Synchronous Condensers

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WEG's synchronous condensers are rotating electrical machines which have been specifically developed to provide voltage support to electrical networks, and to increase the network inertia and short-circuit power capacity. Our synchronous condensers provide reliable and efficient solutions for improving stability and voltage regulation in electrical power grids.
With the retirement of large thermal power plants and the increased reliance on renewable energy technologies like photovoltaic solar and wind power, maintaining stability on power grids can present significant challenges which WEG's synchronous condensers help to address. In addition to providing smooth, step-less, and highly responsive voltage regulation, WEG's synchronous condensers also provide greater short circuit power capacity and increase grid inertia. When variations in the reactive power (VAr) on a grid are not balanced, the results can include voltage instability, system isolation (islanding), voltage collapse and, in extreme cases, cascading failures like the Northeast blackout of 2003 in US. The need for synchronous condensers on electricity grids can be caused by a range of factors, such as retirement of large power generation plants, failures in transmission lines, increasing peak demands, high concentration of wind power generation or other power generation with unstable characteristics, and others.
Providing or absorbing reactive power dynamically and smoothly and without the need for switching, offering inertia and short-circuit power to the system, synchronous condensers are becoming more commonly used to ensure the electrical power quality, stability, and reliability on transmission networks. Using state-of-the-art design tools and first-class manufacturing processes, WEG provides rotating synchronous condensers tailored to our customer's needs and built to support compliance with transmission grid codes as they continue to change along with our changing use of power generation resources.

Applications

WEG's synchronous condensers are most commonly used in electric power generation and transmission systems.

Long transmission lines, when unenergized or carrying reduced loads, tend to experience voltage rises towards consumers due to the lines' capacitive effect. When transmission lines are charged, they tend to experience voltage drops as the lines run further from generation sources due to the effects of mutual induction and of a typically inductive network load.

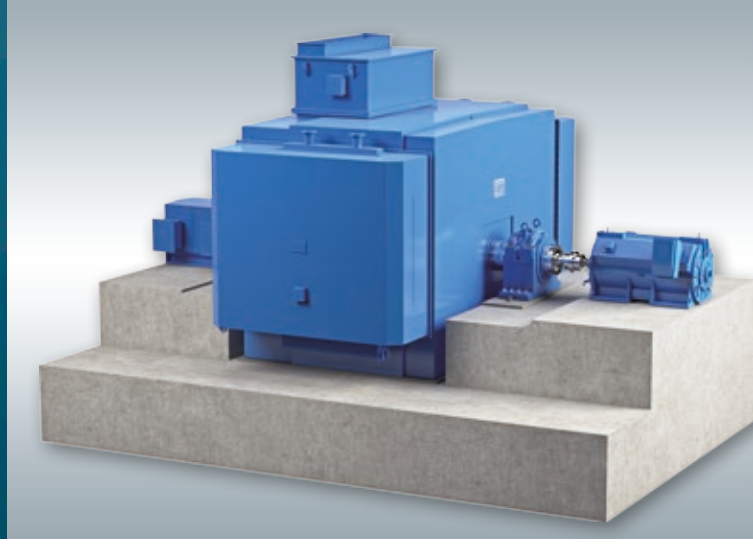
Synchronous condensers, installed where they are most needed, help support transmission voltage and improve transmission line capacity and efficiency.

Grids with low short-circuit power capacity and high instability are optimized with synchronous condensers, due to their intrinsic characteristics of adding short-circuit power capacity and network inertia to the connection point.

Wind farms, which typically have low reactive power generation characteristics and limited short-circuit power capacity, require a synchronous condenser to be close to the generating units in order to facilitate the transmission of the generated energy to consumers. The synchronous condenser, through excitation control, maintains the balance of the power system, absorbing or providing reactive power as necessary and maintaining the voltage of the network within the recommended standards for system operation and for optimal of energy flow.

Why Use Synchronous Condensers?

- Increased flexibility of power system operation in all load conditions. Synchronous condensers provide fast injection of reactive power to limit voltage drops and fast absorption of reactive power to limit voltage rises;
- Provides smooth, step-less, and highly responsive voltage regulation with no switching required;
- Provides reactive power compensation without introduction of significant transients, resonances, or harmonics to the grid;
- Increased network inertia helps to limit the network's rate of change of frequency and helps support low-voltage ride through requirements;
- Compensates for voltage drops over long transmission lines, resulting in improved transmission capacity and efficiency;
- Optimal use of physical installation space;
- Can allow other generators on the network to provide more active power by removing the burden of reactive power support: at wind farms, this can raise the rated plant capacity;
- Avoids constant variation in the taps of the elevating transformers;
- Increases grid reliability: due to the ease of voltage adjustment with a synchronous condenser, it is possible to avoid a series of other operations necessary to achieve the same effect which require more time, more equipment, and more device communication; consequently, more risk.



Technical Characteristics

- Power range: up to ±150,000 kVAr - 15,000 V - 60 Hz
  up to ±120,000 kVAr - 15,000 V - 50 Hz
- Degrees of protection: IP23/IP24W to IP44/IP55
- Constructive forms: IM1001 or IM1005 (B3), IM7311 (D5), IM7315 (D6)
- Cooling: open, air-cooled; totally enclosed, air-water heat exchanger; others available

Standards and Certifications

WEG's synchronous condensers are designed to the appropriate standards, such as IEC, NEMA, IEEE and ABNT, among others. To meet the needs of the most demanding world markets, WEG has a quality system certified by the Bureau Veritas Quality Institute, per the requirements of ISO 9001 and ISO 14001.

Constructive Characteristics

Types of Excitation

Synchronous condensers require a direct current source to power the field winding (rotor winding), which is usually supplied through a static exciter or a brushless exciter.

- ***Static Exciter (with brushes)***
  WEG's static exciters are comprised of an arrangement of collector rings and brushes, which supply the synchronous condenser's field winding. DC power for the field winding is sourced from a static AC/DC converter and the excitation system controller.
  This system allows positive and negative field excitation of the synchronous condenser, as is often required, thus allowing operation of the condenser across its capability curve.
- ***Brushless Exciter***
  WEG's brushless excitation system includes a rotating exciter, typically mounted at the rear of the condenser, which is powered by the excitation control system's AC/DC controller. The exciter's rotor supplies the field winding with DC power through a rotating diode wheel.

Condenser Starting System

WEG typically provides a correctly sized three-phase induction motor, fed by a matching variable frequency drive, which is coupled to the shaft of the synchronous condenser to provide smooth condenser starting with minimum impact to the power supply. The auxiliary motor and respective frequency drive can also be designed to stop the synchronous compensator by regenerative braking, returning energy to the power grid during machine shutdown.
WEG also provides other types of condenser starting systems based on customer preferences.

Cooling Method and Ingress Protection

Most often, WEG provides synchronous condensers which are:

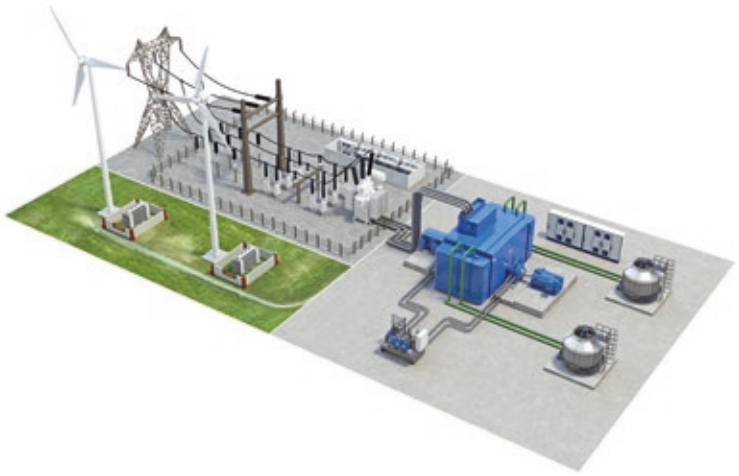
- IC01: open, air cooled with ingress protection degree IP23/IP24W
- IC81W: totally enclosed, with water-to-air heat exchanger with ingress protection degree IP44/IP55

WEG will supply the cooling system that best meets our customer's needs. Beyond the above basic configurations, this includes forced ventilation systems, ducted air inlets and/or outlets, and other cooling configurations as necessary to ensure optimum system performance considering the characteristics of the application and the environment where the condenser will be installed.

Complete Solution

WEG provides the complete solution for synchronous condenser systems:

- Synchronous condenser
- Static/brushless exciter
- Control, protection, synchronization, and excitation system
- Step-up transformer
- Auxiliary transformer
- Condenser starting system
- Cooling system for the condenser
- Lubrication oil supply
- Other equipment as needed



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