Model Verification of Generation Systems in ERCOT

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Background: This proposal is written as an expansion of Task 2A in the description of the project titled *Use of synchronized sampling in substations and system-wide applications* ".

Problem to be solved: Computerized power system modeling and studies are the common practices among utilities to evaluate the performance of the power system and ensure the reliability and security of the system operation. The simulation results are highly depending upon accurate computer modeling of the transmission, generation, and other facilities in the area.

Similar to other power systems, there are some mismatches between simulation results from current dynamic stability analysis data and the real-time event recording information in the ERCOT. Though the mismatches can be reduced after data tuning, it is time consuming and there is no guaranty that data is correct and good enough to predict the responses of future events. It will be difficult for power system planner to predict system responses during different possible incidents and establish effective counter measures to ensure system security. It is important for ERCOT to verify the accuracy of parameters that have been used in the system simulation to ensure the reliability and security of the system.

Historically, actual verification of computer models via field tests would have been either impractical or even impossible. Typical monitoring equipment available to most utilities did not have the features, data formats, or resolution required to evaluate the model accurately. The newly developed Intelligent Electric Devices (IED) and Phasor Measurement Units (PMUs) class of monitoring, control, and protection equipment can now provide the model verification required information with better resolution and time synchronization among measured data.

Approach for solving the problem: This proposed task utilizes historical and real time measurements from the Supervisory Control and Data Acquisition (SCADA) and Energy Management System (EMS), protection relays, system protection schemes, fault data recorders, PMUs and other IEDs to verify generator response modeling and load response modeling. The pattern recognition technology and sensitivity analysis will be used to identify and correct key parameters that affect the system response by using historical information, off-line power system simulation results, and the real-time measurements. In addition to the commercially available software (i.e. PSS/E™, Power World™) other software will be developed for this purpose. The approach for solving the problem is listed below:

- Data collection
  1. Obtain ERCOT power flow and dynamic stability data.
  2. Obtain snap shots of power flow and voltage profile information of ERCOT from SCADA/EMS.

3. Obtain recording information of historical incidents of ERCOT from relays, DFRs, IEDs, and PMUs.

- Steady state power flow and voltage profile verification
  1. Perform and compare power flow analysis of ERCOT system on both Power World and PSS/E.
  2. Power flow of pre- and post-event will be performed and compared with the recording information from SCADA/EMS.
  3. Identify key parameters that affect the study results.
- Dynamic generator and load model verification
  1. Perform dynamic stability analysis of ERCOT system
  2. Load model verification
  3. Generator model verification

Deliverables: The deliverables are described below.

- Steady state power flow and voltage profile verification
  1. Software program to convert data from PSS/E and SCADA/EMS to the format of Power World automatically. This step can be simplified if Power World format of ERCOT power flow information is available.
  2. Procedure of using pattern recognition technology and sensitivity analysis to identify key parameters that affect the study results.
- Dynamic generator and load model verification
  1. Load model verification
     - Develop dynamic load models for the load within the studied area.
     - The load models for the feeders within ERCOT will be established whenever the data is available during the project period.
     - Standard procedure for further load model establishment and improvement.
  2. Generator model verification
     - The generator models/parameters will be verified and corrected whenever the data is available during the project period.
     - A standard procedure will be established for further model improvement.
     - Procedure of using pattern recognition technology and sensitivity analysis to identify key parameters that affect the study results.

Expected benefits to ERCOT: The potential benefits of the development are:

1. Verify generator response modeling and load response modeling to improve the accuracy of ERCOT's dynamic stability analysis data.
2. The simulation results will match the real-time event recording information. ERCOT will be able to use the simulation results to predict the responses of future events and develop counter measures to secure system operation with confidence.
3. ERCOT will be able to use the information to identify the weak spots, estimate system margin for system operation and possible infrastructure improvement.

Budget: Two graduate students and one summer month for the PI, including travel expenses, lab support and overhead. The total is $93,000.00.