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Novel Fault Models for Electronically Coupled Distributed Energy Resources and their Laboratory Validation, IEEE Transactions on Power Systems, 2019

Scientific paper

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Emissions of harmful gases have been growing exponentially in the last few decades, directly following the accelerated development of civilization. The largest emitters of these gases are traditional power plants and vehicles in which fossil fuels such as coal, oil and its derivatives are used for propulsion. On the other hand, given the growing population of the planet, as well as the growing industrialization of urban areas, consumption and demand for electricity is also growing exponentially. If these requirements were followed by traditional power plants and traditional vehicles, the level of environmental pollution would exceed the limit after which it would no longer be possible to return to a sustainable and healthy life of the humanity.

One of the most efficient solutions to this extremely important problem lies in the integration of power plants based on renewable energy sources such as solar and wind, batteries for energy storage, as well as the integration of electric vehicles.

However, power plants based on renewable energy sources, as well as batteries for storing electricity, and even chargers for electric vehicles, use modern - completely different technology compared to traditional power plants. These emerging energy sources are connected to the grid via power electronic devices, and thus their response to the system conditions widely differ from the traditional power plants. Therefore, modeling and calculations of power systems with renewable energy sources are not possible using traditional models. Since the problem of modeling these sources is still unresolved, this is one of the key reasons that slows down the mass integration of renewable energy sources into power systems.

To overcome this challenge, in this paper novel models for renewable energy resources are proposed. In order to simulate the dynamic behavior of these devices, and to develop a model that would be acceptable for currently available algorithms for calculating power system conditions during disturbances, it is proposed to treat these sources through three distinct periods: subtransient, transient, and steady-state. Also, the proposed models fully consider the initial, uncontrolled, fault current. Further, the proposed models are implemented in the algorithm for instantaneous calculation of power systems with disturbances and tested on several real-life systems. In addition, the results were verified

on a state-of-the-art laboratory system (“D-Space”) to examine the behavior of distributed sources during disturbances, and the exceptional accuracy of the proposed models was demonstrated. This contribution is a big step towards the standardization of models for the emerging power sources based on renewable energy, which will consequently enable safe and controlled mass integration of "clean" power plants.

More information regarding the publication:

Link to the complete paper: https://ieeexplore.ieee.org/document/8846092

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