GE
Power Conversion

61 MW Variable-Speed Drive System for test bench

Massa test facility, Italy

Equipping the Massa test bench

As part of GE's commitment to drive eLNG solutions, GE's Power Conversion business developed a new fully electrical solution to equip the Massa test facility in Italy. This 61 MW Variable-Speed Drive System (VSDS) has been specifically designed to test centrifugal gas compressor units at full load and under extreme speed, torque and dynamic response conditions. The aim is twofold: to prove the entire system, with large motor and drive application, works and to ensure the compressors will meet the necessary technical requirements to enable efficient and reliable operation during their normal lifetime.
Operational since the first half of 2013, the test bench allows the testing of gas compressors up to 61 MW.

A fully electric compression solution

The 61 MW VSDS is based on advanced and reliable technologies. It is comprised of three step-down transformers connected to the electrical network and linked to three medium-voltage MV7000 converters, VSI type, in parallel (81 MW = 3x27 MW), which feed a 61 MW 2-pole synchronous motor with two shaft ends.

The VSDS supplies the required electric power to start the whole train and operate it to continually maintain the string production capacity at the requested speed range.

Key benefits

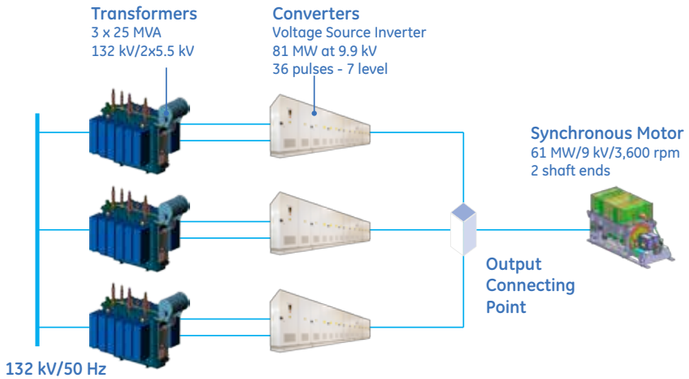
MV7000 converters – VSI technology

- Low harmonics content (external filter not required)
- Improved network stability and grid integration
- High-performing solution with variable-speed technology
- Reduced torque ripple at shaft level
- No torsional vibration through system integration
- Excellent operation of high-capacity diodes and press-pack IGBT based on water-cooled technology
- Very low noise operation with water-cooling
- Patented technology of interleaving pulses

2-pole synchronous motor

- Excellent performance, efficiency and flexibility
- More compact design with MV7000 converter and motor enhancement
- Very good stator behavior with elaborated Roebel bars ends bracing and full VPI treatment
- Good rotor dynamics, based on 3-bearing arrangement and frame design, creating a large speed range
- Torque at zero speed and improved reliability with patented 7-phase induction brushless exciter design
- No spots and homogeneous temperature with very efficient rotor cooling
- Vibration level well below API 546 requirements
- Low noise level

imagination at work



Using GE's advanced technologies

Phase shifted transformers

To reduce harmonic pollution on the network side and comply with the grid owner's requirements, each transformer's phase shift is adjusted to create a 36-pulse reaction.

MV7000 converters – VSI type

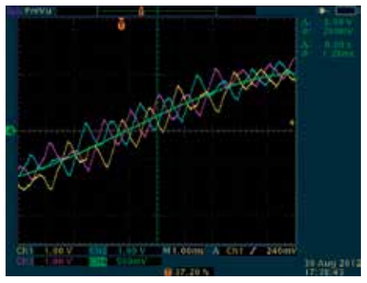
The medium-voltage converters, with a water-cooled design, are based on the latest generation of powerful press-pack IGBT (PPI) technology. The proven Pulse Width Modulation (PWM) three-level inverter provides high-quality performance. Its adjustable PWM patterns and frequency bring a wide range of flexibility for low switching losses.

Interphase reactors

The three converters are put in a parallel configuration through a new type of filter that is used to decrease torque ripples on the motor. The converter output filter is comprised of interphase reactors with two windings that suppress the first harmonics.

Interleaving pulses

Power Conversion's patented technology of interleaving pulses is used to control the IGBT firing. This allows a time shift between the three converters that is calculated to interleave the current wave shapes. As a result, a 7-pulse converter is created, and the current supplied to the motor contains very low total harmonic distortion, and has negligible impact on amplitude of torque pulsation at the motor shaft.



Current measurement at the three converter outputs and motor input

2-pole synchronous motor

Manufactured in Power Conversion's Nancy factory, the 61 MW motor is the most powerful motor driven by a variable-speed converter, VSI type. Because it was painstakingly designed and controlled during construction, the 2-pole synchronous 140-ton motor offers excellent performance, efficiency and flexibility, as well as high reliability.

This machine has a very extended speed range and two shaft ends that adapt it very well to the operating conditions requested by a test bench application.

Technical data

2-pole synchronous motor

Quantity	1
Power	61 MW
Duty type	S9
Rated voltage	9 kV
Drive type	MV7000
Rated frequency	60 Hz
Rated speed	3,600 rpm
Speed range	2,614 to 3,852 rpm
Number of pole	2
Efficiency at full load	98.1 percent
Cooling	TEWAC IC 8A6W7
Insulation class	F with B temperature rise
Degree of protection	IP 55 Exp

MV7000 converters – VSI type

Type and quantity	3 x 27 MW DFE 12 in parallel (MV7927 frame)
Type of cooling	Water-cooled
Nominal input voltage	6 x 5550 V
Nominal output power	61 MW (motor shaft end)
Nominal output voltage	9 kV
Nominal output current	3981 A
Efficiency at full load and rated power	98.8 percent
Network bridge rectifier configuration	36 pulses (3 x 12 pulses with transformer shift)
Semi-conductors technology	IGBT Press Pack
Degree of protection	IP 31

Step-down transformers

Quantity	3
Type	Oil immersed / breathing type
Type of cooling	ONAN
Rated power	25 MVA
Rated primary voltage and frequency	132 kV / 50 Hz
No load secondary voltage	2 x 5550 V
Degree of protection	IP 54

Looking to the future

GE is scaling up its MGV (Moteur Grande Vitesse, High-Speed Motor) direct-drive, well-proven technology, which offers increased performances compared to traditional geared electrical solutions.

As an example, the MGV design features greater overall drive system efficiency, offering customers significant energy savings because there are no losses due to a gearbox, and it has a smaller footprint that enables it to more easily be integrated into diverse environments.

In the coming months, a more powerful solution, including a 80 MW induction motor and larger VSI drives, will equip the Massa test facility.

Contact information

Australia	+61 2 8313 9980
Brazil	+55 31 3330 5800
Canada	+1 905 858 5100
Chile	+56 2 2652 6500
China	+86 21 6414 6080
France	+33 1 77 31 20 00
Germany	+49 30 7622 0
India	+91 44 4968 0000
Italy	+39 055 423 211
Russia	+7 495 981 13 13
UAE	+971 4 429 6161
UK	+44 1788 563 563
USA	+1 713 683 2400

imagination at work

www.gepowerconversion.com

GEA30618 61 MW Variable-Speed Drive System for test bench