



Review

Overview of wind power intermittency impacts on power systems

M.H. Albadi*, E.F. El-Saadany

Department of Electrical and Computer Engineering, University of Waterloo, 200 University Ave. W, Waterloo, ON, N2L3G1, Canada

ARTICLE INFO

Article history:

Received 19 December 2008

Received in revised form 11 October 2009

Accepted 30 October 2009

Available online 27 November 2009

Keywords:

Wind power intermittency

Aggregation effect

Forecasting error

Balancing requirements

ABSTRACT

Although integrating a large amount of wind power is technically possible, higher integration costs might be incurred when the penetration level of this intermittent power increases. This paper reviews wind power variability and its different impacts on power systems. In addition, an up-to-date overview of wind power balancing costs is presented.

© 2009 Elsevier B.V. All rights reserved.

Contents

1. Introduction	627
2. Wind power intermittency and its impacts	628
2.1. Classification of variability	628
2.2. Aggregation effect on variability	628
2.3. Wind power forecasting error	628
2.4. General impacts of wind power	629
2.4.1. Generation efficiency	629
2.4.2. Reserves	629
2.4.3. Curtailed wind energy	630
2.4.4. Reliability	630
2.4.5. Transmission and distribution losses	630
2.4.6. Voltage and reactive power	630
3. Effects on operation of conventional generation	630
3.1. Effect on regulation	630
3.2. Effect on load following	630
3.3. Effect on scheduling and unit commitment	630
4. Wind power balancing requirement summary	631
5. Summary	631
Acknowledgement	632
References	632

1. Introduction

There is a strong growth in wind-installed capacity worldwide due to three main many reasons. The first one is the growing public

awareness and concern about emissions, climate change, and environmental issues related to other, competing, sources of energy. The second reason is awareness about oil and gas reserves depletion and the predicted Global peaking of oil production. According to a report published by the US Department of Energy, fuel prices and price volatility are expected to increase significantly as peaking of world oil production approaches [1]. It is generally believed that the global peak oil production will occur during the sec-

* Corresponding author. Tel.: +1 519 888 4567x37059; fax: +1 519 746 3077.
E-mail address: mhhalbad@uwaterloo.ca (M.H. Albadi).