

Design considerations for S/S with SynCon's with high inertia fly wheels:

In more and more countries requirement for additional inertia and fault contribution in the transmission and distribution grid leads to integration of synchronous condensers (SynCon) in substations. Often are the requirements for inertia and/or fault contribution transferred to renewable energy developers and their EPC contractors, which shall include SynCon's in the scope of the wind/solar farm. These contractors have wide experience of conventional substation design, but they are NOT used to SynCon's and especially SynCon's with high inertia flywheel solutions. High inertia SynCon's with flywheel require special attention related to auxiliary systems and eventually of the enclosure of the fly wheel of the SynCon. The aux. power supply shall be designed to secure aux. power supply during, in the worst case, several hours of run-down time to secure the operation of the lubrication system and ev. vacuum pumps for the flywheel.

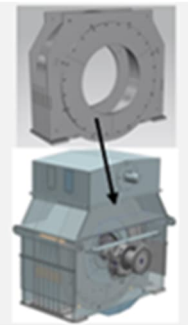
In many cases SynCon's are equipped with emergency lubrication tanks on the bearings, which allows a controlled run-down without damage to the bearings, surrounding equipment and people, even in case of a fault in the aux. power supply. But for high inertia fly wheel solutions there is a risk, which need to be considered and mitigated.

For example:

- 1) a mechanical protection system for the fly wheel

**Risk control, acc to PD project "FW2.0"**

- High quality forged steel, extensive testing
- Divide Shaft and FW (less fatigue ampl.)
- 2x "tandem" FW discs (less consequence)
- Utilize an integrated protection cage
- Advanced calculations performed: FW burst case, cage strength, anchoring stress, foundation stress, etc. (ABB and external)



- 2) auxiliary power system, which will provide aux. power supply even when the connection to the grid HV or MV is in black-out.

Solutions for that are carefully dimensioned UPS systems or diesel generator set's, which quickly can provide the aux. power to the lubrication pumps and to vacuum pumps. Please keep in mind that we speak about hours!

- 3) Auxiliary power system, may also be tested during commissioning, that undervoltage trips in the aux. system is NOT disconnecting important loads such as lubrication pumps, which shall be fed via UPS.

Beside above cases also the use of generator circuit breakers and the evaluation of the fault level in multiple SynCon installations is of importance. This may even require additional protection such as Is-limiters.