Many generators have been in use over many years. On-line monitoring can help with early detection of many conditions such as changes in end winding vibrations at an early stage. This can ideally help prevent unscheduled and expensive outages and enable the scheduled implementation of measures to help extend service life.

The stator end windings of a generator have to fulfill many electrical, thermal and mechanical requirements. The design must account for various operating conditions – startup, shutdown, fluctuating load conditions as well as grid disturbances. Although the end windings in these older generators were designed and fabricated in accordance with the then current standards, the vibration behavior of the end windings can change in particular over the course of service life due to reversible and irreversible effects. This includes heating and cooling as well as material aging and loosening. The latter can be caused especially by grid disturbances such as incorrect switching operations or lightning strikes.

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.

End winding vibrations are monitored online by recording local accelerations during regular operation. This is achieved by placing fiber-optic accelerometers in the stator end windings considering the results of an offline modal analysis (bump test) on the bar ends. At least six and up to eight sensors per end winding are recommended to enable reliable data analysis.

The data can be centrally stored and displayed by adding a server to the system. The server can be integrated in any I&C systems such as SPPA-T3000 or in plant information systems such as the PI-Server or WinTS. These systems can be used to automatically transfer the data to the Siemens Power Diagnostics Center** for further analysis.

Features
GenAdvisor end winding vibration monitoring provides a system for continuous monitoring of stator end winding vibrations during generator operation. The fiber-optic accelerometers enable continuous registration of the vibration modes during power operation and transfer of the received signals directly to the data acquisition unit.

The structural mechanical changes in the end winding assembly can be detected based on an operating mode analysis from a parallel evaluation of all vibration sensor signals. The various transient and steady-state modes are separated from each other by the mathematical method of modal interpolation and their behavior is analyzed as a function of the operating mode. Loosening in the end winding components can be detected based on the trends of individual vibration modes over time.

The GenAdvisor monitoring system for end winding vibrations can be used for all air, hydrogen and water-cooled generators. The system can be easily

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* GenAdvisor is a registered trademark of Siemens AG, Germany.
** Power Diagnostics is a registered trademark of Siemens Energy, Inc., USA.
installed in parallel with other inspection and overhaul activities. Its simple installation enables it to be retrofitted easily.

References
For more than twenty years, Siemens has implemented monitoring systems in more than 140 generators, contributing to the 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 potentially shortened, as necessary repairs can be planned in advance and required spare parts can be provided as needed.

GenAdvisor end winding vibration monitoring – optionally also in combination with the GenAdvisor server – can provide the following advantages:

- Continuous monitoring of end winding vibrations
- Lower maintenance costs due to condition-oriented maintenance
- Better estimation of maintenance requirements with trend analyses
- Optimization of maintenance intervals and maintenance measures as well as of the operating service life of the monitored components
- Advance warning to reduce the risk of unscheduled standstills
- 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 the measured data

- Optional extension with additional GenAdvisor monitoring systems such as rotor interturn short-circuit, partial discharge or shaft voltage and shaft grounding current monitoring
- Structural mechanical condition monitoring strictly through operating data monitoring
- Critical changes in condition parameters enable optimized fact-finding inspection intervals
- Risk minimization of fatigue effects by correlation of trend monitoring at load points

GenAdvisor end winding vibration monitoring (schematic)