

RESEARCH QUESTIONS

In offshore platforms with high penetration of wind power:



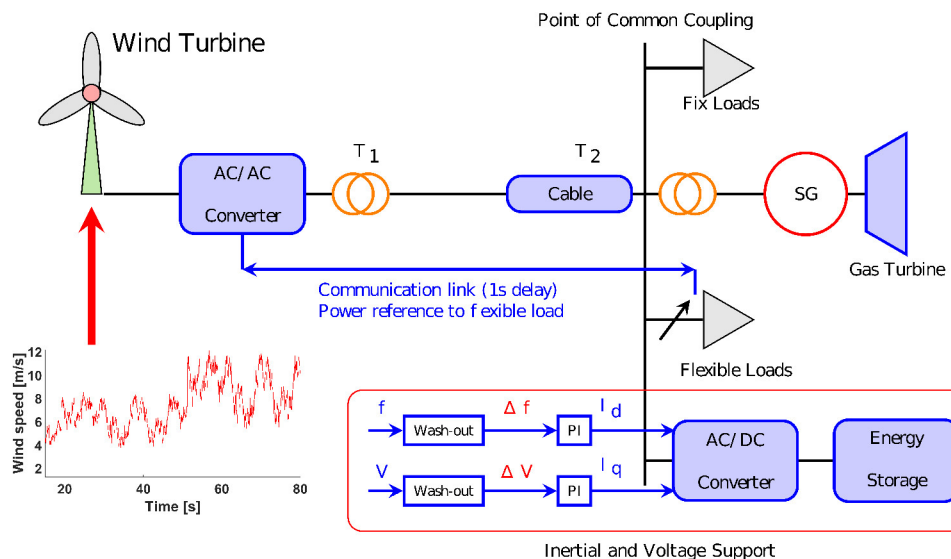
1. Which **power quality** problems in the **time-scale of seconds** appear with **no power from shore**?
2. How **energy storage** can improve **power quality**?
3. What influences the **sizing of the energy storage**?

CONTACT INFORMATION

R^G <https://tinyurl.com/HES-OFF>

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METHOD



System modeling in Matlab/Simulink
↓
Check influence of wind variation on f and V
↓
Check influence of energy storage

Equipment data
Gas Turbine 25MW (GE LM2500)
Wind Turbine 6MW (Hywind Scotland)
Flexible loads 3MW (water injection)
Fix loads 25MW (other motors)
Energy Storage 3MVA rated / 5MVA peak

RESULTS

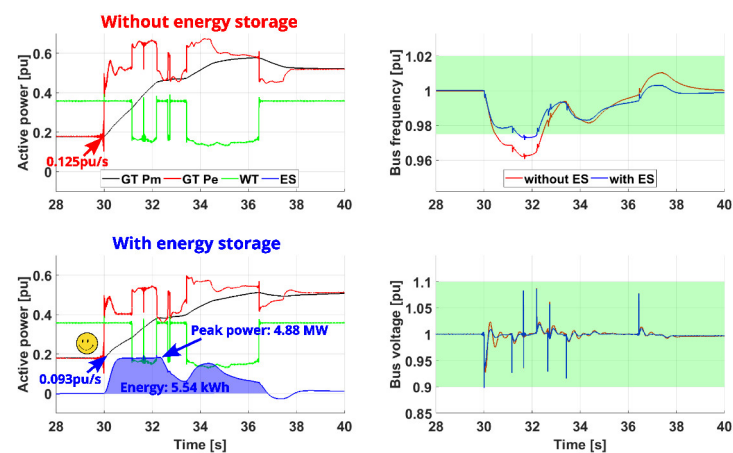


Figure 1: 10 MW load is switched on (1 pu = 25 MVA)

Electrical power quality problems:
 $\uparrow \Delta f$ \Rightarrow \uparrow governor actuation \Rightarrow \uparrow wear and tear
 $\uparrow \Delta V$ \Rightarrow \uparrow ($P_m - P_e$) \Rightarrow \uparrow mechanical stresses

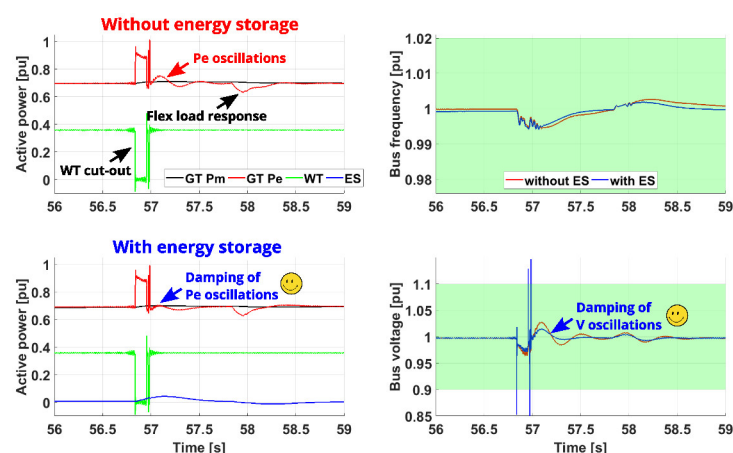


Figure 2: Wind power stops due to cut-out (1 pu = 25 MVA)

Energy storage as inertial and voltage support:
 $\downarrow \Delta f$ oscillations \Rightarrow \downarrow wear and tear
 Shorten $\Delta V / \Delta P_e$ oscillations \Rightarrow \downarrow mechanical stresses

CONCLUSIONS

- | | | |
|-------------------------------|--|---|
| 1 \uparrow wind penetration | \Rightarrow \downarrow power quality | \Rightarrow \uparrow maintenance + \downarrow reliability |
| 2 Energy storage | \Rightarrow f and V support | \Rightarrow \uparrow power quality |
| 3 Energy storage MW | \propto max(wind penetration) | + max(load on/off) |
| 4 Energy storage kWh | \propto control parameters | \Rightarrow frequency droop |