

Wind Turbine Generators

Efficient switching and protecting

The shortage of fossil resources means that the generation of electric power from wind is nowadays more necessary than ever before. Woodward SEG from Kempen on the Lower Rhine has been a constant presence on the market for frequency inverters for wind turbine generators (WTG) for over ten years. The experience gained in power distribution and closed loop control engineering over this time is fed continuously into the development of new products and technologies. State-of-the-art frequency inverters for wind turbine generators must meet the most stringent requirements with regard to switching frequencies and suitability for a wide range of supply grids. An optimised switchgear combination based on Moeller products was therefore developed for the new Concycle Wind frequency inverter generation.



Perfect combination for the partial load range: The NZMH4 800 A compact circuit-breaker protects the generator reliably from overloads in the event of a short-circuit. The DILM-580 contactor with vacuum technology handles the normal connection and disconnection of the wind turbine generator. The combination can be used without any derating at ambient temperatures up to 50° C.

Merging experience and new ideas

The development of state-of-the-art frequency inverters involves the bringing together of diverse objectives that are mostly contradictory. Experience in the wind power sector shows that inexpensive high quality components mostly have to offer a lifespan of 20 years. The production and the service of frequency inverters also has to have a modular design, must be efficient and require little effort. After all, a wind turbine generator is subject to a wide range of influences in various locations, such as extreme cold and heat, humidity, dust or sand, calm periods and storms. For this reason, the selection and arrangement of components and their use in the harshest environmental conditions involves a great deal of technical know-how.

The new frequency inverter generation of Woodward SEG has to meet as a wide range of requirements as possible:

- In spite of the high degree of standardisation, a modular switchboard design is nevertheless needed in order to meet customer requirements. Tried and tested assemblies are therefore produced and tested in standardised production processes.

- Climatic requirements are fulfilled with type-tested panel units with optional units for heating and cooling – simulated in extensive test cycles, as well as in climatic containers.
- Network operators are changing their requirements worldwide towards the active and intelligent support of the electricity grids by means of wind turbine generators. The simulations and software functions needed for this are developed and tested in the company's own test bay. In this way, the latest standards can be implemented within a short time.
- Developments are controlled with the latest Product Lifecycle Management (PLM) methods.
- The different locations of wind turbine generators also require a wide range of wind profiles and therefore different electrical and mechanical load capacities. A frequency inverter can thus connect to the grid up to 2000 times a year.

MOELLER 

An Eaton Brand

THE COMPANY

Woodward SEG GmbH & Co. KG is based in Kempen on the Lower Rhine and supplied its first frequency inverter for a wind turbine generator at the end of 1996, at that time under the SEG logo. As SEG, the company has almost 40 years of experience in the power distribution and protection technology.

Frequency inverter series production for the German market was developed rapidly from smaller pilot series and also for the US market since 2000. The "saturation" of the German wind power market from 2002/ 2003 led frequency inverters from Kempen worldwide into other growing wind power markets: In countries such as France, Spain, Great Britain, as well as Japan, China and Australia they are converting wind power into electricity together with the generator - on land and sea. Up to now more than 5000 inverters have been installed for system capacities between 600kW to 5MW and also for larger capacities in future. (www.woodward-seg.com).

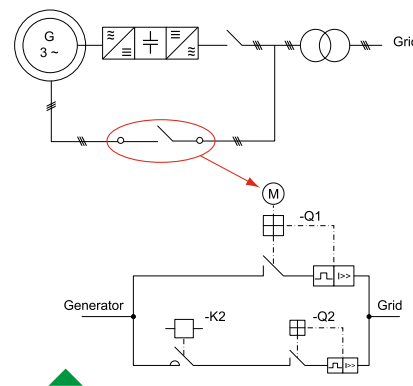
Highly efficient switching up to 2000A with Moeller DILH contactors. The vacuum technology prevents exposed arcing and allows a considerably longer electrical lifespan compared to air contactors. The 2500 A rating class will be added to the series in future

Operating principle

The generator for Concycle Wind frequency inverter consists of a doubly fed slip-ring asynchronous generator. The frequency inverter is switched into the rotor circuit of the asynchronous generator in order to regulate the system output according to the rotor speed. IGBTs (insulated-gate bipolar transistor) generate a voltage with a variable frequency and amplitude from a DC link circuit. The frequency in the rotor circuit is set according to the speed of the WTG, which depends on the wind. The stator of the asynchronous generator is connected to the medium voltage network via a circuit-breaker and transformer.

Alternative connection to the grid

The speed range of wind turbine generators is more often in the lower range than in the rated range. This means that circuit-breakers have to be switched on and off very frequently. Added to this are the safety requirements which must be observed in the connection to an industrial network with short-circuit currents of up to 50 kA. Reducing the number of switching operations reduces maintenance costs as well as downtimes. If operating currents of present day WTGs are to be controlled between 2000...3000A and switched in the event of a fault, series circuits consisting of circuit-breakers and contactors offer a very good technical and yet very expensive solution. However, these kinds of systems are primarily considered from the point of view of costs, and so a cost-optimised circuit should also be used not least for these reasons.



A bypass to the main switch consisting of compact circuit-breaker and vacuum contactor handles the connection to the grid in the partial load range.

There is, however, another solution. A "smaller" bypass consisting of an NZM (-Q2) circuit-breaker and (K2) contactor for the "main switch Q1" can handle the connection to the grid in the partial load range. Even high short-circuit currents with grid transients are controlled by the combination of software-based current monitoring and vacuum tube technology offered the DILM contactor. The short-circuit protection of the bypass circuit is implemented with an NZMH4 circuit-breaker.

Practical experience with this circuit to date has shown that the switching operations of the main switch can be reduced with a bypass. An experienced team, consisting of specialists from Woodward SEG and Moeller tested the use, dimensioning and function of the circuit and assessed the risk in the form of a failure mode and effects analysis (FMEA). The results of the analysis were impressive in every respect.

CONCLUSION

"Our customers have trust in our technical solutions. We are continuously optimising our frequency inverters and thus also reducing the life cycle costs of the WTGs. In this respect we consider ourselves at Woodward SEG as technical partners of our customers", team leader Eric Harmann explained about the use of Moeller components. "We are very happy with Moeller's technical support. The understanding of a system for wind power technology can only be achieved on the basis of continuous cooperation. In my opinion, our strengths are in the search for common and well-founded solutions."



Quicklink ID:

MS1801