Keeping an eye on fast transient overvoltages

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Lightning strikes and switching operations can generate transient overvoltages in the electrical power system. They represent a significant risk to transformer bushings and windings and can even be the source of major breakdowns. Because of this, an effective monitoring system is needed that will mitigate the risks.

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Transient overvoltages can, over time, damage power transformers. They provoke stress on the insulation and can cause breakdowns between turns or from coil to earth. Sebastian Rohde, monitoring R&D engineer, explains: “A large number of transformer failures are reported as dielectric failures. They are not necessarily linked to any particular event when they occur, but may be the result of prior damage from transient overvoltage events.”

Transient overvoltages can be the result of lightning strikes. They can also be due to switching operations that occur during the operation of circuit breakers and disconnectors. In gas-insulated switchgear, transient overvoltage waves can propagate through the system and be reflected and superimposed on the transformer. Also, in new-technology power grid components such as HVDC converters, capacitor banks or reactors, internal faults and trips can cause transient overvoltages.

Continuous online transformer monitoring

Current factory tests are based on the standard waveforms of voltage transients, designed to cover the main phenomena that may take place in

service. Continuous online monitoring provides the sole and effective means for capturing and recording voltage transients of a broad range of waveforms that are associated with such service events. “Then the utility can adopt targeted prevention measures, such as installing surge arrestors,” says Rohde, “to reduce risks and improve transformer reliability and availability.”

Alstom’s MS 3000 Transient is just such an online monitoring system. According to Rohde, “For us, it is the only known online system for continuously monitoring transient overvoltages directly at the power transformer’s bushing voltage taps with a unique bandwidth in the megahertz range and a maximum sampling rate of 50 million samples per second.”

The MS 3000 Transient consists of two prime elements: the voltage sensor installed at the transformer bushing test taps, and the intelligent Data Acquisition Unit (iDAU).

The highly compact capacitive voltage sensor developed by Alstom is suitable for all makes and types of bushing. The coaxial design and the use of special capacitors allow voltage measurement in the megahertz range. It can capture amplitudes that are a multiple of the nominal voltage. “In addition,” says Rohde, “the sensor and sensor cable can be made of special materials that are suitable for operation in offshore environments, where salinity and humidity are very high.” The universal sensor is also used for monitoring bushing conditions and partial discharges.

Collecting and analysing the data

The associated iDAU is designed for very fast data acquisition, analysis, storage and visualisation. It has four channels with a bandwidth up to 5 MHz and an input range of ±200 V that capture the waveform simultaneously. The digitised data is monitored by a trigger unit; trigger conditions such as an excessive amplitude, slew rate or transformer shutdown can be detected. The MS 3000 Transient iDAU's web server provides clear web pages that can be accessed directly without proprietary software.

Dr Sebastian Coenen, monitoring R&D manager, points out that "multiple iDAUs can be synchronised to monitor several transformers within a substation. So, all modules capture the input signal of all the transformers if a trigger condition is met on one channel on one MS 3000 Transient.

The web visualisation will show on which transformer the overvoltage occurred.”

iDAU installed in MS 3000 cubicle

The MS 3000 Transient can be operated stand-alone by means of the built-in web-server or integrated into the full MS 3000 condition monitoring and expert solution. In this way, the fast transient overvoltage events that affect the transformer can be correlated with other monitoring data to ensure exhaustive data management over the lifetime of the power transformer.

MS 3000 Transient Web-visualization

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