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Transformer Hot Spot Hunting

Increasing need to monitor transformer hot spot

Transformer owners are increasingly operating under tighter maintenance and capital expenditure budgets. The time has passed when transformers were specified with hefty design margins. Today, to control costs and increase efficiency, transformers are designed in sizes and capabilities closely aligned with operating needs. However, at the same time utilities face an increasing demand for high levels of network reliability and reduced interruptions. There are many situations when the electrical system, along with its most important asset – the power transformer – is subject to stress. For example, with the increasing number of extreme weather events and supplying peak power in emergency situations. In many cases there is no room for error or equipment failure.

It is widely acknowledged that the winding temperature limits the transformer loading capability. Having the ability to accurately determine the winding hot spot is key when operating the transformer close to its design limitations, while also ensuring the situation is kept under control regarding transformer insulation life and health.

Use of fiber optic sensors in transformers

Fiber optic technology was applied in transformer hot spot monitoring several decades ago and is continually being improved and refined. State-of-the-art design and electronic components are increasingly used in fiber optic monitors and controllers. With appropriate configuration by transformer manufacturing personnel and proper installation in the windings, the fiber optic is capable of operating long after the transformers demise. Therefore today, hot spot fiber optic monitoring systems are proven and trusted to provide real time, accurate information about the temperatures inside the transformer tank, specifically in the transformer windings. However, there are several challenges still to overcome.

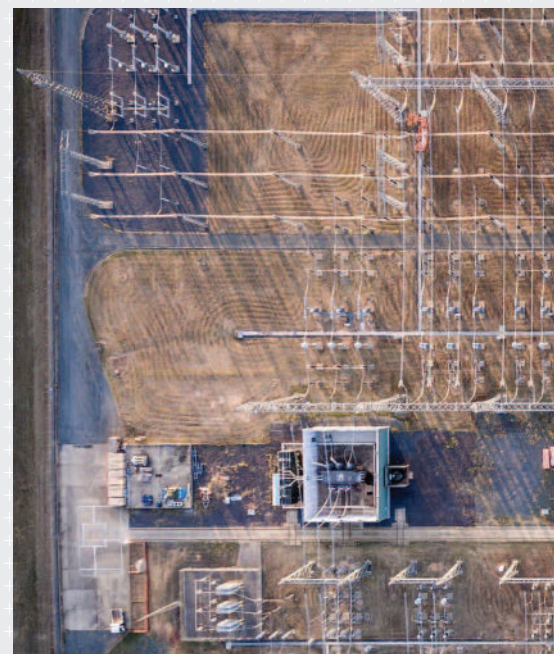
For example, a utility ordering transformers from multiple manufacturers and specifying fiber optic monitoring systems may receive transformers with fiber optic probes installed in different ways in the various insulation components, that have been tested in alternative ways and that have passed different criteria. This is valid even across different manufacturing facilities belonging to the same transformer manufacturer. Although the transformer manufacturers do an excellent job in installing the fiber optic monitoring systems on their transformers, how can utilities purchasing transformers ensure that they receive the transformer with fiber optic probes mounted in insulation in the same way, having been tested equivalently and respecting the same criteria?

The answer is consistency.

As the global leader in transformer insulation design and manufacturing, and a fiber optic monitoring supplier, Weidmann has the capability and expertise to design, produce and test fiber optic temperature probes and insulation assemblies, leading to the lowest fiber failure rate.



The SmartSpacer® can be pre-ordered as part of the transformer OEM insulation package ensuring that it is designed specifically for the transformer type, and tested to the highest standards.





A consistent approach

Given the level of standardization applicable to this topic and existent in industry today, the consistency can be guaranteed only if the assembly of the fiber optic temperature probe with insulation component is manufactured and tested by one, specialized entity. This in its turn guarantees that fiber optic-insulation assemblies perform per specifications, in the same way, while being subjected to stressing elements specific to transformer winding, whether these elements are electromagnetic stress or physical.

SmartSpacer®



Weidmann SmartSpacer® undergoes a rigorous design, FEA analysis, and thermal, mechanical, electrical, and for some designs X ray tests to become certified. This reduces the risk of incorrect probe installation and loss of use or potential reduction of insulation system integrity which can lead to premature failure.

As the global leader in transformer insulation design and manufacturing, and a fiber optic monitoring supplier, Weidmann has the capability and expertise to design, produce and test fiber optic temperature probes and insulation assemblies, leading to the lowest fiber failure rate. At Weidmann these assemblies are called SmartSpacer®. It ensures quality and consistency, as well as realizes savings for both transformer manufacturers and operators.

Improper installation of the fiber-optic probes in the transformer windings can result in inaccurate data or can potentially increase localized stresses in the insulation system. Any discontinuity must be avoided during installation, as well as incompatible materials such as some adhesives, and voids that can reduce the integrity of the overall system. Weidmann SmartSpacer® is designed to eliminate all these issues.

SmartSpacer® provides the manufacturer and end user with the confidence to install fiber optic probes in the windings that will not compromise the integrity of the insulation system or transformer reliability in the long term. The SmartSpacer® can be pre-ordered as part of the transformer OEM insulation package ensuring that it is designed specifically for the transformer type, and tested to the highest standards. This minimizes the work required by the OEM and ensures consistency in the probe assembly and installation leading to a lower risk of breakage or failure.

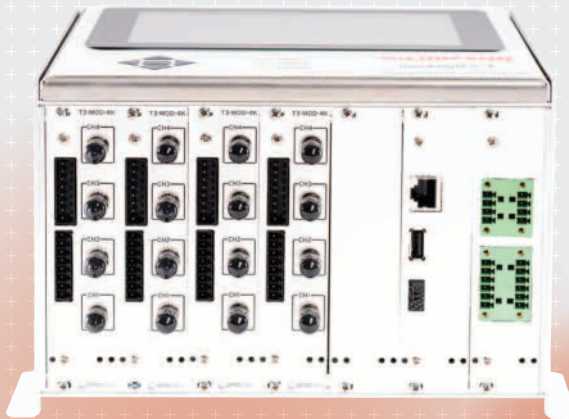
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InsuLogix® T – State-of-the-art monitoring system

The SmartSpacer® is an optional solution that can be supplied along with the Weidmann InsuLogix® T – fiber optic monitoring system. The InsuLogix® T is designed, manufactured and tested to the highest quality standards in one single location at Weidmann's facility in Dresden, Germany. Fiber optic temperature probes, fiber optic cables and the SmartSpacer® are also assembled and tested at Weidmann.

The InsuLogix® T is a state-of-the-art monitoring system, utilizing the latest high-performance processor that increases power and stability to ensure maximum percentage uptime of the device, with minimal maintenance or troubleshooting required. The device combines class-leading configurability with the latest in-built logic and the highest number of configurable relays per channel, all managed through the largest device mounted touchscreen and keypad available on the market today.



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Weidmann SmartSpacer® is designed, tested and manufactured as individual components and shipped with a certificate of compliance confirming the component has met the following five-part Weidmann certification process:

Design: The detailed design of the insulation component and embedded sensor are compatible with normal and emergency electrical stress limits typically found in EHV and UHV liquid-immersed power transformer winding designs, as specified by the transformer manufacturer and operator.

Dielectric Analysis: The component, sensor, and connection system have been extensively modeled and analyzed using Finite Element (FEA) numerical analysis techniques to ensure that the SmartSpacer® is compatible with electric field stresses in the winding and support insulation system designs.

Functional Testing: Insulation components and embedded sensors are tested in the Weidmann or equivalent high-voltage laboratory to demonstrate the output metrics and applicable tolerances required for the sensor. They are suitable for use in the transformer internal environment, in both alternating voltage and impulse conditions, applicable to the BIL voltage class as specified by the power transformer operator.

Manufacturing Processes: All components meet strict manufacturing process controls in compliance with drawings and specifications that preclude the possibility of electric field stress concentration or negative impact on the transformer dielectric system or performance.

Quality: Strict conformance to written quality assurance system standards are met for components and matching sensors throughout the manufacturing, assembly, packaging, and shipping stages. The Weidmann Quality Management System is certified to the ISO 9001 Standard.

The InsuLogix® T is a state-of-the-art monitoring system, utilizing the latest high-performance processor that increases power and stability to ensure maximum percentage uptime of the device, with minimal maintenance or troubleshooting required.



Marius Marinoiu has almost 20 years technical and sales experience at a global level in transformer monitoring applications and analytical services. He holds an Engineering degree in Industrial Automation and Robotics, and a Master's Degree in Non-Conventional Control Systems. At Weidmann he is responsible for assisting in the development and implementation of strategic sales plans for the Transformer Lifecycle Product (TLP) Market Segments in North America. Previously he managed implementation of turn-key transformer monitoring solutions globally.