ELECTRIC GRID RESEARCH

Project Summary

WECC Wind Generator Modeling

Context

The wind turbine models that are currently used in transmission system planning and reliability analyses are known to be inaccurate, and do not represent the new generation of wind machines correctly. Incorrect or uncertain analyses of the impacts of wind power generators dynamic behaviors on the grid can adversely affect both planning and economic and reliable operation of the California electric delivery system.

Proprietary models written by turbine manufacturers for specific generators exist, but in many cases are not readily available, and typically require a non-disclosure agreement (NDA), which constrains their use in a collaboratively controlled transmission system such as the Western Electricity Coordinating Council (WECC).

WECC has assigned the task of developing standard, non-proprietary wind turbine models to their Wind Generator Modeling Group (WGMG), and has chosen four specific generic types of wind turbine machine designs that are believed to represent the vast majority of the utility-scale wind turbine generators in the market today. Utilizing WECC funding, the WGMG has completed the research and development of these four models, which will be used in WECC system simulation studies.

Goals and Objectives

The overall result of this research will be improved transmission planning and operating modeling tools needed to better prepare the transmission grids in California and western North America to accommodate the expected growth in wind power generation in order to meet Renewable portfolio Standard goals, especially California's relatively aggressive ones.

This research and development effort will make available accurate, non-proprietary models of the various types of wind turbines in commercial use today. The specific objectives of this project are to validate the new WECC wind turbine models, and to develop aggregation methods to use the individual models to develop an equivalent, aggregated model of an entire wind farm.

Description

The project will collect and monitor data from several wind power plants representing the four types of wind turbine models developed. Validation of the models will be through two processes. First, model predictions will be compared to the data collected from operating wind power plants. Additionally, model performance will be compared to available high order proprietary models from manufacturers.

The project will develop a methodology to aggregate individual wind generators into a model which represents an entire wind power plant by an equivalent single turbine representation or, if necessary, with a small number multiple turbine representation.

Finally, it will develop guidelines and recommended practices for wind turbine model and wind power plant representation.

Key Results/Conclusions

Dynamic models for each of the 4 types of wind turbines were successfully validated using both wind power plant data and comparison to proprietary models from manufacturers. A method of aggregating an entire wind power plant into a single equivalent turbine was developed along with 2 guide books for doing this, one for power flow and one for dynamic modeling.

Why It Matters

California has established aggressive goals for renewable energy penetration. Since the majority of new renewable energy is expected to be wind energy, validated dynamic models play a critical role in optimizing the balance between minimizing cost and ensuring reliability of the transmission system.

The existence of these models will enable planners, operators and engineers to design real time controls and protective systems that properly reflect the characteristics of modern wind turbines. In addition, researchers at the universities and National Laboratories will have access to validated wind turbine models to conduct further research.

Inaccurate models can result in either not having enough transmission resources, raising the risk of shortages and disruptions, or having too many resources, resulting in economic inefficiencies.

{More details}

ELECTRIC GRID RESEARCH

Project Summary

WECC Wind Generator Modeling

Participating Organizations

Principal Investigator:

National Renewable Energy Laboratory

Research Partners:

California Independent System Operator,
Pacific Gas and Electric
Southern California Edison
Utility Wind Integration Group
Department of Energy
Bonneville Power Administration
Western Electric Coordinating Council
Oak Creek Energy Systems,
Electric Reliability Council of Texas

Project Start Date: May 1, 2007

Project End Date: March 31, 2010

CIEE Contract No.: MTX-07-01

CEC Contract No.: 500-02-004

CEC Work Authorization No: MR-065

Reports

Final Report including Appendices I and II: *WECC Wind Generator Modeling*

Appendix III: *Wind Power Plant Equivalencing*
Appendix IV: *Wind Power Plant Data Collection*
Appendix V: *Model Validation of Wind Turbine Generator*
Appendix VI: *WECC Wind Power Plant Power Flow Modeling Guide*
Appendix VII: *WECC Power Plant Dynamic Modeling Guide* (Not yet available)

Funding

Funds for this project came from a $574,000 award by the California Energy Commission (CEC) through the Public Interest Energy Research program (PIER)

For More Information, Contact

Dr. Merwin Brown,
CIEE Electric Grid Research Program Director
(916) 551-1871
merwin.brown@uc-ciee.org