SMART INSULATION™ - The Next Major Breakthrough

How to Improve Grid Reliability and Asset Utilization as increasing energy demand and an aging infrastructure drives grid investment.
SMART INSULATION™ – THE NEXT MAJOR BREAKTHROUGH

• Smart Grid initiatives around the world, driven by expansion of electrical systems and demands for improved reliability, are driving the market for monitoring products and associated software estimated at 2 billion dollars annual turnover.

• SmartInsulation™ is the next major breakthrough in transformer insulation design that will allow for on-line monitoring of key transformer operational metrics by using embedded sensors directly in the transformer winding.

• WEIDMANN is well positioned within the transformer manufacturing segment of the electrical transformer industry to successfully leverage its breakthrough technology in this rapidly growing market segment.
WEIDMANN

FLEET IS GETTING OLDER AND ...

SOURCE: HARTFORD STEAM BOILER
MAJOR FAILURE CAUSE IS FROM THE WINDING!

Figure 1: Failure locations of Substation Transformers (>100kV) (based on 364 failures)

Figure 2: Failure Locations in Generator Step-Up Transformers (>100 kV) (based on 82 failures)

CIGRE A 2.37
Key Winding Variables: **TEMPERATURE – MOISTURE – FORCE**

THE TMF Transformer “KILLERS”

Withstand Level As New

Spontaneous Loss of Life with T

Loss of Life with TM

Life (and Death) with random TMF Events

Sudden End of Life!
SMART INSULATION™ T,M,F – DIRECT MONITORING APPROACH

Insulation System with Embedded Sensors

Winding Cylinder

SmartSpacer® Sensor Assemblies

Fiber Optic Probes

Temperature
Moisture in Insulation
Clamping Force

SmartSpacer® “T”

SmartSpacer® “M” and “F” sensors in development

Conductor

Typical Key Spacer
VALUE PROPOSITION FOR UTILITIES

WHY WRITE SmartInsulation™ REAL TIME MONITORING INTO YOUR TRANSFORMER SPEC?

Reduced Capex Spending + Improved Asset Utilization = Increased ROI

Reduced Failure Rates:
`60% of power transformers fail in the winding or connections to the windings. Breakthrough TMF Sensor Technology is embedded in the winding insulation and directly measures changes in insulation and winding integrity to increase reliability, mitigate risk and improve overall system performance.

Optimized Transformer Utilization:
SI allows for true dynamic loading and real-time condition assessment. Transformers can be loaded optimally as situations dictate based on its age and condition and the impacts of faults, overloading, and overheating can be modeled and predicted and analyzed post event.
VALUE PROPOSITION FOR OEM’S

WHY INSTALL SI-TMF INTO YOUR TRANSFORMERS?

**Improved bottom line.**

**Improved Quality:** Make a better product. Provide exact TMF measurements during manufacturing and in final factory testing. Monitor TMF at critical points in the manufacturing process. Catch and fix problems sooner in the process. Confirm TMF and provide as part of final factory test results. Reduce likelihood of problems and failures. Reduce warranty costs, offer extended warranty.

**Reduced Manufacturing Costs:** Improve manufacturing processes: Optimize dry-out by monitoring moisture in the insulation through the drying process. Insure insulation structural integrity at design requirements through the assembly process. Reduced Cost of Quality.
WEIDMANN’s Monitoring Strategy

- Use unique sensors to monitor key elements of all major failure modes both internal and external as well as key operating parameters of G,T,D substation transformers in an integrated package.

- Use specialized diagnostics to provide ‘actionable information’ to utilities on the health status and operating condition of these critical transformers allowing for fast, confident decision making.

- Provide unique software that allows utilities to more effectively and efficiently manage their grid by optimizing their asset utilization and life expectancy – real-time dynamic loading!
WEIDMANN

COMPLETE INTEGRATED MONITORING SYSTEM

InsuLogix® Sensors and Monitoring Systems

Optimum Performance Management™ Software Suite

- Load Current Model
- Apparent Power Model
- Winding Temperature Model
- Insulation Aging Model
- Moisture Model
- Bubble Formation Model
- Cooling Efficiency Model
- Cooling Control Model

Dynamic Loading Model

- Ambient T
- Load Current, Bushing Condition
- Winding T,M,F
- Fan
- Pump
- Moisture-in-oil
- H2-in-oil
- Tap position, Dielectric Condition
OPM Combines Sensors, Monitoring System Hardware and Software Library Cornerstone eNamePlate™

- Designed to meet the emerging “Situational Intelligence” needs of the Smart Grid
- Provides the near-real-time capability to manage the performance of a transformer using a combination of sensors and software
- Defines transformer health and condition-based loading limits in a manner that maximizes reliability while minimizing risk and operational cost.
eNamePlate™ loading simulation software lets T&D engineers and managers make quantifiable decisions about how to optimize every power transformers on their system.
Reasons for **Optimum Performance Monitoring**…

1. Utilizing transformer assets closer to their real operating temperature limits without compromising life expectancy or reliability.
2. Determining when units are/are not performing in accordance with the factory-final tests or thermal model design.
3. Optimizing real-time substation loading limits based on changes in ambient condition or operating modes, i.e. Winter/Summer Normal or contingency conditions.
4. Making intelligent decision about shifting load from one unit to another, based on time to reach peak load capability (as an early warning) for short-term outage.
5. Potentially shifting load around a network system in order to select “good, better, best” options based on the health of individual units or load-loss characteristics in order to maximize financial benefits or potentially to reduce cost of losses.
6. Collecting insulation loss-of-life data to enable forecasting of residual life for major maintenance activity or replacement of transformers in the fleet.

…REAL-TIME DYNAMIC LOADING!
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THANK YOU!