MS 3000

Holistic Transformer Monitoring Solution

Faced with increasing pressure to continuously improve network availability and reliability, asset owners are now often looking for increased coverage on their important transformers. Continuously monitoring the transformer's main components (active part, bushings, tap changer, cooling system) is key to maximizing transformer availability, reliability and performance while reducing the life-cycle cost. Asset owners are therefore expanding beyond Dissolved Gas Analysis (DGA) and connecting to or adding more sensors to extend their online monitoring reach.

GE's MS 3000 holistic and modular transformer monitoring system enables essential to comprehensive coverage of the most common causes of failure. It lets you combine the outputs of available sensors to form a homogeneous data flow coming from a single source. It uses analysis and sophisticated models to prevent data overload and deliver an aggregate view of the health of the transformer's main components, providing intelligent alarms, diagnostics and suggested operational next steps. The MS 3000 is an "Expert System" which helps you confidently assess a transformer's condition and optimize its operation and maintenance.

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's Perception software for centralised information and leveraging of fleet data**
- Easy inter-operability of the transformer with the Smart Grid / Digital Substation

Applications

While more specifically aimed at transformer assets where the loss of availability has severe consequences for the network, the MS 3000 benefits from a highly flexible and modular design enabling it to adapt to a wide range of customer demands and types of applications:
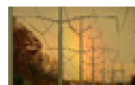
- Suitable for most transformer types and ratings, independent of manufacturer
- Applicable to new and existing transformers
- Used in power generation, transmission and distribution
- Special solutions for HVDC applications
- Ideal for industries with process interruption risks

Dissolved Gas Analysis

- Combines with any GE 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 17% 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 26% 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

Decision Aids

- Transformer health status report can quickly and easily be produced using report generator
- Built-in simulator lets you understand the implications of external or internal events

Expert System

Algorithms for analyzing the data acquired online are implemented in the software and reflect GE'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.
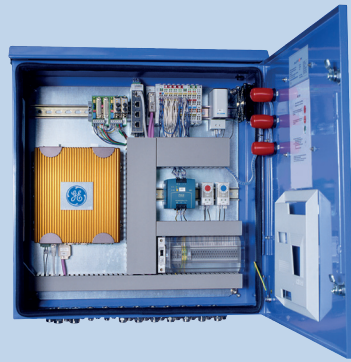
A modular and configurable system that can monitor the various key components of a power transformer listed here, depending on the asset owner's requirements.

Load

• Load currents (A)
• Over-currents (A)
• Total number of over-currents (A)
• Load factor (A)
• Overload capacity (A)
• Emergency overloading time (A)
• Apparent power (A)
• Active power
• Reactive power
• Transformer power factor (cos φ)
• Transformer losses

Dissolved Gas Analysis

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

On Load Tap Changer

• OLTC position (A)
• Number of switching operations (A)
• Number of operations until service (A)
• Cum. switched load current (A)
• Cum. current until service (A)
• Power consumption of motor drive (B)
• Motor drive current
• Operation timing (B)

• Assessed mechanical condition (B)
• Energy index (B)
• Contact erosion
• Gas in oil content
• Moisture in oil content
• Oil temperature
• Oil temperature differences
• Oil level in OLTC

Insulation

• Top oil temperature (A)
• Bottom oil temperature
• Calculated hot spot temperature (A)
• Winding temperature
• Moisture in insulation paper (A)
• Bubbling temperature (A)
• Bubbling safety margin (A)
• Breakdown voltage (A)
• Lifetime consumption (A)
• Ageing rate (A)

Environment

• Ambient temperature (A)
• Ambient humidity
• Cabinet temperature

Bushings

• Operating voltages (C)
• Transient lightening over-voltages (C)
• Total number of over-voltages (C)
• Change of C1 capacitance (C)
• Power factor (tan δ)
• Oil/SF6 pressure/density

Transient Over-Voltage

• Detection of fast transient over- voltages (up to 5 MHz) caused by network switching
• Capture of full waveform

Partial Discharge

• Electrical PD
• UHF PD

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

Oil Analysis

Both off-line and online 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:

Letters (A), (B) or (C) indicate inclusion in the various standard configuration kits, see back page for details.
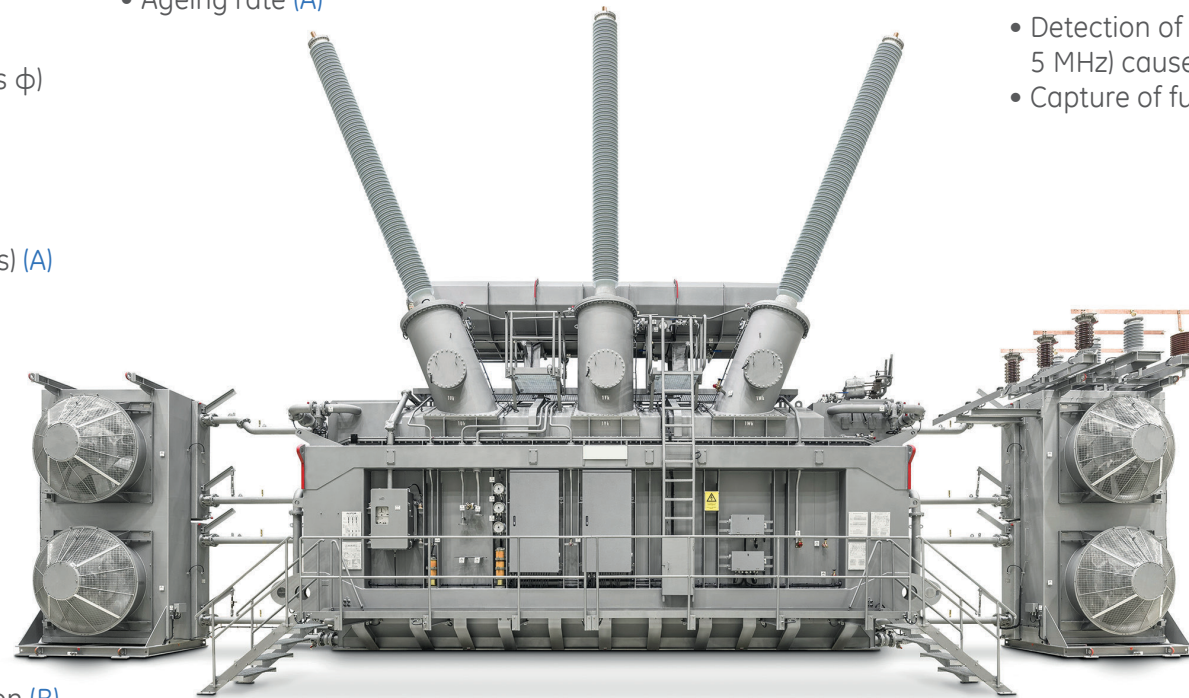
Cooling System

• Operating condition of individual/group fans and pumps (A)
• Operating time of individual/group fans and pumps (A)
• Cooling efficiency (Rth) (A)
• 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

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's Perception software** enables centralised information, leveraging of fleet data and fleet health ranking.

Sophisticated Modelling

With a multitude of sensors constantly delivering refreshed online 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.

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.
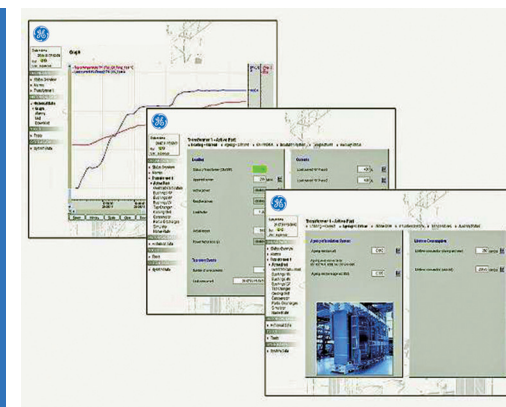
Report Generator

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.

Modular monitoring solution for power transformers

The MS 3000 is a globally recognized online monitoring solution with well over 1,000 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

Flexible System

- Fully configurable system to meet wide set of specifications
- Scalable addition of sensors and functionalities
- Flexible architecture to meet site requirements
- Ability to integrate existing sensors and monitors
- Working with all transformer designs and makes

Implementation support

- Detailed review of suitable options
- Advice on sensor requirement and positioning
- Optional planning site visit
- Solution project management

Successful delivery

- Extensive testing of solution prior to shipping
- Commissioning on site
- Training of personnel
- Global service support

* Source: Cigré WG A2.37

** Coming soon in 2016

STANDARD CONFIGURATIONS

Kit 1 – Base Module (A):

- Dissolved Gas Analysis
- Load
- Insulation
- Environment
- Cooling System
- Basic OLTC

Kit 2 – Base Module + Extended OLTC (A+B):

- Features of "Base Module"
- Extended OLTC monitoring

Kit 3 – Base Module + Bushing (A+C):

- Features of "Base Module"
- Bushing monitoring

Kit 4 – Base Module + Bushing + Extended OLTC (A+B+C):

- Features of "Base Module"
- Bushing monitoring
- Extended OLTC monitoring

Specific content indicated in centre page by letter coding

GENERAL FEATURES

Modular	Sensors and monitoring capabilities as required.
Reliability	Fan-less, robust design for on-transformer installation.
Data	Lifetime data management and storage, using solid state disc (SSD).
HMI	Built-in Web server, available in several languages.
Communications	Wide range of communication interfaces.
Protocols	IEC® 60870-5-101/104, Modbus®, DNP3, IEC 61850

ENVIRONMENT

Operating temperature	-40°c to +55°C -40°F to +131°F
Operating humidity	95% non condensing
Enclosure rating	IP 55 standard, IP 66 optional
Power requirements	100 - 240 Vac 50/60 Hz 85 - 375 Vdc
Dimensions	600 x 600 x 250 mm (23.6" x 23.6" x 9.8") for small enclosure used in standard kits. Up to 600 x 1200 x 300 mm (23.6" x 47.2" x 11.8" for enclosure of large customized systems.
Weight	From 30 to 100 Kg (66 to 220 lb) depending on configuration

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