



Energiforsk GINO

-Grid Interference on Nuclear
power plant Operations

Urban Andersson, Energiforsk

Photo: Annika Adler-Örnberg

Nuclear portfolio:

VATTENFALL



**uni
per**

tvo

fortum



Additional members:



GINO – short facts

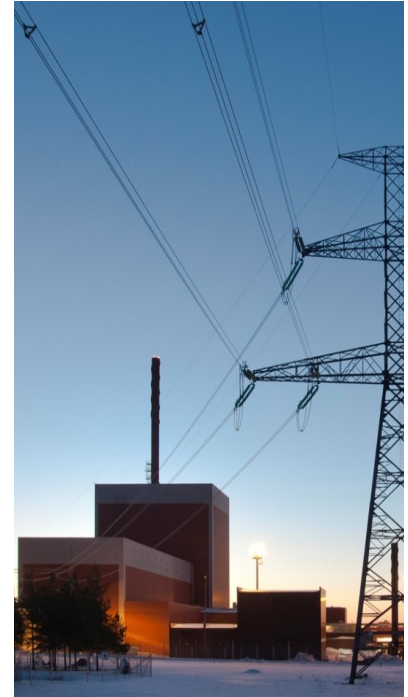
- Vision: The external grid should not cause any unforeseen impact on systems or functions causing interruption in any plant state.
- Annual budget 2,0 MSEK
- University researchers and consultants
- Cooperation with Finnish R&D program SAFIR and other Energiforsk activities



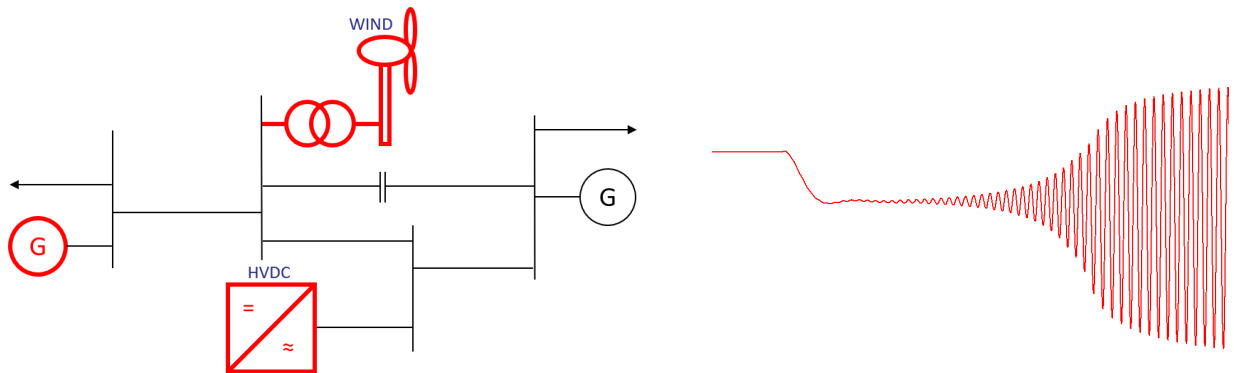
Photo: OKG

Focus areas

- System interaction
- Design principles
- Components
- Replacement strategies



Sub-synchronous oscillations between FPC wind farms, VSC-HVDC links and nuclear power plants

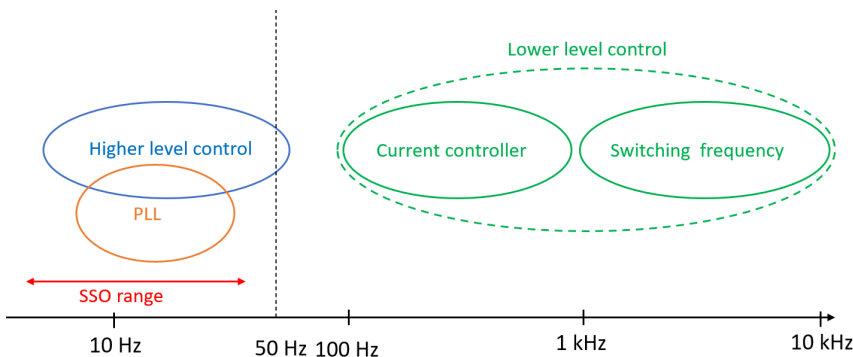
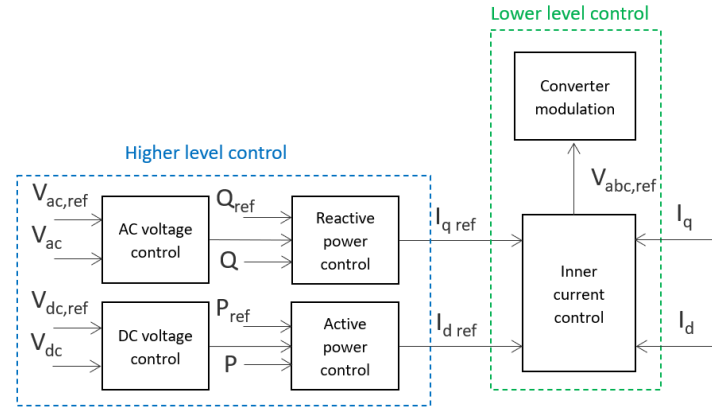


[Energiforsk report 2020-707](#)

Lena Max, Andreas Petersson and Pehr Hjalmarsson, Protrol

Voltage Source Converters

- Many different topologies are used for grid connected VSCs.
- Looking at the dynamic operation of the VSCs, SSO occurs in the same time range as the lower level controls (such as AC voltage controller) and the phase locked loop (PLL).



Conclusions for SSO

- The risk of SSO increases if:
 - The VSC is large
 - The VSC and the synchronous generator are electrically close
 - The grid is weak
- The risk of SSO can be predicted by design parameters.
- The controller of the VSC has a large impact on the risk of SSO and also determines the possible frequencies for SSO.
- For a wind park, there can be differences between the converters that affects the results.