

# 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 ( $\cos \phi$ )
- 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

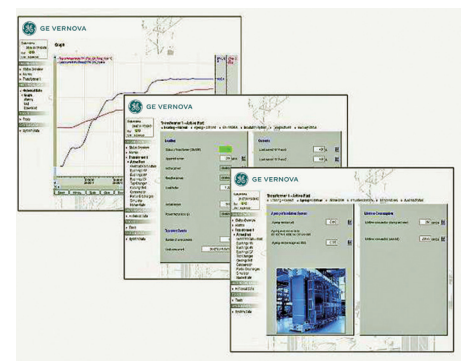
- Operating voltages
- Transient lightning over-voltages
- Total number of over-voltages
- Change of C1 capacitance
- Power factor ( $\tan \delta$ )
- Oil/SF6 pressure/density

## 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

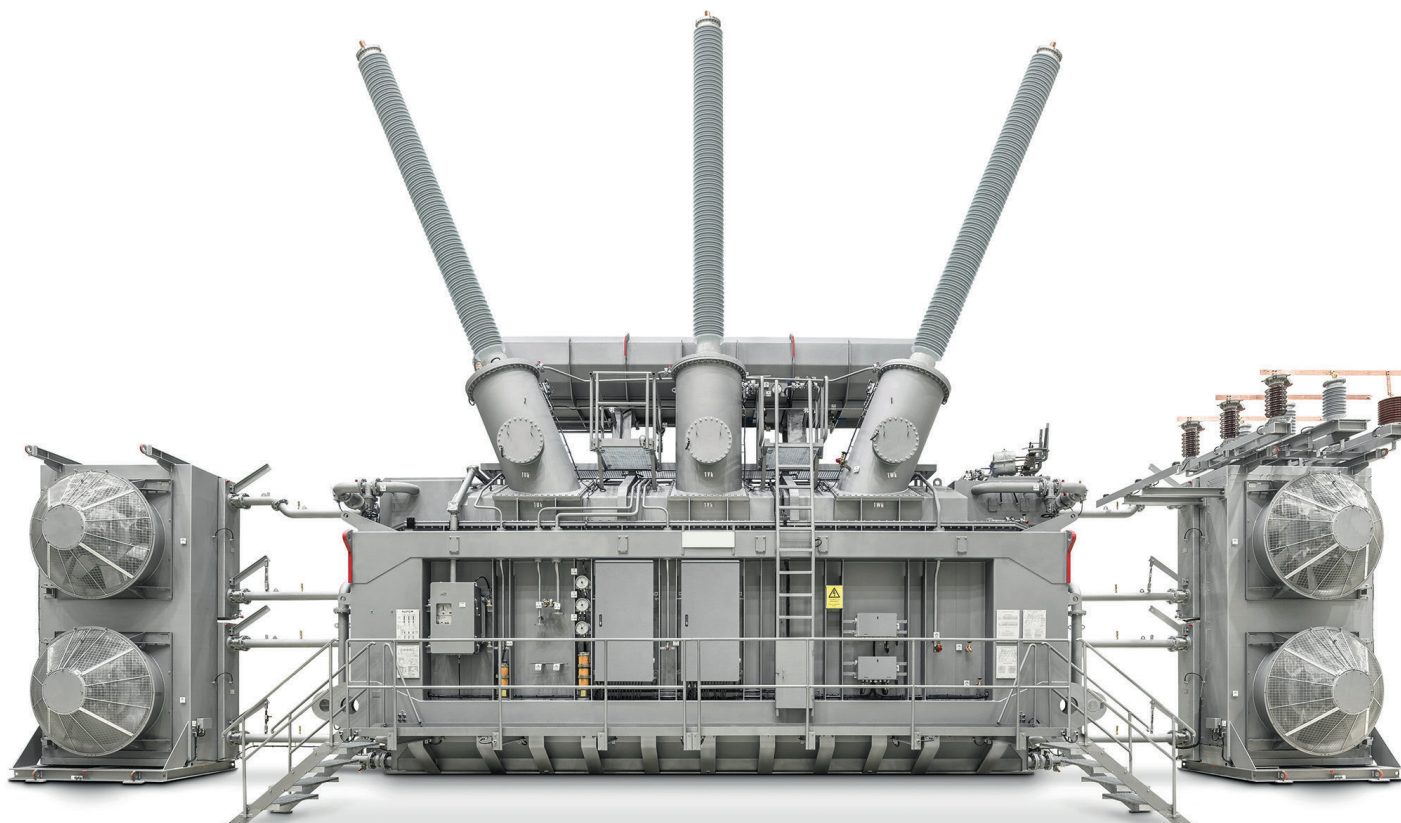
- Operating condition of individual/group fans and pumps
- Operating time of individual/group fans and pumps
- Cooling efficiency (Rth)
- Cooling power
- Inlet and outlet cooling system temperatures
- Difference of inlet & outlet temperatures
- Oil/water flow
- Current consumption of individual/group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



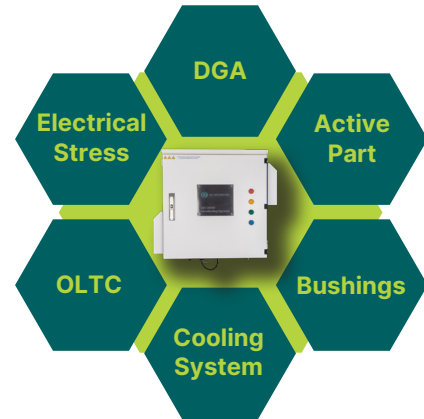
## Modular Monitoring Solution for Power Transformers

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.
<b>FLEXIBLE SYSTEM</b>		
Fully configurable system to meet wide set of specifications	Modular Temperature	Dimensions
Scalable addition of sensors and functionalities	Reliability	600 × 600 × 250 mm (23.6" × 23.6" × 9.8") for small enclosure used in light configurations
Flexible architecture to meet site requirements	Data	Up to 600 × 1200 × 300 mm (23.6" × 47.2" × 11.8") for enclosure of large customized systems
Ability to integrate existing sensors and monitors	HMI	Weight
Working with all transformer designs and makes	Communications	From 30 to 100 Kg (66 to 220 lb) depending on configuration
<b>IMPLEMENTATION SUPPORT</b>	Protocols	
Detailed review of suitable options		
Advice on sensor requirement and positioning	<b>ENVIRONMENT</b>	
Optional planning site visit	Operating Temperature	
Solution project management	-40 °C to +55 °C -40 °F to +131 °F	
<b>SUCCESSFUL DELIVERY</b>	Operating Humidity	
Extensive testing of solution prior to shipping	95 % non condensing	
Commissioning on site	Enclosure Rating	
Training of personnel	IP 55 standard, IP 66 optional	
Global service support	Power Requirements	
	100 - 240 Vac 50/60 Hz 85 - 375 Vdc	

\* Source: Cigre A2.62 WG 2024

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