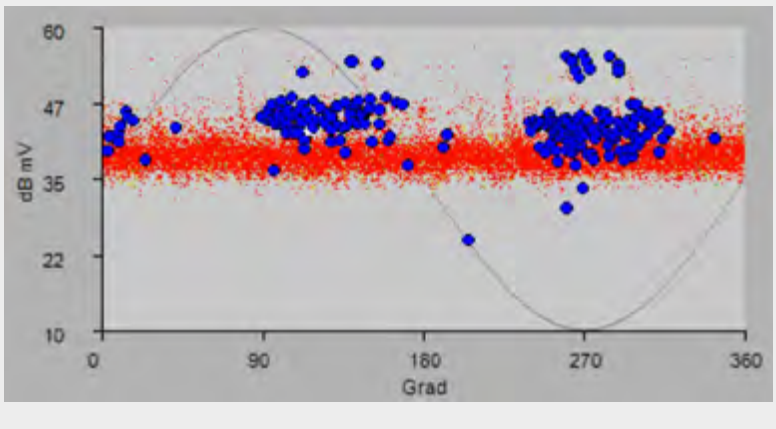
Figure 3: To compare the measurement quality, the liona partial discharge measuring device was connected to both the new VDS PD coupler (top) and HFCT sensors (bottom).



Source: Baur GmbH

Figure 4: The phasing of the partial discharges can also be determined where partial discharge testing is performed using the VDS PD coupler.

intended to show whether the measurement results using the VDS PD coupler are as informative as those where partial discharge testing is performed with inductive couplers.

In many cases, the tests were carried out on older medium voltage routes (**Figure 3**), as partial discharges were to be expected here. The liona partial discharge measuring device was connected to the switchgear using both the HFCT sensors and the new VDS PD coupler. A comparison of the recorded results shows that the values determined with the VDS PD coupler are comparable to those measured with HFCT sensors. Thanks to the sync channel, the measurement results can be displayed according to the correct phase (**Figure 4**).

The field tests also investigated whether partial discharges could be detected using a direct, conventional connection to the VDS sockets. They confirmed the initial assumption that, although partial discharges were detected near the connections, partial discharges on the cable were barely detectable, if at all.

Online partial discharge testing on belted cables

During testing on belted cables, measurement with a connection via the VDS PD coupler proved to be advantageous. Unlike measurements with HFCT sensors, in this case the phases are measured individually. When using HFCT sensors, the common cable screen means that signals of partial discharges on the cable are not detectable or only barely so. In addition, measurement with the VDS PD coupler means that on belted cables partial discharges between two phases can also be detected, which is not possible with inductive sensors.

Online check saves time and increases safety

Field tests have shown that online partial discharge testing using the liona portable measuring device and the VDS PD coupler delivers results of comparable quality to measurement using inductive sensors. As connection to the switchgear VDS sockets is quicker and does not require the disconnection of the cable route or extensive safety procedures, operators of the VDS PD coupler benefit from the following advantages:

Source: Baur GmbH

Figure 5: Automated measurement sequences and software support for evaluation allow online partial discharge testing to be completed in a matter of minutes.

- Measurement can be performed by just one person, as there is no need for the cable route to be disconnected by someone else.
- The measurement equipment is quick to set up and remove and does not involve any assembly work.
- As the switchgear can remain closed and there are thus no relevant risks, no special protective measures need to be taken.
- Automated measurement sequences stored in the liona device and software supported evaluation, enables engineers of any experience level to easily test a cable route for partial discharges and to log the measurement results in around 5 minutes.

Online measurement via VDS PD coupler is no substitute for offline measurement because, for one thing, it does not provide such detailed results – very small partial discharges may go unnoticed and the measuring accuracy is lower – and the location of the partial discharges cannot be determined when measuring on the VDS sockets. Nevertheless, for financial reasons and to ensure high network availability, it is worth incorporating online partial discharge testing with liona and the VDS PD coupler into routine diagnostics: Typically, network operators will only detect significant partial discharges on around 10 to 15% of the cables measured. On these cable routes, it is worth performing additional measurements using offline diagnostics, determining the location of the partial discharges, and, if necessary, taking measures to rectify the fault.

The online spot test with the liona VDS PD coupler makes it possible to get a quick overview of existing partial discharges in the cable network. This allows conspicuously abnormal cable routes to be prioritised, more precise and informative offline diagnostics to be carried out in a targeted manner, and better planning of personnel capacity. In this way, the overall quality of the distribution network can be increased while maintaining the same cost and personnel expenditure.

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