



Overview of Voltage Ride-Through Study, pursuant to OGRR208

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Background

- **OGRR 208 required ERCOT to complete a study of the need for additional VRT capabilities on existing wind generators (WGRs)**

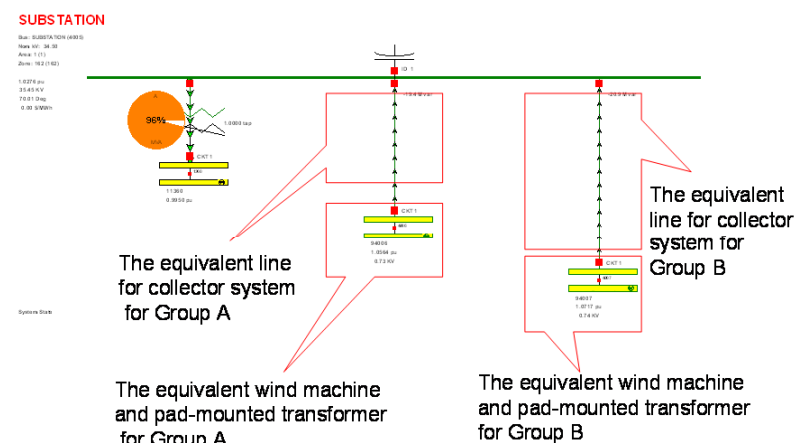
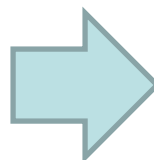
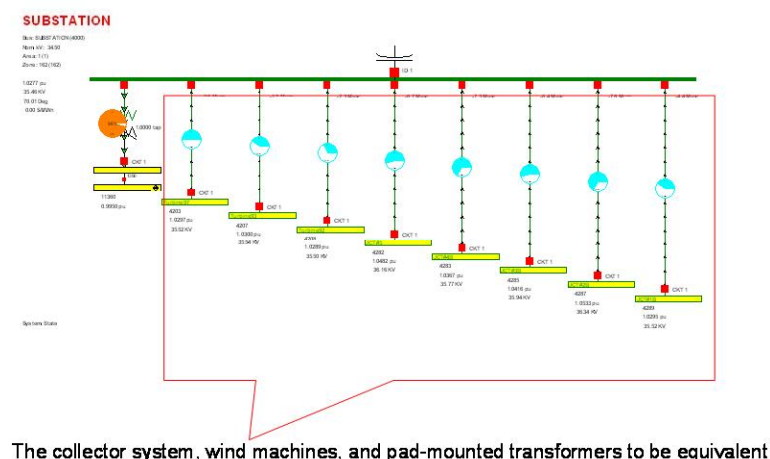
WGRs that are part of a Generation Interconnect Agreement signed prior to November 1, 2008 shall provide information requested by ERCOT, including existing WGR VRT capabilities, for a study to evaluate the need for additional protective relaying and VRT requirements applicable to some or all such WGRs. The study will be conducted using the 2009-2010 transmission system as determined by ERCOT. The study shall be conducted by a qualified organization having no real or apparent bias and with no financial interest in the outcome of the study. ERCOT shall publish study results and provide recommendations to ROS no later than the scheduled ROS meeting of June 2010.

Study Overview

- **ERCOT Issued an RFP and contracted with Parsons Brinckerhoff (PB) World to perform study**
- **Study is made up of three Phases**
 - **Phase I** (completed and presented to Board in Nov. 2009)
 - Perform dynamic fault studies with datasets updated by existing information from WGRs to prepare for Phase III Study
 - **Phase II**
 - Obtain detailed additional and updated information from individual WGRs to develop appropriate WGR dynamic modeling
 - **Phase III**
 - Perform dynamic fault studies with improved modeling information from Phase II
 - Include any knowledge gained from Phase I
 - Identify any reliability problems and investigate solutions

Phase II

- Gathered detailed info on each plant, including turbines, collector lines, reactive devices, transformers, etc.
- Developed detailed model for each wind plant
- Developed aggregated model for each wind plant
 - Standardized process for aggregation



- Performed test simulations of behavior of detailed versus aggregated model on steady-state, dynamic and short circuit characteristics to show validity of aggregation

Phase III

- **Ran dynamic simulations of faults on the system at various key locations**
 - 65 normal clearing and 31 breaker failure events simulated
- **Several scenarios:**
 - High Wind/High Load (HWHL) – 58GW load, 4.8GW west wind
 - High Wind/Low Load (HWLL) – 36GW load, 4.3GW west wind
 - CC1 - HWHL w/no conventional gen in west – 5.1GW west wind
 - CC2 - Same as HWHL with dynamic load modeled in the west
 - CC3 – Same as CC1 with dynamic load modeled in the west
 - CC4 – Low pre-fault terminal voltage
- **Evaluated response based on:**
 - MW of wind gen tripped – MW dispatched and installed capacity
 - Voltage recovery
 - Frequency response

Results

- **Worst NERC category B contingencies trip about 990MW of wind capacity dispatched at about 600MW**
 - Less than largest single unit contingency
- **Worst NERC category D contingency that was studied trips about 1800MW of wind capacity dispatched at about 1200MW**
 - Less than the 2300MW responsive reserve requirement
- **Transfer level modeled in CC3 with no conventional generation on-line in the west resulted in voltage instability (unrelated to VRT capability)**
 - Have evaluated and set W>N voltage stability limit to be enforced in actual operations for when no conventional gen is on-line in west

Action Items

- **“... additional protective relaying and VRT requirements...” for pre-November 2008 wind generators not needed**
- **ERCOT and appropriate Working Groups to develop process/format and have generators submit detailed and aggregated models from VRT Phase II into RARF**
- **ERCOT to modify generation interconnection procedure to provide for development of aggregated model by the TSP through interconnection process funded by generator**
- **TSPs and ERCOT to look for low cost solutions to mitigate risk associated with specific category D contingencies**
- **ERCOT to prepare NOGRR to synchronize VRT requirements with OGRR 208**

Questions?