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HVDC/FACTS - Highlights

Synchronous condenser solutions for Denmark

Energinet.dk, the Danish transmission system operator, placed three orders with Siemens for turnkey delivery of synchronous condenser solutions for the Bjæverskov, Fraugde and Herslev substations.

At the end of February 2015 the synchronous condenser solutions of Fraugde and Herslev were handed over to the client's full satisfaction. In May 2015 Bjæverskov substation had been successfully completed and was passed over to Energinet.dk. The solutions help stabilize the transmission system. The order comprised the engineering, procurement and construction of the complete system by Siemens.



Fig. 1: Site view of the Fraugde synchronous condenser

The scope of delivery for the synchronous condenser solutions included a synchronous generator with brushless excitation, a generator step up transformer and the electrical auxiliary systems, such as control and safety systems, voltage regulators and startup systems. All main components of these solutions come from Siemens' own portfolio. The Siemens SGen-100A air-cooled, two-pole generator was adapted specifically to industrial requirements and, thanks to its modular design can be easily tailored to individual customer requirements. Nearly 400 generators in the SGen-100A series are already in use worldwide. They feature high efficiency, low noise emissions and low installation and commissioning costs.

"These are important projects for Energinet.dk for stabilizing the transmission network in Denmark, and to support higher wind power generation in our country," stated Jakob Søbye, head of substations at Energinet.dk.

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Fig. 2: A look inside the Herslev substation

Each synchronous condenser solution can deliver more than 900 MVA of short-circuit power and +215/-150 MVar of reactive power. The startup time is designed so that the generators can reach up to 3,000 rpm within 10 minutes and be synchronized with the transmission grid. Since the synchronous condensers are designed for continuous operation and the provision of short-circuit currents when voltage dips occur in the grid, they have a minimum availability of 98 percent.

Synchronous condenser solutions have recently been re-introduced worldwide to support transmission systems with short-circuit power, reactive power and inertia. As more and more renewable power generation is added to the overall energy mix, and since converter-based renewable power generation does not contribute short-circuit power to the transmission network, the installation of stand-alone synchronous condenser applications is becoming more and more necessary.

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Fig. 3: The Bjæverskov substation, the first synchronous condenser order from Energinet.dk

“Denmark is one of the few countries to include such a large share of wind energy in its energy mix, which is why we need synchronous condenser solutions to help stabilize the transmission system,” explains Claus Møller, who heads the energy business area at Siemens Denmark. “Siemens is also one of the few suppliers of synchronous condenser solutions with the ability to supply the entire scope of main components from our own portfolio, and at Siemens Denmark we have built up a team of experts who can integrate these components into a complete synchronous condenser system.”

In 2014, wind turbines generated as much as 39.1 percent of the electricity in Denmark. The share of renewables accounted for more than 52 percent of the energy consumption. The Danish government aims to generate 50 percent of its power from wind energy by 2020. At the same time, it expects to cut carbon dioxide emissions by 40 percent.