

APPLICATION NOTE

Modular and transportable static frequency converters (SFCs)

Innovative solution meets increased demand from Norwegian rail network



A new concept that deploys prefa-bricated container modules to house SFCs is upgrading Oslo's railway power supply. The transportable containers enable the converters to be decommissioned, moved and recommissioned in just two weeks.

Project highlights

Five modular and transportable converter units

Operation at different sites

50 Hz supply by different voltages

Short delivery time of 11 months

15 MW short time power demand

Significant lower purchase costs

The challenge

Across Oslo there is a rising demand for train services which, together with increasingly powerful trains, is driving the need for more power to the network. Rising to this challenge, Norway's rail infrastructure operator, Jernbaneverket (JBV), ordered five prefabricated container units housing ABB's SFCs. The units were ordered from Strukton Rail (Västerås, SE) and ABB (Turgi, CH) in 2012 under a project, called Norwegian Mobile Converter Units (NMCU). Completed by 2015, the contract value is 30 million euros.

ABB's solution

Strukton Rail developed the modular converter unit concept, the station control and erected the NMCUs as a turnkey project and commissioned them together with ABB. ABB provided the system design and the engineering for the transportable solution. ABB also designed the converter and delivered the transformers and the complete converter container, including control and protection. The basic engineering was performed only once; units 102 to 105 which followed were replicas. Unit 104, however, was redesigned for input voltages 22 kV and 11 kV. The first unit, 101, was delivered in only 11 months.

The prefabricated converter container includes the converter itself, the intermediate circuit filters for high pass, 33 Hz and 66 $\frac{2}{3}$ Hz, as well as the converter cooling system, the converter room cooling unit and the converter and station control systems.

The assembled modules passed functional tests in their respective factories before being shipped to site. This leads to better quality, shorter on-site setup times and lower costs. After installation and cable connections, final tests were

performed and the units were ready for operation. The total delivery time for the mobile transportable concept, including erection and commissioning, is around 10 months shorter than a normal converter station built on-site with its production costs some 15 percent lower.

— Converter container NMCU, total length ≈15 m, without struts (front side and rear side view, showing heat exchanger on the back)



Units 101 and 102 were first delivered to Jessheim where normally two MegaMacs are in service. In 2013, the units were individually commissioned and then tested in a back-to-back setup to verify their performance. After passing the verification phase, the units were relocated to their respective sites. At all sites the NMCU operate in parallel to existing rotating converters. In Alnabru the two NMCUs operate in parallel.

Technical data – Rail SFC for NMCU, Jernbaneanverket Norway	
Type	PCS 6000 Rail
Application	Traction power supply, 16.5 kV
Installation	Mobile, outdoor
Ambient temperature range	-40°C ... +30°C (100 %) -40°C ... +50°C (50 %)
Frequency	3-ph AC 50 Hz / 1-ph AC 16.7 Hz
Grid three-phase system	3-ph AC 66 kV / 47 kV / 22 kV / 11 kV
Traction system voltage 50 Hz	1-ph AC 16.5 kV
Active power 16.7 Hz per converter	10 MW (continuous) 15 MW (overload)
Cos phi 50 Hz	1.0
Converter cooling	Water / air

ABB's rail static frequency converter 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 10 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

— NMCU installation at Larvik, converter station



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