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

On-line monitoring can help with the early detection of indicators such as changes in shaft voltage or shaft grounding current. This can help prevent many unscheduled and expensive outages and enable the scheduled implementation of measures that can help preserve or extend service life.

Asymmetries in the magnetic circuit, electrostatic charge buildup in the line of shafting and capacitive coupling by the exciter system are phenomena that typically occur during the operation of rotating electrical machines and produce unavoidable potential differences across the shaft (shaft voltage). The generator bearings are insulated to prevent an unwanted flow of current caused by the shaft voltage.

The causes for the voltage and current in the generator shaft include the following:

- Magnetic asymmetries in rotating electrical machinery
- Electrostatic charge buildup in the line of shafting through the turbine
- Capacitive coupling of voltage in applications with a static exciter system or
- Axial magnetic DC or AC voltages through the shaft

If a shaft voltage occurs, it can range from a few volts to 100 volts depending on the individual configuration of the turbine generator set. A shaft grounding brush on the turbine end is intended to provide a generator rotor with a defined ground in order to prevent effects on the turbine bearings from the shaft voltage developed in the generator and to discharge static buildup from the turbines. This grounding current is typically in the range of only a few mA. Insulation damage to the generator bearings, especially on the exciter end, can cause the shaft grounding current to increase significantly. In the event of insufficient bearing insulation, the resulting shaft grounding current flowing through the bearing can give rise to electroerosion on the bearing surfaces and thus to damage to the bearings, as the oil film in the bearing likely would not provide sufficient electrical insulation by itself.

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.

The shaft voltage is measured between the shaft grounding on the turbine end and a measuring brush on the exciter end. This shaft voltage is present during generator operation and depends on the generator power output.

The data can be centrally stored and displayed by extending the system with a server. The server can be integrated in 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.

* GenAdvisor is a registered trademark of Siemens AG, Germany.
** Power Diagnostics is a registered trademark of Siemens Energy, Inc., USA.
**Features**
The GenAdvisor shaft voltage and shaft grounding current monitoring system is designed for continuous monitoring of shaft voltage and shaft grounding current during generator operation. Insulation defects in the bearings as well as malfunctions of the grounding brushes can be detected and it can help prevent potential bearing damage with the continuous monitoring of the shaft voltage and grounding current through the grounding brushes. Evaluation of the shaft voltage frequency spectrum can provide information on the cause of the shaft voltage. The system is also designed to monitor and verify proper operation of the shaft grounding brushes automatically at regular intervals.

**References**
For more than twenty years Siemens has been implementing systems for monitoring generators now numbering more than 140, which have helped with early detection of damage during operation.

**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 ordered and provided as needed.

The GenAdvisor shaft voltage and shaft grounding current monitoring system – optionally also in combination with the GenAdvisor server – can provide the following advantages:
- Continuous monitoring of shaft voltage and shaft grounding current
- Regular testing for proper functioning of the shaft grounding brushes
- 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

- Easy integration 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, rotor interturn short circuit or partial discharge monitoring