Partial Discharge Monitoring on Rotating Machines

In addition to off-line partial discharge (PD) measurements, on-line PD monitoring on rotating machines is also possible. In this case, pre-installed couplers are required to get access to the measurement signals. Both off-line and on-line measurement methods are commonly used within the industry.

The biggest challenge with on-line monitoring is external disturbances that interfere with the measurement signals. To overcome this issue, state-of-the-art measurement systems offer techniques that can distinguish between noise and signals and are able to separate the different PD sources within a machine. This ensures a reliable interpretation and risk assessment of the insulation system condition.

One of the most powerful tools for accomplishing this is the method called 3PARD (3 phase amplitude relation diagram). In this approach, a synchronous measurement is performed on all three phases. This allows the simultaneous acquisition of an impulse on every sensor coming from the same PD source. The amplitudes of the different sensors are displayed in a star diagram. As different sources are located physically in different places, different PD sources will have different locations in this 3PARD diagram (Figure 1).

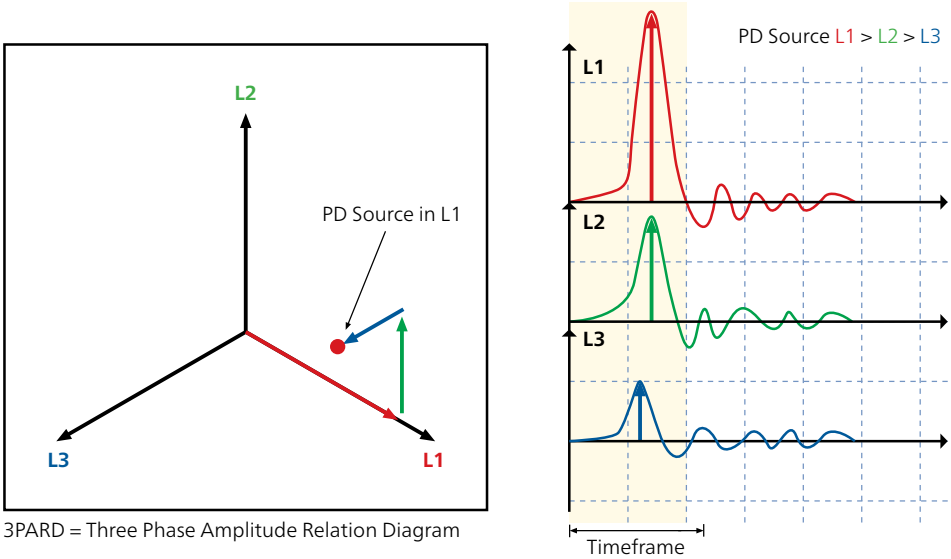

Figure 1: Principle of 3PARD. The simultaneous measurement of the three signals on the right-hand side determines the length of the amplitude vector. The vector sum is the resulting point for this impulse in the 3PARD diagram on the left.

In the 3PARD diagram, several sources of PD are recognizable as different clusters. Back transformation of the chosen cluster to its correlated Phase-Resolved Partial Discharge (PRPD) diagram is possible. This means that the user can mark the cluster. Afterwards, the PRPD view only shows the impulses within this cluster, which allows the user to analyze and classify these pulses individually without interference between the different sources.

The separation of the different sources enables the next step for a faster and easier measurement interpretation. Together with a density-based clustering algorithm, an automatic cluster separation is implemented.

Figure 2: Automated cluster separation. The PRPD diagram and the correlating 3PARD diagram are displayed in this view. The rectangles around the clusters are identified automatically.

Automated interpretation of the measurement results

It is possible to interpret PD sources in rotating electrical machines according to their PRPD diagram. As their attributes in terms of position, shape and other parameters in the phase-resolved diagram are known, algorithms have been developed to automatically distinguish between them. Furthermore, a database with the typical PRPD shapes of the different PD sources has been established.

Both are used for an automated interpretation of the results. First, the attribute-based interpretation is used to identify the PD phenomena. If the attribute-based approach cannot make a final statement, the database is used to come to a final conclusion. In this case, the measured pattern is compared with the pattern from known defects. The data comes from laboratory as well as from on-site measurements. The most probable phenomena is chosen out of this comparison.

Practical verification showed a very high probability to identify the PD source in a correct way. The tool can be considered as a reliable help for the measurement engineer to interpret and classify PD sources.

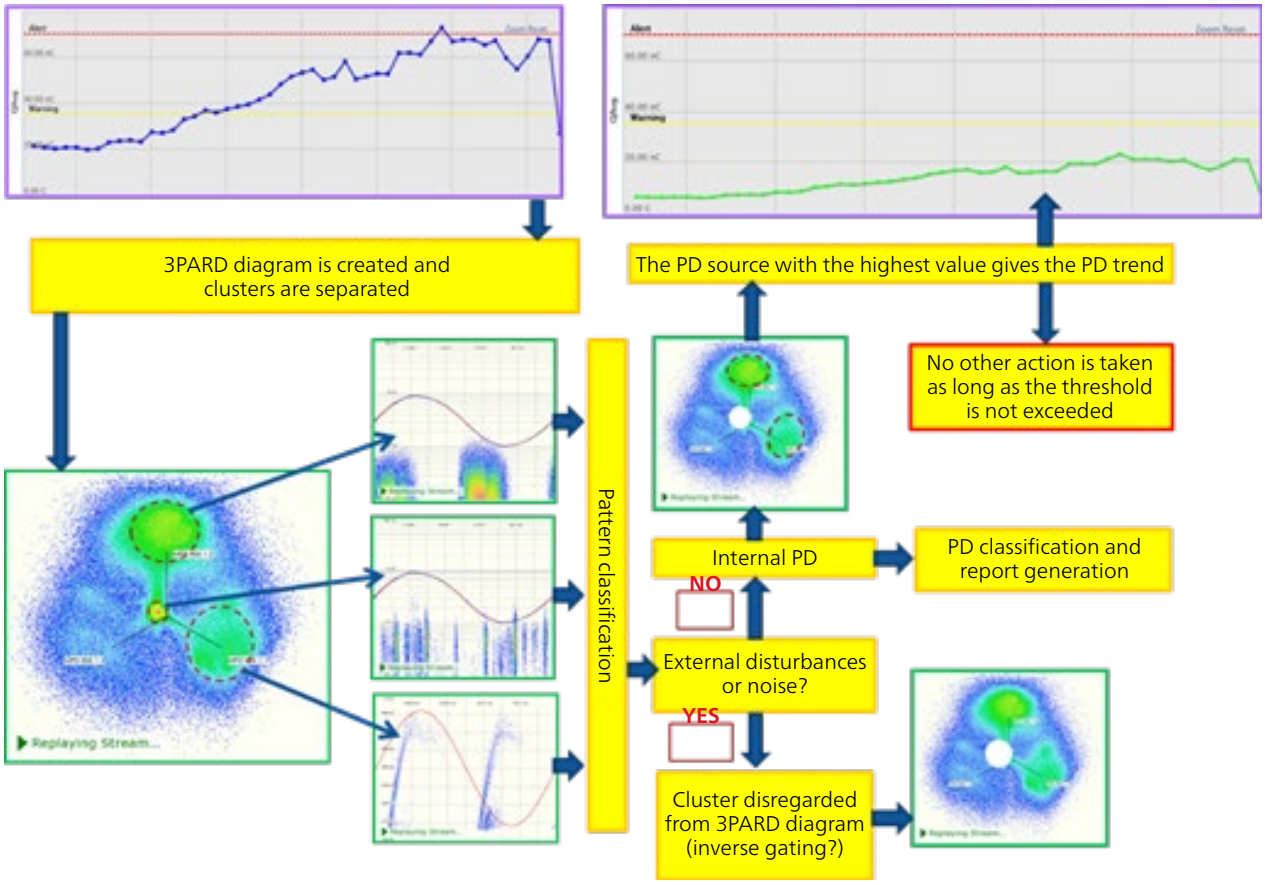

Figure 3: Schematic approach of the entire process between measurement and automated interpretation of the results.