

Q1.04 Are phasor-domain inverter models sufficient for most protection coordination studies and what are the key criteria for deciding when EMT simulations are preferred for evaluating protection performance over conventional phasor-domain short circuit Studies?

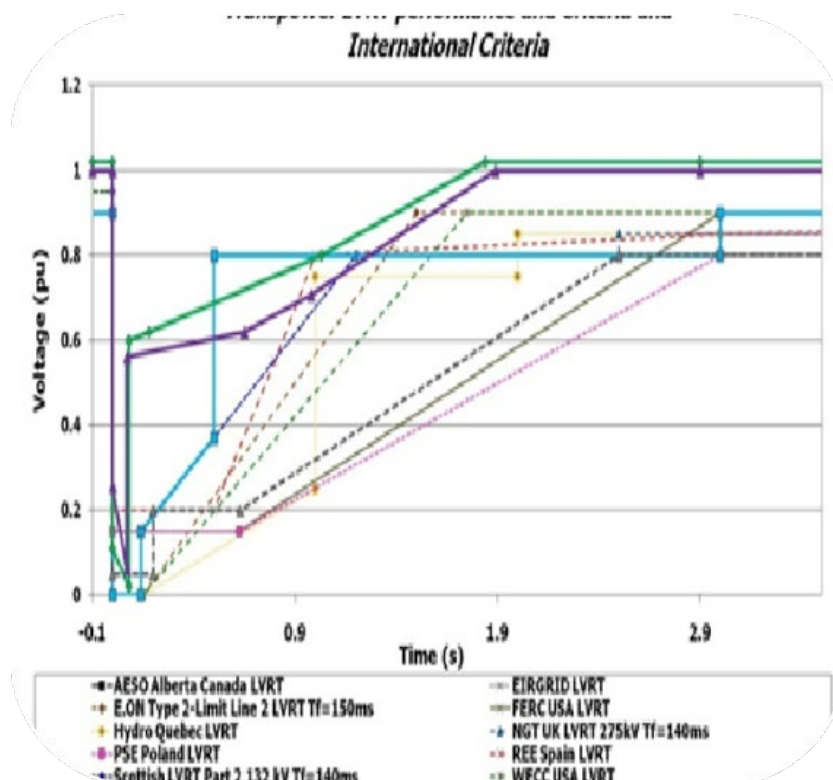
EMT simulations for Fault-Ride Through (FRT) Settings of Renewable Energy Plants, Meshed Distribution networks and Black-start protection studies

- This contribution is based on TB 810 material recently published.
- Existing black-start simulation and protection studies will need to be better understood for both traditional and emerging system dynamics on low-inertia and low-fault current networks. One of the emerging consequences of low-inertia network is modelled (Transient and Dynamic) and observed (PMU) changes to network frequency dynamics.
- These changes are being observed during normal, abnormal and extreme event progression.

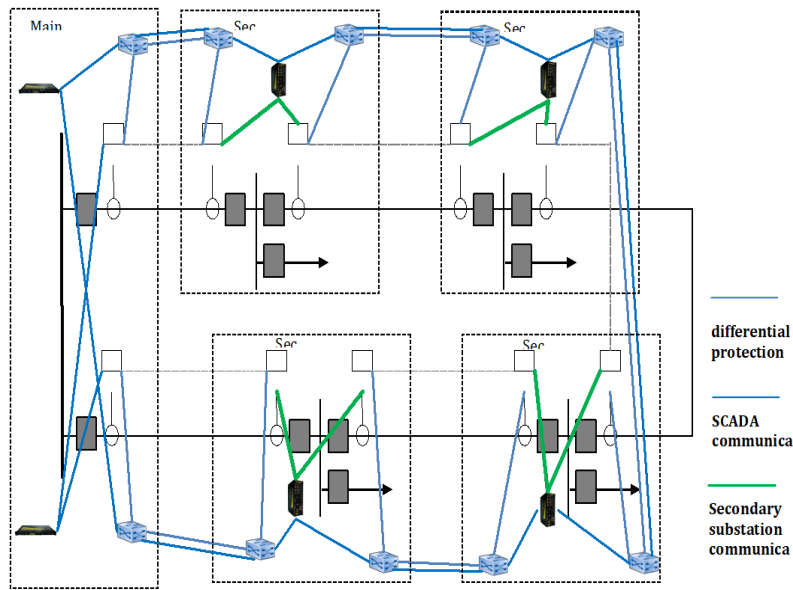
Three examples given here to answer question PS 1: Q 1.03.

First Case: Blackout propagation have been attributed to Fault-ride through settings of large-scale wind farms in recent years.

- A particular incident with regards to multiple lightning strikes accompanying a high-impact low probability event in South Australia has been discussed in TB 810
- Should the large-scale wind generation plant trip or not during large-scale grid disturbance, usually accompanied by a fault will need to be revisited and EMT simulations can help.



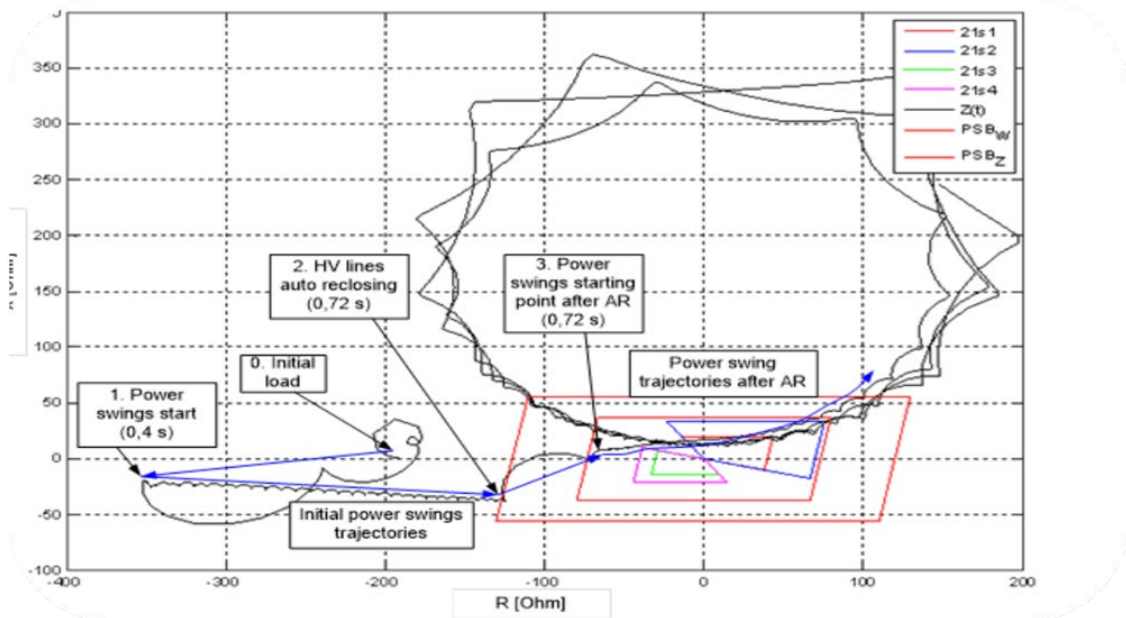
Second Case: Meshed Distribution Networks



- **Low SC Current- Protection Philosophy and Setting Changes:** The meshed nature of distribution network will require changeover from over-current relay/recloser/fuse coordination philosophy to other schemes like differential, travelling wave, sensor based, Machine-Learning/AI based etc. potentially requiring EMT simulations.

Third Case: Black-start Protection Studies

Figure below picked up from TB 810, illustrates this.



- **Lower System Inertia- Challenges in accommodating black-start dynamics alongside normal power swing-distance protection coordination.** EMT simulations can help coordinate better timing with the various interactions with the synchronous machine and turbine dynamics.