

MS 3000



Holistic Transformer Monitoring Solution

Faced with growing pressure to improve network availability and reliability, asset owners are expanding monitoring coverage on critical transformers. Continuous monitoring of key components—active part, bushings, tap changer, and cooling system—is essential to maximize availability and performance while reducing life-cycle cost. This often means going beyond DGA and integrating additional sensors.

GE Vernova's MS 3000 is a holistic, modular transformer monitoring system offering essential to comprehensive coverage of major failure causes. It unifies data from multiple sensors into a single, homogeneous stream. Advanced analytics filter noise, highlight key insights, and provide intelligent alarms, diagnostics, and actionable recommendations. As an expert system, the MS 3000 helps operators assess transformer health and optimize maintenance and operations with confidence.

Key Benefits

- Continuous supervision of the whole transformer, integrating data from available sensors
- Modular: essential through to comprehensive coverage of transformer failure modes
- All information available at a glance, even across several substation transformers
- An "Expert System" to help you assess and manage your costly assets
- Optimum operation efficiency with reduced life-cycle cost
- Web server HMI, no need for software to access the data analysis
- Integration with GE Vernova's APM software for centralised information and leveraging of fleet data
- Easy inter-operability of the transformer with the Smart Grid / Digital Substation

Applications

Designed primarily for critical transformers where the loss of availability has severe consequences for the network, the MS 3000's flexible, modular architecture allows it to adapt to diverse customer needs and applications.

- Suitable for most transformer types and ratings, independent of manufacturer
- Applicable to new and existing transformers
- Used in power generation and transmission
- Special solutions for HVDC applications
- Ideal for industries with process interruption risks

Dissolved Gas Analysis

- Combines with any GE Vernova or other DGA monitor and provides even more powerful diagnostics by correlating with load and temperature

Active Part Supervision

- A transformer's active part (e.g. core, winding, insulation, leads) has a finite design life
- Extending it requires detecting stress situations causing premature degradation and correcting them

Bushing Monitoring

- Bushing failures represent approximately 25 % of sub-station transformer failures*
- Many of these are "catastrophic" leading to total loss of the transformer with significant additional collateral damage

Cooling System

- Common causes of overheating (like non-functioning fans) can easily be detected
- Cooling efficiency can be improved

On Load Tap Changer

- When present, OLTC, can account for up to 19 % of sub-station transformer failures*
- The regular maintenance of frequently working OLTCs can also be optimized

Electrical Stress Detection

- Partial discharge and transient over-voltages can erode/damage solid insulation if not detected and removed or attenuated



A Modular And Flexible Solution Covering The Key Transformer Elements

Expert System

Expert System Algorithms for analyzing the data acquired on-line are implemented in the software and reflect GE Vernova's extensive experience with transformers. The expert system highlights issues through configurable alarms and provides clear correlated information as well as recommendations concerning the transformer continued operation, the suggested "next steps" and the need for service/maintenance.



On Load Tap Changer

- OLTC position
- Number of switching operations
- Number of operations until service
- Cumulative switched load current
- Cumulative current until service
- Power consumption of motor drive
- Motor drive current
- Operation timing
- Assessed mechanical condition
- Energy index
- Contact erosion
- Gas in oil content
- Moisture in oil content
- Oil temperature
- Oil temperature differences
- Oil level in OLTC

HMI

The Web server built into the MS 3000 provides web pages in several languages which can be accessed using a standard web browser. The key data overview screen will highlight any alarm and enable to drill down into more specific data. When part of a transformer fleet, integration with GE

Vernova's APM software enables centralised information, leveraging of fleet data and fleet health ranking.



Sophisticated Modeling

With a multitude of sensors constantly delivering refreshed on-line data, the MS 3000 uses sophisticated models to analyse all this data, correlate it when additional sources are available and convert the data into actionable information in order to enable the asset owner to get the most out of the transformer.

Load

- Load currents
- Over-currents
- Total number of over-currents
- Load factor
- Overload capacity
- Emergency overloading time
- Apparent power
- Active power
- Reactive power
- Transformer power factor ($\cos \varphi$)
- Transformer losses

Dissolved Gas Analysis

- Gas in oil content (1 to 9 gases)
- Gas in oil rate of change
- Moisture in oil content
- DGA in OLTC

Insulation

- Top oil temperature
- Bottom oil temperature
- Calculated hot spot temperature
- Winding temperature
- Moisture in insulation paper

- Bubbling temperature
- Bubbling safety margin
- Breakdown voltage
- Lifetime consumption
- Ageing rate

Environment

- Ambient temperature
- Ambient humidity
- Cabinet temperature

Bushings

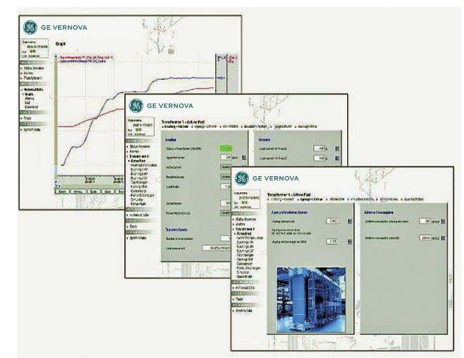
- Operating voltages
- Transient lightning over-voltages
- Total number of over-voltages
- Change of C1 capacitance
- Power factor ($\tan \delta$)
- Oil/SF6 pressure/density

Other Measures

- Oil level in main tank
- Oil pressure
- Humidity of air inside conservator
- Gas quantity/gradient in Buchholz relay
- Other digital and analogue inputs
- Other parameters on request

Simulator

The built-in simulator module allows the user to simulate external events or internal transformer events and to study the corresponding effect on the transformer's behavior. It can be invaluable for weighing up options when faced with a difficult decision but can also be used for training of personnel.



Report Generator

The configurable report generator quickly and easily creates a user-friendly report on the status of the transformer and of its main components. The report can be created on demand for selected monitored functions over a specified time frame.

Partial Discharge

- Electrical PD

Cooling System

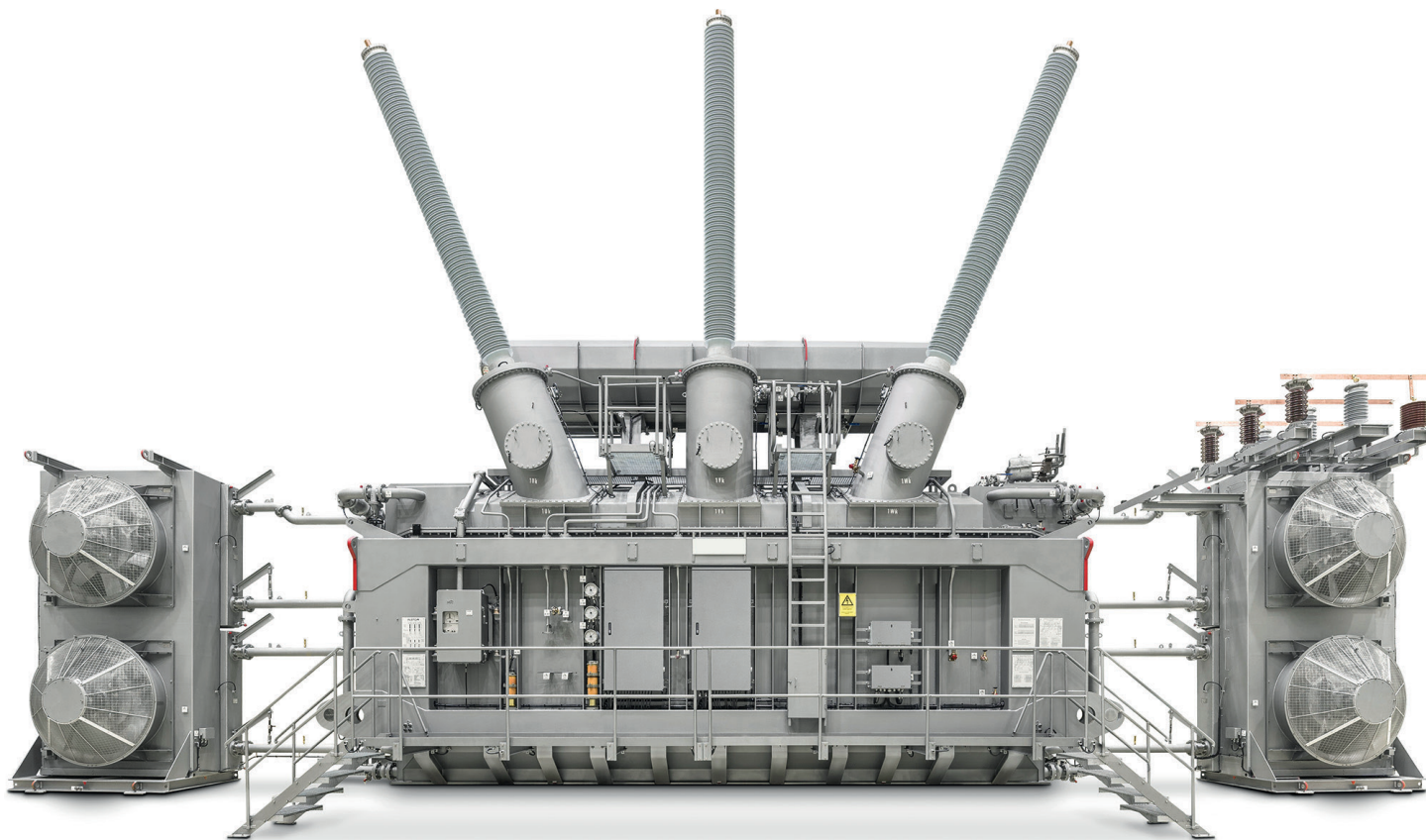
- Operating condition of individual/group fans and pumps
- Operating time of individual/group fans and pumps
- Cooling efficiency (Rth)
- Cooling power
- Inlet and outlet cooling system temperatures
- Difference of inlet & outlet temperatures
- Oil/water flow
- Current consumption of individual/group fans and pumps
- Intelligent cooling control for conventional and speed controlled fans

Oil Analysis

Both off-line and on-line data can be analysed. DGA using the most common diagnostic tools: Duval's triangle, Rogers and Doernenburg ratios, Key Gas methods, etc. as per IEEE C57.104 and IEC 60599. Users can select the method most appropriate to their situation. They can also perform Furfural determination and oil condition evaluation according to IEC 60422.

Holistic Transformer Risk Index

The MS 3000 risk index per transformer considers the most important parameters from all transformer components, such as active part, bushings, OLTC, cooling system and conservator. The real time Risk index is based on recognized international guides, established industry practices and GE Vernova's domain knowledge.



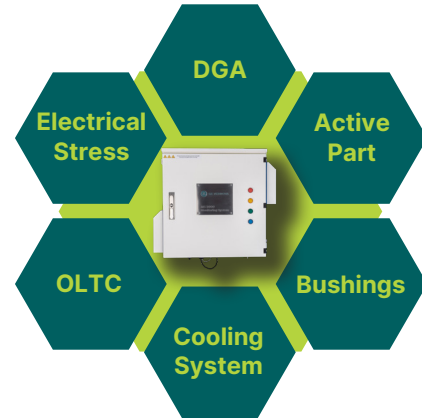
Modular Monitoring Solution for Power Transformers

The MS 3000 is a globally recognized on-line monitoring solution with well over 1,500 installations worldwide which benefits from extensive transformer manufacturing DNA. It is a powerful tool that concentrates most of the transformer data available and combines it with sophisticated models, diagnostic algorithms and practical experience to help the user evaluate the health of the transformer, monitor its current performance and optimize its operational efficiency.

The MS 3000 is modular and highly configurable so that it can accommodate a wide range of specifications or customer requirements surrounding monitoring of the 6 main areas responsible for the failure of power transformers. Standard configurations are also available to cover typical requirements.

Its wide range of communication options facilitates connection to SCADA systems, data historians and Asset Performance Management (APM) systems.

All this is provided by a single vendor with extensive transformer manufacturing and monitoring experience, which supports the customer from conception to deployment, ensures that the solution meets expectations and stands by it for the long term.



Technical Specifications

CUSTOMIZED SOLUTION	GENERAL FEATURES		ENVIRONMENT CONT.	
FLEXIBLE SYSTEM	Modular Temperature	Sensors and monitoring capabilities as required	Dimensions	600 × 600 × 250 mm (23.6" × 23.6" × 9.8") for small enclosure used in light configurations
Fully configurable system to meet wide set of specifications	Reliability	Fan-less, robust design for on-transformer installation		Up to 600 × 1200 × 300 mm (23.6" × 47.2" × 11.8") for enclosure of large customized systems
Scalable addition of sensors and functionalities	Data	Lifetime data management and storage, using solid state disc (SSD)	Weight	From 30 to 100 Kg (66 to 220 lb) depending on configuration
Flexible architecture to meet site requirements	HMI	Built-in Web server, available in several languages		
Ability to integrate existing sensors and monitors	Communications	Wide range of communication interfaces		
Working with all transformer designs and makes	Protocols	IEC® 60870-5-101/104, Modbus®, DNP3, IEC 61850		
IMPLEMENTATION SUPPORT	ENVIRONMENT			
Detailed review of suitable options	Operating Temperature	-40 °C to +55 °C -40 °F to +131 °F		
Advice on sensor requirement and positioning	Operating Humidity	95 % non condensing		
Optional planning site visit	Enclosure Rating	IP 55 standard, IP 66 optional		
Solution project management	Power Requirements	100 - 240 Vac 50/60 Hz 85 - 375 Vdc		
SUCCESSFUL DELIVERY				
Extensive testing of solution prior to shipping				
Commissioning on site				
Training of personnel				
Global service support				

* Source: Cigre A2.62 WG 2024

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