



ESTW
ERLANGER STADTWERKE

Tracking down partial discharges

Continuous status monitoring for rotating machines

The cumulative occurrence of partial discharges in the stator slot or the stator windings of generators can indicate ageing or damage to the insulation materials. Defects of this kind can be caused by various factors and in worst case scenarios lead to system downtimes. Erlanger Stadtwerke, a municipal utilities company in Erlangen, Germany operates a heating power plant. Following a generator failure the company was forced to pay extra costs due to the need to purchase energy above the regular quota. As a result, the company decided to evaluate various diagnostic systems able to detect potential or impending issues in future. An OMICRON PDM 600 partial discharge analysis system has now been continuously monitoring the insulation status of a 21.9 MVA turbo generator for a year. This has provided the service team with support in planning targeted condition-based maintenance.

12 Application

Erlanger Stadtwerke has been operating a heating power plant for over 40 years to provide the city with district heating. Two steam turbines and one gas turbine, working according to the principle of combined heat and power, supply Erlangen with both electrical power and heat. These three generators produce a combined electrical output of approximately 45 megawatts. Any energy required above this level is then purchased from an alternative source. The generator failure that occurred several years ago was particularly unfortunate, as this generator was the only one in operation. "The two other generators were undergoing planned upgrades at the time," recalls Robert Finkl, Head of Network Management at Erlanger Stadtwerke. Up to this point, the generators had been tested and maintained based on a maintenance plan. "To be able to detect changes in condition both reliably and in time, it is vital to monitor the equipment while it is running," explains Robert Finkl, providing the reasoning behind the purchase of the OMICRON PDM 600 monitoring system.

Status assessment of rotating machines

Rotating machines (generators, motors) are often subjected to severe environmental conditions, and electrical and mechanical stress during standard operation. This leads to wear, damage, or even complete failure of the system. Ageing materials or decreasing insulation strength can, among other things, be detected by recording and then analyzing partial discharges.



"The OMICRON system facilitates early detection of insulation faults."

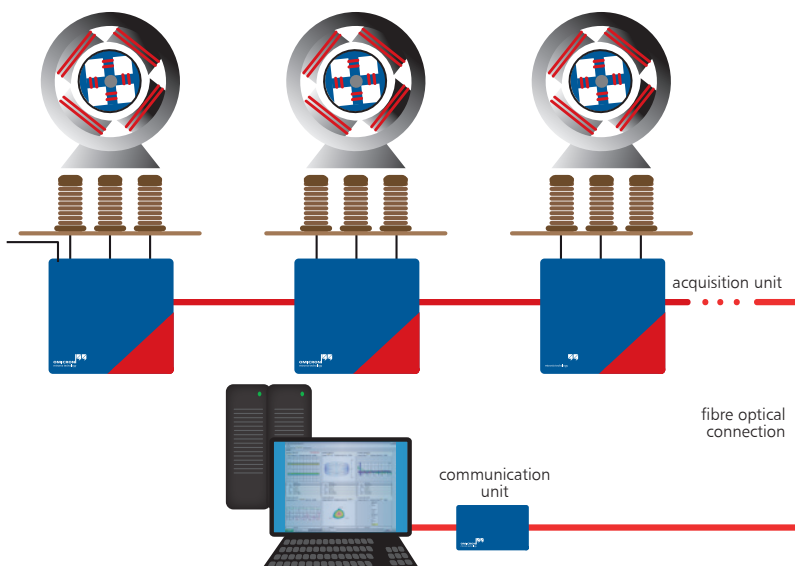
Dipl.-Ing. Robert Finkl
Head of Network Management
Erlanger Stadtwerke, Germany

Partial discharges are an indicator of decreasing insulation properties

The occurrence of partial discharge phenomena is always an indicator of insulation degradation. Since partial discharges, in many cases, precede failure of the insulation in high voltage components, a system for reliable detection and monitoring is essential. Inadequate mounting of the winding, wear or an aged semiconductor coating of the stator bar can, for example, lead to surface discharges in the stator slot. Mechanical vibrations, as well as accumulation of dirt particles and moisture lead to winding head discharges, while bubbles in the insulation or delamination of the insulation bands lead to inner partial discharges.

Reliable separation of different partial discharge phenomena

The various forms of partial discharges can occur simultaneously in rotating machines. Each partial discharge phenomena shows a different pattern. Partial discharge pulses, which occur in a phase of the generator winding, are coupled capacitively or inductively into the other two phases. Due to the complex winding structure of the machine, each internal partial discharge source generates



Typical system setup for monitoring partial discharges on rotating machines with the PDM 600.



Fitted directly to the generator's bus bars:
Capacitive couplers for detecting partial discharge signals.

a unique amplitude ratio between the original partial discharge pulse and the two overcoupled pulses. This supplies a unique 'fingerprint', which can also be distinguished from external interference. The 3PARD (3-Phase Amplitude Relation Diagram) in the PDM 600 supports users in localizing the source. This allows various partial discharge sources and interference to be differentiated from one another. The 3CFRD (3-Center Frequency Relation Diagram) shows the partial discharge sources based on their frequency signature and is used to separate and identify typical partial discharge patterns. Even the smallest discharges, in the range of a few pico-coulombs (pC), can be precisely detected and reliably evaluated with the PDM 600 monitoring system, while simultaneously using test voltages in the kV range.



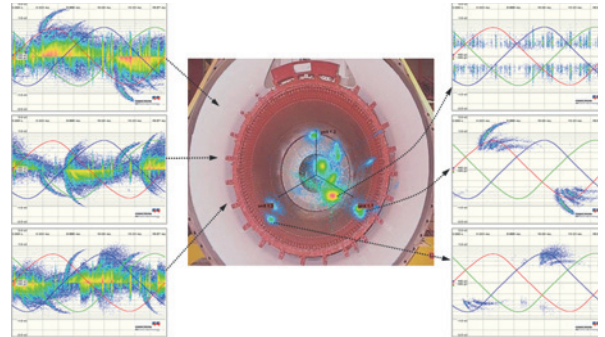
We benefit from the knowledge of OMICRON experts in evaluating the monitoring data.



Product and accompanying service

Two generators at Erlanger Stadtwerke are now equipped with the PDM 600, and the third is set to follow. "The measurement accuracy of the OMICRON system is extremely high, allowing precise examination and assessment of the fault location,"

The 3PARD analysis allows various partial discharge sources to be reliably separated.



explains Robert Fenkl. OMICRON also provides a database of typical partial discharge patterns. This allows users, based on the partial discharge pattern, to detect where in the generator the fault is located. Threshold values can also be defined, at which the analysis system issues corresponding warnings and alarms. "In addition, OMICRON can work on the system directly via remote maintenance access if necessary," adds the department head, describing an important detail of the cooperation. "This means that we can benefit from the know-how of the OMICRON experts in interpreting complicated partial discharge pattern."

Increasing availability

"The investments involved are considerable," adds Robert Fenkl, "but the continuously analyzed data, recorded online, provides us with important information for targeted condition-based maintenance, which in turn allows us to make key long-term improvements to the operational reliability and availability of our systems."