High voltage bushings are critical components whose failure can have serious consequences. Thermal and electrical stress, ambient conditions and more put high demands on bushings. Because of the high electrical stress levels, failures originating in the bushings most often lead to severe consequences such as fires and explosions.

A 2015 CIGRÉ study on transformer and reactor failures concluded that 17 percent of failures on units above 100 kV failed due to their bushings. For reactors, bushings accounted for over 30 percent of the failures. Although the failures can have many causes – failure of the bushings themselves and electrical, mechanical and thermal stresses from the grid system – a flashover in an oil impregnated bushing with ceramic insulators often produces an explosion with shattered insulators and oil spills as a result.

Condition assessment and replacement of bushings that show signs of deterioration therefore reduces the risk of transformer failures. Certain types and applications may have a higher risk which is yet another reason for condition assessment.

Oil-filled bushings may be considered for upgrade to dry-type with polymer insulators to reduce the consequences of failures. Repair of high-voltage condenser bushings is normally not economically justifiable, however exceptions exist. Our offering includes installation, preventive maintenance, condition assessment as well as replacement/upgrades.

Exchange of bushings
Replacing a high voltage bushing is a critical procedure that should be done by an experienced transformer service organization.

Prior to an exchange, a design review needs to be conducted where engineers look at it from a mechanical and electrical point of view. Aspects considered are:
- Internal and external geometry
- CT pocket length
- Internal and external connection
- Internal shielding
- Flange design

If any aspect is changed from the original transformer design, the new solution needs to be reviewed by qualified transformer design engineers.

Preventive maintenance and condition assessment
Little maintenance is required other than checking of the oil level (if applicable), visual inspection and cleaning, if needed. Bushings exposed to salt spray, cement dust and other deposits are subject to a special hazard and should be cleaned regularly to prevent flashovers and corrosion of parts.
Experience has shown that age is not the best indicator of a bushing’s condition. To understand the condition and prioritize bushing replacement, it is recommended to perform condition assessments on critical and high risk units using a combination of:

- DGA (Dissolved Gas Analysis)
- Moisture in oil
- DFR (Dielectric Frequency Response analysis)
- Tan delta (dissipation factor)
- Capacitance test

Dry technology

The majority of installed high voltage bushings are of the OIP (Oil Impregnated Paper) condenser type. A popular alternative is to replace OIP with dry type bushings like RIP (Resin Impregnated Paper).

The benefits with the dry types are:

- Reduced risk for explosions and fires due to lack of oil and polymer insulators instead of porcelain.
- Lower maintenance since no oil leakage can occur and the surface of the polymer insulators have a hydrophobic surface that reduces the need for cleaning.
- Reduced risk of moisture contamination after bushing failure.
- Can be stored and transported at any angle and can be put into operation on short notice.
- Lower weight and size.

ABB Transformer Services

With over 100 years of experience and close cooperation with experts from bushing and transformer factories around the world, ABB Transformer Services has positioned itself as the number one partner for a bushing replacement of both ABB and non-ABB bushings on all types of transformers and reactors.

With a global service network of over 1000 people in 26 countries, there is always a unit close to the customer to support making the correct decisions and optimize the lifetime cost of the transformer.