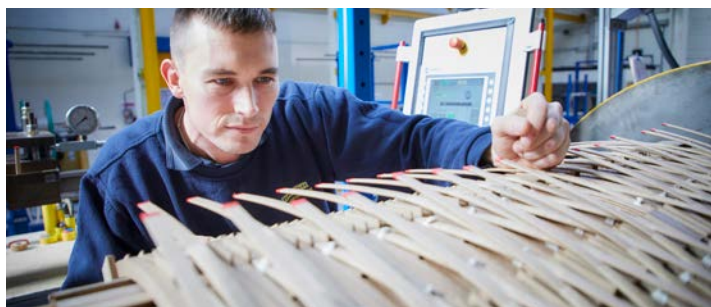
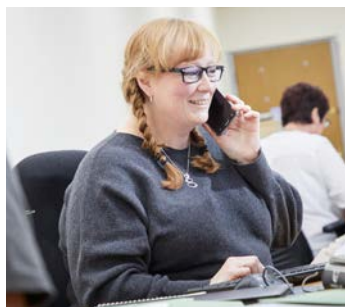




TRUST. WELL EARNED.

Transformer Services

Global support network that keeps you running



www.brush.eu

Replacement Transformers

BRUSH Transformers are exceptionally proud of our lineage as world renowned and ever-present suppliers of quality Transformers, with a site team to match this stellar reputation. With over 125 years of experience, you can be sure that your products are in safe hands.



The arduous and complex task of replacing a transformer is taken care of by our experienced service team, offering you hassle free peace of mind.

BRUSH Transformers supply a comprehensive range of transformers for a spectrum of applications, these include:

- System Transformers: for the UK, Overseas utility network operators and many private network operators.
- Generator Step Up Transformers: for use with; hydro-electric generation schemes, gas turbine generator stations and CHP plants.
- Grid Connection Transformers: for wind generation schemes.
- Power Transformers: for industrial applications, traction systems, petrochemical projects, offshore oil and gas production facilities and special applications up to 132kV.
- Series Current Limiting Reactors: for industrial applications.
- Motor Unit Transformers: for industrial applications and petrochemical plants.
- Rectifier Transformers: for traction systems.

Where required, BRUSH are also able to supply transformers with alternative cooling systems such as forced air cooled and water cooled using heat exchangers.

For 33kV systems, BRUSH manufacture transformers using alternative cooling fluids such as Midel and FR3, where transformers are either located inside buildings

giving rise to issues related to increased fire risk or where there are environmental concerns.

For traction systems BRUSH are able to provide 132/25kV traction supply transformers, 25-0-25kV auto transformers, 25kV 300 Amp trackside booster transformers.

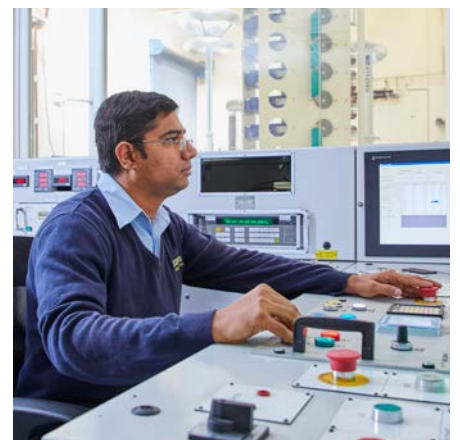
Why Choose a BRUSH Replacement?

With BRUSH Transformers you get quality, consistency and peace of mind. All of these things lead to an effective service all year round for our customers and yours.

With over 125 years of expertise in the power industry, BRUSH Transformers offer a wide range of products up to 132kV and 160MVA – catering for almost any circumstance and customer.

We offer a range of key features and options including, but not limited to, the following:

- BRUSH is the only UK manufacturer that manufactures its own range of tapchangers. AT and AE tapchangers are used on transformers worldwide and supported 24/7 via our dedicated Service 24 centre.
- BRUSH has dedicated transformer and tapchanger Service Engineers strategically located in key areas around the UK ensuring same day response to all customers. Our Service Engineers can also be rapidly deployed worldwide.
- BRUSH manufactures and installs more power transformers in the UK than any other transformer manufacturer. We deliver, install and commission in excess of 150 units per annum.
- BRUSH Service Engineers are trained to the highest standards and hold all of the required certification to work on site.
- Following a £5 million investment at our Loughborough manufacturing facility, BRUSH supply a state of the art facility in which your products are manufactured, ensuring the highest quality of our products.



BRUSH transformers are installed around the globe, creating an impressive reference list. This highlights our outstanding credentials and gives substance to what we say and what we supply.

Installation, Commissioning & Maintenance

BRUSH Transformers is globally renowned for the quality of its products, innovation and service. Our markets include the utility, oil, petrochemical, coal, steel and rail industries worldwide.

We focus on working with our clients to provide solutions tailored to meet their exact requirements.

BRUSH Transformers has a dedicated service division to provide maintenance and repair to all makes of transformers, including but not limited to: BRUSH Transformers (BTL), South Wales Transformers (SWT) and Hawker Siddeley Power Transformers (HSPT).

These services include:

- Maintenance programmes and service
- Spares
- Health checks
- Inspections
- Repairs on site or at our dedicated Loughborough facility

We ensure that BRUSH are able to reach every transformer, no matter where in the world it is situated. BRUSH offer a complete global facility.

BRUSH Transformers Services are totally committed to providing the best possible service to all of its customers.

Offering a complete after sales service, reinforced by quality assurance and a helpful, willing service team.

BRUSH Service engineers also cover worldwide, offering this same level of first rate service across the globe.

Installation and commissioning

We have the ability to offer a complete installation service with our experienced site technicians, supplying complete method statements and risk assessments in accordance with our ISO 9001 accreditation.

Alternatively, should you prefer, we can supply a supervisor to oversee and guide the installation, testing and commissioning of your equipment.

Whatever your preference, dedicated site quality plans are compiled for every site contract.

To compliment our stellar reputation for the supply and installation of transformers, we can provide highly qualified and competent commissioning engineers who are able to undertake all aspects of electrical testing and commissioning of transformers.

BRUSH Transformers has a worldwide reputation for the supply and installation of a varied range of electrical power transformers and tapchangers covering various applications and locations.

These include land-based industrial facilities, marine and the oil and gas sectors both onshore and offshore.

Transformer relocation

We are able to provide a transformer relocation service, not only for BRUSH Transformers but also for third party transformers.

This service includes all planning and methodology behind the disconnect and installation of the transformer (i.e. cranes, heavy haulage, oil tankers etc.)

Full risk assessments and method statements, liaising with the required local authorities (where necessary), and booking/hiring of any additional equipment or contractors.

Safety

All personnel are supplied with and trained in the correct use of PPE. All work is pre-planned and method statements and risk assessments issued. Each team has at least one member trained in first aid.

To compliment our stellar reputation for the supply and installation of transformers, we can provide highly qualified, competent engineers.



Transformer Repairs, Overhauls and Upgrades

BRUSH possesses comprehensive manufacturing facilities manned by professional personnel for repairing and overhauling equipment. These facilities are supported by technical and project functions to achieve complete customer satisfaction.

Typical transformer factory repair services offered include:

- Tank replacement
- Winding rewind
- Core replacement
- Tapchanger overhaul
- Transformer uprating
- High voltage testing facilities

Factory repairs

When it is not possible to repair equipment in the field due to constraints such as space, environment or lack of suitable resources then BRUSH offer a factory-based solution.

Control systems

Typical power management and cooler control systems services offered include:

- Automatic Voltage Regulator fault finding and calibration
- Cooler Control System fault finding and calibration
- Transformer protection relay testing

BRUSH have factory-based service support facilities which include:

- Workshops with cleaning facilities and vacuum drying ovens
- Modern machining and fabrication facilities
- Assembly workshops including large capacity craneage
- High voltage test facility
- Coil manufacturing and core manufacturing facilities



BRUSH Tapchangers

BRUSH Transformers are proud to be one of the very few transformer manufacturers that are able to supply its own range of tapchangers.

BRUSH Transformers are able to offer a complete range of tapchangers that are easy to maintain, fully automatic or manual operation and feature the much-

coveted bi-directional power flow which can come as standard on any new unit and more importantly, be retrofitted onto almost any third-party transformer, including:

BRUSH
Crompton Parkinson
AEI Models
Ferranti
Fuller
Associated Tapchangers (ATL)

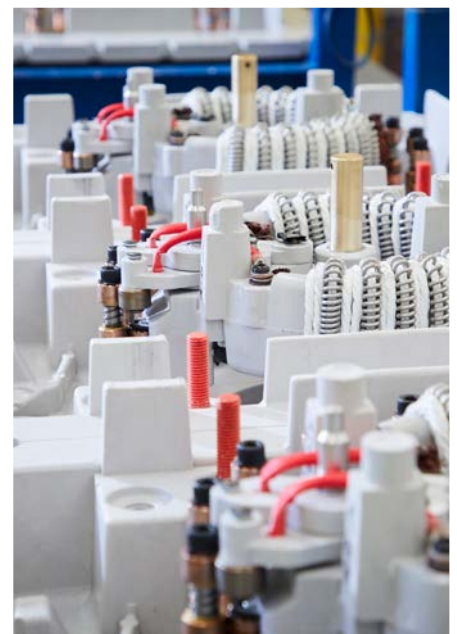
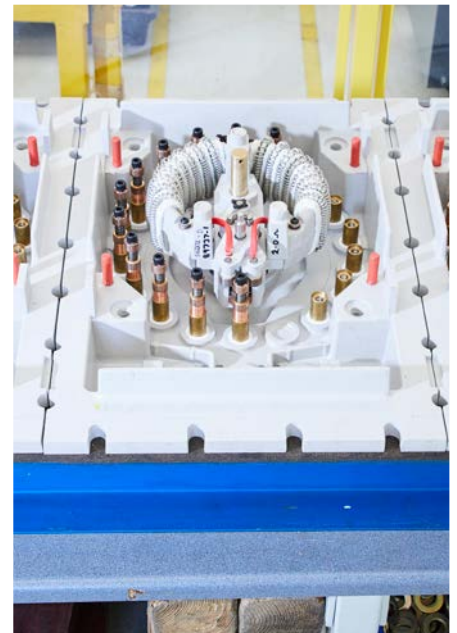
The retrofit option can greatly save money due to reduced yearly maintenance on older, existing tapchangers.

Our experienced site teams are able to completely retrofit these tapchangers with very minimal disruption to the network.

We guarantee peace of mind for our customers, knowing that you will be receiving a quality product that outshines all others.

This service will include the following steps, all carried out by our helpful Service team:

- Planning & methodology i.e. cranes, heavy haulage
- Pre-installation site visit
- Risk assessment & method statements
- Disconnecting of the old unit & removal
- Fitting & connection of a new BRUSH MKIII AT or AE Tapchanger
- Re-filling with oil & commissioning
- Fitting of a bespoke adaptor throat fabrication (joggle box)



AT Tapchanger

The AT range of single compartment units with high-speed resistor transition is designed for three-phase systems with voltages of 44kV and 66kV line end or 132kV neutral end and nominal rated current of 300A.

A maximum of 17 tapping positions (16 steps) is possible for linear regulation and 33 tapping positions (32 steps) for reversing of coarse/fine regulation.

The AT tapchanger is designed such that power flow can be handled in either direction at full-rated current.

The AT is a flange-mounted tapchanger where the oil in the switch compartment is kept separate at all times from the oil in the main transformer.

- Linear, reversing or coarse/fine versions
- Suitable for 52kV, star or delta windings
- Suitable for 145kV star winding (Neutral Only)
- Vertically-mounted option also available
- Manufactured in accordance with IEC 60214 & many other international standards
- Compact
- 400A version (Linear Only)
- Single phase version available
- High speed Resistor on-load selector switch





Why Retrofit?

Unfortunately, all things get older and with this, problems arise and issues are formed.

However, there is an effective, low-cost solution that prolongs the life of transformers: **Retrofits**.

Retrofits have the ability to greatly improve your transformers performance and longevity, giving a worry-free solution for many years to come. In this case, replacement of tapchangers.

Either original BRUSH products or third-party products can be replaced with the BRUSH AT or AE Tapchanger.

There are many reasons for retrofitting;

- Control scheme upgrade
- OLTC in poor overall condition
- Parts can be difficult to source
- OLTC design obsolete

To counteract these reasons, we strongly suggest a retrofit. Retrofitting has a great many benefits including:

- Latest tapchanger technology
- Lower cost than a full replacement
- Greatly reduced lead times compared to new transformers
- Minimal disruption to the network
- Cost effective parts
- Full reverse power flow capability
- Increased network reliability – reduced outages
- Low oil quantities
- Remote control panels can be supplied to suit

Transformer Services

BRUSH Transformers can offer annual maintenance contracts so that your transformers are always being looked after and informing you of any issues before it's too late.

Maintenance contracts

BRUSH Transformers can provide short and long term maintenance contracts, tailored to our customers specific needs. These support operators by:

- Enabling a continuous mode of operation. The use of long term maintenance and health care contracts may be developed to suit the customer's needs
- Enabling designation of inspection points, spare parts and recommendations for continued equipment performance
- Assist in reducing operating costs associated with unplanned outages as a result of equipment failures

Field repair

To complement the inspection capabilities, we can offer a wide range of repair services.

These are performed in the field where we have considerable experience working in vastly differing environments, including both onshore and offshore installations, worldwide.

Our dedicated team of engineers can carry out repairs and upgrades on site, saving you downtime costs, transport costs and increasing the operational lifetime of your transformer.

Typical transformers field repair services offered include:

- Transformer refurbishment
- Radiator repair or replacement
- Cooler equipment replacement
- Cable box replacement
- Oil processing & analysis
- Oil replacement
- Tapping switch modification/ replacement
- Gasket seal replacement
- Transformer relocation
- Transformer up-rating



BRUSH Spares Services

BRUSH Transformers can offer spares and kits of parts in very short time frames so that your transformer is kept up and running.

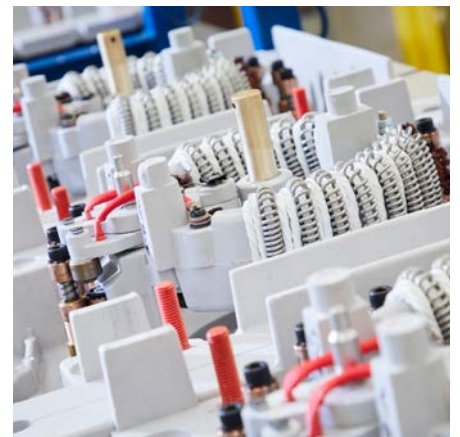
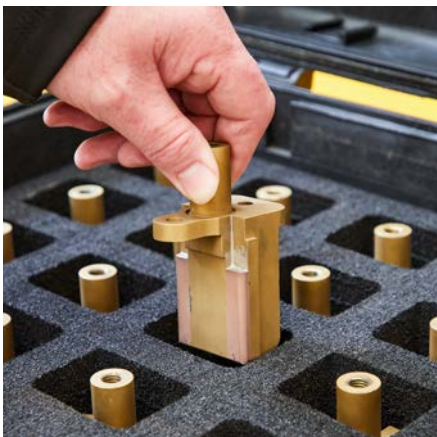
Using the latest technology available, our data capture system enables us to identify component parts and provide necessary spares for either pre-commissioning or operational requirements.

BRUSH Transformers Services can provide bespoke kits which can be bulk ordered and stored at our facility.

This makes them readily available, providing exceptionally short lead times and less stressful ordering of products as well as reduced cost.

Spare parts that are available, but not limited to, are as follows:

- Bushings
- Radiators
- Gaskets
- Tapchanger contacts
- Buchholz relays
- Pumps
- Drier elements
- Temperature sensors
- Fan motors
- Oil alarm and indicators
- Valves
- Terminal lugs



Condition Monitoring

SFRA – Sweep Frequency Response Analysis

A reliable method of monitoring the physical condition of transformers. The windings and core of a transformer may be subjected to mechanical stress during transport, heavy short circuit faults and lightning impulses.

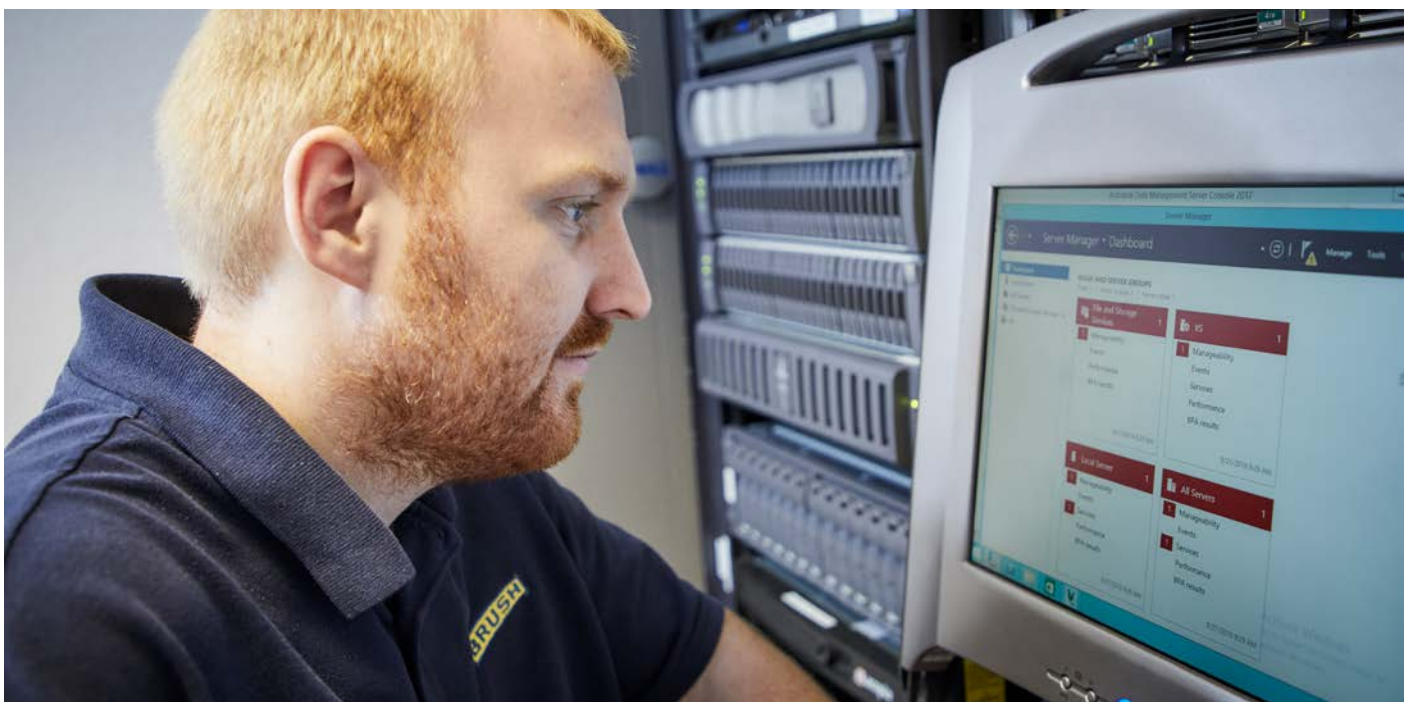
SFRA can efficiently detect displacement of transformer cores, deformation of windings, faulty core grounds, broken or loose connections etc.

DFRA – Dielectric Frequency Response Analysis

This type of testing is an excellent tool for diagnosing transformer insulation issues.

DFRA testing is used mainly for assessing moisture in power transformers.

The dryness and condition of paper insulation is a key factor in both short and long-term power transformer reliability. DFRA testing is the most accurate method available today for estimating moisture in insulation systems.





Capacitance and Dissipation Factor δ

Measuring capacitance and dissipation factor helps you to determine insulation condition between windings or within bushings. Changes in capacitance can indicate mechanical displacements of windings or partial breakdown in bushings.

Aging and degradation of the insulation, coupled with the ingress of moisture, increase the amount of energy that is converted to heat in the insulation.

The rate of these losses is measured as dissipation factor.

Winding Resistance

Measuring a transformer's DC winding resistance from one external terminal to another assures that the windings are intact and that the internal connections are correct.

The resistance measurements also indicate that there are no severe mismatches or open circuits throughout the tapping range.

Dissolved Gas Analysis

When insulating oil is subjected to high thermal and electrical stress, gasses are generated from the decomposition of the oil.

Different types of faults generate different gasses; the analysis of these gasses will provide useful information about the condition of the transformer.

Polarisation Index

Polarisation Index is used to indicate the condition of transformer insulation. It is a ratio of the insulation resistance measured for 10 minutes to the insulation resistance value measured after 1 minute.

Product Care

As with all electrical machinery, transformers require essential maintenance to keep them effective.

However, this can often be an extremely time-consuming experience and uncover potentially costly problems.

BRUSH Transformers have devised an effective, cost efficient 'Lifecycle Management' package to help counteract these issues.

There are a multitude of reasons to introduce this 'Lifecycle Management' package into your regular maintenance.

The information gathered is held on file at BRUSH and from this, the condition of a transformer can be tracked.

- Suspected Transformer Fault
- Condition Assessment for Network Planning
- Confirmation of Condition – Pre/ Post Transformer Relocation
- Confirmation of Condition on Delivery
- Transformer Failure Investigation
- Condition Assessment for Refurbishment
- Tracking of Transformer Condition – Plotting of Degradation

'Lifecycle Management' is a package of electrical tests designed to indicate the condition and predicted life expectancy of transformers on customers networks.

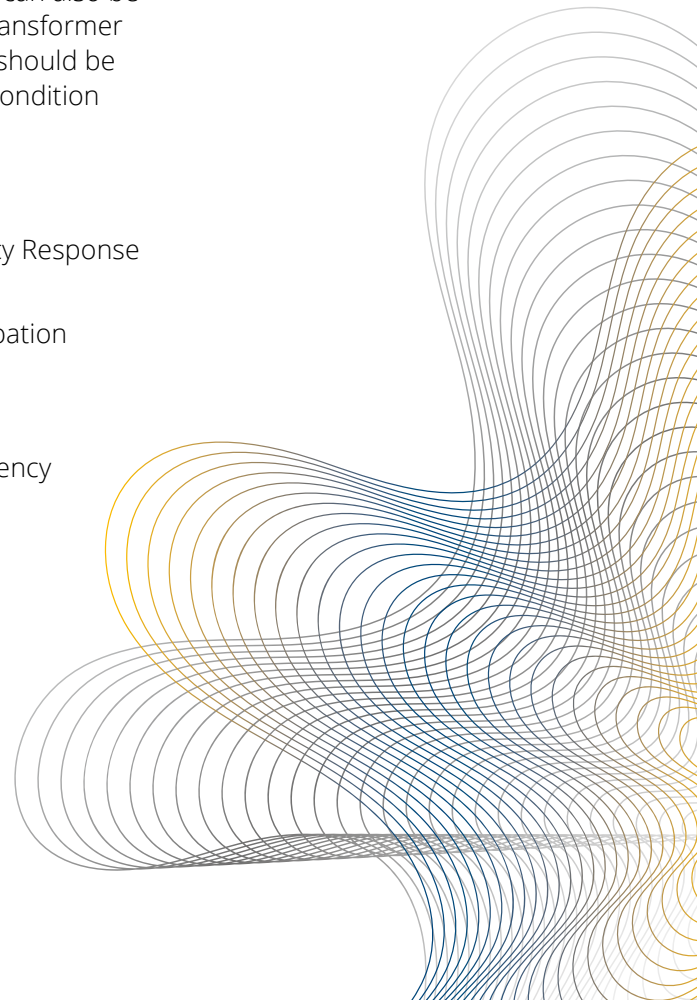
This process starts at the beginning of the transformers life and testing should be carried out at regular intervals.

The same series of tests can also be used to determine if a transformer has been damaged and should be removed from service (Condition Assessment).

These tests are:

- SFRA (Sweep Frequency Response Analysis)
- Capacitance and Dissipation Factor
- Polarisation Index
- DFRA (Dielectric Frequency Response Analysis)
- Winding Resistance
- Dissolved Gas Analysis

Using leading edge test equipment and site engineers with a wealth of knowledge and experience, we can use these tests to safely and efficiently extend the life of our customers products and offer suggestive or essential upgrades and modifications that can be carried out at site or at our state of the art production facility in Loughborough.





Inspections

As part of this comprehensive 'Lifecycle Management' programme, BRUSH Transformers offers a structured inspection scheme which can be tailored to meet the operational needs of the installed equipment and facility.

These inspections are available for all BRUSH Transformer products in addition to third party equipment.

By following this inspection programme, the equipment outage time is reduced to a known minimum period.

It also provides a continuous appraisal of the equipment's current condition. As a result of each inspection, potential problems arising can be addressed prior to them causing serious failure.

'Lifecycle Management'

Adopting a 'Lifecycle Management' package guarantees the best possible performance and longevity for all of your products.

This service can be utilised from the initial commissioning of your new transformer or simply when you feel necessary changes may need to be made to your existing equipment.

Maintenance

The notion that prevention is better than cure lies at the heart of any maintenance programme.

BRUSH Transformers Services are fully equipped to provide all existing operators with a customised support package.

This may be adapted to suit the individual operator's needs.

- Results kept on file for future comparison.
- Advanced warning of transformer condition deterioration.
- Highlight high priority asset.
- Reduced risk of unexpected outages.
- Proof of condition upon delivery.
- Possible reduced repair costs if fault found before failure.



TRUST. WELL EARNED.

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