Paris Session 2022

Impact of reduced fault level on power system phenomena

SC C4

Question 21: What practical and/or simulation-based experiences is there on the impact of high share of large-scale and distributed inverter-based resources including both the grid-forming and grid-following inverters on power system stability, power quality, protection systems, and insulation coordination and what are the most suitable screening methods to provide an early understanding of the likely issues?

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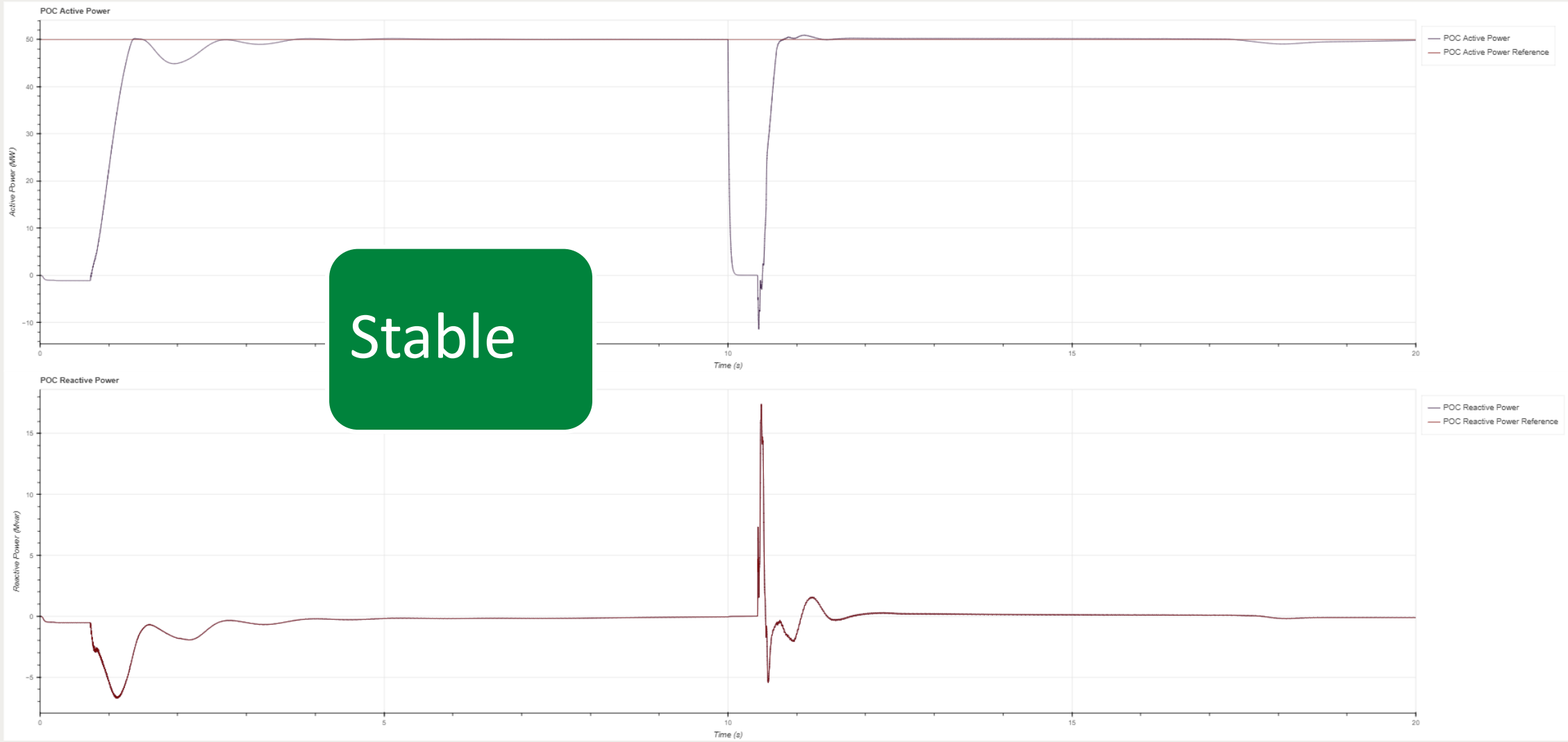
Impact of reduced fault levels

Phenomena	Typical frequency range	Circuit theory	Relation to control bandwidth	Factors influencing	Overall impact
System stability (inc. protection)	< ~300 Hz	If ↓ → Z ↑ ↓ SCR=(1/Z) ↑	Within	☑ Control systems ☑ Circuitory	↔
Power system harmonics	>50/60 and < ~10 kHz	↑ ↑ ↑ Vh= Ih x Zh	Often outside	? Control systems ☑ Circuitory	↔ SHE work in progress
High-frequency transients	> ~ 3 kHz and up to a few MHz	L ↔ C	Outside	✕ Control systems ? Circuitory	●

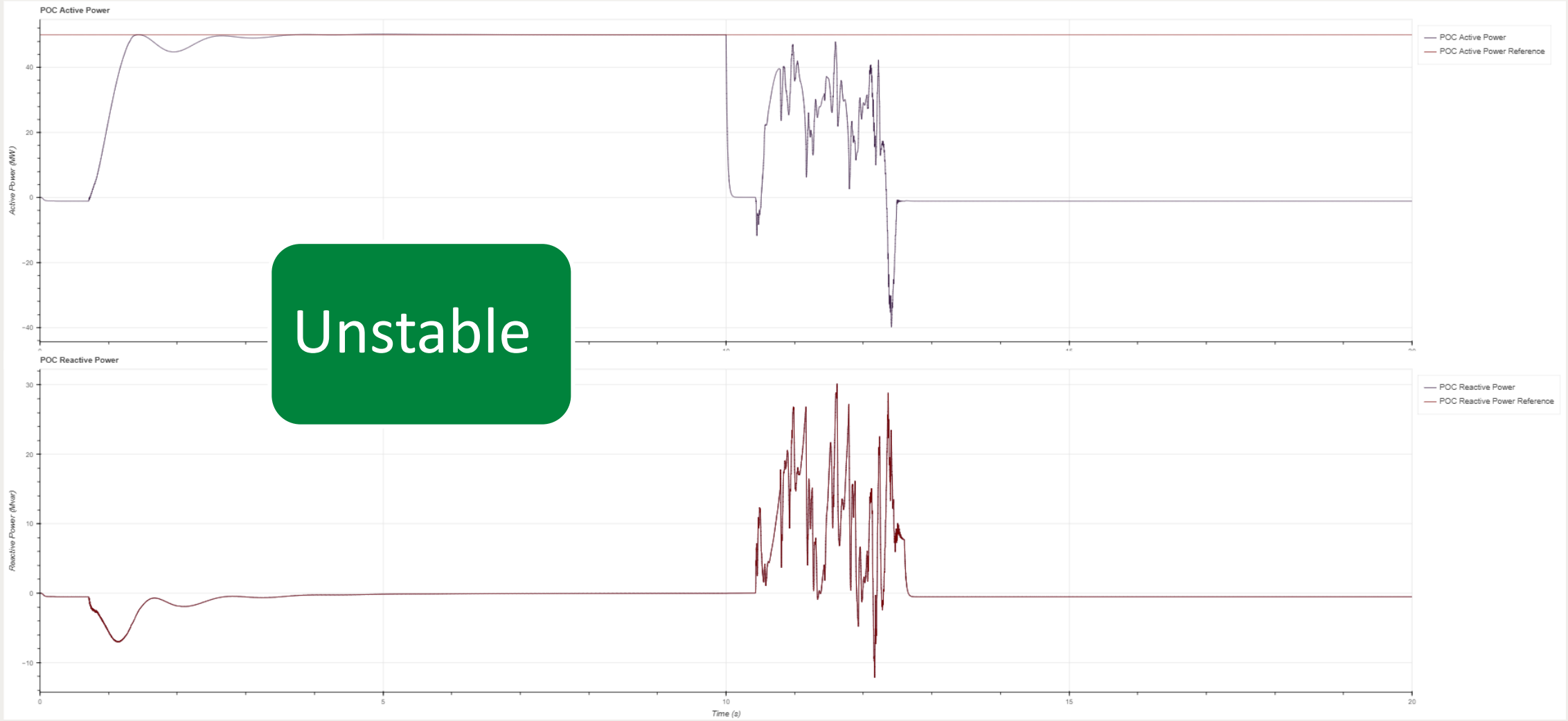
Circuitory includes transformers, lines, cables, filters, and converter bridges (inc PWM)

Impact of SCR variations on stability of example grid-forming inverters (low SCR)



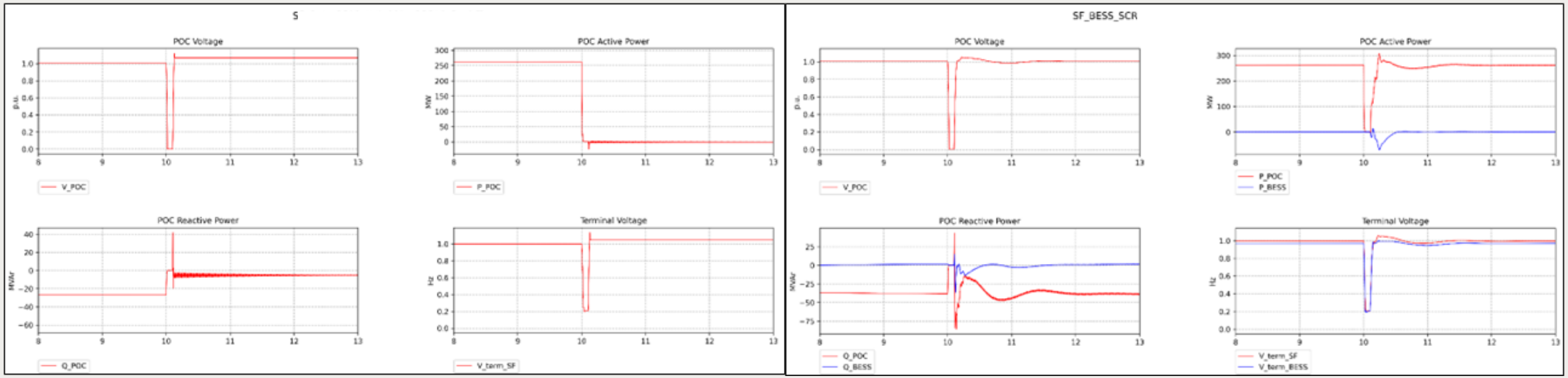
Stable

Same grid-forming inverter under very low SCR conditions



Unstable

Example demonstrating the stabilising impact of grid-forming inverters



Failed ride-through without grid-forming inverters

Successful ride-through with grid-forming inverters