

NERC Lessons Learned and Industry Recommendation



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- Lessons Learned
 - Loss of Wind Turbines due to Transient Voltage Disturbances on the Bulk Transmission System
- Industry Recommendation
 - Loss of Solar Resources during Transmission Disturbances due to Inverter Settings

- NERC lessons learned published July 11, 2017: Loss of Wind Turbines due to Transient Voltage Disturbances on the Bulk Transmission System
 - Two specific examples: Australia and Texas
 - Voltage disturbance events have highlighted concerns with wind turbine control system parameters

- September, 2016
- Five transmission system faults within period of 87 seconds
- Of 1,826 MW of load, 883 MW supplied by wind generation
- Voltage disturbances caused 456 MW of wind generation to trip offline
- Tie line to the rest of the Australian grid relayed out on over current and South Australian grid blacked out

- 5 separate events where line faults or bus faults resulted in temporary loss of wind generation
- Each event showed loss of several hundred MW of wind generation resulting from a low voltage excursion caused by a transmission fault

- Following September, 2016 event, Australian Energy Market Operator worked with plant operators to improve the voltage ride-through settings to not trip during such voltage excursions
 - In March, 2017, there was a voltage disturbance event and all of the wind generation was able to ride-through showing the new control settings were successful

- ERCOT noted several different issues:
 - Failure of the wind turbine auxiliary uninterruptible power supplies (UPS)
 - Did not have functioning “Smart Crowbar” hardware, preventing ability to properly ride-through
 - Ride-through tuning parameters similar to Australia

- Wind generation owners should verify voltage ride-through capabilities and ensure correct models provided to the BA/TOPs
- If units lack ride through capability, contact RC to model loss of generation as a contingency and properly control to it
- Wind generation owners should verify that UPS and “Smart Crowbar” systems are maintained and functioning properly
- High speed PMU data is critical for visibility to analyze tripping data and make tuning parameter changes

- NERC industry recommendation published June 20, 2017: Loss of Solar Resources during Transmission Disturbances due to Inverter Settings
- Potential characteristic of some inverter-based resources, particularly PV, reduces power output during fault conditions
- Potential risks to BPS reliability
- With increase in PV, need for industry knowledge/action
- Industry should identify reliability preserving actions to reduce impacts if widespread loss of solar during faults

- Several events involving faults on the transmission system resulted in the loss of a significant amount of solar PV generation
- Most significant event resulted in the loss of ~1,200 MW
- Facilities ceased output in response to transient faults
- Largest percentage of loss was attributed to incorrectly calculated low frequency condition causing unit to trip
- Second largest contributor was inverter “Momentary Cessation” due to system voltage reaching the low-voltage ride through setting of the inverters

- Review the 1,200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report for more technical and detailed description of inverter behavior
- GO and GOP should ensure inverter controls will not trip due to an erroneous instantaneous frequency measurement during transients on the power system

- If inverters momentarily cease to inject current for voltages above 1.1 p.u. or below 0.9 p.u. during abnormal voltage conditions, GO and GOP should ensure the time to restore output of the inverter to pre-event state as soon as practical but no greater than five (5) seconds
- Inverters may continue producing real and reactive power outside of the ride through operation conditions defined by PRC-024-2 unless other actions are required as part of a special protection scheme, to protect the inverter from damage, or to isolate the faulted equipment directly connected to the inverter

- If equipment identified left unmitigated, RC and BA should consider in their daily resource plan the potential for the loss of these resources during transmission faults on the power system and take appropriate mitigating measures
- GO and GOP should provide their responses to the questions in this alert for each plant in service to NERC and to their RC, BA, and TOP for each respective site(s) area where the plant is located

- PJM Generation Department contacted NERC-Registered solar resources requesting copy of data sheet being sent to NERC
 - Data has been received and being analyzed
- PJM also plans to poll other inverter-based resources using NERC-provided spreadsheet as a template
 - Data needed for operations planning purposes
 - This will be expanded to include non-solar inverter-based resources (e.g. wind, storage)
 - Will also include questions regarding reactive and voltage regulating capability