

Siemens Wind Turbine Weak Grid Option Modeling in PSSE WECC library

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Background

- Wind power penetration increased
- More weak grid interconnected projects
- Weak grid projects experienced voltage oscillations and turbine tripped
- Weak grid option(WGO) was applied in projects to help stabilizing turbine/POI
- ISO/Utility demand WECC model but WECC library model don't have this option

Weak Grid Definition

What is a weak grid?

 Short Circuit ratio (SCR) refers to 3-phase short circuit level MVA divided by the aggregate turbine MW at point of interconnection (POI)

 An SCR above 4 is recommended to ensure steady-state stability in VDN Transmission code 2007 (Germany)

• SCR≤ 4 is considered a "weak grid"

• Siemens wind turbine can be tuned to work for SCR=1.5

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Wind Project Challenge for Weak Grid Connection

Main concerns:

• Low frequency voltage/power oscillations from small signal disturbance

• FRT capability—voltage/power stably restored after fault is cleared

 HVDC or Series capacitor connected wind plants has difficulty to restore stable operation after fault is cleared

WGO Control Strategy



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Wind Plant Performance without WGO(SCR ≈1.7)



Scenario 1. Standard wind turbine control

- a) 3 phase fault is applied at 1s.
- b) After fault is cleared, the turbine ramp up the output active power
- c) The turbine output reactive power dropped quickly
- d) The grid voltage lose wind plant support and get another dip
- e) Wind turbine in FRT mode again, which gain more reactive power/voltage support
- f) FRT in-out is repeated to cause the oscillation



Wind Plant Performance with WGO(SCR ≈1.7)



Scenario 2. Wind turbine response with WGO applied

- a) After fault is cleared, the active power is not ramped to the rated power immediately
- b) The turbine output reactive power to support POI voltage
- c) Turbine restore stability and ride through the fault



Discussion: How to model WGO in WECC

- 1. Control is on turbine level and applied in projects
- 2. Siemens has WGO in PSSE user defined model
- 3. How can WECC implement WGO in the library model?