Introduction to Integrating Distributed or Renewable Generation Minitrack

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Distributed and renewable technologies in the electric power industry are advancing rapidly, highlighting the need to better understand both their technical and the market integration, and to develop new tools for system planning, operations and control strategies. The papers in this mini-track address modeling, simulation and hardware developments relating to planning, operations and control, as well as economic and market issues, and include system analyses and case studies.

Electricity market restructuring, advances in energy generation technology and agreements on the reduction of global greenhouse gas emissions encourage increased penetration of renewable generation connected at both the transmission and distribution levels. With wind generation currently having the largest share of the new capacity, and solar generation having the highest rate of growth, this trend is expected to continue to produce an increasing amount of variability and uncertainty in system generation portfolios. In the first session, the paper titled “Flexible Wind Dispatch, System Reliability and EPA’s Clean Power Plan” discusses the US EPA’s current policy for reducing pollutant emissions from existing power plants and analyzes the effectiveness of additional options for such reductions. The paper “Optimal Power Flow with Random Wind Resources” presents a stochastic OPF with chance constraints for wind integration, including case studies to support the theoretical analysis. A second stochastic model for integrating renewables and demand response is developed in “Comparing Robust and Probabilistic Reliability for Systems with Renewables and Responsive Demand.”

This paper presents a strong background in the topic, along with case studies to demonstrate the model. The final paper in this session, “An integrated agent-based and production-cost modeling framework for renewable energy studies,” combines standard production cost with behavioral agent modeling in order to bring strategic behavior into the production cost analysis. The framework allows for the analysis of case studies with non-traditional market behavior.

Distributed energy resources include customer-side generation, energy storage, flexible loads, and distribution-side sensing devices, and may or may not have coordinated operation as microgrids. In the second session, the paper “Advanced Energy Storage Management in Distribution Network” presents a multi-objective optimization model for managing small distribution systems with distributed energy resources. The model formulation allows for minimizing system cost, voltage fluctuations and power loss. The paper “Electric Vehicle Participation in Transactive Power Systems Using Real-time Retail Prices” analyzes three mechanisms for the interaction between electric vehicles and the power grid including real time pricing and demand elasticity. Highlighting the interdependencies between energy efficiency programs and available demand response resources, the paper “Residential Energy Efficiency and Electric Demand Response” combines an analysis of power systems with the thermal characteristics of buildings and AC specifications in order to quantify the potential demand response potential from HVAC systems. In the final paper for the session, “On Impact of Randomly Distributed Small Residential PV Systems,” the authors address the fact that residential photovoltaic systems are often installed ‘randomly’ from the perspective of system operators. The paper presents a modeling framework that combines stochastic simulation with a traditional power flow, and includes interesting case studies to demonstrate the model.