Investigation of methods for reduction of power fluctuations generated from large grid-connected photovoltaic systems

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Abstract

Photovoltaic (PV) systems are presently allowed to inject into the grid all the power they can generate. However, in the near future, utilities are expected to impose additional regulations and restrictions on the power being injected by large centralized PV systems because of their possible adverse impacts. One of the main issues associated with large PV systems is the fluctuation of their output power. These fluctuations can negatively impact the performance of the electric networks to which these systems are connected, especially if the penetration levels of these systems are high. Moreover, the fluctuations in the power of PV systems make it difficult to predict their output, and thus, to consider them when scheduling the generating units in the network. The main objective of this paper is to investigate some methods that can be used to reduce the fluctuations in the power generated from a large customer-owned PV system, in the order of megawatts. This paper focuses on three methods: 1) the use of battery storage systems; 2) the use of dump loads; and 3) curtailment of the generated power by operating the power-conditioning unit of the PV system below the maximum power point. The emphasis in the analysis presented in this paper is on investigating the impacts of implementing these methods on the economical benefits that the PV system owner gains. To estimate the maximum revenues gained by the system owner, an linear programming optimization problem is formulated and solved. Moreover, the effect of varying different parameters of the problem is investigated through sensitivity analysis.

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