Measured power losses in wind power plants due to icing

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From November 2008 to march 2009 HoloOptics stimulatingly measured power output, wind speed and icing on a 600 kW wind power plant in H鴻?d., Sweden. The plant is situated on a small hill at the shores of the Baltic Sea and close to the town of H鴻?d. The town of H鴻?d is 360 km north of Stockholm. (lat. N 63). Icing was measured with two T23 Icing rate sensors situated at the plants hub. One of the sensors was configured as an ice detector and the other as an icing rate sensor. This measured both the intensity and the length of the icing events. Power output from the plant and wind speed was measured as 10 minutes mean values. With the wind speed the nominal power of the plant was calculated by using data supplied by the manufacturer. The nominal power was corrected for the air temperatures and pressure. This nominal power was compared with measured power output. Although there were large differences between the two at the 10 minutes level, the difference over a longer period was small.

Without icing the nominal power was approx. 3 % higher than the measured. This may be due to the fact that the plant was more than 10 years old. During the test a total of 38 icing events was registries. The length of the events varied between 2-4 hours and 8 days. In total icing occurred during approx. 35 % of the time. Ice thickness was between 0,1 mm to 10-12 mm.

During light icing there was no significant reduction of the plants power output. In some cases the measured power output was higher than the nominal. During medium icing the power losses was 10-30 %. During heavy icing the plant was often shut down. Events with heavy icing often commenced with high winds, but followed by a period with very light winds and low temperatures. As the wind speed often was lower than the minimum operating speed for the plant the power losses due to icing was reduced.

It is estimated that icing reduced the total power output with 12-15 % over a whole year. The project was sponsored by Vindforsk, H鴻?ds Milj?sp; och Energi AB, Sollefte 嫲 aft AB and HoloOptics.