



# TRANSFORMER TECHNOLOGY<sup>MAG</sup>



POWER SYSTEMS  
TECHNOLOGY

TMAA SPECIAL SECTION



**NORTHERN**  
TRANSFORMER

**NORTHERN  
TRANSFORMER'S EVOLUTION:**  
THE DIGITAL SOLUTION FOR  
POWER TRANSFORMERS

## BUSHINGS & COMPONENTS

### LTC'S, GAGES, CONTROLLERS

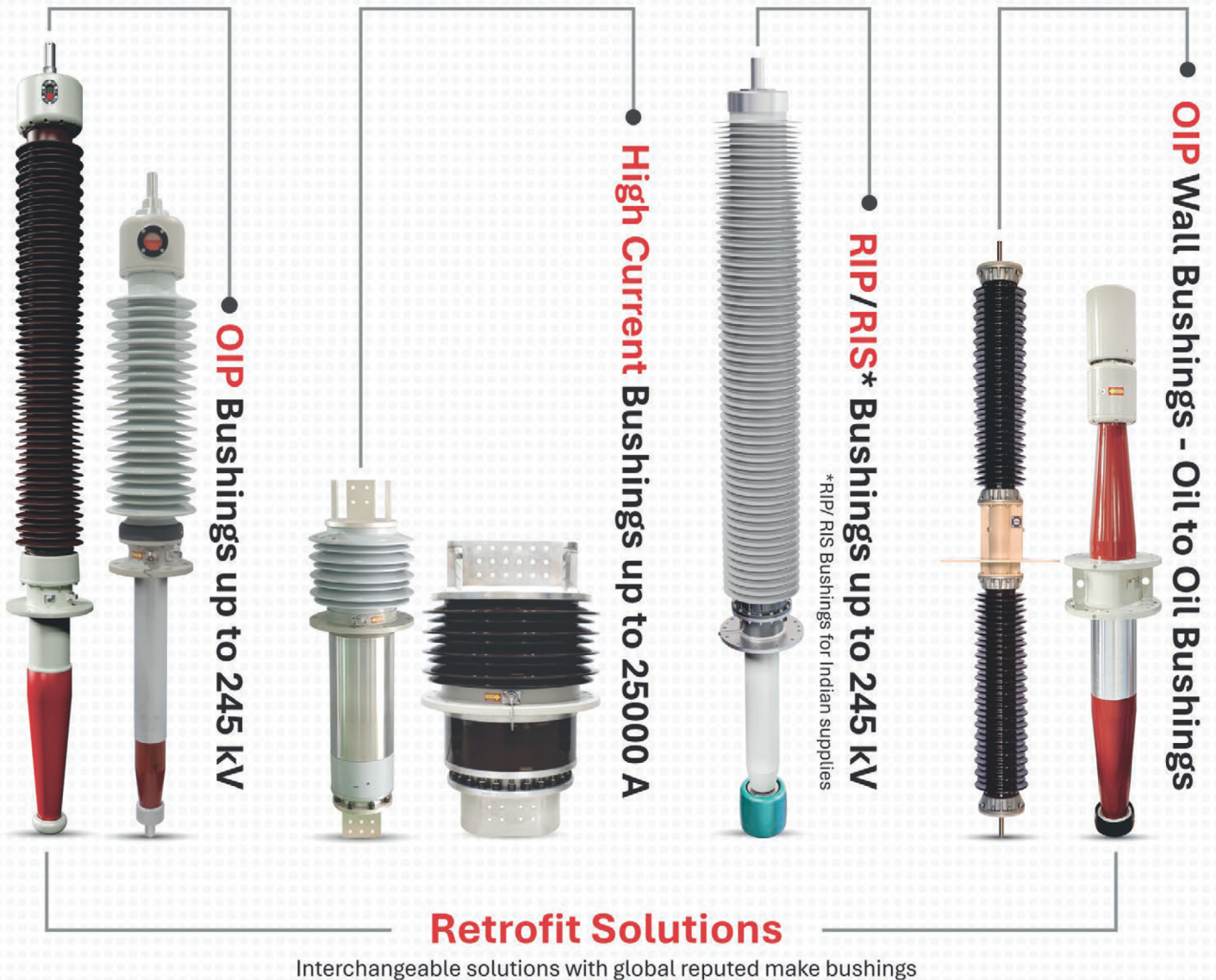
**Ben Lanz:** Inside  
CIGRE Paris 2024

**Chris Rutledge and Tyler Willis**  
on DGA Technology for Tap Changers

**POWER PANEL DISCUSSION**  
Bushings and Components



## Our comprehensive range of Transformer Bushings



## Why YASH®

- Supplying as per **IEC, IEEE**, and other **global** standards
- Fully **type tested** products at accredited laboratories with **ILAC**
- **60+** global installation bases in countries like, America, Europe, Australia, Middle East, etc.
- **State-of-the-art** manufacturing and testing facility consisting of equipment sourced from reputed manufacturers around the globe

SCAN TO KNOW MORE





# EVOLUTION OF GLOBAL POWER GRIDS AND CHANGING NEEDS FOR TRANSFORMER BUSHINGS





## Introduction

With the evolving **dynamics** of global **power grids** and the rising demand of electricity driven by factors such as **population growth**, **rapid developments of infrastructure such as railways/data-centers/EV charging stations**, **upgradation of ageing power grids** and the integration of **renewable energy generation** to support **sustainability & carbon neutrality**, the **need for transformers and transformer bushings** has also transformed significantly. These changes require innovations in design, performance, and reliability to meet the growing and more complex demands of modern power systems.

In this article, we briefly describe the factors behind the advancing global power demand, and how Yash Highvoltage Ltd. adapts to catering the progressive needs of the industry. Yash Highvoltage Ltd. is a manufacturer of niche, condenser graded transformer bushings with supplies to over 60 countries. With a further rapidly expanding supply base globally, YASH envisions to playing a vital role in enhancing the world's power generation and transmission landscape.

## Factors driving the power demand and evolution of Global Power Grids

### *Renewable energy and sustainability*

As the **global population** continues to **rise**, the **demand for power and energy** has **surged** at an unprecedented rate. This growing need is fuelled by the **increasing reliance on electricity** for daily life, infrastructure, and emerging technologies.

In **1990**, the per capita primary energy consumption was recorded at **17,972.46 kWh/person** globally, which has **increased** and reached **21,393.7kWh/person** globally in **2023**. This clearly indicates that energy needs have expanded beyond traditional usage such as heating, cooling, and lighting over the past two decades.

Charging electric vehicles, which are becoming more prevalent in efforts to reduce carbon emissions, places additional strain on power grids. Similarly, railway systems that are shifting from fossil fuels to electric traction, require substantial energy to operate efficiently. Moreover, as the global economic landscapes are shifting towards **net-zero emissions & carbon neutrality**, demand for generating electricity from **renewable energy** sources like solar, wind, hydro and nuclear are gaining precedence and preference. Most renewable energy generation is cyclic and variable, owing to its dependence on natural sources such as wind, sunlight or waves in the ocean for example. Devices such as Static VAR compensators (SVCs), popularly known as STATCOMS are seeing increasing significance and usage across global Powergrids for reactive power compensation, keeping the grid stable against varying loads and improving the power quality. STATCOMs utilize Coupling Power Transformers on MV Side (for connection to Grid) typically requiring 36kV ~ 72kV Transformer Bushings with Current Rating between 5000A & 10,000A.



| 52kV 6600A 300 BCT High current bushing for POWERGRID STATCOM projects

Along with these factors, innovations in the power sector have further boosted efforts to generate clean energy, a notable one being the production and usage of **green hydrogen**.

Green hydrogen is collected through **electrolysis**, a process that uses electricity generated from renewable sources—to split water ( $H_2O$ ) into hydrogen ( $H_2$ ) and oxygen ( $O_2$ ). A significant amount of power is required for carrying out electrolysis at large scale, requiring specialized Power transformers at the input source, calling for High current bushings typically ranging between 5000 to 7000A currents at the MV side of those transformers.

At YASH, we have successfully developed and have supplied several MV Bushings for High Current Applications with end use in STATCOM coupling transformers as well as Transformers for use in Green Hydrogen production.



### India - towards a sustainable future

With a focus on carbon neutrality, developing countries such as India have committed to reducing carbon emissions by 50% by 2030 and achieving net zero by 2070. These government initiatives are driving the demand for renewable energy.

A prime example of this is the Bhadla Solar Power Plant in the Northwestern part of the country, spread over an area of 56 square kilometres and a total installed capacity of 2,245 megawatts (MW), making it the largest solar power plant in the world as of April 2024.

In addition to carbon neutrality, the expansion of Dedicated Freight Corridors (DFCs), highways, and high-speed rail (bullet train) and inter-city metro rail projects is increasing energy demand drastically.

For instance, **India's Dedicated Freight Corridors (DFCs)** are electrified rail projects designed to enhance the efficiency of freight transportation. These corridors significantly increase **energy consumption** due to the shift from diesel to electric trains. **Traction transformers**, installed at substations, convert grid power to the voltage needed to run the trains.

**Yash's range of OIP Transformer bushings rated 52kV up to 245kV** have been used in across several railway and traction projects within India as well as internationally, for instance for the Italian Railways (RFI).

### Natural disaster and extreme environment

Natural calamities such as hurricanes, earthquakes and floods require robust power infrastructure which can sustain extreme conditions. Utilities in seismic zones are increasingly opting for **transformer bushings with Silicone/Composite/Polymer insulators** over traditional porcelain insulators to minimize damage during earthquakes and enhance overall safety and reliability.

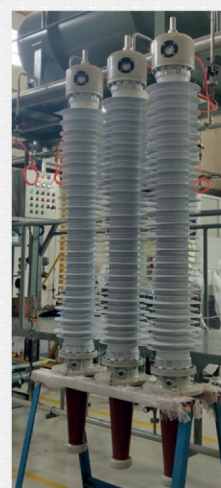
OIP bushings with Polymer insulators



36kV 3150A OCT



72.5kV 800A 300CT



170kV 800A 300BCT

YASH with its state-of-the-art infrastructure and R&D centre has developed, type tested, and eventually manufactured and supplied hundreds of OIP bushings with Silicone/Composite/Polymer insulator to various customers globally. One of the noteworthy products under execution include 245kV OIP bushing with polymer insulator for a renown transformer customer in Turkey, for end use in the Turkish grid.

Having successfully engineered and supplied **OIP (Oil Impregnated Paper) bushings** for power grids located in regions with extremely low temperatures, capable of withstanding conditions as harsh as **-50°C** and **-40°C**, YASH has established a niche as an innovative solution provider. For such bushings, **special insulating oil with low pour point** and **O-Rings / Gaskets** suitable for **minus temperatures** are used.





| Exported special 145kV 1250A 600BCT OIP bushing suitable for -45°C Temperature

#### *Transformer Bushings for Global Markets*

The world of transformer bushings is complex, with several countries having their own standard requirements. These variations encompass dimensions, technical specifications, voltage ratings, and construction types. Rather than view these differences as challenges, YASH has embraced them as opportunities for innovation.

While the company produces a robust standard range of transformer bushings to meet IEC 60137, its true strength lies in engineering customized solutions tailored to the specific needs of diverse international markets. This commitment to quality and innovation ensures compliance with global standards while addressing the unique demands of power utilities in various regions.

#### *Tailored Solutions for European Utilities*

For instance, to meet the stringent requirements of European power utilities, Yash Highvoltage developed a complete range of **Shorter Oil End Length Bushings**. These bushings meet the requirements as per the CENELEC/EN standards, ensuring they are specifically suited to the unique challenges of the European grid. Featuring a specially designed Oil End Insulator with an embedded electrode, these bushings are engineered to perform reliably under higher radial and axial stresses, with exact dimensional interchangeability to existing reputed European makes of bushings. This enables transformer designers to seamlessly utilize the YASH short oil end bushing solution without any change in transformer design or engineering. This bushing range is available upto 170kV as of today and will be expanded upto 245kV within a year.



| 72kV 800A Shorter Oil End Length Bushings Tailored for European Utilities

#### *Meeting U.S. Standards*

In addition to its offerings in Europe, Yash Highvoltage has worked towards building a reputation for its specialized transformer bushings, which are designed and type-tested **to meet IEEE C57.19.00/01 and C57.19.04 standards in the United States**. These standards encompass both high-voltage condenser bushings for power transmission and high-current bushings used in power generation. Our custom-built solutions are thoughtfully engineered to meet the specific conditions and ratings required by U.S. power systems, allowing for seamless integration and interchangeability with well-known global bushing manufacturers, while also ensuring reliable performance.

The Yash range of OIP condenser IEEE bushings spans from **15kV to 230kV** in rated voltage. We have had the opportunity to work with several transformer manufacturers in the U.S. and those exporting to the U.S. – to utilize our IEEE range of OIP condenser bushings. One notable example is our 34.5kV 8000A 534BCT high-current bushings, supplied to reputed transformer OEM Siemens India, for a project with LADWP in the U.S., and the bushings have been working satisfactorily for over 3 years.

#### *A Landmark Achievement*

In the realm of power generation, generator transformers (GSU's) play a pivotal role by stepping up generated voltage for transmission across extensive power grids. High current bushings are essential for safely transmitting large electrical currents carried by busducts between the power generator and the Generator step-up transformer. A notable milestone in YASH's journey was the recent manufacture and export of India's first 25,000A rated High Current bushing, supplied for a renown international hydropower plant.



### | Range of Bushings as per IEEE Standard



34.5kV 8000A 534BCT



25kV 1200A 534CT



34.5kV 3000A 534CT



69kV 800A 550CT



138kV 800A 534CT



### | 36kV 25,000A High Current Bushings developed for Hydropower Plant

To meet the increased demand for Transformer bushings globally, YASH have augmented their existing manufacturing facility to produce close to 12,000 OIP bushings annually. The facility addition is equipped with cutting-edge technology sourced from renowned manufacturers in Europe/USA and is well-positioned to cater customers with industry best lead times.

### | Electro-Magnetically Shielded EHV Test Laboratory 1500kVp Impulse Test Lab System 600kV HV Test System





## | SCADA Controlled Autoclave System



By continually addressing the unique challenges of global markets, Yash Highvoltage Ltd. not only enhances its product offerings but also plays a vital role in shaping the future of energy distribution worldwide. Through each tailored solution and technological advancement, we believe in transforming the energy landscape - **one transformer bushing at a time.**