Impact of integrating large-capacity hybrid renewable energy systems into Qatar's power grid.

ALI, D. and KHALIL, S.

2016

ARC '16

مؤتمر مؤسسة قطر
السنوي للبحوث
QATAR FOUNDATION
ANNUAL RESEARCH
CONFERENCE

Towards World-class
Research and Innovation

مؤسسة قطر
Qatar Foundation
لإطلاق قدرات الإنسان
Unlocking human potential

Energy and Environment Pillar

http://dx.doi.org/10.5339/qfarc.2016.EEOP2240

Impact of Integrating Large-Capacity Hybrid Renewable Energy Systems into Qatar's Power Grid

Dallia Ali, Shady Khalil

Texas A & M University at Qatar, QA

Email: dallia.ali@qatar.tamu.edu

The implementation of large-scale renewable energy systems (such as solar and wind) in the GCC is widely growing nowadays, particularly in remote areas generation applications where the grid extension is costly. The integration of renewable energy systems into the existing power grids, especially the hybrid ones like hybrid solar wind systems, not only provide a clean environmentally friendly supply of electricity but also provide a more reliable supply of electricity through the utilization of different energy sources. However, the operating characteristics of such renewable energy systems are strongly influenced by the weather patterns, i.e. intermittent generation, and will therefore impact the operation of the power grid into which they are integrated. Certain amounts of renewable distributed generation can be integrated into the existing grid without affecting its operation; however, the massive introduction of large-scale renewable energy systems into the grid will result into an increased level of risk of overload and over voltage, unacceptable levels of power quality and reliability, together with the possibility of incorrect operation of the protection system. Therefore, significant investments will be needed to enable the existing power grids to accommodate such a large scale of renewable energy systems into it while avoiding such impacts.
In this paper, a comprehensive study of the impact of integrating large-scale hybrid renewable energy systems into Qatar's electrical power grid is carried out. The study includes investigating the grid power flow, power quality, efficiency, transient stability, and reliability under both normal and contingency operating conditions. The study aims to give solutions for allowing the increase in large scale hybrid renewable energy systems penetration into Qatar's grid while reducing their influence and maintaining the grid reliability and stability during all operating conditions. The study is performed based on Qatar's grid real-time operating conditions, and takes into account Qatar's climate profile (e.g. Qatar average annual wind speed and solar irradiation) in order to simulate the intermittent output of the integrated hybrid renewable energy system. Moreover, an economic study and an environmental impact study are carried out to evaluate the large-scale integration of hybrid renewable energy systems into Qatar's grid from

Cite this article as: Ali D, Khalil S. (2016). Impact of Integrating Large-Capacity Hybrid Renewable Energy Systems into Qatar's Power Grid. Qatar Foundation Annual Research Conference Proceedings 2016: EEOP2240 http://dx.doi.org/10.5339/qfarc.2016.EEOP2240.

different aspects. In summary, the carried out studies will show the impact of implementing large-scale hybrid renewable energy systems on the performance of Qatar's power grid, together with its environmental and economic benefits. The real-time implementation will suggest how to introduce the large scale hybrid renewable energy systems gradually into Qatar's grid, and will propose the best scenario for operating both the existing conventional stations and the integrated hybrid systems while balancing their electricity generation with the demand. The real-time implementation utilizes a new smart control and management mechanism that is proposed to allow such a balance between the generation and demand on introducing large-scale hybrid renewable energy systems into Qatar's existing power grid. The outcome of this study will help Qatar in assessing and evaluating the operational, environmental and economic aspects of large scale hybrid renewable energy systems penetration into Qatar's power grid, and will demonstrate the challenges that will face Qatar when integrating such a large capacity into its grid.