PO.057

Performance evaluation of a commercial de-icing system in one year operation of a windfarm

Konstantinos Gkarakis, Konstantinos Loukidis

Athens University of Applied Sciences (TEI Athens) – Energy Technology Engineering Dept., Athens, Greece

Abstract

Atmospheric icing has a significant impact on the development/construction and the operation of windfarms. It causes production losses and represents a safety risk for passers-by and the service personnel. Also, there is an emerging market for wind energy projects in high altitudes with better wind potential but cold climate and frequent snowfalls and icing. Furthermore, reduced electricity tariffs increase the pressure on existing projects to maximise the production in order to stay sufficiently profitable. In this context, the performance and the efficiency of a de-icing system is a main aspect for a successful operation of a windfarm.

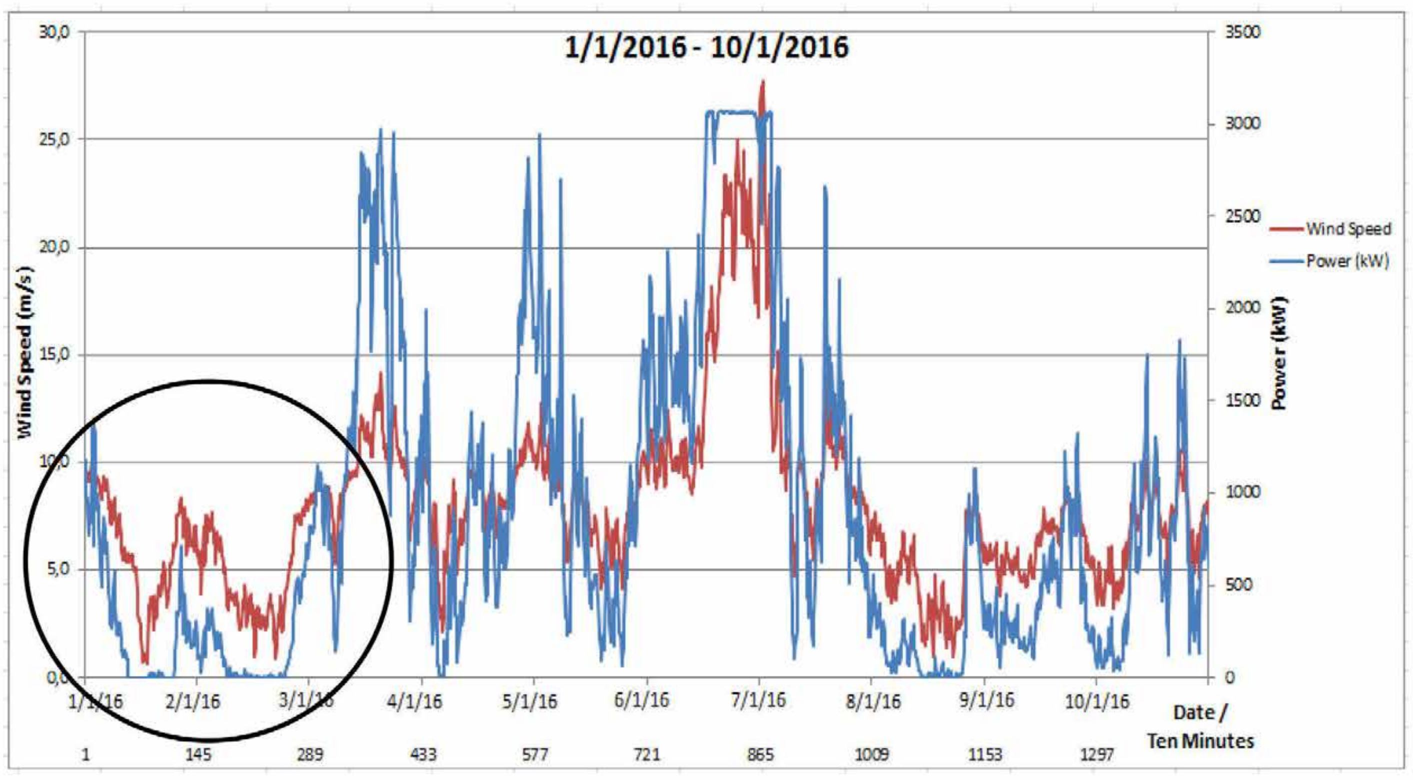
In this paper, a windfarm with seven 3MW windturbines equipped with rotor blade heating located in Central Greece at appr. 1100m asl, is monitored for one complete year in order to evaluate the performance under icing conditions. The windturbines are equipped with a commercial active de-icing system which could reduce the downtime due to icing, by heating the rotor blades by re-circulating heated air. This melts the ice at an early stage and the windturbine is operational sooner. The operational data of the windturbines and the reference onsite meteorological mast were examined.

Methods

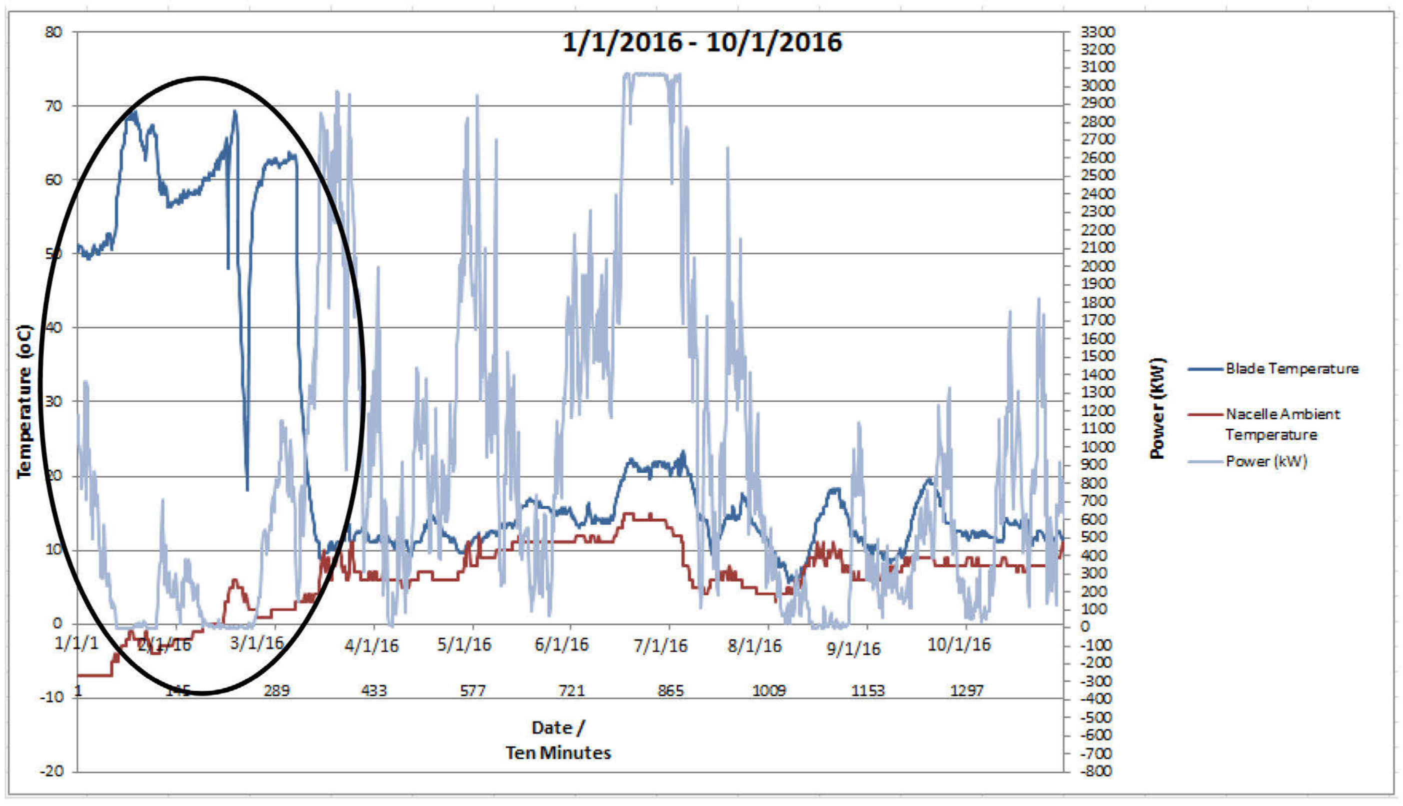
Analyses are performed for the mild winter 2015-6, from 1 November to 31 March. The analyses are based on operational data of the windturbines (wind speed, wind direction, operation status, ambient, blades and nacelle temperatures, rotor speed, produced capacity, consumed energy) and the onsite meteorological mast (wind speed/direction and temperature). Furthermore, it is used EMD ConWx data from a nearest grid point to assess the year-to-year variability for the 20 years period. Energy production losses due to icing are calculated based on the real energy production derived from wind speed measured at the nacelle and site-specific power cu rves and the production numbers in the SCADA data. Furthermore, for a month the de-icing system of one windturbine de-activated so to be examined in detail the operational performance and to be extracted the energy production loss.

Results

1. De-icing system malfunction

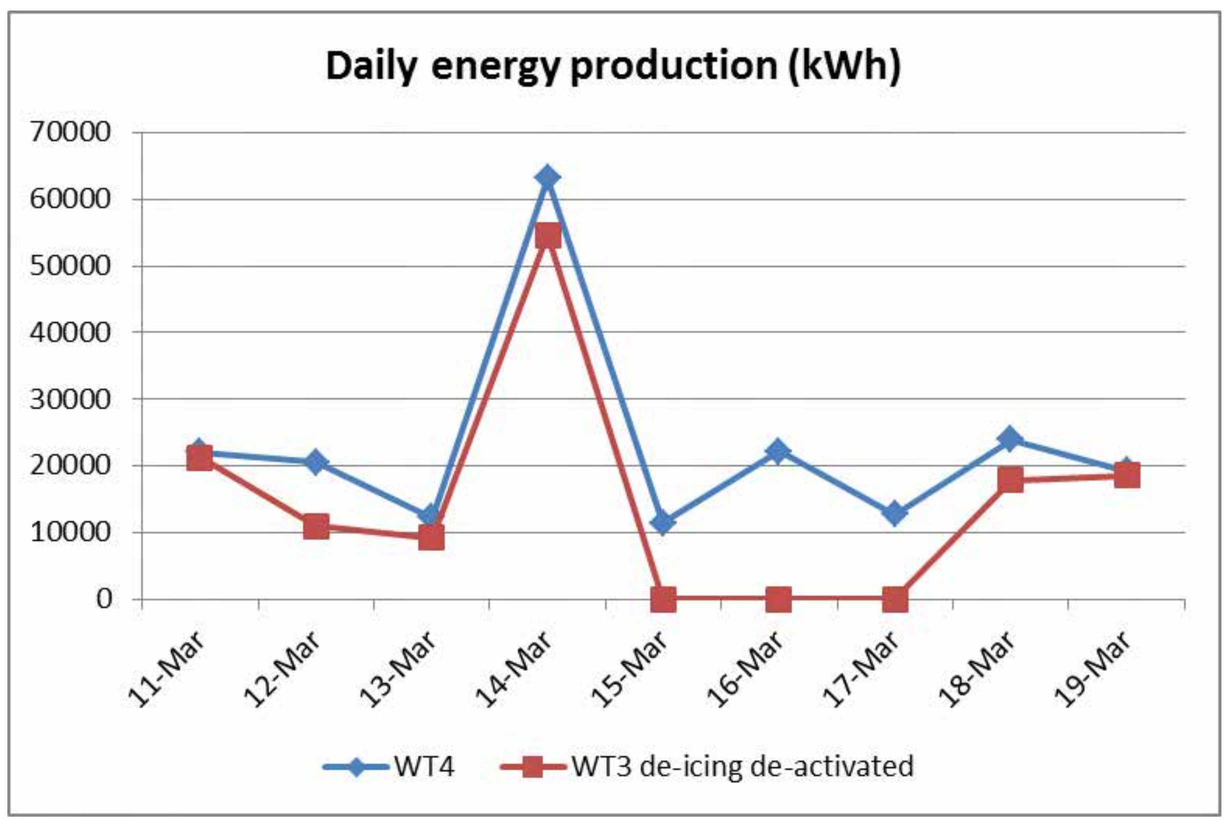


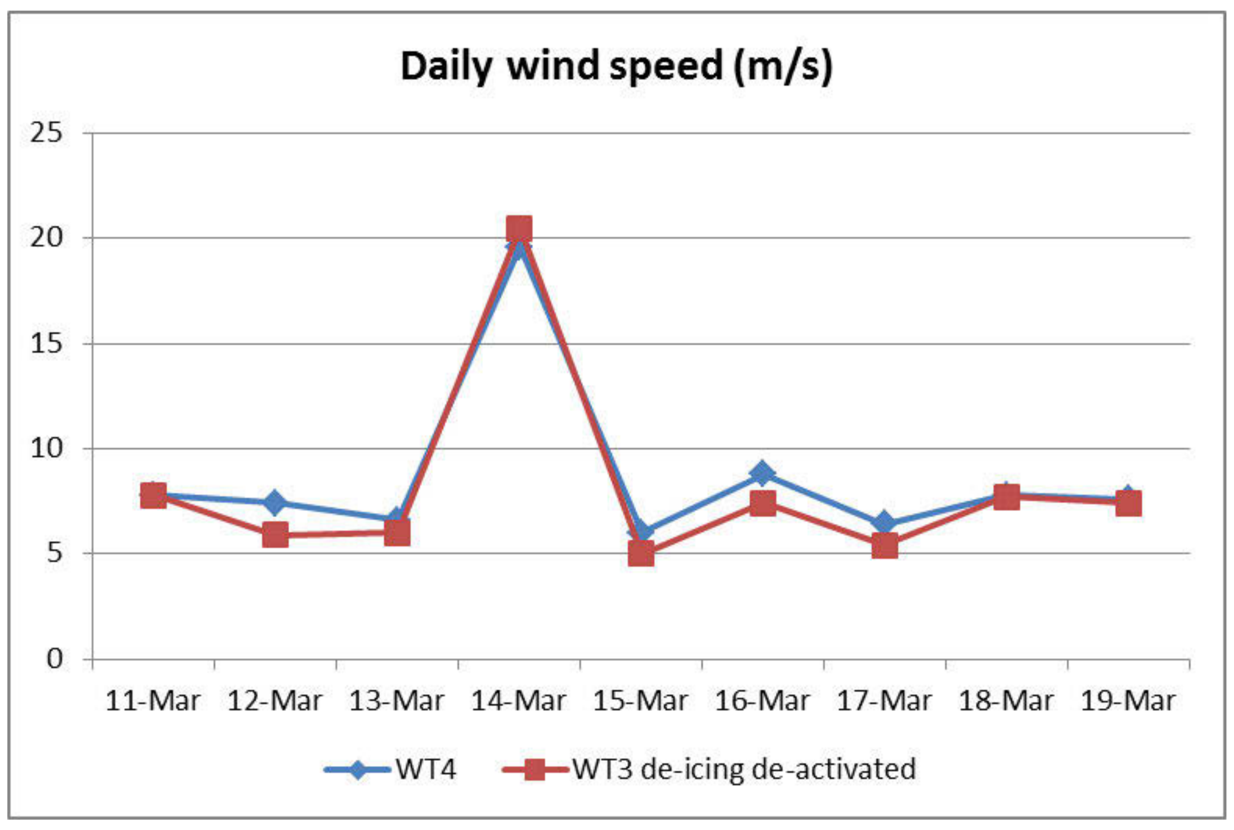
Graph 1: Wind Speed - Power output (1/1/2016 - 10/1/2016)



Graph 2: Nacelle ambient temperature-Power output (1/1/2016 - 10/1/2016)

2. De-icing system of one windturbine de-activation





The system showed improvement of the production and high operational availability. In the certain windfarm the theoretical increase of the energy production has estimated approximately 11,5% (in the limits of the 9-12% from relative literature) but **in reality the percentage was approximately 6% due to time periods that the system was not be able to defrost satisfactorily the blades and after few minutes the windturbines stopped. Possible reason is the method of the ice detection, the high rate of icing due to existing humidity.**

Conclusions

Especially examples during single ice events where the systems increased the power output was found, but the examples also showed possible improvements regarding the size of the system, the time response and the duration of the de-icing cycles. Additional benefits like for instance decreased loads, risk for standstill and ice throws could also be provided by the system. Based on the final gain in production, during the studied time period, the system is profitable and the payback period is less than a year. The energy consumption of the system is much lower than the gain in energy production. Important characteristics of the system were found as the duration of the cycle, the trigger-point for activation of the system and the operation of the windturbine without it. The results, having a large percentage of unsuccessful operation with stopped windturbines which consumed energy, states the de-icing system is necessary for areas with snow and ice existence. It presents significant gain in energy production but system is not perfect, improvements are needed.

References

1. Baring Gould et al. : Recommended Practices Wind Energy Projects in Cold Climate, IEA Task 19 (arcticwind.vtt.fi), 2012