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Publications

Bridging the gap between utilities and the smart grid.

Monte Carlo Analysis of Plug-in Hybrid Vehicles and Distributed Energy Resource Growth with Residential Energy Storage in Michigan Jaesung Jung, Yongju Cho, Danling Cheng, Ahmet Onen, Reza Arghandeh, Murat Dilek, Robert P Broadwater, accepted for publication in Applied Energy.

This paper considers how the addition of Plug-in Hybrid Vehicles (PHEV) and Distributed Energy Resource (DER) generation affects the system. The PHEV and DER are considered with energy storage technology applied to the residential distribution system load.

Phasor-Based Interdepedencies of Harmonic Sources in Distribution Networks Reza Arghandeh, Ahmet Onen, Jaesung Jung, Danling Cheng, Robert P. Broadwater, Virgilio Centeno, Electric Power Systems Research, June 14, 2014, pp. 94-105.

This paper analyzes phasor-based interdependences of harmonics from multiple sources, especially Distributed Energy Resources, on distribution networks. The paper proposes a new index, Phasor Harmonic Index (IHP), which considers both harmonic source magnitude and phase angle.

Coordinated Control of Automated Devices and Photovoltaic Generators for Voltage Rise Mitigation in Power Distribution Circuits Jaesung Jung, Ahmet Onen, Reza Arghandeh, Robert Broadwater, Renewable Energy 66C (2014), pp. 532-540.

This paper presents a coordinating, model-centric control strategy for mitigating voltage rise problems due to photovoltaic (PV) penetration into power distribution circuits. The coordinating control objective is to maintain an optimum circuit voltage distribution and voltage schedule, where the optimum circuit operation is determined without PV generation on the circuit.

Current Status and Future Advances for Wind Speed and Power Forecasting Jaesung Jung, Robert Broadwater, Renewable & Sustainable Energy, Vol. 31, March 2014, PP 762-777.

This paper presents an overview of existing research on wind speed and power forecasting. It discusses state-of-the-art wind speed and power forecasting approaches, forecasting accuracy based on variable factors, and potential techniques to improve the accuracy of forecasting models are reviewed.

Model Based Coordinated Control Based on Feeder Losses, Energy Consumption, and Voltage Violations Ahmet Onen, Danling Cheng, Reza Arghandeh, Jaesung Jung, Jeremy Woyak, Murat Dilek, Robert P. Broadwater, Electric Power Component and Systems, Vol. 41, Issue 16, Oct. 23, 2013.

This article presents an economic evaluation of a model-based distribution control scheme that is independent of circuit topology and integrates legacy and modern control equipment. Distributed engineering workstation simulation results show savings for both the customers and utility, due to reduction of demand and losses.

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Concept and Application of Distributed Compressed Air Energy Storage Systems Integrated in Utility Networks Miroslav P. Petrov, Reza Arghandeh, Robert Broadwater, Proceedings of the ASME 2013 Power Conference, July 2013, Boston, Massachusetts.

This study aims to analyze the plausible distributed compressed-air energy storage units, examining the likeliness for their practical implementation and analyzing their behavior, as well as devising the possible control strategies for optimal use of grid-integrated renewable energy sources at small scales.

Evaluation of DER Adoption in the Presence of New Load Growth and Energy Storage Technologies Jaesung Jung, Haukur Asgeirsson, Thomas Basso, Joshua Hambrick, Murat Dilek, Richard Seguin, and Robert Broadwater, Proceedings of 2011 IEEE PES General Meeting, July 26-29, 2011, Detroit, Michigan.

This study considers potential system effects of the addition of Plug-in Electric Vehicle (PEV) load, together with concurrent market adoption of Distributed Energy Resources (DER) and energy storage technologies, to individually metered residential customers, to offset the associated load growth.

Configurable, Hierarchical, Model-based Control of Electrical Distribution Circuits Josh Hambrick, Robert Broadwater, IEEE Transactions on Power Systems, Pages Volume:26, Number:3, August 2011, Pages 1072-1079.

This paper presents a model-based distribution control scheme that is independent of circuit topology and integrates legacy and modern control equipment. Simulation results indicate the proposed method can improve circuit performance under both normal and abnormal conditions.

Analysis of Distributed Resources Operating in Unbalanced Distribution Circuits Fangxing Li, Robert Broadwater, Jeffrey Thompson, Frank Goodman, IEEE PES Summer Meeting, Vol. 4, pp. 2315-2319.

This paper focuses on the operation of Distributed Resources in unbalanced distribution circuits.

Economic Optimal Operation of Community Energy Storage Systems in Competitive Energy Markets Reza Arghandeh, Jeremy Woyak, Ahmet Onen, Jaesung Jung, Robert Broadwater, submitted to Applied Energy.

This paper presents a way to realize additional benefits of distributed, controllable energy storage devices by taking advantage of the fluctuating costs of energy in competitive energy markets. An algorithm for optimal charge/discharge scheduling of community energy storage (CES) devices, as well as an analysis of several of the key drivers of the optimization are discussed.

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PEVs in the Motor City Haukur Asgeirsson and Nick Carlson, May 2011, published in Transmission & Distribution World.

Detroit Edison examines adoption of PEV scenarios to determine distribution system impacts. For this analysis, DTE Energy asked EDD to create an application to aid in the analysis of the effects of various PEV adoption levels in the Distributed Engineering Workstation.

Local Steady-State and Quasi Steady-State Impact Studies of High Photovoltaic Generation Penetration in Power Distribution Jaesung Jung, Ahmet Onen, Kevin Russell, Robert Broadwater, submitted Renewable and Sustainable Energy Journal.

This paper presents analysis of high Photovoltaic (PV) penetration in distribution circuits using both steady-state and quasi steady-state impact studies. The steady-state analysis evaluates impacts on the distribution circuit by comparing conditions before and after extreme changes in PV generation at three extreme circuit conditions, maximum load, maximum PV generation, and when the difference between the PV generation and the circuit load is a maximum. The quasi steady-state study consists of a series of steady-state impact studies performed at evenly spaced time points for evaluating the spectrum of impacts between the extreme impacts.

Model Centric Approach for Monte Carlo Assessment of Storm Restoration and Smart Grid Automation Danling Cheng, Ahmet Onen, Reza Arghandeh, Jaesung Jung, Robert Broadwater, Charlie Scirbona, Proceedings of the ASME 2014 Power Conference, July 28-31, 2014, Baltimore, MD.

A model centric approach for Monte Carlo simulation for evaluating the economic and reliability benefits of automated switches for storm restoration is presented. A very detailed circuit model with over 20,000 individual customers modeled is used in the simulation. The simulation uses non-constant equipment failure rates based upon actual utility measurements.