Abstract: Wind Energy Conversion Systems (WECS) produce fluctuating output power, which may cause voltage fluctuations and flicker. Flicker assessment in networks may be difficult, since its evaluation requires long computing time and special procedures to calculate the flicker severity index, Pst. A frequency domain method to study flicker propagation is presented. This method is based on propagation of frequency components from WECS output currents throughout the grid. In this way, a fast flicker analysis in a network of any size can be performed. An algorithm for flicker measurement in the frequency domain, which allows Pst calculation, is proposed. Several study cases were performed, and results are compared with time domain simulations, showing good agreement between them.
Keywords: Flicker, power quality, wind turbines
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Dynamic Multi-Physics Model for Solar Array

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Abstract: An approach to model the solar cell system with coupled multi-physics equations (photovoltaic, electrothermal, direct heating and cooling processes) within the context of the resistive-companion method in the Virtual Test Bed computational environment is presented. Appropriate across and through variables are defined for the thermal terminal of the system so that temperature is properly represented as a state variable, rather than as a parameter of the system. This allows enforcement of the system power conservation through all terminals and allows simultaneous solutions for both the electrical potentials and the system temperature. The thermal port built accordingly can be used for natural thermal coupling. The static and dynamic behaviors of the solar array model based on the approach are obtained and validated through comparison of simulation results to theoretical predictions and other reported data. The electrothermal modeling method developed here can be generally used in the modeling of other devices, and the method to define the across and through variables can also be generalized to any other interdisciplinary processes where natural coupling is required.
Keywords: Electrothermal modeling, resistive companion method, solar energy conversion, virtual test bed simulation.
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Power System Analysis, Computing, and Economics

Transmission Loss Allocation: A Comparison of Different Practical Algorithms

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Abstract: A pool-operated electricity market based on hourly auctions usually neglects network constraints and network losses while applying its market-clearing mechanism. This mechanism determines the accepted and unaccepted energy bids as well as the hourly market-clearing prices. As a result, ex post procedures are needed to resolve network congestions and to allocate transmission losses to generators and demands. This paper focuses on transmission loss allocation procedures and provides a detailed comparison of four alternative algorithms: pro rata, marginal allocation, unsubsidized marginal allocation, and proportional sharing. A case-study based on the IEEE RTS is provided. Different load scenarios covering a whole year are analyzed. Conclusions and recommendations are stated.
Keywords: Transmission losses, electricity market, loss allocation.
Preprint Order Number: PE-002PRS (02-2002)
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A Linear Dynamic Model For Asynchronous Wind Turbines With Mechanical Fluctuations

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Abstract: A specific linear dynamic model for an asynchronous machine is presented. This model is based on the balanced dynamic model of the asynchronous machine, and it is developed for asynchronous wind turbines when the mechanical power (wind power) has sinusoidal fluctuations. The dynamic and the proposed linear models for real and reactive powers and voltage fluctuations analysis are considered and compared.
Keywords: Asynchronous rotating machine, power quality, wind energy.
Preprint Order Number: PE-705PRS (02-2002)
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A Hybrid Method for Generator Tripping

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Abstract: Generator tripping is one of the most effective approaches to enhance the transient stability of a power system. An online prediction method of transient stability and an offline analysis method of generator tripping are studied, respectively. Firstly, a polynomial curve fitting technique is employed to improve the online prediction accuracy of system stability. Then a shell program is developed to automatically generate and update lookup tables for generator tripping. Based on these, a hybrid method is proposed. It uses the lookup tables to determine generator tripping requirements, and before sending out generator tripping signals, instability is confirmed by online prediction of system stability. Simulation results show this hybrid method can avoid unnecessary generation shedding.
Keywords: Curve fitting, generator tripping, online stability prediction, offline lookup table.
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Allocation of the Reactive Power Support Requirements in Multitransaction Networks

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Abstract: This paper presents a new physical-flow-based mechanism for allocating the reactive power support requirements provided by the generators in multitransaction networks. The allocatable reactive support requirements are defined with respect to the support required for the network with no transactions in place. The requirements in the presence of the proposed transactions are formulated as the sum of two specific components: the voltage magnitude variation component and the voltage angle variation component. The formulation utilizes the multitransaction framework used for the allocation of losses. The formulation leads to a natural allocation as a function of the amount of each transaction. The physical interpretation of each allocation as a sensitivity of the reactive output of a generator is discussed. The extensive testing indicates that the allocation scheme approximates with good fidelity the actual net var outflow from each generator and is able to deal effectively with the nonlinearities due to the generator reactive power limits. The numerical results also indicate that the proposed scheme behaves in a physically reasonable and intuitive way.
Keywords: Electricity markets, transmission services, ancillary services, reactive support, voltage control, multi-transaction networks, allocation, unbundling, voltage profiles.
Preprint Order Number: PE-324PRS (02-2002)
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