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A Statistical Model for Wind Power on the Basis of Ramp Analysis

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A Statistical Model for Wind Power on the Basis of Ramp Analysis

Abstract

Due to stochastic nature of wind distribution, wind power output comes with unscheduled changes called ramp events. In this paper, a semi-analytical approach is considered to analyze the distribution of ramp events. A simple empirical equation is derived based on the probability of wind ramp events considering the stochastic nature of wind power distribution for the Indian state of Karnataka. The proposed functional relationship shows a satisfactory approximation of the actual distribution of ramp events and helps to estimate the statistical behaviour of wind output in terms of frequency of ramp events for pre-defined threshold power outputs.

Keywords: Ramp events; wind power-bin; statistical behaviour; stochastic; probability

1. Introduction

Wind power is considered as one of the main enablers in our transition to a sustainable energy future. The year 2012 witnessed additional global installations of 44.8 GW of wind power, leading to a cumulative installed capacity of 282.5 GW (Global Wind Report: Annual Market Update 2012). Utility system planning and operations for both generation and transmission can be affected by wind power with its increasing penetration (Smith et al. 2007). However, wind power is inherently intermittent and comes with large amount of unscheduled fluctuations. This makes it challenging to keep the load and generation balanced, posing a threat to grid reliability. The integration of significant wind energy into the existing electricity supply system is a