



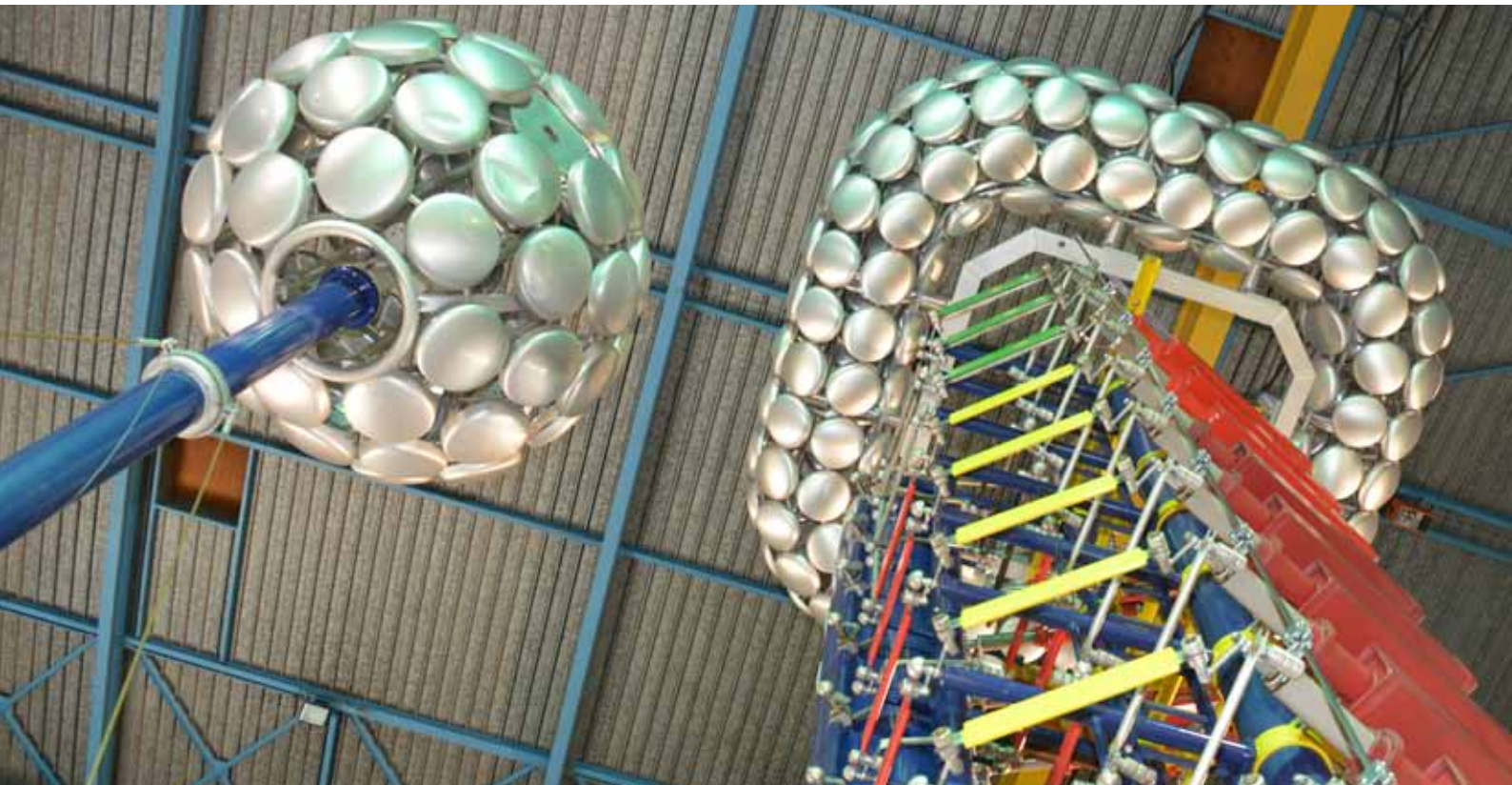
BUSHING SERVICES

Trench France SAS

THE **PROVEN** POWER.



WHO IS TRENCH FRANCE SAS ? OUR PROPOSAL – YOUR BENEFIT



Trench France is manufacturing bushings & instruments transformers for more than 60 years.

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

As the global leader in Oil Impregnated Paper technology (OIP), the products portfolio

includes transformers bushings from 24kV up to 550kV, with rated current 800A to 5000A, generator bushings, current transformers & voltage transformers.

With more than 250 000 bushings in service around the world, and a yearly production of 10 000 units, Trench is a leading player in the energy market.

WHY SHOULD YOU BE CONCERNED ABOUT BUSHINGS?

Transformer bushings are a critical component of a transformer and often the most forgotten one. The bushing allows the electrical power to flow from the source through the transformer and connect to the distribution network and finally to the end user.

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

Several investigations of transformer failures have been done in the past, e.g. by CIGRE Transformer Reliability Survey reference WG A2.37 dated April 2012. According to these investigations bushing failures caused 17% of transformer failures.

HOW DOES A BUSHING AGE ?

The Oil Impregnated Paper (OIP) active part of the bushing, 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 high voltage OIP 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 paper and oil will develop. The service temperature is dependent upon ambient temperature, transformer oil temperature and service current.



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



EXAMPLE OF ISSUES EFFECTING THE LIFE OF A BUSHING

- Temperature hot spot : Localized heating at the top terminal due to insufficient tightening
- Low oil level : Oil level not according to the service manual resulting from mechanical damage or loss of sealing integrity of the gasket system
- 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

Level 2 :
Check test in HV lab

Level 3 :
Forensic investigations



LEVEL 1 : ON-SITE EVALUATION

- Capacitance and Power Factor measurement
- Oil sampling for Dissolved Gas Analysis (DGA)
- 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 ACCREDITED 550kV TEST FIELD INCLUDING

- capacitance , power factor
- partial discharge measurement (PD)
- power frequency withstand voltage test
- lightning impulse test

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 :
FORENSIC INVESTIGATIONS FOR A DETAILED EVALUATION**

- Check of the winding process of the active part
- Paper degree of polymerization (DP)
- Oil measurement (power factor at 90°C, dielectric breakdown voltage (DBV), water content)

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.

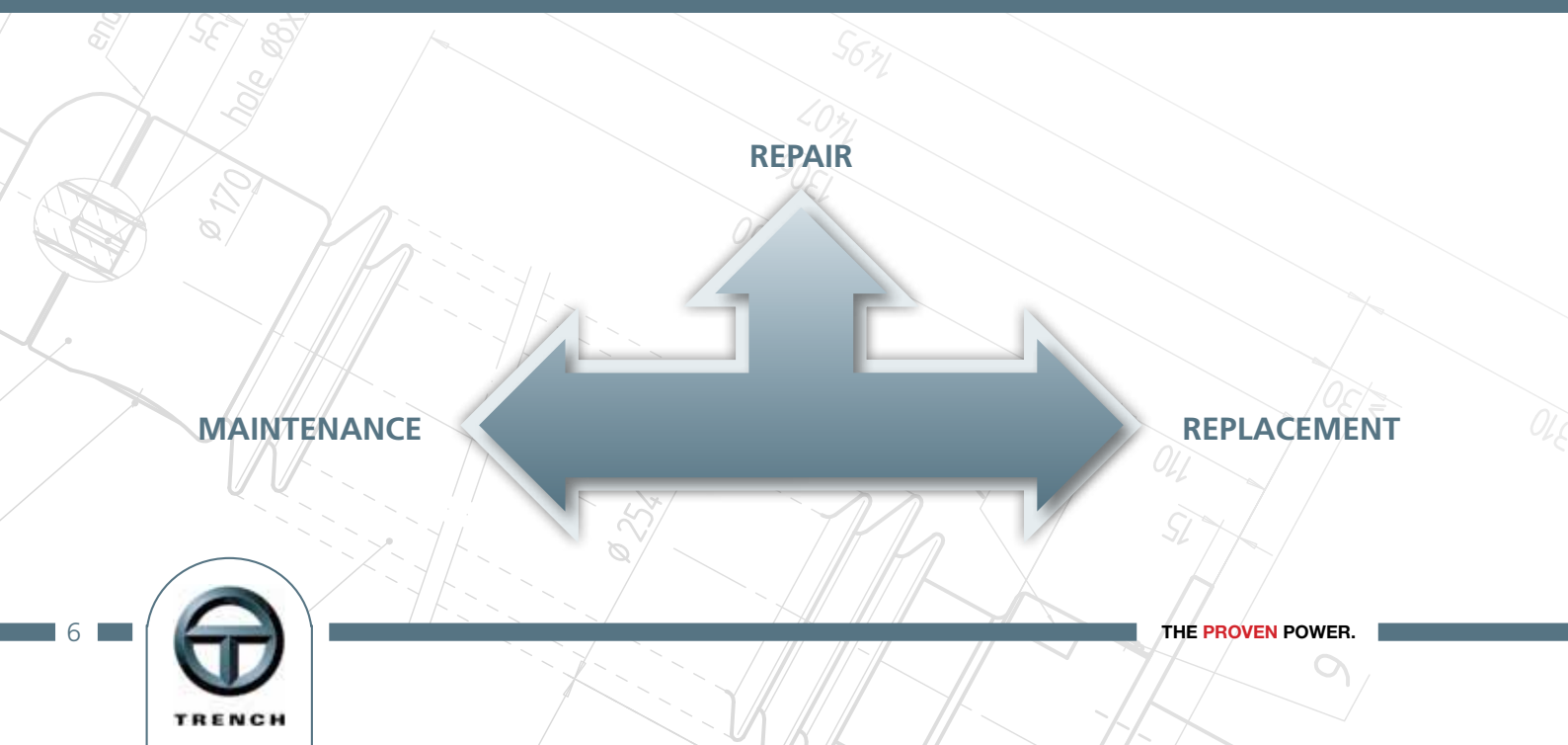
The condition of the bushing, network configuration and budget constraints will all contribute to the final plan.

Key aging factor	Parameters to be checked	Frequency
Thermal	Thermovision DGA DP Oil measurement	Yearly On request On request On request
Mechanical	Oil level Visual	Monthly Yearly
Dielectric	Capacitance and Power Factor DGA PD Repetition of routine tests	Every 3-5 years On request On request 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 oil level check, thermovision of the primary connection, capacitance and dissipation factor 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 all brands of bushings, especially by replacing the OIP 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/Canada 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 • Transformer 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, Haefely AG , Bushing Company, Trench UK, Trench Canada.

Based on the original design, Trench is able to propose fully interchangeable bushings which will fit exactly into the transformer : 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 • Transformer in service until bushings delivered 	<ul style="list-style-type: none"> • Longer lead time for non-Trench Bushings • Minor modifications to air side connections 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.

For more information check out our website at www.trench-group.com or send an e-mail to sales@trench-group.com

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