Performance Verification Certificate - WINDCUBE® v2

System	*WLS7-436*
Test date	*07-2019*

Reference system

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

The Reference Lidar was certified by Danish Technical University (DTU) in January 2019 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	0.993	yes
	Wind speed regression offset is 0±0.2 m/s	0.026	yes
	Coefficient of determination R^2 is greater than 0.99	0.998	yes
80m	Wind speed regression gain is 1±0.015	1.000	yes
	Wind speed regression offset is 0±0.2 m/s	0.002	yes
	Coefficient of determination R^2 is greater than 0.99	1.000	yes
120m	Wind speed regression gain is 1±0.015	1.000	yes
	Wind speed regression offset is 0±0.2 m/s	0.004	yes
	Coefficient of determination R^2 is greater than 0.99	1.000	yes
160m	Wind speed regression gain is 1±0.015	1.000	yes
	Wind speed regression offset is 0±0.2 m/s	0.007	yes
	Coefficient of determination R^2 is greater than 0.99	1.000	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±2°	0.095	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±0.1m/s	0.016	yes
	Wind speed std deviation of deviation is 0±0.2 m/s	0.031	yes
80m	Wind speed deviation is 0±0.1m/s	0.002	yes
	Wind speed std deviation of deviation is 0±0.2 m/s	0.027	yes
120m	Wind speed deviation is 0±0.1m/s	0.001	yes
	Wind speed std deviation of deviation is 0±0.2 m/s	0.043	yes
160m	Wind speed deviation is 0±0.1m/s	0.004	yes
	Wind speed std deviation of deviation is 0±0.2 m/s	0.044	yes

Validation Service agreement

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

Dale Lamell