



## 100kW WTGS Operation Report in Korea

From January, 2014 to July, 2014

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2014-08

**Abstract:** One FD21-100kW wind turbine from Shanghai Ghrepower was installed and running in Jeju Island, Korea on November 28<sup>th</sup> 2013. Since the Operation, the wind availability had reached over 97.65% without the consideration of regular maintenance. Based on the operation data analysis from January 2014 to July 2014 through the SCADA system (the remote monitoring system for WTGS), the operation state of the 100kW wind turbine was briefly introduced as following:

### 1. Location of the installation

The wind turbine was located in the north-west of Jeju Island near the sea ( latitude: 33°32'15.81, Longitude: 126°47'20.84). From figure 1- figure 3, the annual average wind speed was about 6-7 m/s, it belonged to oceanic climate.

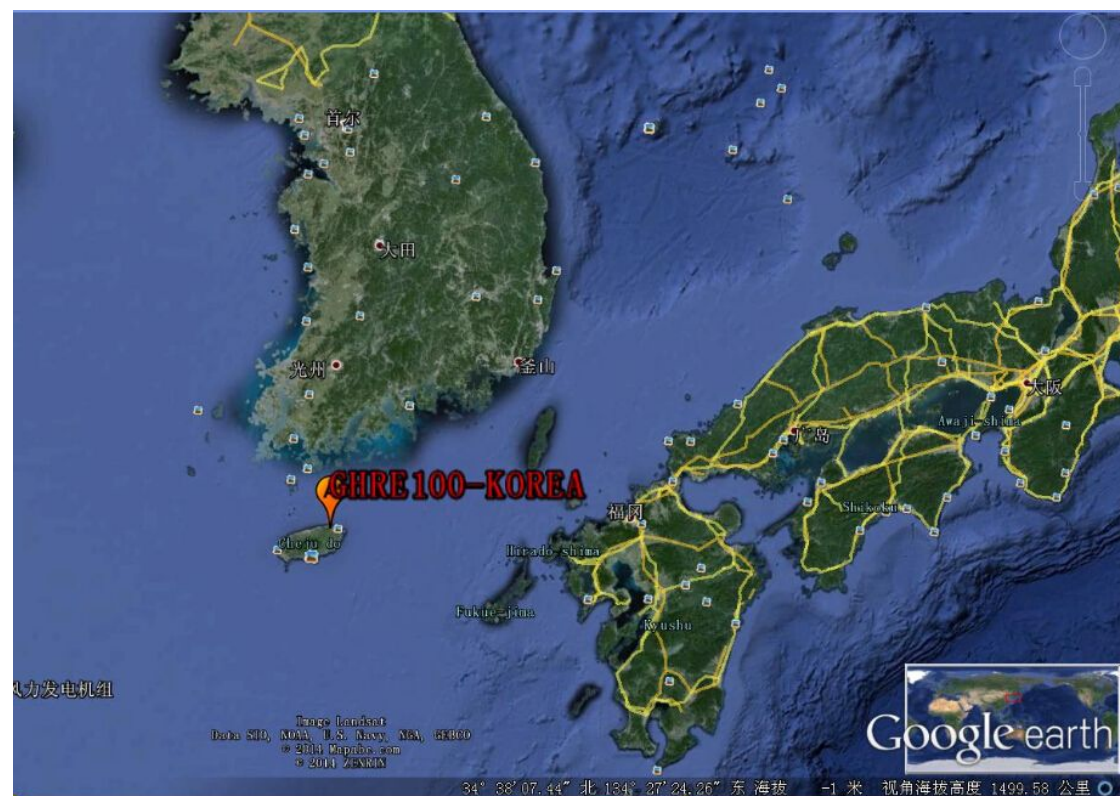


Figure 1



Figure 2



Figure 3



2. Meteorological environment of the site

- The average wind speed and maximum wind speed of the first half year of 2014 is shown as Figure 4. The wind speed area between 4m/s and 6m/s was frequency, covering 39.81% of the whole measured wind speed data.

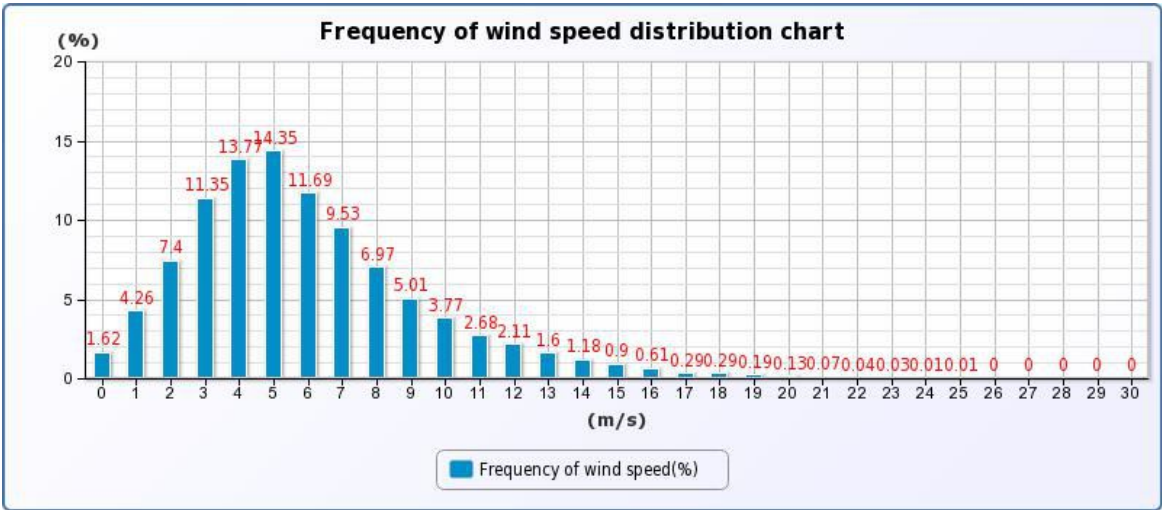


Figure 4

- From the wind rose of the first half year shown as Figure 5, the wind direction of southwest, west and northwest were much common, which covered 12.30%, 10.31% and 6.39%.

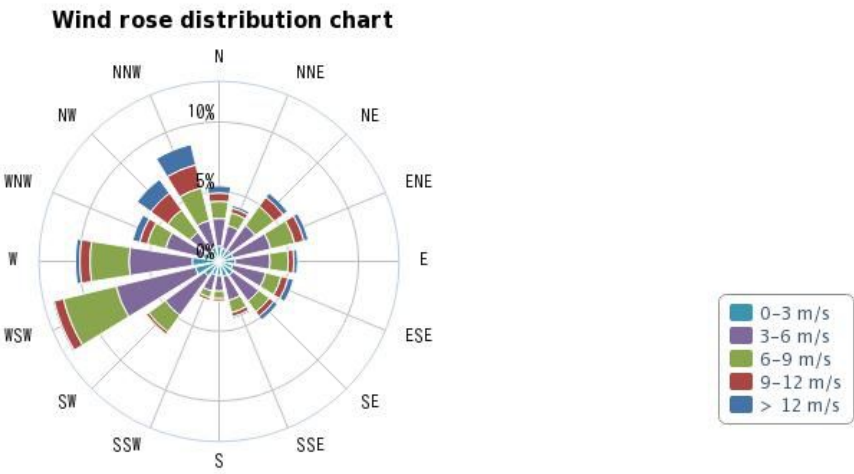


Figure 5

Table of Frequencies (%)						
N	1.09	1.98	1.23	0.60	0.53	5.43
NNE	0.96	1.67	0.95	0.35	0.22	4.15
NE	1.01	2.18	1.69	0.81	0.39	6.08
ENE	1.03	2.77	1.77	0.68	0.35	6.60
E	1.16	2.48	1.32	0.40	0.28	5.64
ESE	0.98	2.46	1.13	0.52	0.42	5.51
SE	1.21	2.30	0.95	0.39	0.34	5.19
SSE	1.11	1.75	0.91	0.31	0.14	4.22
S	1.00	1.11	0.53	0.21	0.04	2.89
SSW	0.98	1.19	0.49	0.21	0.03	2.90
SW	1.30	3.47	1.47	0.22	0.04	6.50
WSW	1.75	5.84	3.88	0.70	0.13	12.30
W	1.90	4.55	2.80	0.73	0.33	10.31
WNW	1.18	2.75	1.35	0.58	0.53	6.39
NW	0.94	1.64	1.98	1.49	1.23	7.28
NNW	1.04	1.97	2.41	1.70	1.51	8.63
Total	18.64	40.11	24.86	9.90	6.51	

### 3. Availability statistics of WTGS

Based on the comprehensive availability statistics from 2014 January to 2014 July through SCADA monitoring system, seeing as Figure 6, the average availability was 97.65%. During the 7 months, the availability of February 2014 was 92.3%, because of the first normal maintenance for WTGS after 3 months operation. The availability of the other 6 months was all over 95%. The availability statistics had proved that the WTGS had always been working in high utilization state with little failure.

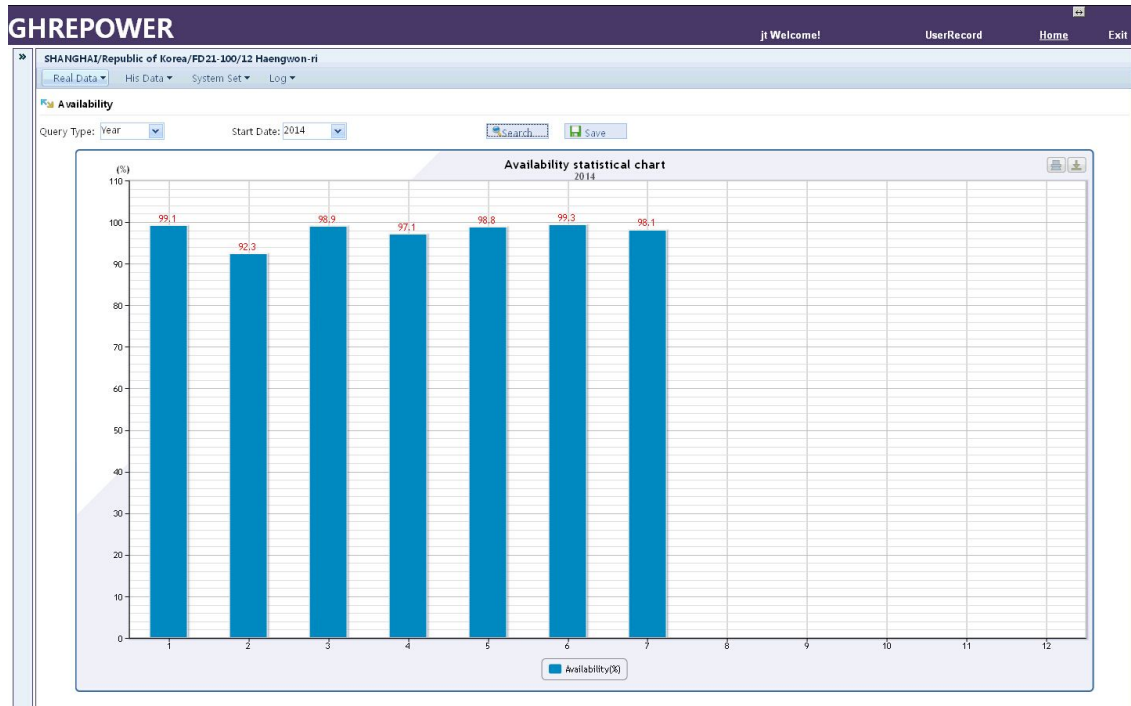


Figure 6

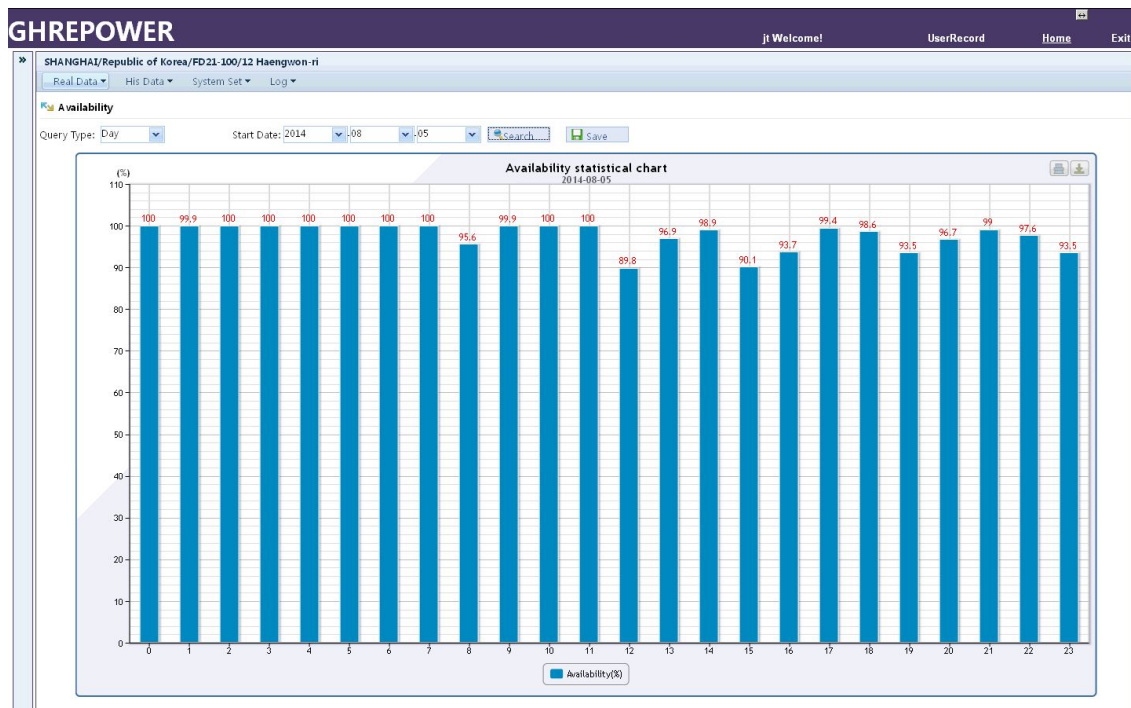


Figure 7

#### 4. Analysis for generation of WTG

During the first half year of 2014, the wind resource state of the installation site was shown as Figure 7: average wind speed was 5.91m/s, maximum measured wind speed

d reached 33.21m/s. Since the operation of December 2014 , the total generation of the WTGS was 116467.5kWh. And the generation from 2014 January to 2014 July had reached 112788.2kWh. The generation of each month is shown as Figure 8.

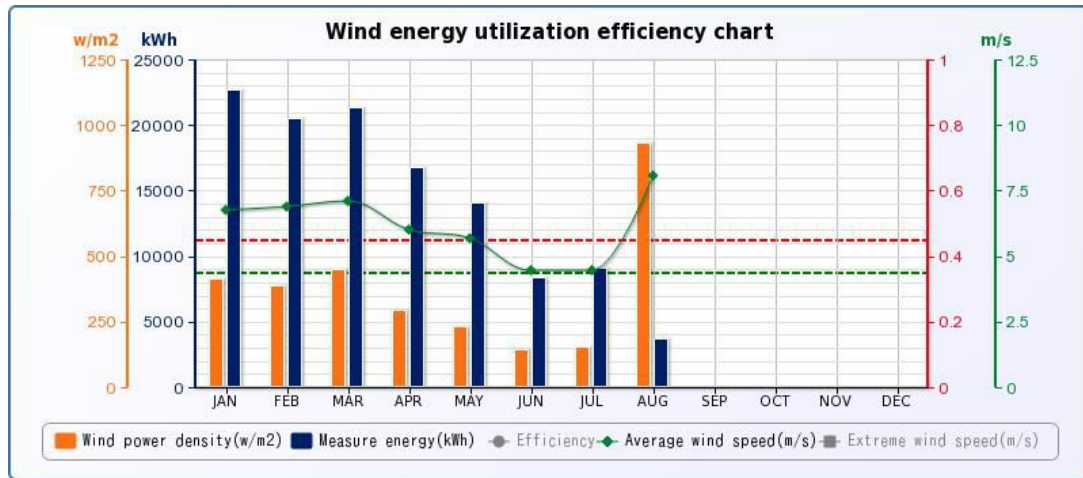


Figure 8

FD21-100 Haengwon-ri		
Date	Average wind speed(m/s)	Kilowatt Hours per Month ( kWh )
Jan-2014	6.76	22673.7
Feb-2014	6.89	20529.2
Mar-2014	7.1	21274.7
Apr-2014	6.01	16783.8
May-2014	5.68	14051.5
Jun-2014	4.46	8354.3
Jul-2014	4.46	9121

- The actual generation on the average wind speed from Jan to Jul was close to the theoretical generation.

## 5. Operation state of WTGS

Since the operation, the WTGS had survived from several strong Typhoon. And the wind speed between 21m/s to 32m/s had happened for 23 days in 7 month.

- The operating power curve and power scatter of WTGS on Apr 6<sup>th</sup>, 2014 for 48 hours in strong wind is shown as following Figures:

The average wind speed of Apr 6<sup>th</sup>, 2014(0:00-23:00) was 11.20m/s, maximum wind speed was 22.68m/s.

From the power curve and power scatter, it was clear that the generation output of the WTGS was smooth under different wind speed. Especially, the output was kept at rated output value with obvious fluctuation, which was close to the designing effect of WTGS theory.

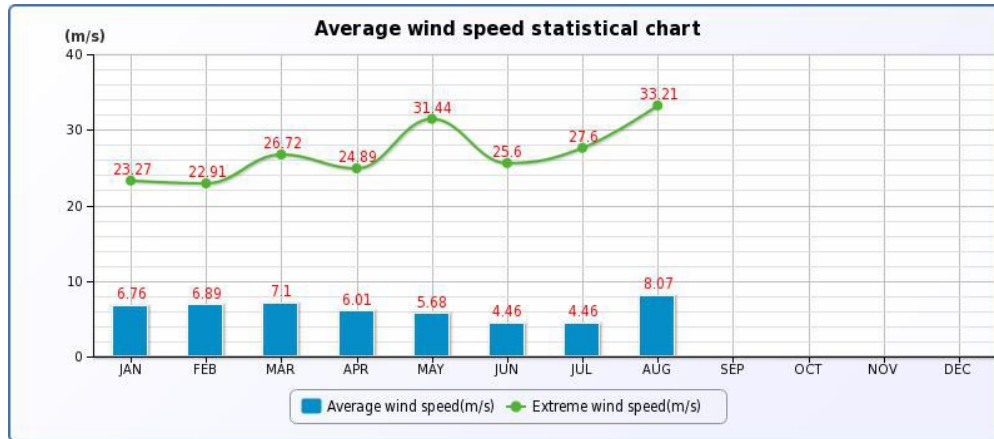


Figure 9

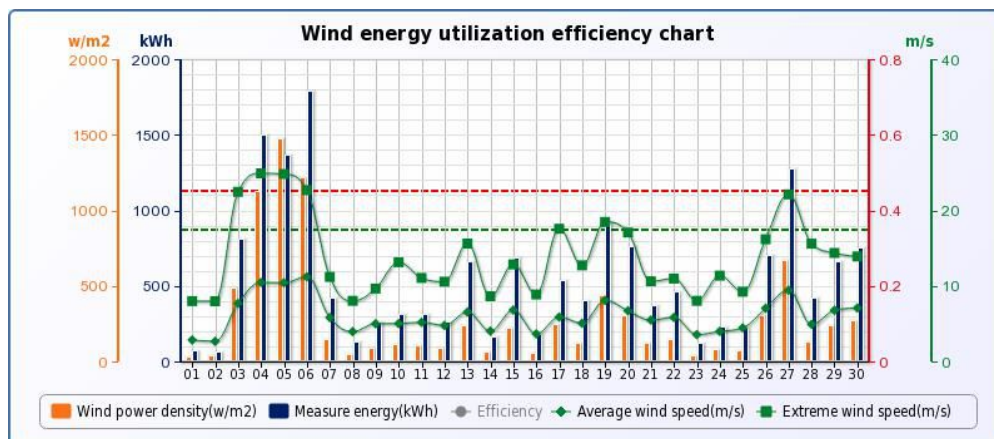


Figure 10

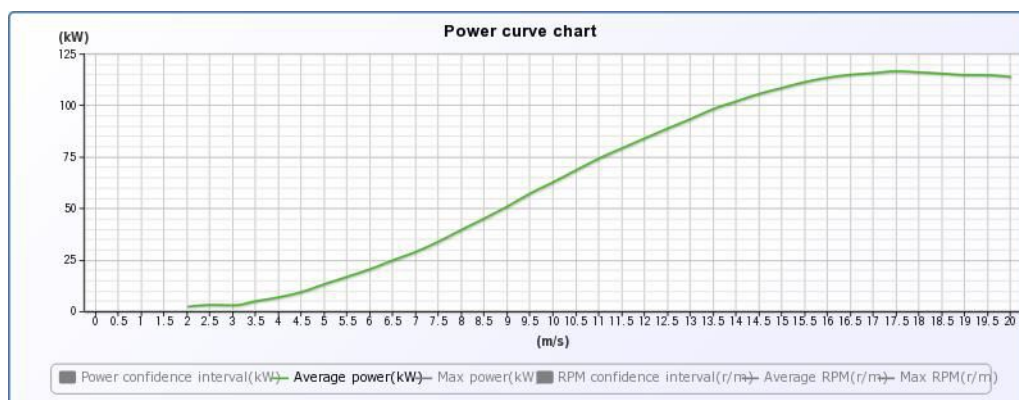


Figure 11



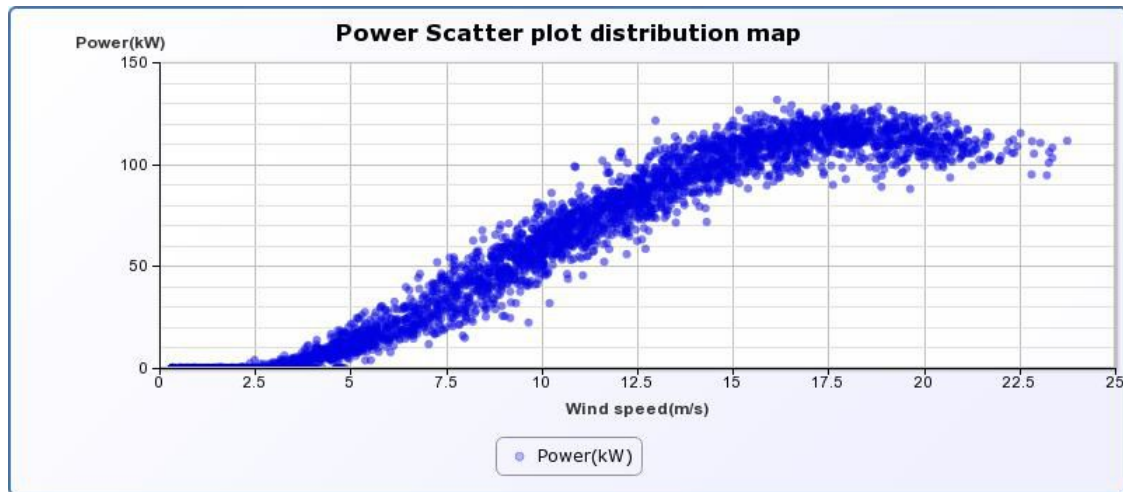


Figure 12

- Figure 13 has shown the generator rotating speed, torque, voltage and power scatter. It was clear that the inverter had always been in maximum power tracking state during the operation. When the output reached rated output, the rotating speed of generator was kept at 58RPM, the DC voltage of the system was kept at DC650V. Voltage and rotating speed had no obvious scatter distribution. The WTGS had been in operation under the ideal environment of constant torque, rotating speed and voltage.

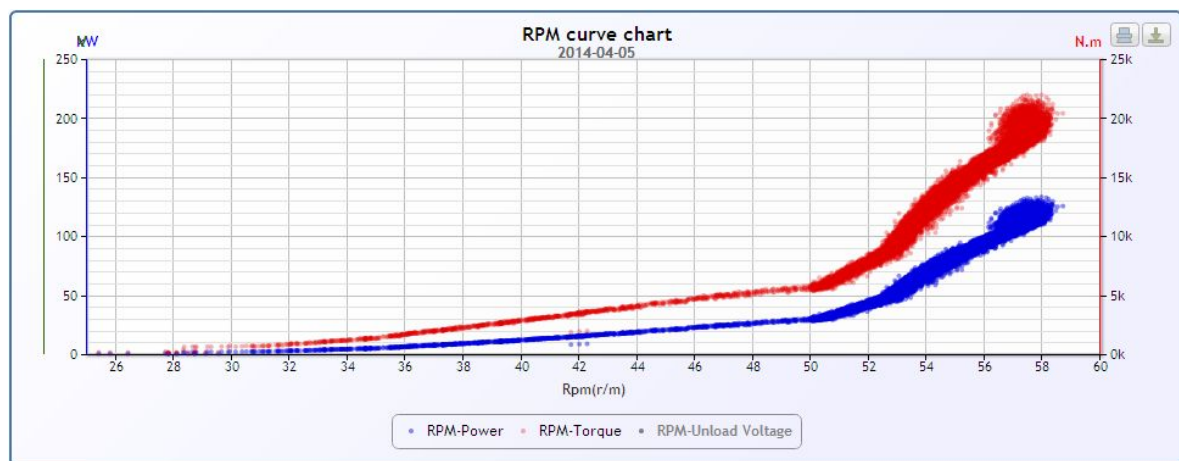


Figure 13

- The whole WTGS had been working successfully without any system alarm, mechanical components damage after several typhoon.

## 6. Anti-corrosion state

- The WTGS was installed on the Island surrounding by Sea, whose components may be contacted with the salty water due to the prevailing land and sea breeze. Therefore, it was highly required for the anti-corrosion. During the design, anti-salt-mist material had been added. Such as: 1. The bolts, nuts and other fasteners were disposed with Dacromet anti-rust and galvanization technology. 2. The surface of the blades was covered with photocatalytic coating, which can use the sunshine, rain and air as basic reaction medium to decompose the pollutant, achieving the goal of anti-fog and self-cleaning. 3. The area where the electrical components centralized was sealed to repel moisture with cooling protection, so that the corrosion rate can be slowed down. After 7 months operation, it was clear that the anti-corrosion of the WTGS worked well from the Figure 14-19.



Figure 14



Figure 15

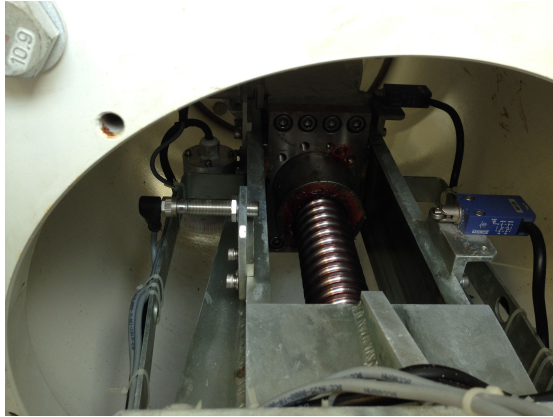


Figure 16



Figure 17



Figure 18



Figure 19

#### Conclusion:

Generally, the operation state of the 100kW wind turbine generator system was perfect in the first half year of 2014 in Jeju Island. The availability of the WTGS and its generation at different wind speed were close to the goal of theoretic designed value. And the operation state of WTGS was smooth and steady without obvious fluctuation when facing the strong wind, even several typhoon. What is more, until now, the sea salty fog had little impact on the mechanical components of WTGS. The subsequent operation of the whole WTGS remains to be in observation.