



GENERATOR SWAPOUTS CREATING POWER SOLVING PROBLEMS



BRUSH IN THE UNITED STATES

CONTENTS

- 03 Swapouts
- 04 Why Swapout?
- 05 Benefits
- 09 Case Studies
- 10 Our Hub in the USA
- 12 Contact Details

Established in 1879, BRUSH has always been intrinsically linked with the USA. Charles Francis Brush formed the Brush Electric Company in Cleveland Ohio at the same time forming the Anglo-American Electric Light Company in London, England. Since those early days BRUSH has grown to become the largest independent manufacturer of turbo generators in the world with the greatest concentration of our machines installed in the United States.

We offer worldwide support for all BRUSH products and equipment which includes three manufacturing sites in Europe, a major repair facility in Pittsburgh, PA and sales support offices in Houston, TX, Abu Dhabi and Malaysia.

Our Aftermarket sales support provides fast responsive support anywhere in the world. The comprehensive services we offer concentrate on maximizing the performance of your generator regardless of it being a original BRUSH machine or that of any other OEM.

WHY ENDURE TO ENDLESS REPAIRS? THE PEACE OF MIND YOU'RE SEARCHING FOR IS DELIVERED WITH A BRUSH GENERATOR SWAP OUT.

BRUSH has validated its internal ventilation design with model and machine testing programs and service history in generation operations across the globe.

Some other manufacturer's generators use a ventilation system that is single ended so air gets hotter as it passes through the coils to exit at the opposite end. Depending on the operating regime of the generator and air inlet temperature the cooling effect can be compromised.

Where generators are running continuously, on a lower power factor, or with high ambient temperatures the expected operating temperatures can be exceeded.

Higher operating temperature accelerates degradation of insulation properties leading to life threatening stresses and high partial discharge in the slots.

BRUSH uses water coolant directly through the coils on larger capacity generators – 350 MVA upwards. Where there is an internal water coolant passage they also use hydrogen in the free space inside the pressure casing.

In machines up to 200MVA BRUSH closely mould and consolidate the copper and insulation into a rigid and dense structure which has good heat transfer properties.

The coils are pushed into the stator iron core and are close fitting. Air is forced through the core around the coils and end windings to ensure heat is conducted away into the exhaust ducts. In generators larger than 60 MVA the air compartments are split to provide contra flow air across the core and coils to ensure balanced temperatures along the length of the stator.



A RETROFIT PROJECT CAN TAKE AS LITTLE AS 28 DAYS. AN UNPRECEDENTED AMOUNT OF TIME IN THIS FIELD.

24 HOUR GLOBAL SUPPORT FOR ALL GENERATORS

WHY A BRUSH SWAPOUT?

Some customers have made substantial winding repairs more than once, in some cases spending millions of dollars. BRUSH can offer an alternative solution to endless repairs with a customized solution for your replacement generator.

BRUSH has broad experience supplying generators for all types, ratings and configurations of turbine. We do not supply one generator to fit one turbine – we have multiple generator selections with many alternate fittings already developed; we mix & match detail to suit the customers turbine.

- Single or double ended drive
- Brushless & static excitation
- Air or water cooled
- Indoors or outdoors
- Modern excitation controller systems to match generators
- Custom fabricated line & neutral cubicles when needed
- Pull out to start up time for site work is an expected 30 days
- BRUSH will take the lead on site and provide a complete replacement service.
- BRUSH can provide turnkey works to fit and commission (including disposal of old machine)
- BRUSH has shown it can be done.



OUR EXISTING DESIGNS, INDEPENDENT FROM THE TURBINE PACKAGERS, HAVE SERVED THE INDUSTRY FOR OVER HALF A CENTURY

BENEFITS OF NEW MACHINE

- New OE generator is plant tested with full set of OE test and quality records
- New OE generator comes with new machine warranty with extended options
- Modern excitation system that can connect to plant monitoring systems/DCS
- Stator slot couplers for on-site PD monitoring
- Current parts & service support available
- BRUSH is one of the few independent OE manufacturers who can custom manufacture
- Modular construction giving a fine balance between flexibility and standardization of components for fast economic construction
- Fully developed system readily adapted to any turbine design
- More efficient operation and lifecycle costs.

BRUSH DAX GENERATORS HAVE BEEN SUPPLIED FOR THE FOLLOWING TURBINE/COMPANIES

Allen Power	General Electric Frame 9	Mitsubishi Heavy Industries	Shin Nippon Machinery Co
Alstom	General Electric LM 2500	Mitsubishi MF1 11	Siemens GT35
Dresser Rand	General Electric LM 2500+	Pratt & Whitney FT4	Siemens Westinghouse W251
Elliot Company	General Electric LM 5000	Pratt & Whitney FT8	Siemens Westinghouse W501
Franco Tosi	General Electric LM 6000	Rolls Royce Avon	Siemens Westinghouse W701
General Electric Frame 5	General Electric LMS 100	Rolls Royce Olympus	Skoda Power
General Electric Frame 6	Hitachi	Rolls Royce Spey	Toshiba
General Electric Frame 7	Man Turbo	Rolls Royce Trent	

HOW DO WE DO IT? WITH MILITARY STYLE PRECISION AND PLANNING



WHEREVER THE LOCATION, WHATEVER THE SIZE OF PROJECT, BRUSH ENSURE THAT FROM THE POINT OF ENQUIRY TO THE MOMENT YOUR NEW GENERATOR IS INSTALLED WE WILL HANDLE YOUR PROJECT WITH MILITARY STYLE PLANNING AND PRECISION.

USA - SWAP OUT 2 POLE GENERATOR WE SWAPPED OUT A WESTAC GENERATOR FOR A BRUSH DAX WITHIN TWENTY EIGHT DAYS.

Quixx Corporation and Borger Energy Associates were experiencing continual problems with their W501 gas turbine power generating equipment at their Blackhawk Power Station in Borger, Texas, USA, and decided to replace the generator under a planned outage. BRUSH offered a solution that would fit within the existing power package envelope and committed to a timescale of 30 days to deliver, install and commission the new generator.

However, in the interim the existing generator failed severely curtailing the power station's ability to meet its customer needs in terms of steam, water and electricity. Quixx Corporation asked BRUSH for any improvement on the delivery for the generating equipment, together with a support programme that would ensure the machine was installed and commissioned safely.

BRUSH responded directly to the challenge and, by working closely with the Quixx and the Blackhawk Power Station management teams, was able to deliver not just what the customer ordered, but more.

The generator delivery time was shortened and, with a team of mechanical and electrical supervisors from the UK and Houston, installation and commissioning was completed in just 28 days but, more importantly, it was right first time.

The power plant was back in service with a new generator within the gas turbine package envelope, synchronized and producing over 100MVA of power - completely operational four months earlier than originally planned.

R Ross McCausland of Quixx Corporation, in appreciation of the work carried out by BRUSH, provided the following comments:

"Quixx/Borger Energy Associates has been very impressed with the machine construction and comprehensive plant testing, along with the expedited installation, start up and commissioning support services which BRUSH provided.

The generator is crucial in meeting the demands of our contracted customers for electric power and steam. Vital signs of the now running gas turbine generator unit are excellent and we expect many years of durable service supported by your expertise and customer service.

Our company would have no hesitation in recommending BRUSH..."

GERMANY - SWAP OUT 4 POLE GENERATOR

KWG Staßfurt mbH were experiencing continual problems with their 42.125MVA steam turbine generator at their Staßfurt facility in Germany.

The existing 4-pole generator with a cylindrical rotor had been experiencing unexpected outages for some time which was causing significant loss to production.

BRUSH offered a solution that would fit within the existing power package envelope and undertook the project to replace the existing unit with our own design DG215ZL-04 generator. This entailed removal of existing generator, site work preparations and modifications to suit the new generator, design and manufacture of the replacement generator, design and manufacture

of the replacement AVR panel and finally the installation and commissioning of replacement generator and auxiliaries. The outage requirements were very tight but with a team of skilled BRUSH mechanical and electrical engineers and supervisors installation and commissioning was completed in just 28 days.



PITTSBURGH, PA OUR HUB IN THE USA



BASED IN PITTSBURGH : SERVICING THE WORLD

From our Pittsburgh base BRUSH has provided engineering driven solutions for generation equipment in electric utility and industrial plants for over 20 years. With a full range of inspection, testing, repair and patented retrofits, BRUSH ensures our customers receive a timely and quality service incorporating custom engineering for life extension and maintenance of a wide range of generators and excitation systems.

BRUSH is dedicated to upholding our high standards of excellence and we offer value solutions for all 3rd party generators providing technical solutions in line with the OEM, utilizing our own OEM expertise and support network for BRUSH generators and control systems.

Our highly skilled and uniquely qualified service engineers are dedicated to providing timely service to meet both scheduled and emergency outage needs. Our support teams can answer any queries you may have about our capabilities to deliver quotations and possible technical advice.

Our comprehensive capabilities focus on maximizing the performance of your generator, with the ultimate aim of extending its life, and include:

Rotor Repairs

BRUSH offer complete rotor servicing including: inspection, testing, rewind, machining, life extension and engineering. BRUSH has experience rewinding the fields of all the major OEMs. BRUSH has capability in its 50,000 sq ft manufacturing plant

to handle rotors up to 100 tons. With two heavy duty lathes and a complete compliment of milling machines, BRUSH can perform any necessary machine operation.

Stator Repairs

BRUSH can offer complete stator services from a visual inspection and testing by experienced personnel to a complete rewind. BRUSH provides all the standard electrical and mechanical testing and inspections plus EL-CID, loop test and end winding stiffness ("Bump") testing and analysis.

With manufacturing plants worldwide, we have the capability to reach you anywhere in the world.

BRUSH FACILITIES

- 50,000 sq ft of high bay space
- Capable of 100 Ton lift
- Clean environment
- 24/7 security
- Truck and rail access

BRUSH SHOP TOOLING

- Two 50" x 72" horizontal boring mills
- Two lathes
- 60" swing and 600" centers
- 90" swing and 480" centers (Transportable)
- Two vertical boring mills
- Rotor winding clean room
- 1800 sq ft clean room
- Air conditioning & humidity controls

For more information about
BRUSH Aftermarket, please
call us direct, email or visit
our website.

BRUSH Aftermarket

601 Braddock Ave.
Turtle Creek, PA.
15145, USA

T +1 412 829 7500
F +1 412 829 1692
E serviceus@brush.eu

BRUSH Aftermarket

Nottingham Road,
Loughborough, Leicestershire,
LE11 1EX, United Kingdom

T + 44 (0) 1509 611511
F + 44 (0) 1509 612436
E serviceuk@brush.eu

BRUSH Aftermarket

P.O. Box 111209, Abu Dhabi,
United Arab Emirates

T + 971 4362 6391
F + 971 2550 1920
E serviceme@brush.eu

BRUSH Aftermarket

P.O. Box 3007, 2980 DA,
Ridderkerk, The Netherlands

T + 31 (0) 180 445500
F + 31 (0) 180 445445
E servicenl@brush.eu

BRUSH Aftermarket

Lot 7 Jalan Majustret U1/26,
Hicom Glenmarie Ind. Park,
40150 Shah Alam,
Selangor DE, Malaysia

T + 60 3 7805 3736
F + 60 3 7803 9625
E servicemy@brush.eu

BRUSH Aftermarket

Tr. Edvarda Beneše 39/564,
301 00 Plzeň,
Czech Republic

T + 420 37 8210717
F + 420 37 8210337
E servicecz@brush.eu