Webinar: Deploying synchronous condensers to boost grid quality and resilience

Presentation Abstract—The intermittent and variable nature of renewables – particularly solar and wind – reduces network stability. Synchronous condensers (SynCon's) with their rotating inertia can help to maintain grid quality and fault support. They represent an old, well-proven technology that is now in demand for its ability to mitigate network issues and compensate for the increasing penetration of renewables.

Guest expert, Christian Payerl, Sales Manager for Synchronous Condensers, ABB Motors and Generators, responds to some of the live audience questions that were received throughout the online discussion.

How big should a grid system be in order to install a synchronous condenser?

The synchronous condensers can be in size applied to any type of grid size and strength from Microgrid to big grids. But it shall be noted, that during transient conditions in the grid, a decentralised approach is better, meaning that SynCon´s shall be installed in different parts of the grid to increase the total system inertia, as well as provide short circuit contribution in the whole grid, not only somewhere centralised.

Assuming the rotor of a modern condenser is asynchronous enabling it to absorb and deliver real power—Practical use is frequency control using condenser as a flywheel. Can you comment?

Synchronous Condensers are synchronous machines, providing MWs (inertia) to the grid based on their natural behaviour to run at synchronous speed. If there is a frequency deviation in the grid, the SynCon will, based on its inertia (in the rotor stored kinetic energy) try to slow down the Rate of Change of Frequency (RoCoF).

With a fly wheel connected to the SynCon, this inertia can be increased with that influence even better to the delta f. During faults the synchronous condenser will also provide grid support, by delivering short circuit current (based on the reactance of the SynCon). This type of grid support can be extended

by via field forcing provide cap. current to the grid. In addition, the SynCon can participate in the voltage control scheme, by controlling the excitation of the machine.

What is the demand forecast (how many units) for Synchronous Condensers in Europe in next five years?

About 10 - 30 projects are expected. Yes, but SynCon will have their share.

How do you select the size of the condenser for a given size of renewable plant?

The selection is based on the requirements put forward by the Transmission System Operator (TSO). Unfortunately, there is no common practice used by the TSO´s in different countries, BUT a practical approach by the Australian regulator, AEMO, is using a kind of tum rule - for short circuit contribution: SCR at point of connection, shall not be below 3,0. For inertia: the renewable plant shall participate with a similar amount of inertia as a synchronous generation plant would provide. Based on the energy mix used, they are using H-factors as the multiplier of the MVA amount for the renewable plant. The H-factor is normally between 2.3 to 2.0.

Which party is responsible for implementing the location and the operation of condensers? Transmission companies? Is it up to each operator to decide an implementation of such technology?

The decision if and where SynCon´s shall be used is very much based on the regulators/TSO´s intentions and planning. In Australia, this is very much regulated by the regulator AEMO, who is requiring SynCOns for each new connected renewable plant. In other countries this is still more centralised controlled, such as in Germany or some regions in the United States of America.

In general, it can be said that there would be an advantage for the total system strength to implement a similar approach to Australia, as this will provide a more decentralised system strength approach. If we are talking about tap changer voltage control, which is a good way of voltage control in a typical power system, but in future, when DER and RES are getting more common, this voltage regulation will not work and other solutions for voltage control are needed.

Does the inertia constant of the machine decrease with the size of the Synchronous Condenser in MVA? And do 'high-inertia' machines have lower efficiency?

As per our experience the inertia constant is not changing a lot between different optimised machines, BUT in ABB´s case we have the possibility to add a fly wheel solution to a quite small machine. This means that the inertia constant for this arrangement can be up to 6.5 - 7.0 OR expressed in MWs around 450MWs. The advantage is that even when the requirements for inertia is high, the customer does NOT need to buy a big machine.

As SynCon´s are often running just a few MVAr´s, there is an advantage to use smaller machines (because of the losses). In the Phoenix project in the United Kingdom, we used a 70 MVA machine providing about 90 MWs, but the same type of machine could be used to provide around 450MWs inertia when adding a fly wheel. The efficiency for ABB´s fly wheel solution is very good, as the additional losses in the fly wheel are small compared to the losses in the machine.

See more news on the Phoenix project here.

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