

Wind turbine blade heating – does it pay?

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1. Wind Energy Meteotest

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Icing has a strong effect on the operation of wind turbines: It influences the aerodynamics of the blades and causes production losses. Moreover, additional ice loads lead to extreme and fatigue loads. Iced wind measurement sensors at the wind turbine's nacelle lead to erroneous behaviour and security stops. Finally, ice throw represents a significant safety risk for pedestrians and service personnel. Nowadays, only very few turbine manufacturers offer solutions for ice detection and de-icing of wind turbines. Hence, there is only little experience in the effectiveness and the added value of such systems.

In Switzerland, nearly every planned wind park is located in areas where icing is likely to occur during the winter months. Therefore, there is an urgent need to get more information about the performance of wind turbines under such conditions. A unique experiment has been started in Switzerland in fall 2009 at two Enercon E-82 wind turbines. They are located in a distance of approximately 300 m to each other in St. Brais in the Swiss Jura at 1'100 m asl. Both wind turbines are equipped with the Enercon hot air blade heating.

One of the wind turbines was equipped with additional meteorological instruments as well as automatic cameras taking pictures of the blades and the instruments at the nacelle of the wind turbine in regular intervals. Based on these camera images, information on the frequency of meteorological icing (active ice formation) and instrumental icing (ice persistence) could be obtained. Furthermore, the reliability of the ice detection as well as the effectiveness of the blade heating could be assessed.

In order to gain more information about the added value of a blade heating, the blade heating of one wind turbine has been deactivated for the duration of one month i.e. the wind turbine was operating like a wind turbine without blade heating. The other wind turbine was operating normally. The comparison of energy production against the energy needed for the blade heating showed that the turbine with deactivated blade heating suffered from significant production losses as the wind turbine was standing still over longer periods due to icing.

A comparison of energy production for the whole winter 2009/10 between a wind turbine with and one without blade heating has been carried out in order to assess the benefit of a blade heating over a longer time period. The results show that the operation of the wind turbines without a de-icing device would have resulted in significant production losses and that the blade heating therefore is a valuable tool to increase the production at this site.

During winter 2009/10, the wind turbine needed to be stopped to heat the blades. During winter 2010/11, the wind turbine will be operated and monitored in a mode where the blades are heated during operation in order to minimise the losses due to icing even more.

Within this paper, a detailed overview over the results as well as their consequences for wind resource assessment will be presented.