

Performance Verification Certificate - WINDCUBE® v2

<i>System</i>	<i>WLS7-436</i>
<i>Test date</i>	<i>08-2016</i>

Reference system

Renewable NRG Systems reference Lidar: **WLS7-94**

The Reference Lidar was certified by Danish Technical University (DTU) in February 2015 at the Høvsøre Test Site. The reference Lidar measurement has been compared to a 116m reference mast with a test process approved by DANAK.

Data analysis

Data used for comparison are averaged 10 minutes data.

Wind speed and direction data are compared using regression curves applying the model $y=ax+b$. Where y is the Lidar wind speed, x the reference wind speed, a the regression gain and b the regression offset. R^2 is the coefficient of determination.

Wind speed mean deviation presented in this report is the mean of wind speed difference between the reference and the tested Lidar during the validation period. The mean deviation and its standard deviation are given in m/s.

Results

Horizontal Wind speed regression:

Altitude	Criteria	Value	Passed
40m	Wind speed regression gain is 1 ± 0.02	1.018	yes
	Wind speed regression offset is 0 ± 0.2 m/s	-0.006	yes
	Coefficient of determination R^2 is greater than 0.99	0.998	yes
80m	Wind speed regression gain is 1 ± 0.015	1.007	yes
	Wind speed regression offset is 0 ± 0.2 m/s	-0.008	yes
	Coefficient of determination R^2 is greater than 0.99	0.999	yes
120m	Wind speed regression gain is 1 ± 0.015	1.007	yes
	Wind speed regression offset is 0 ± 0.2 m/s	0.001	yes
	Coefficient of determination R^2 is greater than 0.99	0.999	yes
160m	Wind speed regression gain is 1 ± 0.015	1.010	yes
	Wind speed regression offset is 0 ± 0.2 m/s	0.033	yes
	Coefficient of determination R^2 is greater than 0.99	0.999	yes

Wind direction regression:

Altitude	Criteria	Value	Passed
100m	Wind direction regression gain is 1 ± 0.01	1.002	yes
	Wind direction regression offset is $0\pm 2^\circ$	-1.416	yes
	Coefficient of determination R^2 is greater than 0.99	1.000	yes

Horizontal Wind speed Deviation and Standard deviation of deviation:

Altitude	Criteria	Value	Passed
40m	Wind speed deviation is 0 ± 0.1 m/s	0.043	yes
	Wind speed std deviation of deviation is 0 ± 0.2 m/s	0.073	yes
80m	Wind speed deviation is 0 ± 0.1 m/s	0.022	yes
	Wind speed std deviation of deviation is 0 ± 0.2 m/s	0.057	yes
120m	Wind speed deviation is 0 ± 0.1 m/s	0.038	yes
	Wind speed std deviation of deviation is 0 ± 0.2 m/s	0.072	yes
160m	Wind speed deviation is 0 ± 0.1 m/s	0.095	yes
	Wind speed std deviation of deviation is 0 ± 0.2 m/s	0.106	yes

Validation Service agreement

System **WLS7-436** has passed Renewable NRG Systems, Inc. acceptance tests.

Llewellyn Cobden