Application note

Static frequency converter supports 50 Hz rail network
Advanced power conversion keeps Queensland Rail's network on track

ABB is upgrading the feeder station at Wulkuraka in Australia as part of a program to strengthen the rail power supply for Queensland Rail's Brisbane suburban operations.

The challenge

As part of the New Generation Rollingstock state project, the rail power supply on the 46 kilometer (km) western route from Corinda to Ipswich and Rosewood, needed to be strengthened. The route is forecast to have an increase in train traffic to and from the new Wulkuraka maintenance center. Queensland Rail, therefore, needed to strengthen the existing feed from the three-phase national grid to support both the depot and the related train movements.

The existing feeder station at Wulkuraka, just west of Ipswich, was initially built with a conventional single transformer. However, to cope with the planned rail power supply, a second transformer was needed to meet the future network operational requirements. Instead of providing an additional transformer, Queensland Rail decided, after an extensive technology research, to install a static frequency converter (SFC) to augment the existing feeder station, which was commissioned in 2006 following electrification of the Ipswich – Rosewood line in 1993.

Project highlights
Turnkey solution with a 20 MVA converter and switchgear
High-level control ensures optimized operation
Balanced three-phase connection and unity power factor
Grid code compliance with dedicated filters
Lower fault current on single- and three-phase side
Synchronous parallel operation with existing feeder transformers
Reliable and high efficient IGCT* technology

* Integrated Gate-Commutated Thyristor

ABB's solution

To meet Queensland Rail's power supply needs, ABB provided a turnkey rail SFC system. Rated at 20 mega-volt amperes (MVA) and equipped with the most advanced power electronics, the system efficiently converts electricity from the country's three-phase high-voltage grid, rated at 50 Hertz (Hz), to the 50 Hz required by the single-phase 25 kilovolt (kV) grid of Queensland Rail.

The SFC is based on the PCS 6000: a technology that has proven reliability since its introduction in the year 2000.

Among the benefits of using an SFC at Wulkuraka are mitigated network issues with unbalanced loads and harmonics, softened step changes in load, improved reactive power support on the substation's three-phase and single-phase sides and the ability to share load with the adjacent feeder station, thus giving greater strength to the power network.
ABB's SFC can limit short-circuit current at its nominal rating, thus ensuring that the short-circuit design of the existing overhead contact system (OCS) can be retained.

As part of the turnkey contract, ABB is responsible for the design, engineering, installation and commissioning of the SFC system. Key components of the containerized solution include transformers and SFC as well as control and cooling systems.

Inside view of the rail SFC container delivered to Queensland Rail

Technical data – Rail SFC for Wulkuraka, Queensland Rail in Australia	
Type	PCS 6000 Rail
Application	Traction power supply
Installation	Outdoor
Ambient temperature range	-6°C ... +45°C
Frequency	3-ph AC 50 Hz / 1-ph AC 50 Hz
Grid three-phase system	3-ph AC 110 kV
Traction system voltage 50 Hz	1-ph AC 25 kV
Active power 50 Hz per converter	16 MW
Cos phi on incoming 3 ph side	1.0
Converter cooling	Water / air

ABB's rail static frequency converter (SFC) solutions

ABB has a long history of SFC technology, providing reliable railway interconnections since 1994. The success of ABB's rail SFCs is based on continuous development and technological innovation. Its medium-voltage rail SFC solution allows the connection of three-phase public grids to single-phase railway power grids, at rated frequencies of 16.7, 25, 50 or 60 Hz. The SFC not only acts as a voltage and reactive power source, but is able to handle the smooth and interruption-free transition from interconnected system operation to island mode in case of disturbances in the grid. Furthermore, it is capable of acting as sole power supply to an isolated section of the railway, and of subsequently re-synchronizing with the rest of the railway grid after the disturbance has been cleared.

Key features and benefits

- Higher system availability
- Reduced maintenance costs (no rotating parts)
- Improved efficiency over entire power range
- Controlled bi-directional active power transfer
- Proven fault ride-through (FRT) functionality
- Reliable black-start and island mode operation
- Reactive power compensation of the public and railway grid
- Prepared for active power flow control
- Grid synchronization capability with converter in operation
- Standardized container modules
- Comprehensive life-cycle services and support

Available configurations

- Modular system for ratings from 15 MW to 120 MW
- Indoor and outdoor solutions
- Mobile solutions
- Direct feed to AT-line (auto transformer) catenary systems
- Direct catenary feed solutions
- Feed to centralized railway grid (110 kV / 132 kV) solutions

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