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Thriving cities seek investment

Queensland Rail adopts advanced **power conversion**

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To support the introduction of new EMUs, the power supply on Brisbane's suburban network is being strengthened with a static frequency converter fed from the national three-phase grid.

By mid-2016, a new static frequency converter is due to be commissioned at Wulkuraka, as part of a programme to strengthen the traction power supply for Queensland Rail's Brisbane suburban operations. The electrified 1067 mm gauge South East Queensland network covers more than 800 track-km and serves around 145 stations.

Under the New Generation Rollingstock project launched by the state government in 2013, suburban rail capacity is to be increased by around 30% over the next few years. The Qtectic consortium of Bombardier Transportation Australia, John Laing, Itochu Corp and Uberior is to supply and maintain 75 six-car electric multiple-units under a 30-year PPP agreement valued at around A$4·4bn. The first train is due for delivery before the end of 2015, and following tests is expected to enter service in mid-2016. The remainder will be progressively rolled out by the end of 2018.

The trains are to be maintained and serviced at a purpose-built depot at Wulkuraka, just west of Ipswich, which is being constructed as part of the PPP package and is due to be completed next year. As part of the project, it was determined that the traction supply needed to be strengthened on the 46 km western route from Corinda to Ipswich and Rosewood, which will see an increased number of train movements to and from the new maintenance centre.

Queensland Rail therefore awarded a contract to ABB for a turnkey package to strengthen the existing feed from the three-phase national grid to support both the depot and the related train movements. This contract is based on the use of SFC technology to augment the existing feeder station at Wulkuraka, which was commissioned in 2006 following electrification of the Ipswich – Rosewood line in 1993.

Top: The first of 75 six-car EMUs being supplied under the NGR PPP is due to be delivered for testing by the end of this year.

Below: The South East Queensland electrified network serving Brisbane's suuburbs is continuing to expand.

Connecting the grids

In recent years, more and more railways have begun to use large SFCs based on power electronics to transfer energy between national and railway transmission networks. Intensively-used electric railways have a huge demand for power, and many railways operate their own high-voltage supply networks.

Some even have dedicated generating plant, although few are totally autonomous. However, drawing power from the national grids is not always straightforward as there are significant differences between the two systems. Domestic grids generate, transmit and distribute three-phase power, whereas most AC electrified railways use a single-phase supply.

Some railway electrification uses a different frequency from the national grid, and SFCs have become increasingly common for feeding the 16·7 Hz rail networks in Europe, as well as the 25 Hz systems in the USA. To date,

SFC technology has not been widely used to support 50 Hz rail traction supplies, but it can offer advantages even where the frequency is the same (as with the 50 Hz network in Queensland), as the railway and national grids are not necessarily synchronised.

ABB has been using SFC technology for rail applications since 1994, offering medium-voltage converters to feed single-phase railway power networks at 16·7, 25, 50 or 60 Hz. The converter acts as a voltage and reactive power source, but is also able to handle — without interruption — a transition from an interconnected system to stand-alone operation in the event of any disturbances in the grid. This means that it can act as the sole power supply for an isolated section of railway, until it can subsequently re-synchronise with the rest of the railway power supply after the disturbance has been cleared.

Due to be commissioned next year, the new static frequency inverter at Wulkukara will be similar to SFCs that ABB has supplied for railways in Europe.

Wulkuraka takes shape

Queensland Rail carried out extensive research into the technology before concluding that there would be several advantages to using an SFC at Wulkuraka instead of a conventional single-phase transformer connection. These include reduced network issues from unbalanced loads, step changes in load and harmonics, plus better reactive support on both the three-phase and single-phase sides of the substation. The SFC can also share the load with the adjacent feeder station thus giving greater robustness to the power supply network.

ABB is providing a complete turnkey feeder station package, which includes a static frequency converter, a modular switch room with gas-insulated medium voltage switchgear, civil works, installation, commissioning and servicing for the first two years of operation. It is also handling the project management and co-ordinating the various equipment suppliers to meet the overall project objectives.

Rated at 20 MVA and equipped with the most advanced power electronics, the Wulkuraka SFC has been designed to convert electricity from Powerlink Queensland's 110 kV 50 Hz three-phase grid to the 25 kV 50 Hz required by Queensland Rail. This is the first SFC of this specific configuration to be manufactured by ABB, although it is the third such converter to be used in Australia.

The PCS 6000 converter uses containerised transformers and frequency converters as well as separate containers for the control and cooling systems. It will ensure greater power unity on the rail corridor's traction supply, and filter out any harmonic disturbances, ensuring that Queensland Rail can meet the harmonic compliance requirements set by the electrical grid operator. ■

The NGR maintenance depot at Wulkukara is being built by Laing O'Rourke and is expected to open in 2016.