GE VERNOVA

CASE STUDY

SFC FOR RAILWAY TRACTION POWER SUPPLY

Bauhinia electrification project, Australia
2 × 19 MVA Static Frequency Converter (SFC)

In 2014, GE Vernova's Power Conversion business delivered and commissioned the SFC systems for the Bauhinia electrification project in Australia. It was the very first time that power electronic converters were employed to feed a 50 Hz electric railway.

System overview

The project encompassed two independent feeder stations, each featuring a 19 MVA converter system based on Power Conversion's proven MV7000 converter technology.

These converters are housed within a transportable substation building, which includes a control room, while additional supporting equipment is located externally.

A single converter block comprises the following main components:

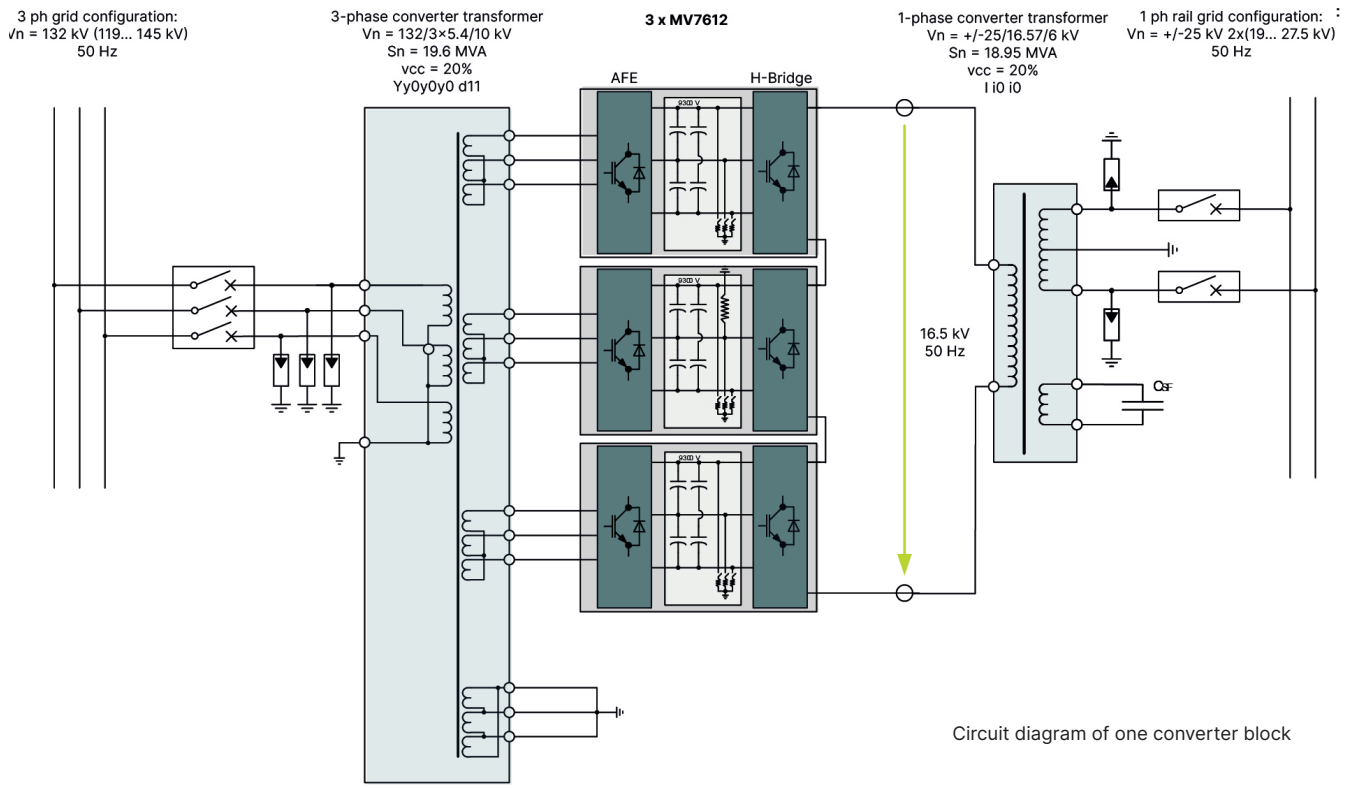
- Input 3-phase 4QS sub-inverter with three single-phase modules
- DC link with an extensive capacitance
- Output 1-phase 4QS sub-inverter with two phase modules

The core components of each sub-inverter are the press-pack IGBT modules, arranged in two phase segments and equipped with a patented pull-out mechanism, including the IGBT control amplifiers.

WORLD'S FIRST APPLICATION OF 50-50HZ RAIL STATIC FREQUENCY CONVERTERS

- The project covered the **electrification of the entire 107 km Bauhinia rail spur**, from Rangal south to the Rolleston coal mine in Central Queensland, Australia. The objective was to enhance the railway's capacity to meet the anticipated rise in coal demand. It was completed in early 2015.
- The project entailed the construction of a **25 kV, 50 Hz overhead wire system** with autotransformers. Given the short construction timeline and the need to minimize grid connections, the customer opted for **SFC technology for traction power**. This project marked the first global application of 50-50 Hz rail static frequency converters.
- Power Conversion utilized its **proven SFC technology, adapted for a 50-50 Hz application**, to deliver a reliable and efficient solution for this project. The new converter station was designed, constructed, and installed within just 14 months, despite the remote location and harsh environmental conditions of the Australian outback.

SFC systems details



Circuit diagram of one converter block

Transformer

The design of the converter system necessitates the installation of two transformers for each converter block. Both transformers are designed for outdoor use and feature an ONAN cooling system, tailored for the hot weather conditions of Queensland, Australia. The input transformer, rated at 132 kV and 50 Hz, has three output windings that directly supply the three inverter units. The output transformer increases the converter's single-phase 16.5 kV output voltage to supply the railway with a ±25 kV, 50 Hz power. A railway filter is connected to both the output of the railway transformer and its auxiliary winding.

Cooling system

Each converter block features its own dedicated cooling system, using a glycol-water mixture to directly cool the power electronics. The cooling system is designed to operate in temperatures up to 45 degrees Celsius and includes an enhanced water-air heat exchanger to manage the minimal temperature difference between the ambient air and the required inlet fluid temperature. Two water pumps are installed with complete redundancy to ensure continuous circulation, with the pumps alternating every 24 hours.

Additional air conditioning is provided for the station premises.

Control system

The internal converter control system facilitates the following operational modes:

- Standard control in all four quadrants,
- Phase shift operation (supplying reactive power solely to the railway grid),
- Parallel operation with the existing standard 50 Hz railway feeding system,
- Isolated mode (establishing its own railway grid).

The control system can be operated locally or remotely through a user-friendly HDM interface.

PROVEN EXPERTISE AND LOCAL SUPPORT

Opting for Power Conversion's SFC technology offers several benefits:

- An unparalleled blend of **proven static frequency converter technology, extensive global rail expertise, and localized support**, including engineering, project management, and service,
- **High efficiency and low operating costs**,
- Single output transformer,
- **High availability,** due to a modular design and high degree of standardization,
- IGBT design **optimized for highly dynamic loads**,
- **Maintenance-optimized** design,
- **Short commissioning time**,
- **Scalable** concept.

TECHNICAL SPECIFICATIONS

Temperature range	**-6... 45 °C**
Public grid	**3-phase AC 119 kV... 145 kV / 50 Hz**
Railway grid	**1-phase AC +/- 19 kV... +/- 27.5 kV / 50 Hz**
Number of blocks	**2**
Apparent power Active power	**20.1 MVA per block** **18 MW per block** **(cos φ = 0.8)**
Availability	**99%**
Efficiency	**98%**
Cooling (converters)	**Ambient air and mix glycol/water**
Cooling (transformers)	**ONAN**

About Power Conversion, a GE Vernova business

GE Vernova's Power Conversion business provides energy conversion technologies, systems, and services across the power and energy intensive industries, driving the electric transformation of the world's energy and industrial infrastructure.

www.gevernova.com/power-conversion/contact

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