



READY TO BE YOUR BUSHINGS PARTNER

GENERATOR BUSHING SERVICES

TRENCH FRANCE SAS



TRENCH

WHO IS TRENCH FRANCE SAS ?

OUR PROPOSAL – YOUR BENEFIT



Trench France is manufacturing generator bushings for more than 60 years.

Previously known under the name of Haefely, since 2004, the company belongs to the Siemens Group.

As a global leader in generator bushing using two main technologies , resin impregnated

fibre glass and resin bonded paper, the portfolio includes air cooled bushings up to 19 kA, gas cooled bushings up to 35 kA and water cooled bushings up to 50 kA.

With more than 10 000 bushings in service around the world Trench is a leading player in the energy market.

WHY SHOULD YOU BE CONCERNED ABOUT BUSHINGS?

Generator bushings are a critical component of a generator.

The bushing allows the electrical power to flow from the stator windings to the step up transformer which is connected to the transmission network to finally serve the end user.

Generator failures can result in unplanned outages which effect customers, reduce revenue and create a substantial cost to repair/rebuild the generator equipment.



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HOW DOES A GENERATOR BUSHING AGE?

Two main technologies are used for the design and manufacturing of the active parts: Resin Impregnated Fiber Glass or Resin Bonded Paper.

The active parts, gaskets and O-rings are the key components of the bushings which will have the greatest impact on its lifetime.

WHAT ARE THE FACTORS INFLUENCING THE BUSHING LIFETIME ?

The generator bushings have an average lifetime of 30 years depending on service conditions. The aging factors are diverse and mainly related to the following parameters :



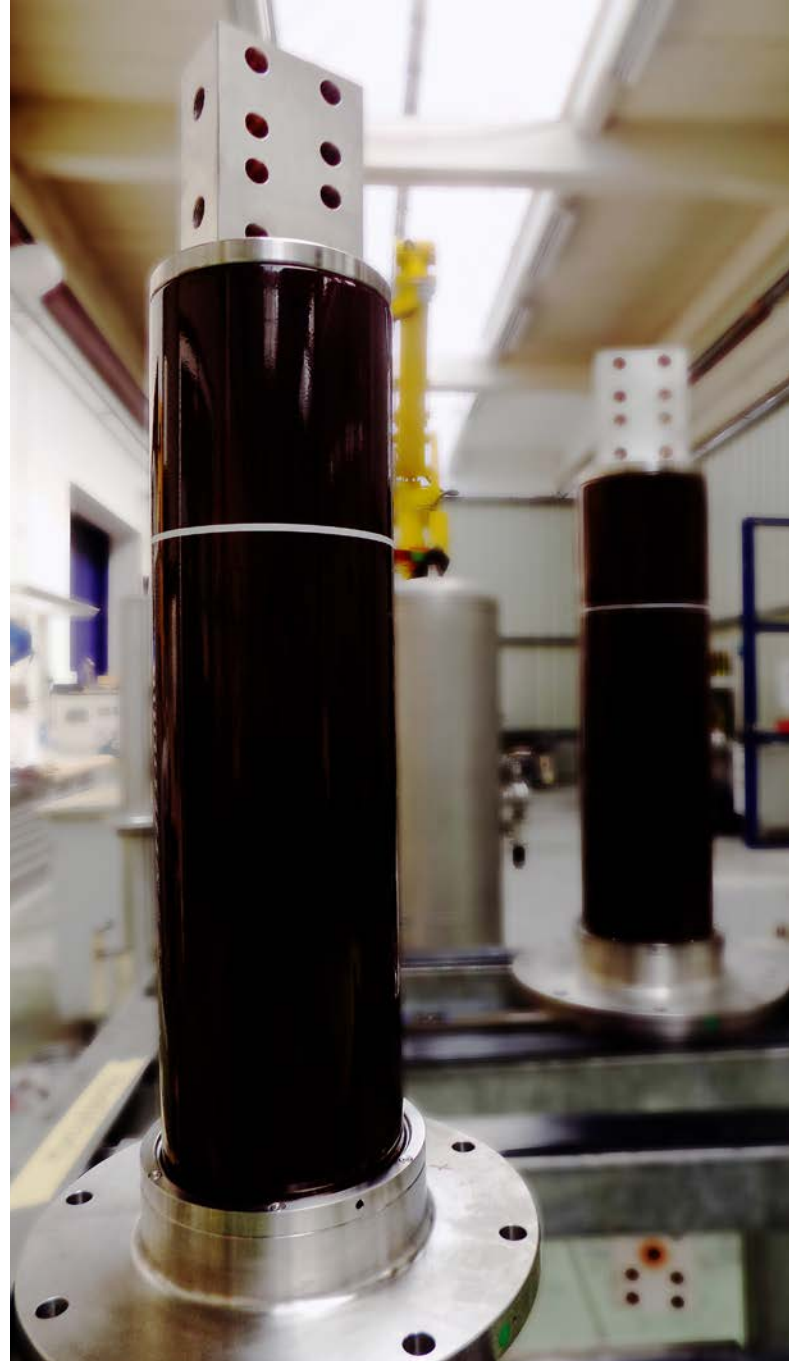
Temperature : the higher the service temperature, the quicker the aging process of the insulating material (paper/ fiber glass) and gasket will develop. The service temperature is dependent upon ambient temperature, generator cooling conditions and service current.



Voltage : overvoltages, transients may influence the aging process and trigger some partial discharge phenomena leading gradually to degradation of the main insulation.

EXAMPLE OF ISSUES EFFECTING THE LIFE OF A GENERATOR BUSHING

- Temperature hot spot : Localized heating at the terminals due to insufficient tightening or damaged contact surface.
- Mechanical vibration leading to high forces at the flange/terminal and possible leakage of hydrogen.
- Insulation breakdown : Capacitance and dissipation factor shift with time due to service conditions leading to partial breakdown. There are some ways to determine the condition of the bushings in order to plan the maintenance , repair or the replacement.



WHAT CAN BE DONE TO EXTEND THE LIFE OF MY BUSHINGS?



Maintenance : preventative maintenance and with the knowledge gathered, a plan can be created outlining priorities to properly manage these valuable assets.

The plan can then be implemented to the time and budget restraints for a custom solution to extend the bushing lifetime.

Trench is committed to support the end user to assess its bushing fleet and determine what would be the best way to manage it .

EVALUATION OF THE BUSHING FLEET IMPROVE LIFECYCLE - RISK MANAGEMENT

LEVEL 1 : ON-SITE EVALUATION

- Capacitance and Power Factor measurement
- Insulation resistance measurement
- Overall mechanical condition
- Thermovision infrared scan

These checks bring a first level of information about the current status of the bushings.

LEVEL 2 : CHECK TEST IN OUR TEST FIELD INCLUDING

- Pressure test with helium leak rate measurement
- Capacitance , power factor
- Partial discharge measurement (PD)
- Power frequency withstand voltage test
- Lightning impulse test
- Insulating resistance

The above tests provide a better understanding about the progression of the aging process, especially while performing PD tests, accurate capacitance and dissipation factor measurements.

The standards IEC 60137-2008 and IEEE C57.19.100-2012 are stating that the test voltages for bushings which have been in service shall be reduced to 85% of the original voltage test levels.

LEVEL 3 : DISASSEMBLY FOR A DETAILED EVALUATION

- Check of the mechanical condition of the active part
- Check of the aging for the gaskets/ O rings
- Check of the terminal surface quality

These measurements are the basis for the estimation of the remaining lifetime of similar bushings in the network





SUMMARY OF DIAGNOSTIC TESTS:

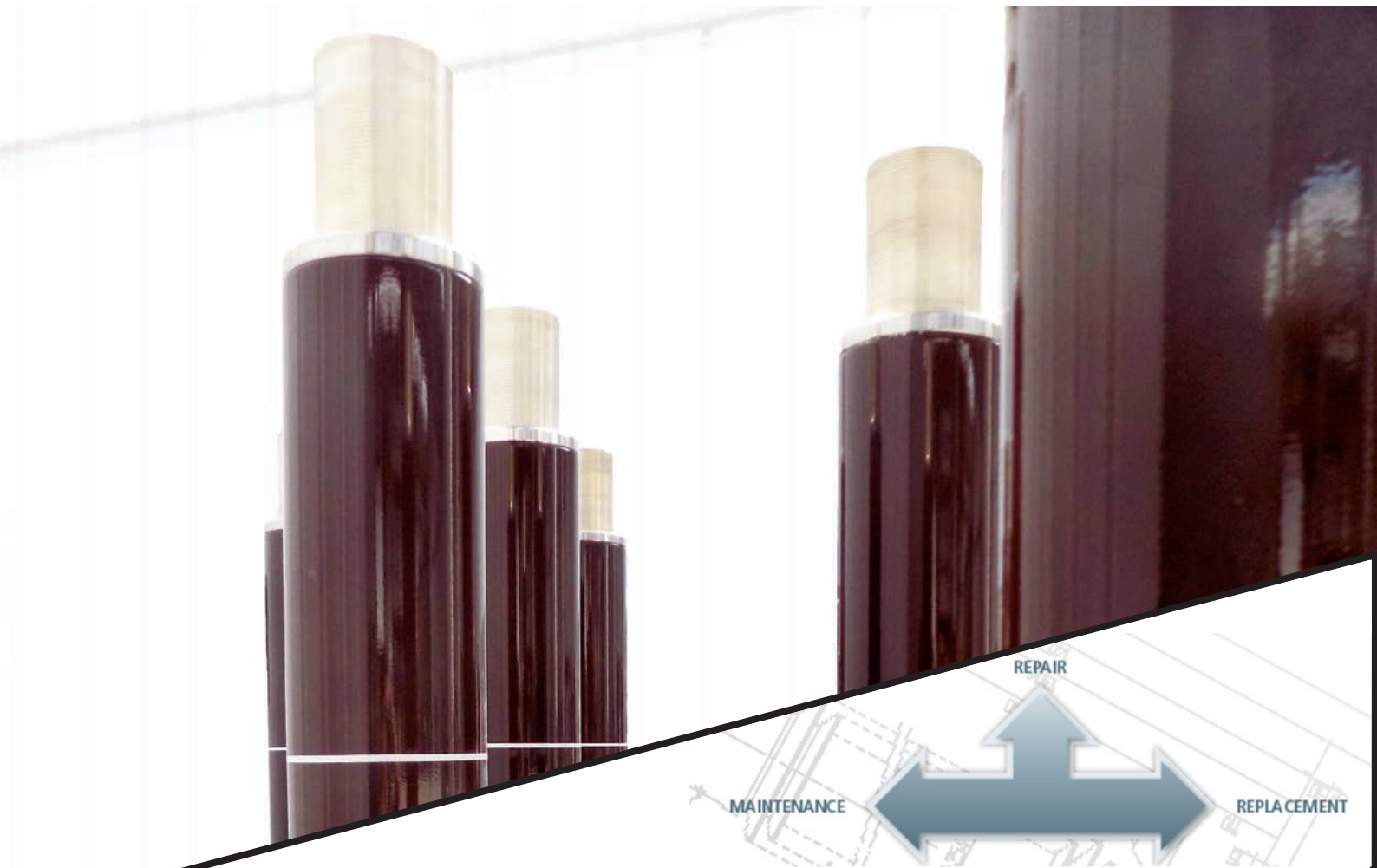
With test results available, an action plan can be developed.

The condition of the bushing, network configuration and budget constraints will all contribute to the final plan

Key aging factor	Parameters to be checked	Frequency
Thermal	<ul style="list-style-type: none"> * Thermovision * Gasket/O-ring status * Terminal surface condition 	<ul style="list-style-type: none"> * Yearly * On request * On request
Mechanical	<ul style="list-style-type: none"> * Gas leaks * Visual 	<ul style="list-style-type: none"> * Monthly * Yearly
Dielectric	<ul style="list-style-type: none"> * Capacitance and Power Factor * Insulation resistance * Repetition of routine tests including PD test 	<ul style="list-style-type: none"> * Every 3-5 years * Every 3-5 years * On request

EVALUATION OF TEST RESULTS

SET UP OF AN OPTIMIZED MAINTENANCE POLICY



Based on the information gathered through the different evaluation steps, suggested actions can be categorized into three levels as described here below:

1) MAINTENANCE

The maintenance checks including gas leaks, thermovision of the primary connection, insulation resistance measurement can be managed in various ways depending on company policies. In order to support these initiatives, training sessions can be organized by Trench France at the customer premises. Further maintenance strategies including on line monitoring can be analyzed.

ADVANTAGE	LIMITATION
<ul style="list-style-type: none">• Simple checks to be performed at site• Enables to have a global overview of the fleet and to detect aged bushings	<ul style="list-style-type: none">• Aging rate unknown• Remaining lifetime unknown

2) REPAIR

It is possible to repair different brands of bushings, especially by replacing the RBP active part and the gaskets/O-rings.

ADVANTAGE	LIMITATION
<ul style="list-style-type: none">• Shorter lead time to have a bushing back in operation in case of Haefely or Trench France originally manufactured bushings• Lower cost compared to new bushing	<ul style="list-style-type: none">• Long lead time if Trench/Haefely is not the original manufacturer• Generator out of service during repair cycle• Remaining lifetime of other components difficult to estimate

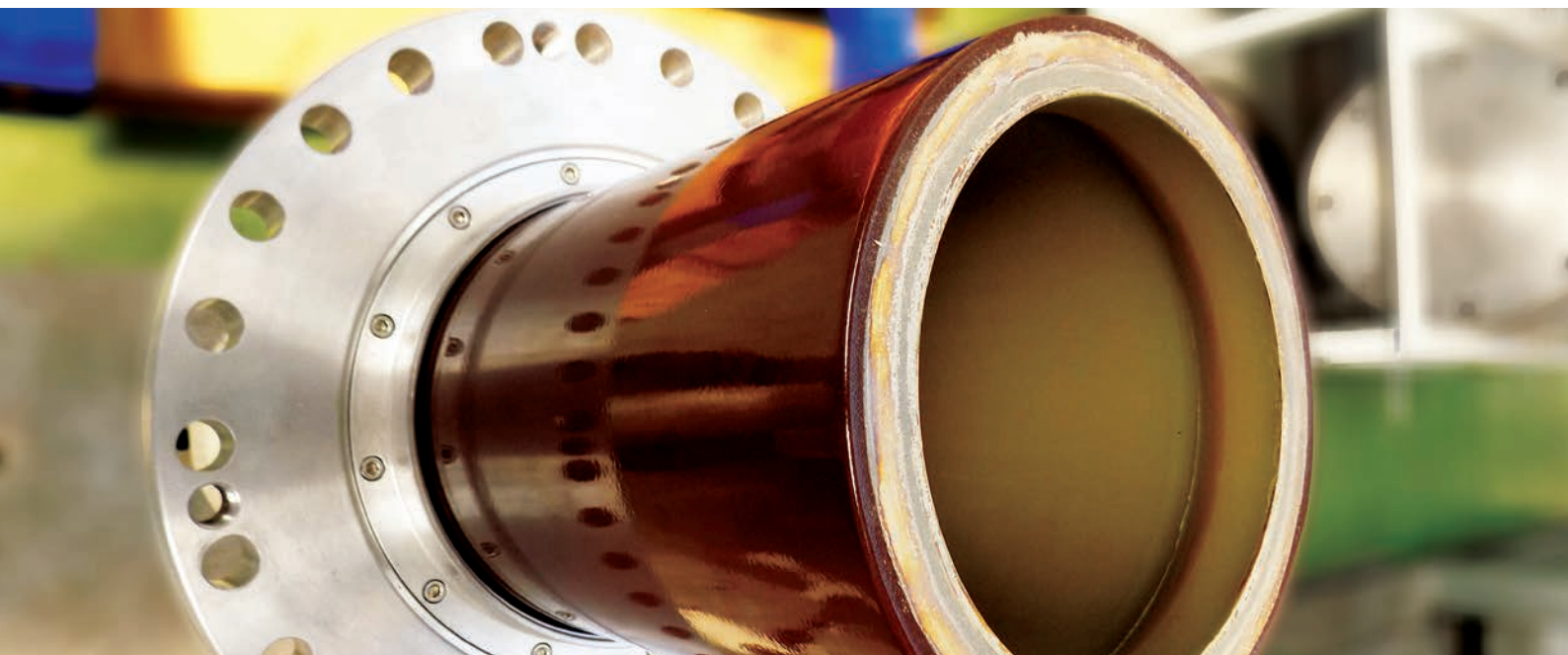
3) REPLACEMENT

Trench keeps most of the original documents including drawings, parts lists and tests reports from former bushings manufacturers such as Fibre & Mica and Haefely AG.

Based on the original design, Trench is able to propose fully interchangeable bushings which will fit exactly into the generator: the installation and related adaptation costs will be minimized accordingly.

Trench is also able to replace other brands of bushings as long as the original outline drawings are still available.

ADVANTAGE	LIMITATION
<ul style="list-style-type: none">• Possibility to build an interchangeable bushing• Design according to the latest standards and therefore matching the highest requirements• Expected lifetime : 30 years after replacement• Generator in service until bushing is delivered	<ul style="list-style-type: none">• Longer lead time for non-Trench Bushings• Minor modifications may be required





The Trench Group is your partner of choice for electrical power transmission and distribution solutions today and for the development of your new technology solutions of tomorrow.

BUSHING SERVICES

TRENCH FRANCE SAS

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