Most generators are in use over many years. Operating stresses and aging can cause successive damage to various components such as the rotor insulation. Greater flexibility requirements with an increasing number of starts and stops, changes in grid requirements and instabilities also contribute to increased stresses.

On-line monitoring can help with the early detection of indicators such as rotor interturn short circuits. This should ideally prevent unscheduled and expensive outages and enable the scheduled implementation of measures for service life extension.

Rotor interturn short circuits due to aging-induced damage to the insulation can occur in all generators that are older or have been subjected to service loads. In most cases, an interturn short circuit will not initially result in generator failure, but it can have unfavorable effects on generator operation. An interturn short circuit or a short circuit between two coils is frequently manifested by an elevated exciter current, the result of a reduced number of active windings in the rotor. The elevated exciter current results in increased heating of the rotor. Nonuniform heating can result in a thermal imbalance and elevated rotor vibrations.

The effects on operation generally become greater the more windings are affected by an interturn short circuit and the lower the electrical resistance at the fault location. Consequential damage and propagation of the damage by mechanisms including arcing and elevated temperatures at the fault location are highly probable. For example, an interturn short circuit under the rotor retaining ring can damage the retaining ring to the point of mechanical failure.

Our solution

The modular GenAdvisor™ platform provides various systems for monitoring Siemens generators as well as generators from other manufacturers. Each system can be implemented individually or in combination with a central server and other monitoring systems.

A sensor in the air gap between the rotor and stator is used to detect rotor interturn short circuits. The signals from the sensor are transmitted to a data acquisition unit in the turbine building. All relevant data is stored there and can be downloaded for diagnosis purposes. Expansion of the system with a server enables central storage and display of the data. The server can be integrated in any I&C systems such as the SPPA-T3000 or in plant information systems such as the PI server and WinTS. These systems can be used to automatically transfer the data to the Siemens Power Diagnostics Center for further analysis.

Features

If rotor interturn short circuits occur between coils, the resulting change in the slot magnetic field can be detected by the sensor, enabling detection of the interturn short circuit based on its location in the winding and the number of short circuited windings.

Most interturn short circuits can be detected in the usual changes in active and reactive power during normal generator operation. It is no longer necessary to approach special load points between zero load and full load in order to achieve good measurement sensitivity.

Cables are routed through existing penetrations when accessible or new penetrations can be made if necessary for both hydrogen- and air-cooled generators.
The generator must be shut down and for many generators a rotor removal is no longer required to enable installation of the sensor and routing of the necessary cables. The data acquisition unit can be set up and connected at any time.

References
For more than twenty years Siemens has been implementing monitoring systems that contribute to the early detection of damage during operation and the flux probe is currently installed in more than 400 generators.

Your benefits
With GenAdvisor, Siemens provides you with customized solutions for reliable on-line monitoring of generators and high-voltage equipment. Advance recommendations based on generator condition enable scheduled outages to be optimized and shortened, as necessary repairs can be planned in advance and required spare parts can be provided as needed.

GenAdvisor rotor interturn short circuit monitoring – optionally also in combination with the GenAdvisor server – can provide the following advantages:
- Continuous interturn short circuit monitoring with high sensitivity for detection of the slightest changes
- Air-gap sensors proven in long-term operation
- Data acquisition unit can also be combined with sensors from other manufacturers
- Lower maintenance costs with condition-based maintenance
- Better estimation of maintenance requirements with trend analyses

- Optimization of maintenance intervals and maintenance measures as well as operating service life of monitored components
- Advance warning to reduce the risk of unscheduled outages
- Easily integrated in I&C systems (e.g. SPPA-T3000) or plant information systems (e.g. PI Server, WinTS)
- Optional connection to the Siemens Power Diagnostics Center for remote evaluation/analysis of measured data
- Optional extension with additional GenAdvisor monitoring systems such as end winding vibration or partial discharge monitoring

GenAdvisor visualization software for monitoring rotor interturn short circuits

GenAdvisor rotor interturn short circuit monitoring (schematic)