Summary of experiences and studies for Wind Integration – IEA Wind Task 25

Hannele Holttinen
VTT Technical Research Centre of Finland

André Robitaille
Hydro Quebec, Quebec, Canada

Antje Orths
Energinet, Fredericia, Denmark

Ivan Pineda
European Wind Energy Association, Brussels, Belgium

Bernhard Lange
Fraunhofer IWES, Kassel, Germany

Enrico Maria Carlini
TERNA RETE ITALIA, Rome, Italy

Mark O'Malley, Jody Dillon
University College of Dublin, Dublin, Ireland

John Olav Tande
SINTEF, Trondheim, Norway

Ana Estanqueiro
LNEG, Lisbon, Portugal

Emilio Gomez-Lazaro
Univ. Castilla La Mancha, Spain

Lennart Söder
KTH, Stockholm, Sweden

Michael Milligan
NREL, Golden, CO, USA

Charles Smith
UVIG, Southern Shores, NC, USA

***Abstract*— IEA WIND R&D Task 25 on "Design and Operation of Power Systems with Large Amounts of Wind Power" collects and shares information on wind generation impacts on power systems, with analyses and guidelines on methodologies. This paper summarizes the main results from the report published on January 2013 describing experience of wind integration as well as the most relevant wind power grid integration studies in the 15 participating countries. The studies build on the already significant experience in integrating wind power in power systems addressing concerns about the impact of wind power's variability and uncertainty on power system security of supply and costs as well as grid reinforcement needs. The mitigation of wind power impacts includes more flexible operational methods, incentivising flexibility in other generating plants, increasing interconnection to neighbouring regions, and application of demand-side flexibility. Electricity storage is still not as cost effective in larger power systems as other means of flexibility, but is already seeing initial applications in places with limited transmission.**

Keywords-wind; wind integration, reserve requirements, balancing costs, capacity credit

I. INTRODUCTION

In recent years, numerous reports have been published in many countries investigating the power system impacts of wind generation. The results on the technical constraints and costs of wind integration differ, and comparisons are difficult to make due to different methodologies, data and tools used, as well as terminology and metrics in representing the results. Estimating the cost of impacts can also be conservative due to lack of representative data. Some recent efforts on compiling the results have been made in [1] and [2]. Due to a lack of detailed information on the methodologies used, a direct comparison can only be made with few results.

IEA WIND R&D Task 25 on "Design and Operation of Power Systems with Large Amounts of Wind Power" collects and shares information on wind generation impacts on power systems, (http://www.ieawind.org/task_25.html). An effort for more in-depth review of the studies was made under this international collaboration in the state-of-the-art report [3] and final report 2006–2008 [4]. Many wind integration studies already incorporate solar energy, and most of the results and methodologies discussed are also valid for other variable renewables besides wind power. Task 25 has also been working on Recommended Practices for Wind Integration studies [5]. This paper presents the main results of the latest summary report [6] where the most relevant wind power grid integration studies and experience in participating countries have been collected.

The national case study results are grouped according to impacts: balancing the power system on different short-term time scales; grid related impacts and power (resource) adequacy (i.e., capacity value of wind). The report also presents characteristics of variability and uncertainty in wind power from experience of measured data from large-scale wind power production and forecasting.