Generator Service

Customer Event Steam Turbine and Generators 2023



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1. Serviced Fleet
2. Spare Parts & Capital Spares
3. Maintenance & Repairs
4. Mods & Uprgrades
5. Advanced (Future) Service

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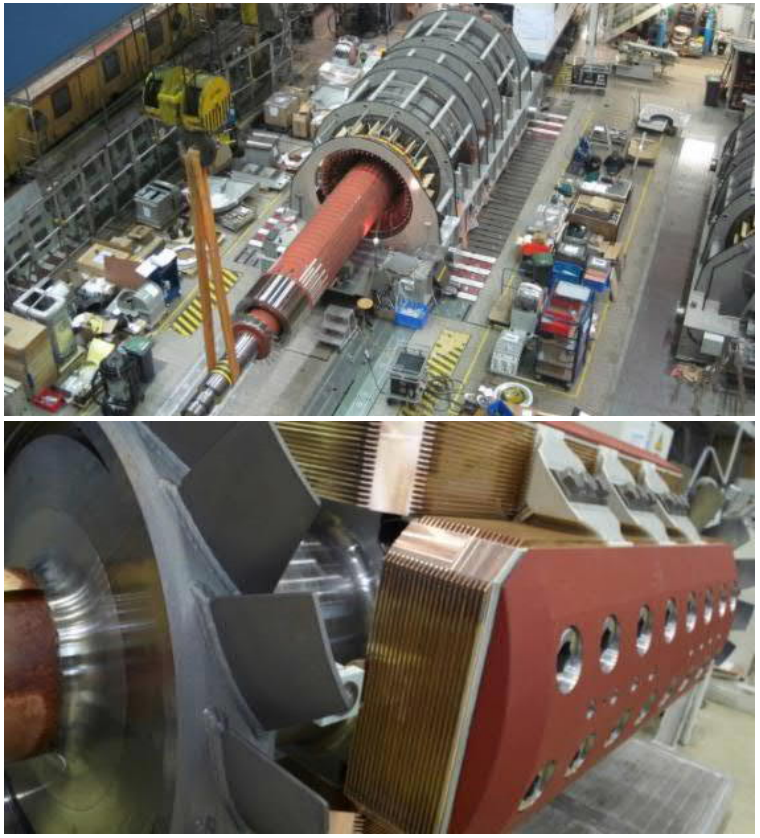
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Serviced Fleet

Service for all

- Air-cooled 2-pole, 4-pole generators
- Synchronous condensers
- in 50 and 60 Hz markets
- OEM generators
- Other OEM generators

We offer comprehensive generator services tailored to your specific needs



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Spare Parts and Capital Spares



„Our generator specialists are capable of developing custom-tailored solutions“

For Operation and Maintenance

- From nuts and bolts to
- Brushes and Bearing shells to

We offer spare parts for

- Siemens Energy
- AEG (Kanis) and OOEM generators

Capital Spares

- Stator, Rotor and Exciters
- Controls

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Maintenance & Repairs



„A regular maintenance reduces the risk of unplanned outages“

We offer

- Comprehensive field service solutions*
- On-site and factory repairs

We are knowledgeable of potential generator issues through our significant fleet experience

We support you with an optimal outage scheduling

We offer a global network of workshops and regional contacts

We continuously expand our service with new technologies

*Example Robotic Inspection

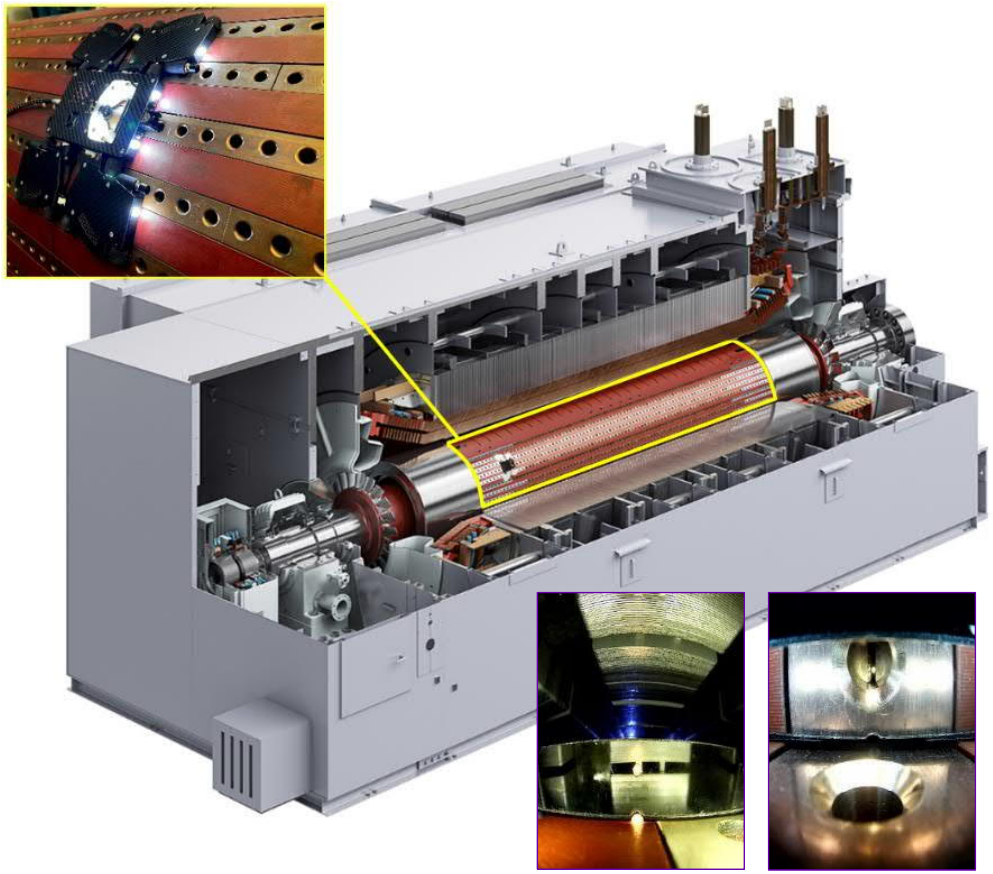
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Maintenance & Repairs
Robotic Inspection

A fast and efficient robotic in-situ inspection with the same scope of a major inspection*

- Minimized disassembly without rotor puling
- Full fact finding during shorter outages
- Optimizing outage schedule with robotic pre-inspections

Up to 90% savings



*depending on the generator design and actual condition

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Maintenance & Repairs

Advantage of Robotic In-Situ Maintenance Schedule

MAINTENANCE CYCLE

Initial Implementation

Traditional Maintenance Schedule

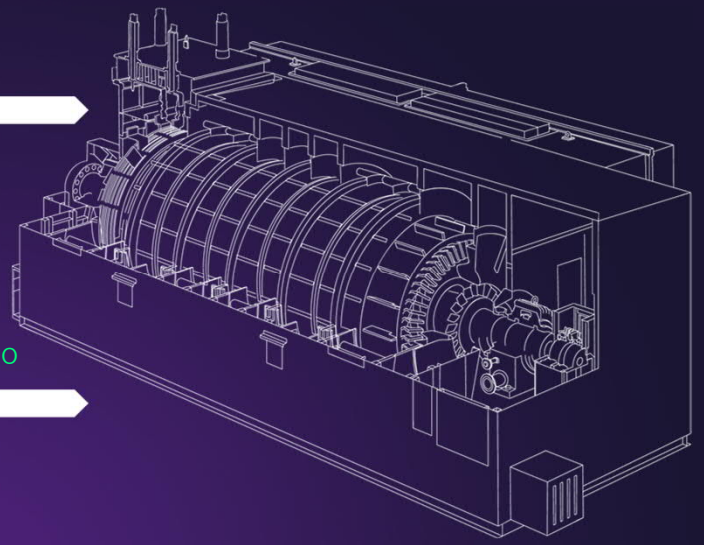
- Rotor pulling and mounting
- Risk of prolongation due to serious findings during inspection

Short | Minor | Short | **Major** | Short | Minor

Robotic In-Situ Maintenance Schedule

- No rotor pulling
- *Robotic Major Inspections* replaces traditional Major Inspection

Short | Robotic MIO | Short | Robotic MAO | Short | Robotic MIO



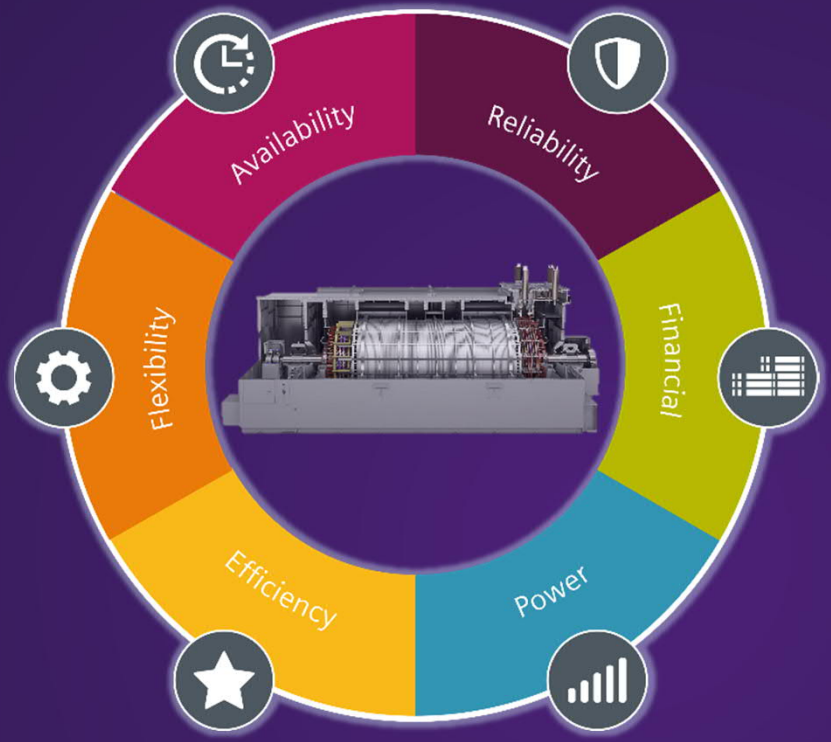
Robotic In-Situ Maintenance Schedule
Extended inspection capabilities
Reduces the service costs for your generator assets

Robotic- vs Traditional- Major Inspection
Same inspection scope but…
Cost savings up to 90%
Inspection time slashed down to 25-40%

Further Advantages
Defect tracking to delay repairs to planned outages
Optimized planning for repair schedules

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Mods & Upgrades
Repacements & Footprint



Replacements of key components with optional

- Change of cooling methods
- Change of excitation type
- Power uprates and efficiency increase

Footprint (state-of-the-art)

- For any type and OEM with optional
  - Change of cooling methods
  - Change of excitation type
  - Power uprates and efficiency increase

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Advanced (Future) Service



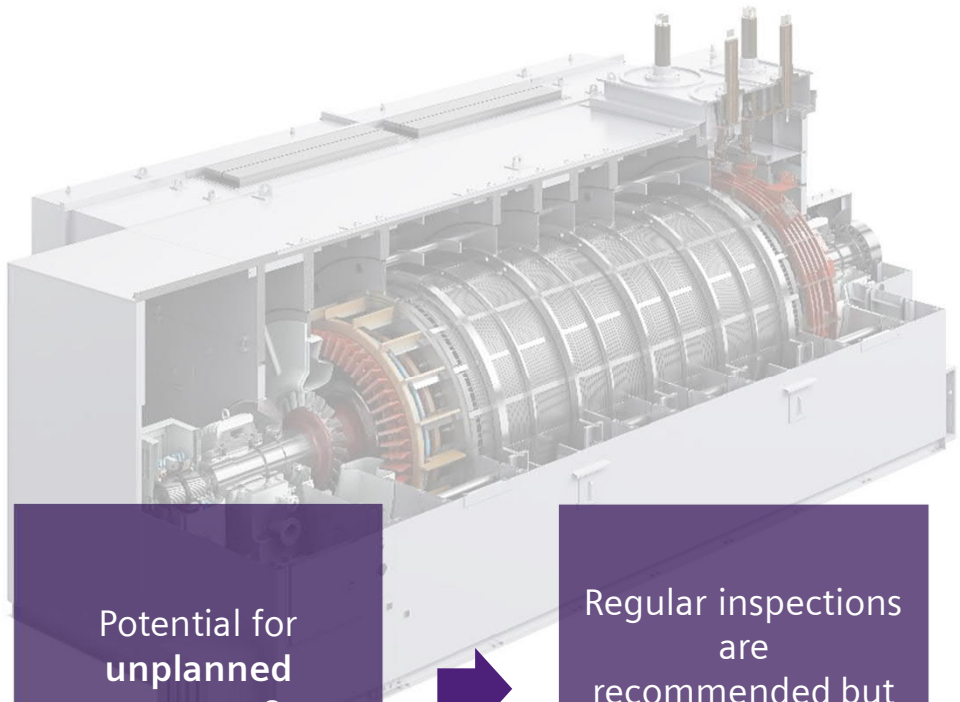
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Monitoring Overview
Driver & Motivation

Higher flexibility requirements with increased starts & stops, changes in grid requirements and instabilities

Increased stress for the generators



Potential for **unplanned outages & equipment issues**

Regular inspections are recommended but those do **require an outage**

Demand for growing **predictive / condition-based maintenance strategies**

Leveraging data via **digitalization**

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Monitoring Overview
Driver & Motivation

Online Monitoring

- Provides real-time information about the machine condition during operation (difference to offline tests)
- All operating forces are present (difference to offline tests)
- Can help to optimize outages and to extend operating period
- Supports condition-based maintenance
- Can help avoid unexpected trips and outages



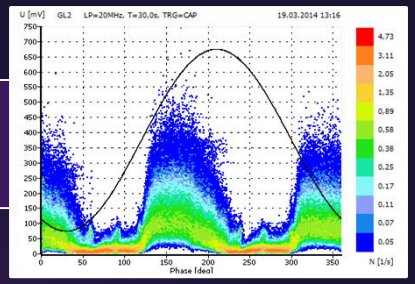


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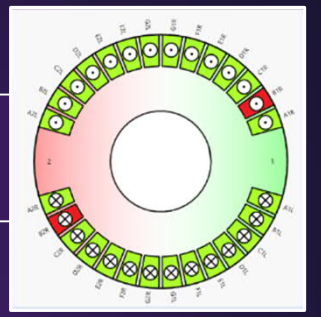
Monitoring Overview

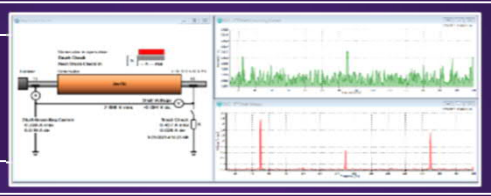
GenAdvisor – Monitoring of

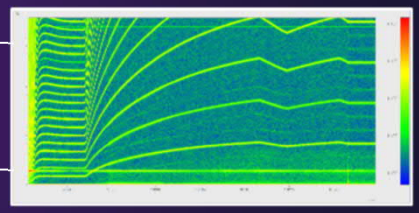
- Partial Discharges (PDM)
- End Winding Vibrations (EWVM)
- Rotor Interturn Short Circuits – Flux Probe (FM)
- Rotor Shaft Voltage and Shaft Grounding Current (SVCM)
- Torsion Vibration (TVM)







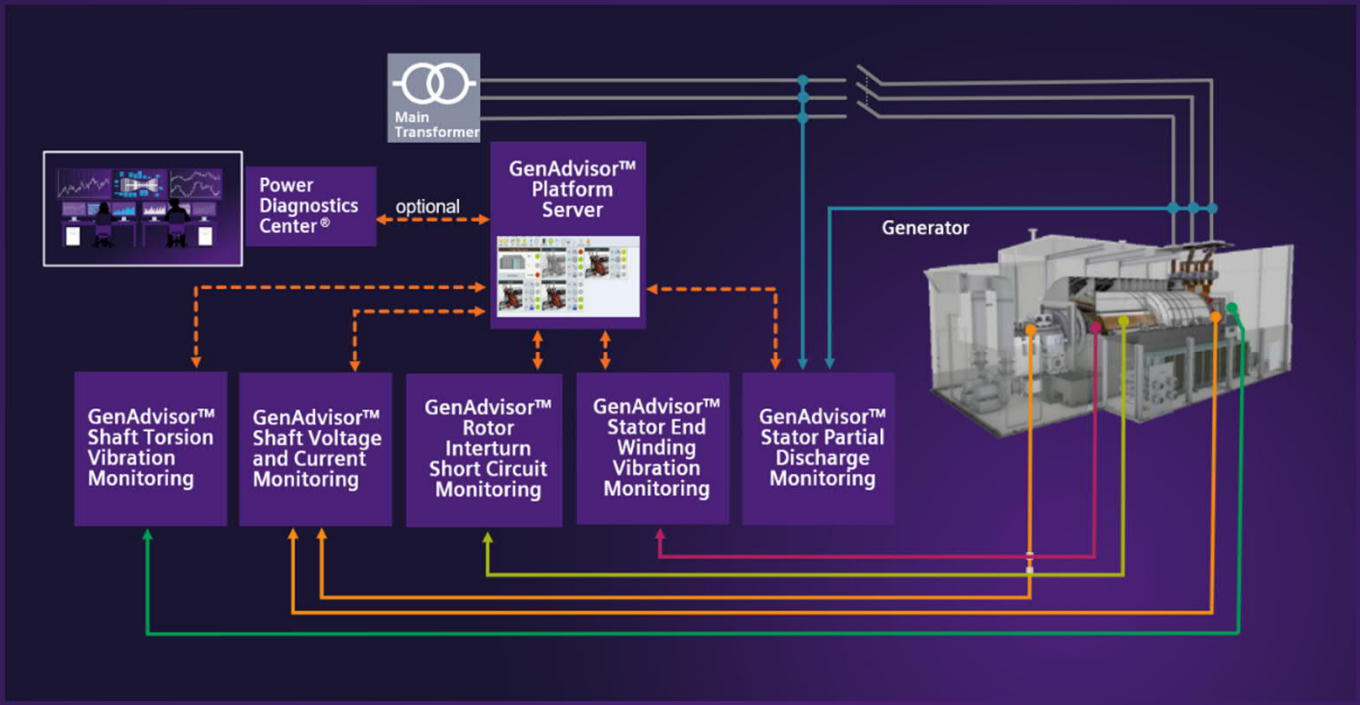




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Monitoring Overview



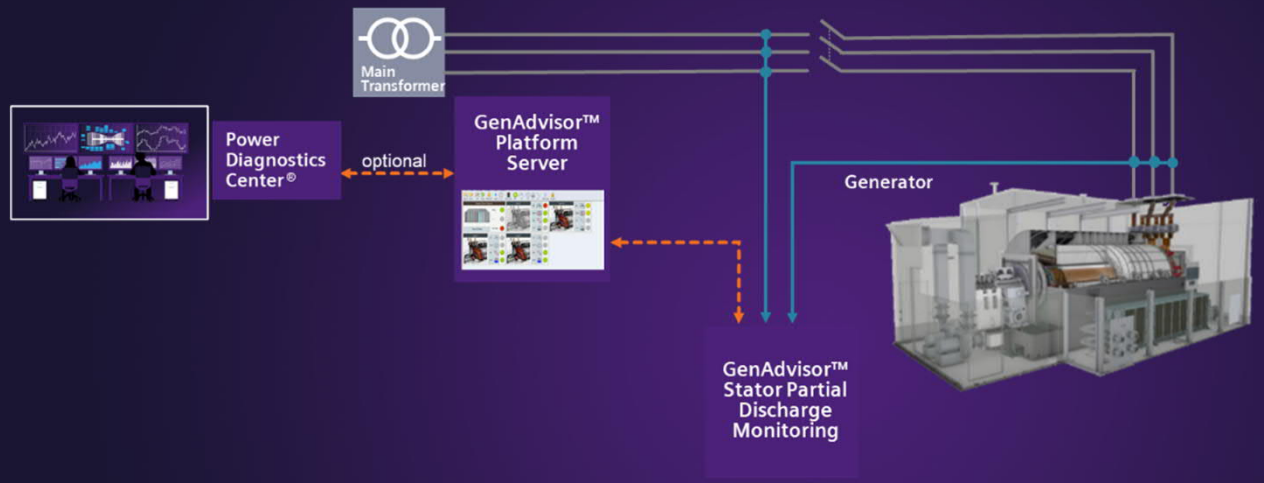
Overview of GenAdvisor™ Monitoring System Configuration

- Modular in design, the GenAdvisor™ monitoring platform provides five specialized monitors
- Each monitor can be operated as a **stand-alone** application or in **any combination** with the other GenAdvisor™ monitors using a **platform server**
- The **platform server** also allows concurrent monitoring of **multiple generators** and connection to the **Power Diagnostics® Center**

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GenAdvisor™

Partial Discharge Monitoring

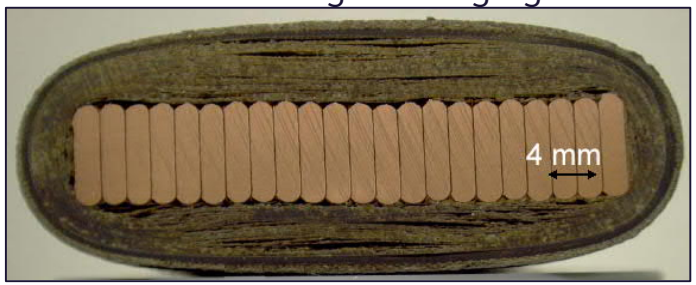


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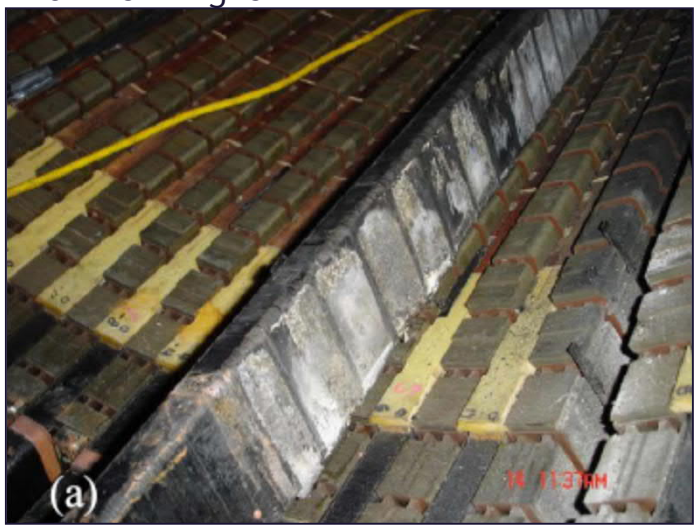
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Partial Discharge Examples

Delamination / Long Term Aging



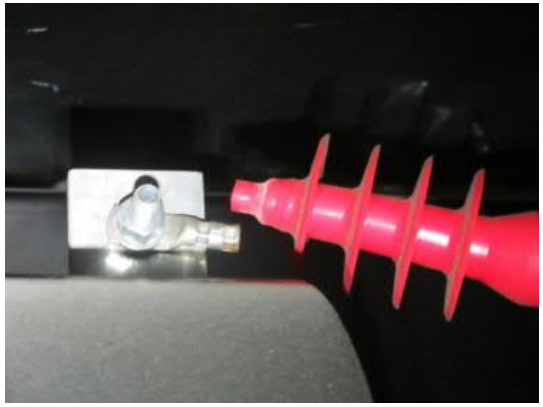
Slot Discharges



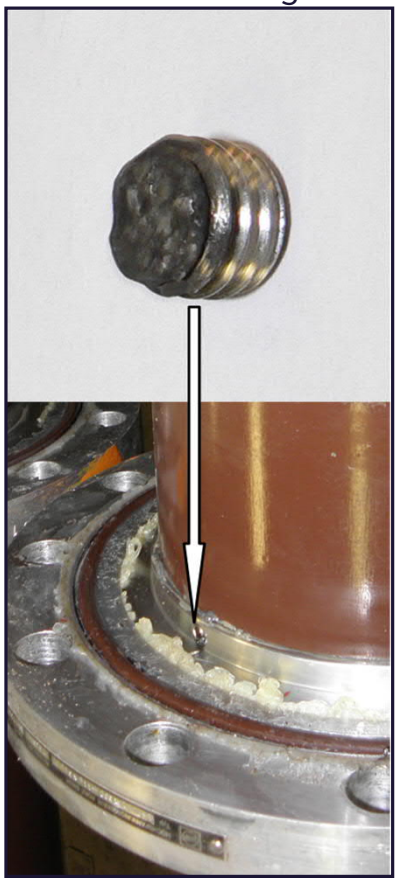
Separated Strand of Flexible Link



Broken Neutral Point Connection

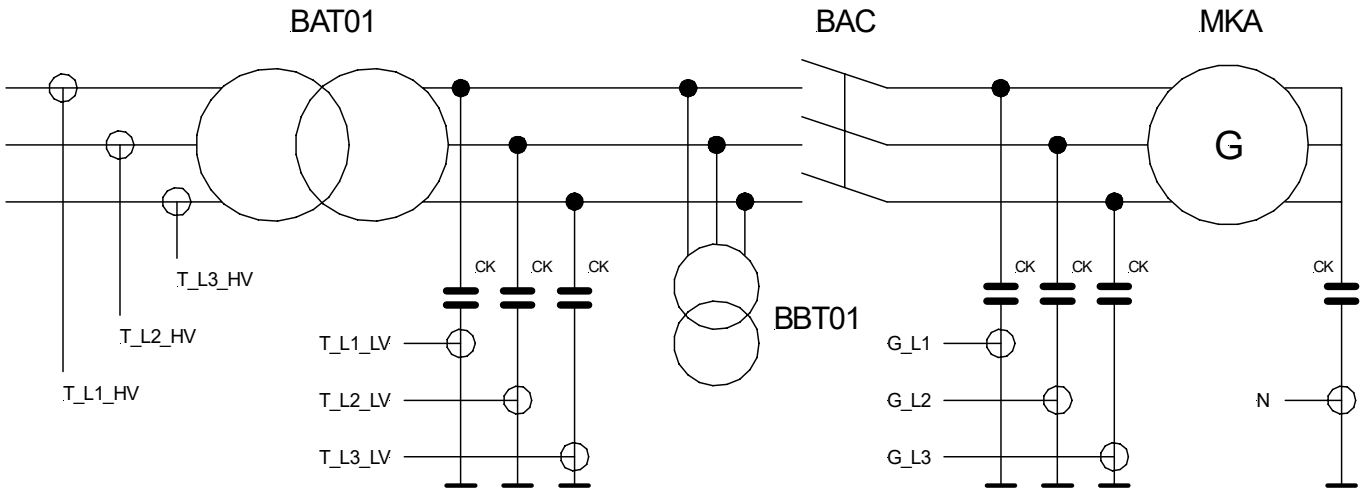


Defective Bushing



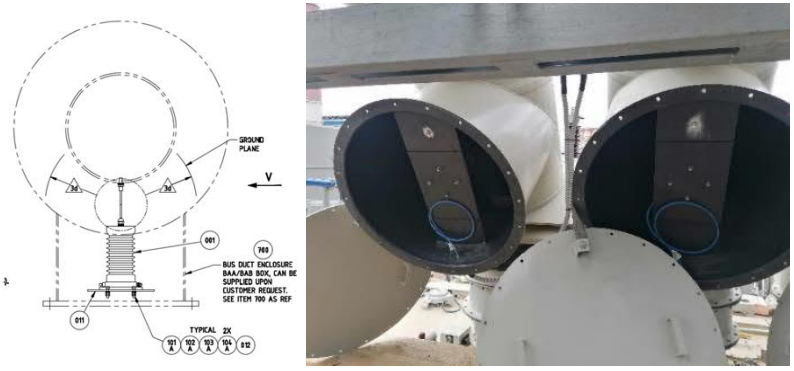
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Partial Discharge
Measuring Points Standard Arrangement





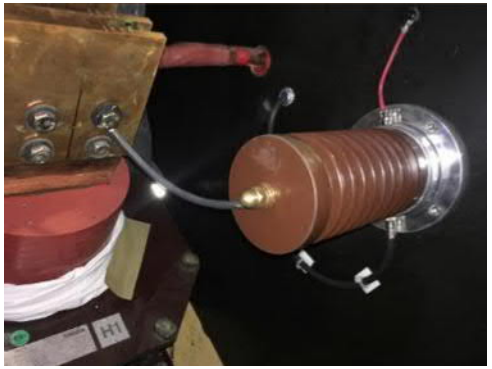
CC inside neutral cabinet



Coupling Capacitors (CCs) inside IPB housing



CCs at generator terminals



CC at generator terminal

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Partial Discharge
Main Features 1/2

PRPD-Pattern (Phase Resolved Partial Discharge)

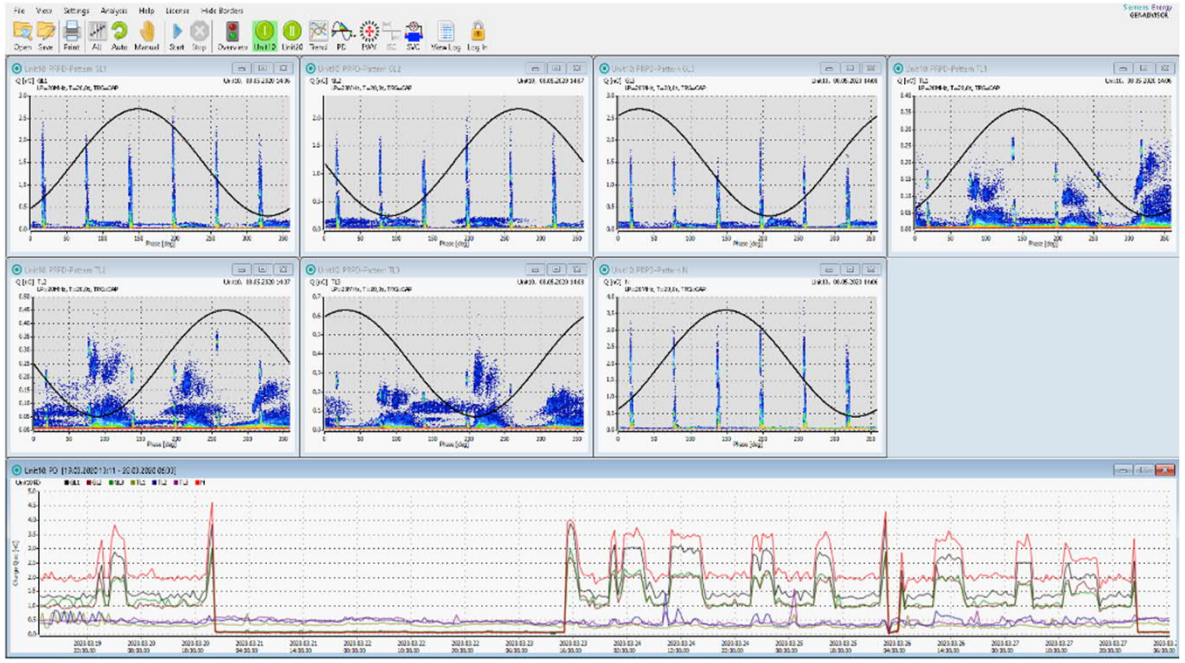
- Classification according international pattern catalog (IEC 60034-27-2)

Trends over the whole life time

- Fingerprint measurement
- Abnormal trend deviations

Correlation of PD with operating parameters

- Active Power
- Reactive Power
- Temperatures (slot, warm gas, cold gas...)



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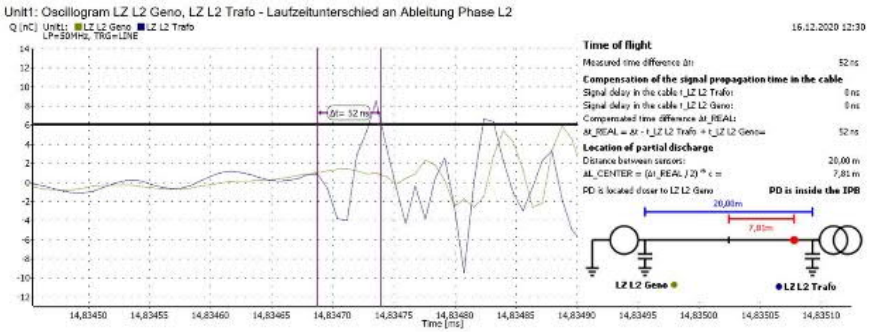
Partial Discharge
Main Features 2/2

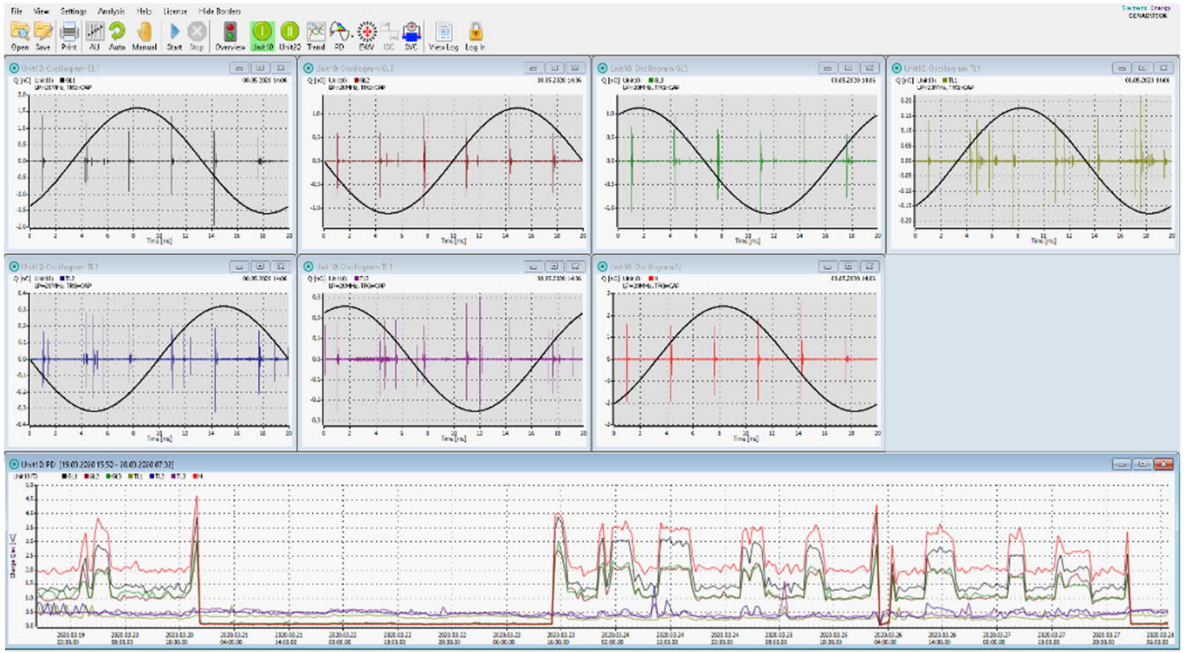
Oscillograms,125 MS/s, 4 CH

- Enable detailed expert analysis
- Slew rate e.g. damping by generator winding

Time of Flight (ToF) measurements for PD localization

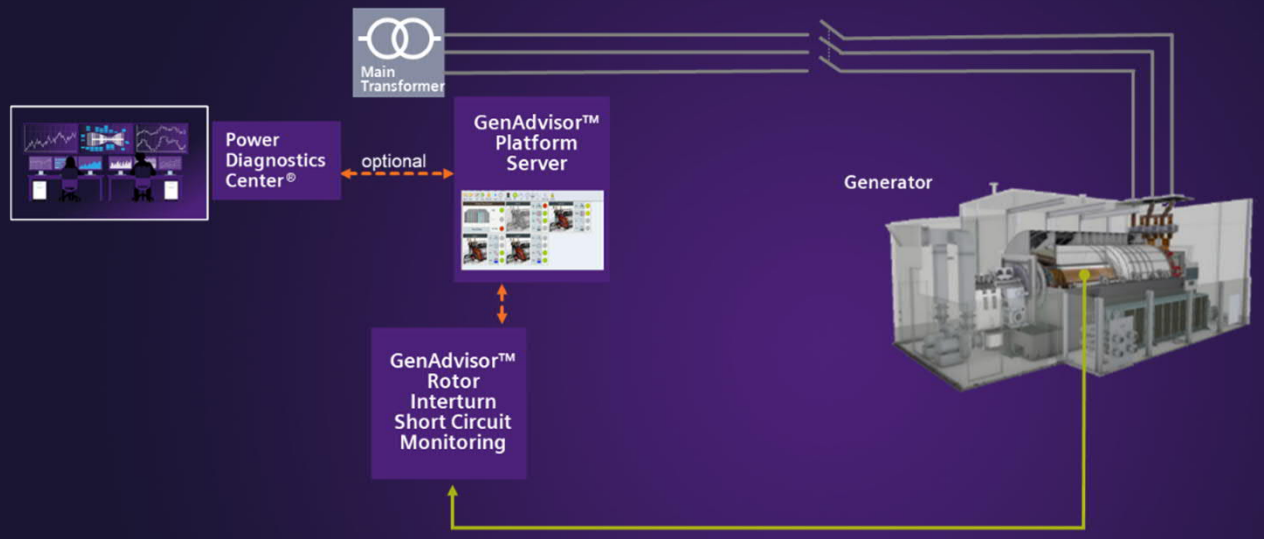
- PDs propagate with nearly light speed
- ToF measurements in [ns]





GenAdvisor™

Rotor Interturn Short Circuit / Flux Probe



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Rotor Interturn Short Circuits / Flux Probe Examples

Aging by relative movements of the rotor turns

- Misalignment of the insulation layers
- Failure of turn-to-turn insulation

Damaged Turn-to-Turn Insulation



Loosening of blocking elements in the end winding

- End-turn distortions

End-Turn Distortions



Contamination

- Conductive connections between the turns

Copper Chloride Contamination

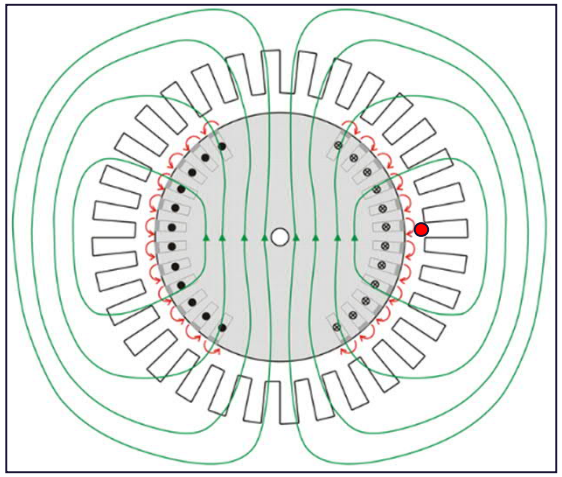


Rotor Interturn Short Circuits / Flux Probe Sensor and Signal Acquisition Unit





Sensor at SGen5-1000A



Sensor Position

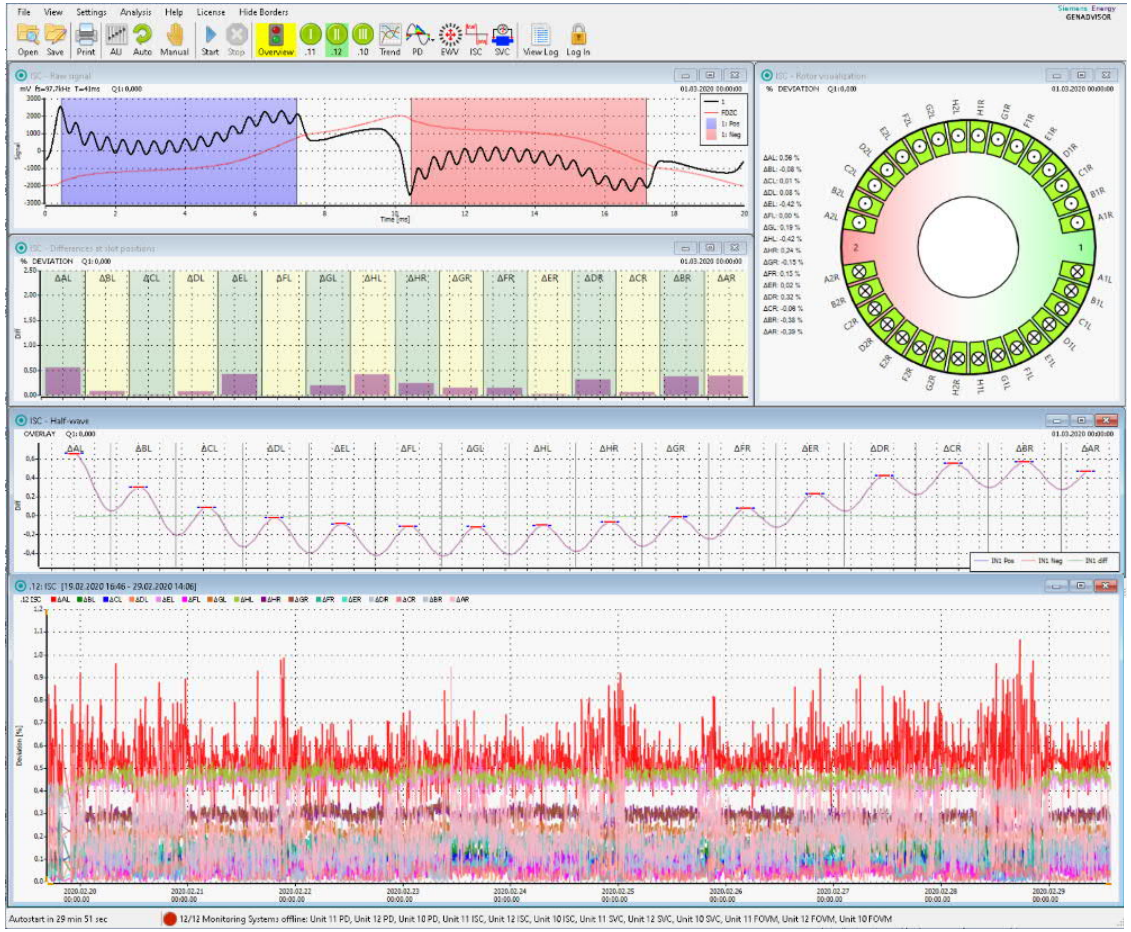


GenAdvisor BASE
and BASE Display for standalone operation

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Rotor Interturn Short Circuits / Flux Probe Main Features

- Monitoring of the rotor winding flux
- Evaluation by pole-to-pole comparison of flux
- Indication of slot with shorted turn(s)
- ISC trends per slot correlated with operational parameters (e.g., active, reactive power)
- Automatic check of signal quality to mitigate false alarms



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