

TRANSFORMERS

# Increasing safety with combined insulation bushings

Sagnik Murthy, Regional Marketing Specialist Northern Europe, for ABB's Transformer Components explains how utilities are increasingly turning to combined insulation bushings as the proven material of choice for replacing bushings.



— ABB Comem CRS combined insulation bushings enable customers to eliminate brittle oil-filled porcelain

Bushings are a critical component of power transformers. They connect the windings of the transformer to the overhead line or busbar while providing an insulated barrier between the live conductor and the transformer body. They also perform as a mechanical support for the overhead conductor.

## Oil-filled porcelain bushings

Traditionally, bushings are made of a central brass or copper conductor surrounded by a stack of porcelain insulators separated by protective gaskets. Between the conductor and the porcelain, a void is filled with insulating oil that increases the electrical withstand. In addition, a fixing system holds the stack together and consists of a collar flange and some pressure components that also connects a metallic cover.

Failure can have major consequences in terms of loss of service. If and when oil-filled porcelain bushings fail, it tends to be through sudden explosive shattering of the porcelain. This leads to risk from porcelain projectiles as well as leakage of the synthetic or ester insulating oil and the potential hazard of an oil fire.

The operating environment can impact the life of outdoor equipment and bushings are particularly open to the elements as they are exposed to wind, rain, harsh UV, pollution, heat and cold on top of the transformer. In addition, they experience thermal and electrical stresses during their lifetime.

Many thousands of such bushings are in place on the UK's aging transformer fleet, creating a major challenge for operators in how to best maintain the bushings and their individual components.

## Moving towards combined insulation bushings

Rather than replace time-served bushings with brand new oil-filled porcelain replacements, operators are increasingly opting for combined insulation bushings as they achieve higher levels of safety, reliability and environmental sustainability.

Inside a combined insulation bushing, an organic insulation resin layer is directly moulded onto the conductor rod at the core. A silicon rubber insulator is then moulded on top to protect the resin and create the final shape, also known as the shed profile, in one single self-contained piece. This delivers a bushing that has the lowest possible level of partial discharge and the highest mechanical strength.

While both types of bushing have the capability to withstand the stresses experienced in service, combined insulation bushings have better performance across the board in terms of mechanical, thermal, dielectric and leakage characteristics.

#### **Advantages of combined resin and silicon**

Combined insulation bushings have several major advantages over their oil-filled predecessors, mainly because each bushing is a single component formed from tough and resistant resin and silicon. Ultimately, the choice of modern engineering materials has created a hard working product with simpler handling, installation and maintenance requirements and fewer operational risks.

At a stroke, by removing porcelain and oil, the design eliminates the potential for oil leakage and the potential for shattering. Second, whereas porcelain is delicate and fragile, handling and transport of a combined insulation bushing is more simple and straightforward, with no need for special storage and handling measures and the capability to install them at any angle from horizontal to vertical. In service, they are resilient in spite of temperatures as low as -60°C.

Third, as a single piece, assembly is easier and faster. Technicians need to clamp together individual porcelain pieces and gaskets when assembling and maintaining oil-filled porcelain bushings and the process calls for measures for handling of oil. By removing the oil and all gaskets other than the ones that separate the bushings from the transformer tank, combined insulation bushings eliminate the need to maintain the gaskets.

The last advantage is related to the silicon rubber surface, which is self-cleaning, flexible and sturdy. This makes them a no-maintenance option that is even suitable for use in heavily polluted and offshore environments.

#### **Practicalities**

ABB's combined insulation bushings are available from 24 to 72.5 kV and 630 to 6,300 A and are manufactured to the IEC 60137 standard at our Comem unit in Montebello, Italy. They are designed to be fully interchangeable with conventional porcelain bushings made to the historic EN 50180 standard and can be optimised for utility, renewables and industrial applications.

In 2015 the ABB Comem combined insulation bushings passed a challenging environmental test when South African utility ESKOM tested units at its Koeberg Insulator Pollution Test Station (KIPTS), which is recognised as the world's leading site for testing the natural aging of outdoor components due to extreme seasonal wet and dry conditions, UV, high winds, salt, sand and pollution.

Today, a fleet of Comem combined insulation bushings is in operation on transformers for various applications for UK customers including National Grid, UK Power Networks, Western Power Distribution, DONG Energy, Bombardier and other industrial customers.