Voith Turbo

VOITH

Projektreport 2009

Voith Turbo Wind GmbH & Co. KG

DeWind D8.2 50 Hz Prototyp Cuxhaven, Deutschland

Januar 2009

Die Gesamtbetriebszeit der DeWind D8.2 50 Hz lag Ende Januar 2009 bei 7341 Stunden. Dabei produzierte die Anlage einen Energie von 6,17 GWh.

DeWind D8.2 50Hz Prototype Cuxhaven, Germany

January 2009 Update

Introduction

The first DeWind 2 MW D8.2 variable speed wind turbine, using a hydrodynamic WinDrive® from Voith Turbo Wind, directly coupled to a synchronous generator, was erected in Cuxhaven, Germany in December 2006.
The use of this technology provides an alternative to the more common full or partial power conversion systems that rely on power electronics.

DeWind took the well proven D8 2000 kW Doubly Fed Induction Generator (DFIG) wind turbine, which has been deployed in the field since 2002, and replaced the DFIG Generation system with a Conventional Generation system using a fixed speed Synchronous generator driven by a Torque controlling Variable speed Gearbox. The resulting system shares many common and well proven features, including the rotor, first two stages of the gearbox, front bedplate and yaw system.

This evolution of the well proven DeWind D8 – 2000 kW has been undergoing field testing at this near shore wind site, operated by DEWI-OCC, in order to verify the following design goals:

•Power performance as good as the Doubly Fed Induction Generator (DFIG) version,
•13.8 kV, medium voltage, operation,
•A larger power factor range than traditional power converter based designs,
•Flexibility in interconnection and ability to connect directly to a grid without a transformer,
•Improved Power Quality compared to a DFIG,
•Ability to meet grid standards for LVRT without additional equipment or software.

These design goals have all been achieved.

Commissioning and testing milestones.

Following assembly at the LMG facility in Lübeck, the turbine was moved to the DEWI-OCC off-shore test facility in Cuxhaven Germany.

- **Erected December 16, 2006**.
- **January 6, 2007. First Grid Connection**
- February 15 2007 Operational start.
- April 2, 2007 Supervised automatic daytime
- May 7 2007, Un-attended automatic operation.
- **May 29, 2007Continuous rated power operation**
- August 2007 the turbine nacelle was taken down and the WinDrive® was inspected by Voith. The WinDrive® showed no wear patterns. An updated version of the WinDrive® was installed which included efficiency improvements based on data gathered from the turbine since commissioning.

The D8.2 at the DEWI-OCC test site Cuxhaven

- September 1,Continuous power production resumed
- September 14, Power curve and Power Quality Measurement started.

Optimization Steps

The test results enabled key improvements to be developed to the overall performance of the DeWind D8.2. These included:

•Tuning pitch controller to control highly turbulent wind conditions,
•Setting up the WinDrive® to optimize aerodynamic performance and drive train efficiency,
•Ensuring that the synchronization process minimized transients and ramped up smoothly,
•Optimizing the cut-in and ramp-up processes in order to minimize any adverse grid impacts such as Flicker.

Performance Curve

The power performance testing has been carried out by Dr. Ing. Frey,an accredited wind turbine performance test engineering consultant, to IEC 61400-12-1 specifications and the certificate is shown below.

Measured Power Curve

DeWind D8.2 2000kW in Cuxhaven

Measured Power Curve				Uncertainties		
Bin	Wind-Speed	Data sets	Electric Power	Power coefficient	Cat. A	Cat. B	Cat. A_B
i	v_w m/s	N -	P_el. kW	c_p -	std. dev. kW	std. dev. kW	std. dev. kW
1	2.50	0	0.00	0.0000	0.000	0.000	0.000
2	3.00	0	0.00	0.0000	0.000	0.000	0.000
3	3.50	0	0.00	0.0000	0.000	0.000	0.000
4	4.00	0	0.00	0.0000	0.000	0.000	0.000
5	4.50	0	0.00	0.0000	0.000	0.000	0.000
6	5.10	4	83.06	0.2032	9.222	8.483	12.530
7	5.50	18	103.00	0.2013	7.626	24.639	25.792
8	6.01	48	215.73	0.3223	11.365	37.608	39.288
9	6.51	108	317.87	0.3735	6.045	43.850	44.265
10	7.01	158	448.67	0.4237	6.354	48.283	48.670
11	7.48	146	556.35	0.4309	6.136	52.567	52.924
12	8.00	113	703.18	0.4458	7.850	59.742	60.255
13	8.51	95	841.20	0.4427	8.885	66.061	66.655
14	8.97	108	986.11	0.4438	9.091	75.900	76.443
15	9.47	77	1150.99	0.4396	12.246	84.629	85.501
16	10.00	88	1340.59	0.4356	11.946	97.049	97.782
17	10.48	54	1529.83	0.4323	15.541	110.572	111.659
18	10.97	52	1745.57	0.4290	17.409	95.097	96.677
19	11.47	43	1871.71	0.4024	12.241	55.451	56.786
20	12.01	45	1939.90	0.3635	9.277	36.015	37.191
21	12.50	42	1984.95	0.3299	6.543	26.857	27.643
22	12.99	47	2009.66	0.2980	2.214	18.252	18.386
23	13.50	56	2014.69	0.2660	2.274	15.977	16.138
24	13.98	58	2016.88	0.2400	0.878	15.682	15.706
25	14.49	58	2012.84	0.2148	1.253	15.900	15.949
26	14.98	37	2011.14	0.1941	1.423	15.606	15.670
27	15.48	26	2012.22	0.1763	1.742	15.801	15.897
28	16.00	17	2004.52	0.1591	7.592	15.560	17.314
29	16.51	7	2011.00	0.1451	3.459	15.840	16.213
30	16.98	10	2011.31	0.1335	2.597	15.606	15.820
31	17.55	3	2011.19	0.1209	5.951	15.627	16.722
32	17.95	5	2013.24	0.1131	3.483	15.770	16.150
33	18.46	6	2006.52	0.1035	0.728	15.612	15.629
34	19.02	5	2010.39	0.0948	2.812	15.905	16.116
35	19.61	1	2007.75	0.0865	0.000	0.000	0.000
36	20.00	0	0.00	0.0000	0.000	0.000	0.000
37	20.50	0	0.00	0.0000	0.000	0.000	0.000

Ingenieurbüro Frey
messen auswerten berechnen
Dr.-Ing. Dieter Frey
Bürgermeister Kröger Str. 17
D – 21244 Buchholz – Sprötze
Tel 0 41 86 / 55 51; Fax 50 44

Manufacturer:
DeWind Ltd.
Seelandstraße 1
D-23569 Lübeck

Short description of the wind turbine:

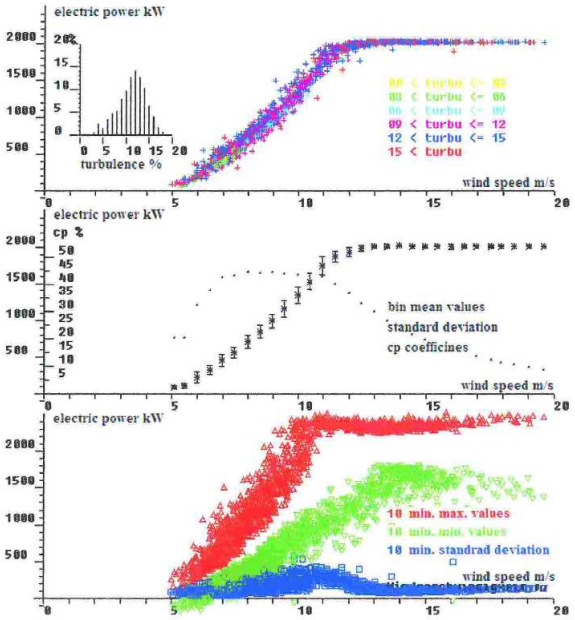
Number of blades	3
Rotor diameter	80 m
Hub hight	80 m
Blade adjust angle	0°
Rotorspeed	11 - 20 1/min
Rotor tilt angle	5°
Rotor cone angle	1°
Bladetype	DW80
Nominal generator power	2000 kW

Guide line:
IEC 61400-12-1

Measuring time:
01.01.2008 – 30.04.2008

Further information concerning the measurement:
- The cup anemometer is a Thies 1st Class Anemometer, No. 010 44 94.
- The measured values are choosen from the +195° - +315° sector.
- The turbulence intensity is 0 % - 20 %.
- The minimal / maximal air temperature is 1°C / 35°C.
- The air pressure is between 820 hPa and 1040 hPa.
- The average air density in the measuring time is 1.2417 kg/m³.
- The power curve is corrected to an air density of 1.225 kg/m³.

Accuracy of the sensors:
- The cup anemometer +/- 0.1 m/s, MEASNET calibration
- The electric power sensor is class 0.5 %
  The test certificate shows a max. uncertainty of 0.5 %
- The current transformers are class 0.5 %
- Air temperature sensor according test certificate 0.303°C at 0°C
- Air pressure sensor according test certificate –0.5 hPa at 1049.5 hPa
- The data collecting frequency is 10 Hz. 10 min averaged datas are stored



Power Quality

Power quality measurements to IEC 61400-21 were carried out by WINDTEST. The following bullets summarize the excellent results,(to be expected from a Synchronous Generator):-

•Voltage Ride Through (VRT) ability due to the natural behavior of the synchronous generator.
•Smooth synchronization process due to smart control algorithm.
•Long term flicker as good as the DFIG version.
•Flicker coefficient better than the DFIG version.

D8.2 Synchronization

The fully automatic synchronization is smooth and no significant transients are evident.

D8.2 Certification

DeWind has Statement of Compliance for Design assessment from DEWI-OCC to IEC 61400 for both the 50 & 60hz Turbines

DEWI-OCC Offshore and
Certification Centre GmbH
Am Seedeich 9, D-27472 Cuxhaven

Statement of Compliance
for the Design Assessment
STC – 080401, Rev. 0

The Design of the wind turbine **D8.2 - 2000 60 cps (Hz)**

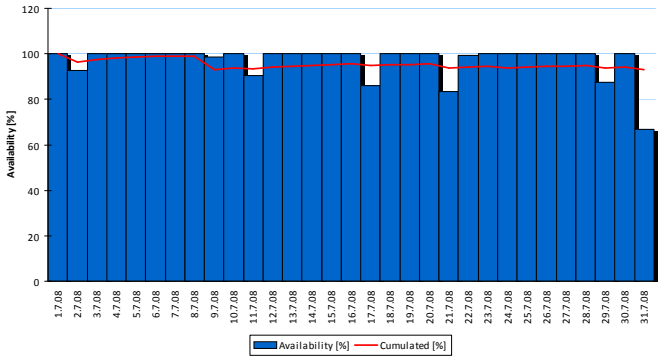
designed and manufactured by DeWind Inc.
Seelandstr. 1
23569 Lübeck
Germany

with characteristic basic data given in the annex and calculations and technical drawings listed in the relevant Certification Reports is conform to the following normative references:

IEC 61400-1 Wind Turbine Generator Systems – Part 1: Safety Requirements, Second Edition, 1999-02
assessed acc. to IEC Type Class II A

Turbine Operation.

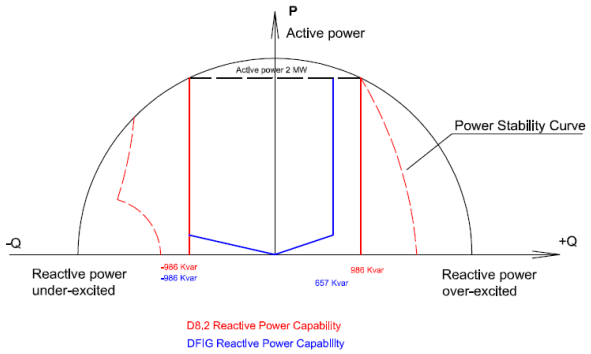
Availability 96.9% July 2008



Availability affected by software updates during the development process.

Reactive Power Capabilities

Measurements were taken to prove that the Generator can deliver 1MVAr leading and lagging at rated 2MW.



D8.2 PQ Stability capabilities measured

In summary, as of the end of January 2009 the DeWind D8.2 50 Hz prototype had run for over 7341hrs and produced more than 6.17 GWh of energy.

This was achieved despite the turbine being a test unit, with a range of optimization activities being undertaken. Proof gained that with 24/7 monitoring and service 97% availability easily achieved.

For further information on DeWind Turbines please contact us at (949) 428-8500 or (940) 455-7450

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Projektreport 2009

Voith Turbo Wind GmbH & Co. KG

DeWind D8.2 HE 50 Hz Veladero, Argentinien

Januar 2009

Bis Ende Januar 2009 war die Anlage 2400 Stunden am Netz und erzeugte eine Energie von 2,4 GWh.

January 2009 update

DeWind D8.2 HE 50Hz Veladero, Argentina

Introduction

Barrick Gold contracted with the Seawind Group to carry out the necessary studies and provide them with a turnkey solution for their mine sites. The first site to be considered was Veladero in the north east of Argentina near the Chilean border in the Andes Mountains. This site is at an elevation of 4,300 meters (14,000 ft approx.) which poses severe problems for typical “utility scale” wind turbines that rely on power conversion electronics.

The DeWind D8.2 turbine is an ideal solution for this challenge since it avoids power conversion electronics and instead achieves variable speed operation using a hydrodynamic WinDrive© developed by Voith Turbo of Germany. This directly coupled to a 4 pole synchronous generator allows power to be produced at 6.6kV, which is ideally suited for the mine’s electrical grid.
In addition to the technical challenges, there were also many logistical challenges to be overcome, not least of which was the winding road to the site. Special transport was developed to allow the large wind turbine components to be taken up the mountain, an example of a specialized blade trailer can be seen below.

A short video showing the unique transportation solution for the wind turbine and its installation of can be found on the Barrick web site at:
http://www.barrick.cl/noticias/detalle_comunicados.php?id=81&info=Noticias

Mine Site

The Veladero mine is located in San Juan Province, Argentina, immediately to the south of the Pascua-Lama Property, approximately 320 kilometers northwest of the city of San Juan in the highly prospective Frontera District. The property is located at elevations of between 4,000 and 4,850 meters above sea level.

Geographic Location of Veladero Mine
Courtesy of Barrick Gold

The DeWind D8.2 HE with a 80m rotor was installed at Veladero on a 65m tower. The generator voltage was 6.6kV to allow the turbine to function at the high elevation and to integrate to the mine grid without the need for a transformer. The turbine is shown below installed at the Veladero mine site.

Technical Challenges for High Altitude Wind Turbines

At an altitude of 4,300 m (14,000 ft approx.) the air pressure is approximately 600 mbar and the air density is approximately 0.74 kg/m3, which is extremely low when compared to a standard sea level air density of 1.225 kg/m3. The lower air density has an influence on the turbine in the following ways:

- Aerodynamic behavior of the turbine changes
  - The turbine will produce less energy for a given wind speed at lower air densities, but this also means that the turbine can operate at higher wind speeds and stay within the certified load spectrum.
- Lower cooling effect from the air
  - The DeWind D8.2 has cooling systems that are working well within their capability to ensure the turbine will operate within its temperature range even at these lower air densities. The generator runs well

within its rated temperature range at 2 MW, no de-rating is required due to the lower air density.

•Reduces the basic Insulation levels of electrical insulation systems.

•The basic insulation properties of electrical components are reduced due to the lower air densities. Wind turbines that utilize power conversation electronics are affected by the low air density and cannot be used above 2,000 m elevation.

•The DeWind D8.2 does not use power conversion electronics and is not affected by this problem. The DeWind D8.2 has been designed to be suitable for the elevation at this site by using the 15 kV insulation system of the generator but equipping it with a 6.6 kV winding which is the required voltage for the mine electrical grid.

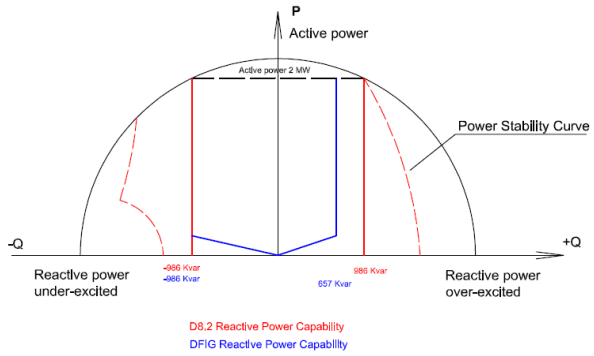
The turbine is connected to a 6.6kV electrical grid which is a stand-alone system with a capacity of approximately 13.44MW of diesel generation. The local load is between 4 and 6 MW of electrical power, and the generation is located 6 km from the mine which is connected by a 6.6kV overhead line.

The configuration of the DeWind D8.2, using a directly connected synchronous generator is particularly suitable for connecting to this relatively "weak" electrical grid and helps maintain system stability.

The 4x short circuit capability of the generator allows for direct on-line starting of the large mine motor without the electrical grid fluctuations causing loss of synchronization of the wind turbine.

Dynamic Reactive Power Capabilities

The PQ stability curve for the D8.2 is shown below in red, compared to an enhanced DFIG in Blue

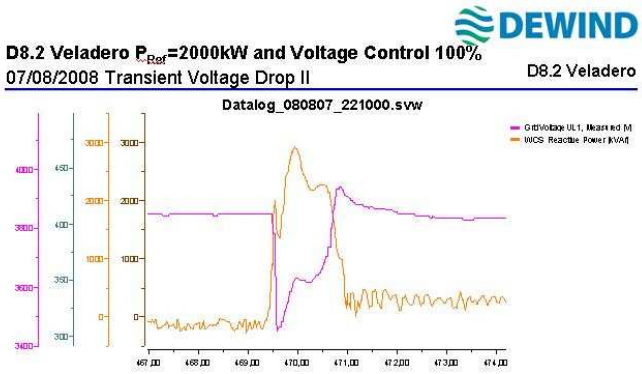


The 0.9 Lag to 0.9 Lead capability is further enhanced by the Dynamic VAr ability of the D8.2.

The start of the 1MW gold mine stone crusher, located close to the turbine, 6km from the 14MW of Diesel Generation, produces a transient voltage drop in the islanded 6.6kv grid system.

The grid-voltage drops from 3848V to 3465V (-11%) during the start up event.

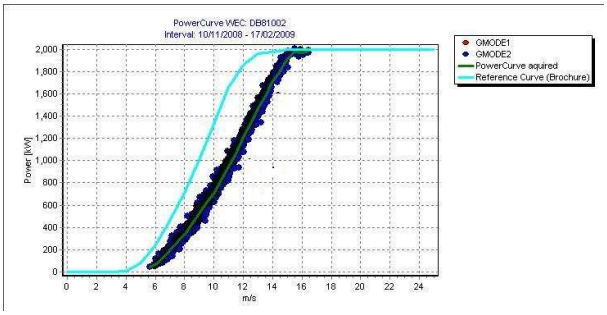
With the Turbine in "Voltage support "mode, the Generator provided 3MVAr "transient" voltage support that prevented the voltage dip being much bigger.



- AVR in voltage control mode and D8.2 synchronous generator supports weak grid with high transient reactive power peak.

Power Performance

The "screen shot" below shows nacelle anemometer based power performance data, dark blue dots. A sea level power curve, pale blue solid line, is also shown.



Power performance data from SCADA system

The effect of the lower air density can be clearly seen in the reduction in power at specific wind speeds when compared to the sea level reference curve.

This is the 2nd D8.2 Turbine and was installed in December 2007 & has been running throughout 2008

At the end of Jan 2009, the Turbine has run for 2400hrs synchronized with the Grid and generated 2.4GWh

For further information on DeWind Turbines please contact us at (949) 428-8500 or (940) 455-7450

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Projektreport 2009

Voith Turbo Wind GmbH & Co. KG

DeWind D8.2 60 Hz Demonstrator Sweetwater, Tx, USA

Januar 2009

Die Windturbine war bis Ende Januar 2009 2500 Stunden am Oncor-Stromnetz und lieferte eine Energie von 2,7 GWh.

January 2009 Update

DeWind D8.2 60 Hz Demonstrator Sweetwater, TX, USA

Introduction

In mid-2007 DeWind entered into an agreement to provide Texas State Technical College (TSTC) a turnkey solution for the provision of the first DeWind D8.2 60 Hz wind turbine. The turbine was to be both a technology demonstrator for DeWind and to provide the technician training program at TSTC with a hands on training opportunity.

A location for the turbine was secured on land owned by the City of Sweetwater near the Roscoe High School.

The turbine is the third D8.2 2000kW turbine to be placed into service and like the preceding two turbines has been placed into a challenging environment. In this case, not only does the turbine demonstrate 60 Hz operation but also the ability to directly connect to a medium voltage distribution line, without the need for a transformer. This is a unique feature of the D8.2 turbine, which is accomplished through the use of a hydrodynamic torque variable converter that allows speed operation of the wind turbine rotor while supplying constant speed to a medium voltage directly connected synchronous generator.

A video of the erection of the turbine can be seen on the TSTC West Texas Web Site at the following address:
http://www.windenergyeducation.com/turbine.htm

Sign showing owners and vision for the future of the site.

Foundation

A Pier type of foundation was designed following geotechnical studies of the site. Following site preparation foundation construction was undertaken during November and December of 2007.

Installation of Outer Can of the foundation

Installation of Turbine

The turbine erection took place in January 2008 and went smoothly despite some days that were lost due to high winds and bad weather.

The installed D8.2 at Sweetwater

Electrical Configuration

The electrical grid at the turbine location is a distribution network that is owned by Oncor, the distribution arm of TXU. The voltage on this distribution network is nominally 12.47kV and thus within the capability of the D8.2, which can generate power at up to 13.8kV without the need for a step up transformer.

January 2009 Update

Point of Common Coupling

The point of common coupling provides the grid protection and anti-islanding required by Oncor. The grid protection is provided by a recloser equipped with a relay that provides the necessary over/under voltage, over/under current and over/under frequency protection. The recloser is located on the left hand pole shown in the figure below. The cabinet houses the transfer trip equipment that provide the anti islanding protection required by the utility. The pole to the right is owned by Oncor and provides the connection to the existing grid and also has the revenue meter.

Point of Common Coupling Equipment

Pre Commissioning at NREL

Tests were performed on the complete DeWind D8.2 nacelle in late November through early December 2007, at NREL's National Wind Technology Center (NWTC), Dynamometer south of Boulder, CO. The turbine's functionality on a 60Hz grid, ability to achieve 2 MW continuous power output, proof of cooling system up to 35℃ ambient, and many other system tasks were successfully completed.

Commissioning

The final mechanical and electrical completion began on February 24th 2008 to prepare the turbine for commissioning. Commissioning started on February 29th and first wind driven 60 Hz power was delivered to the grid March 3rd 2008.

Performance Testing

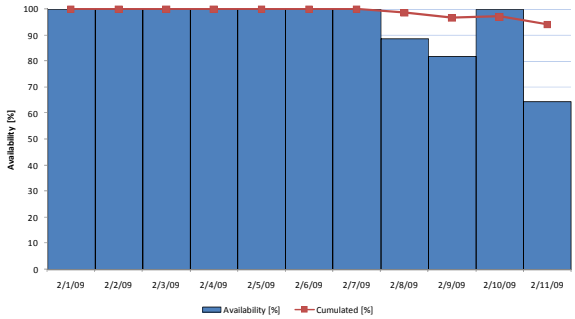
Reliability test passed 25th April

From that date, there was an extended period resolving problems caused by a weak grid, Oncor re-strung part of line; and DeWind fully explored and proved the synchronous generator capabilities, by running at 2MW in voltage support mode whilst connected to a "Weak" Grid.

TSTC took formal ownership on 24th Sept 2008.

Screenshot of turbine running at 2MW Feb 11th 09

Average availability 94% at end Jan 09



Proof that with 24/7 and service support, the D8.2 achieves good availability

This is the 3rd D8.2 to be installed and the 1st 60hz unit.

By the end of January 2009 the Turbine has run 2500hrs synchronized with the Oncor Grid and generated 2.7 GWh

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Hermes Award für Voith WinDrive

Internationaler Technologiepreis geht 2009 an Voith Turbo

Voith Turbo erhielt in diesem Jahr den begehrten internationalen Technologiepreis der Hannover Messe, den Hermes Award. Der mit 100.000 Euro dotierte Preis wurde im Rahmen der Eröffnungsfeier der weltgrößten Industriemesse vergeben. Die unabhängige Jury zeichnete damit einen neuen Voith-Antrieb für Windkraftanlagen der Zukunft aus: den Voith WinDrive.

Der Hermes Award hat sich in den vergangenen fünf Jahren zum „Oscar für Ingenieure“ entwickelt. 70 Produktinnovationen musste die Jury bewerten, und daraus fünf Unternehmen für die Endausscheidung nominieren. Dort setzte sich schließlich Voith Turbo mit seinem Antriebskonzept Voith WinDrive durch. „Die in diesem Jahr prämierte Innovation sorgt für frischen Wind auf dem stark wachsenden Windenergiemarkt“, begründete Prof. Wolfgang Wahlstätter die Arbeit der unabhängigen Jury bei der Verleihung des Preises, den Dr. Andreas Basteck als Geschäftsführer von Voith Turbo Wind entgegen nahm.

In den Multimegawatt-Klassen moderner Windenergieanlagen liegt die technologische Herausforderung in zuverlässigen, effizienten Windturbinen, die alle Anforderungen der Netzeinspeisung nach Kraftwerkstandards erfüllen. Bestehende Konzepte basieren auf der Umrichtertechnologie, meist gekoppelt mit mechanischen Getrieben, und können diese Anforderungen zur Netzeinspeisung nicht allumfassend erfüllen. Der Voith WinDrive ermöglicht als hochdynamisches mechatronisches System erstmals, kraftwerkserprobte Technologien in Windturbinen einzusetzen und sorgt für die notwendige Netzstabilität. Damit werden auch Umrichtertechnologien, deren mittlere Ausfallhäufigkeit sich unter zwei Jahren belaufen, überflüssig. Eine hohe Verfügbarkeit von Windparks sowie geringere Betriebs- und Wartungskosten sind das Ergebnis. Bei Multimegawattanlagen sind aufgrund unterproportionaler Wachstumsgesetzen des WinDrive Gewichtsreduzierungen in der Gondel und damit verbunden im Turm und Fundament realisierbar.

Zu den wesentlichen Vorteilen des ausgezeichneten Antriebssystems zählt die hohe Netzeinspeisequalität. Durch den Einsatz bewährter Synchrongeneratoren können Anforderungen wie Blindleistungsregelung oder Stabilisierung des Netzes bei Kurzschluss, problemlos erfüllt werden. Außerdem zeichnet sich der WinDrive durch hohe Zuverlässigkeit aus. Da Frequenzumrichter und Step-up-Transformatoren wegfallen, wird die Komplexität der Windturbine maßgeblich reduziert. Das reduziert Ausfallwahrscheinlichkeit und Stillstände, so dass die Zuverlässigkeit um mehr als 30 Prozent steigt. Durch den drehzahlvariablen Betrieb kann der Windrotor mit verschiedenen Drehzahlen bei verschiedenen Windgeschwindigkeiten im aerodynamischen Optimum betrieben werden. Synchrongeneratoren erlauben den Betrieb auf Mittelspannungsebene ohne zusätzliche Komponenten. Der Gesamtwirkungsgrad eines Windparks verbessert sich somit um über 1 Prozent. Nicht zuletzt ermöglicht der WinDrive Reaktionszeiten im Millisekundenbereich und reduziert dadurch Lasten im Antriebsstrang.

Die WinDrive Technologie ist bereits vom Komponentenansatz On- und Offshore-tauglich, auch ein Inselbetrieb ist möglich. Einsatzorte in Höhenlagen von mehr als 4.000 Meter ü. NN und schwache Energienetze stellen für den WinDrive kein Problem dar. Darüber hinaus kann der WinDrive auch in Wasserkraftwerken zur Effizienzsteigerung drehzahlvariabler Wasserturbinen eingesetzt werden. Seit einem Jahr läuft der WinDrive in Pilotanlagen in Cuxhafen (Deutschland), Valedaro (Argentinien) und Sweetwater (USA) problemlos.

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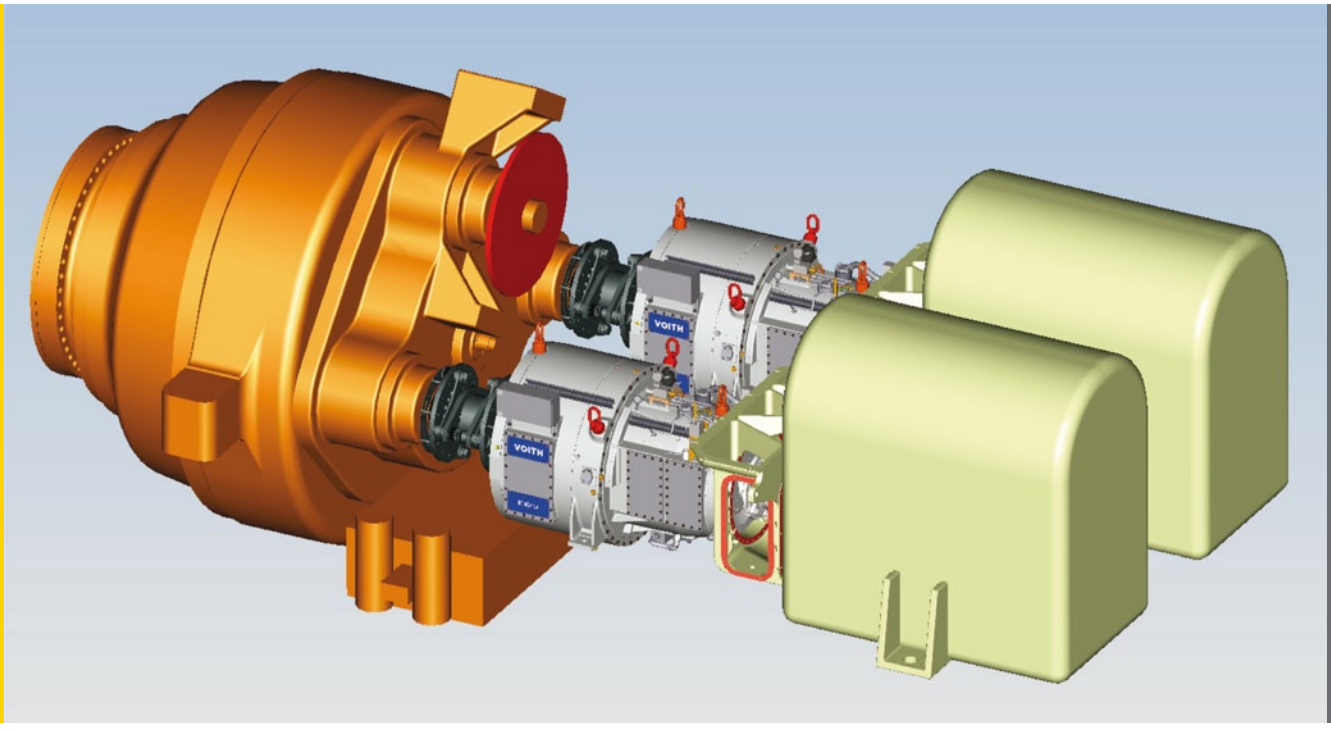
Voith Turbo Wind GmbH & Co. KG

Gleiche Dimensionen mit 30 % mehr Leistung

BARD entwickelt mit Voith Turbo neue Antriebskonzepte für seine Windkraftanlage BARD 5.0

Mit dem Windenergieanlagenhersteller BARD hat Voith Turbo Wind einen weiteren Partner für den kürzlich mit dem Hermes Award ausgezeichneten WinDive gefunden. Beide Unternehmen haben sich darauf verständigt zusammen ein Antriebskonzept für den Triebstrang der Windturbine „BARD 5.0“ zu entwickeln.



Antriebskonzept BARD 6.5 mit Voith WinDrive

Die BARD-Gruppe entwickelt die Technik ihrer Windkraftanlage BARD 5.0 weiter. Durch ein neues und leistungsfähigeres Antriebskonzept bei gleichem Rotordurchmesser von 122 Metern und gleicher Nabenhöhe von 90 Metern, kann die Ressource Wind bald noch besser ausgeschöpft werden.

Eine Weiterentwicklung des bisherigen Triebstrangs „Bard 5.0“ zu höherer Leistung bis zu 6,5 MW (7 MVA) ist ein wichtiger Schritt um die Offshore Windkraft in ihrer Wirtschaftlichkeit weiter zu entwicklen. Zentrale Kompenente im Triebstrang der Turbine wird der WinDrive von Voith Turbo werden, der erstmalig in einer BARD Windturbine eingesetzt werden soll.

Die BARD-Gruppe und Voith Turbo Wind GmbH & Co. KG entwickeln somit eine 6,5 MW (7 MVA) Offshore Anlage unter Nutzung der WinDrive-Technologie mit Erstauslieferung Frühjahr 2010.

„Die WinDrive Technologie ist für uns die optimale Verknüpfung bestehender Technologie kombiniert mit Innovation“, so BARD zu den Gründen für die Zusammenarbeit. Mit dem WinDrive System von Voith Turbo komme man sehr dicht an die Forderung der Energieversorgung nach Kraftwerkseigenschaften von Windkraftanlagen.

Der WinDrive von Voith Turbo Wind GmbH & Co KG ist ein regelbares Planetengetriebe mit Drehmomentwandler. Seine Aufgabe besteht in der variablen Drehzahlregelung des Windrotors bei konstanter Abtriebsdrehzahl zum Betreiben von Synchrongeneratoren. Durch den WinDrive wird der Windrotor in Abhängigkeit der Windgeschwindigkeit in den besten Arbeitspunkt mit bestem Wirkungsgrad eingeregelt. Bei Nennleistung dient der WinDrive zur unterstützenden Regelung der Momentenbegrenzung.

Mit der WinDrive-Technologie gelingt es erstmalig direkt in das Netz gekoppelte kraftwerkserprobte Synchrongeneratoren in Windturbinen einzusetzen, wodurch die Stromeinspeisung nach den erforderlichen Netzeinspeiseanforderungen voll umfänglich erfüllt werden.

Die leistungsfähigeren Windkraftanlagen sollen in den nächsten Jahren in den Offshore Projekten der BARD-Gruppe zum Einsatz kommen. Neben dem bereits genehmigten Projekt „BARD Offshore 1“ hat die BARD-Gruppe bereits weitere Genehmigungsanträge für Offshore-Projekte beim zuständigen Bundesamt (BSH) gestellt. Die Gesamtleistung aller zukünftigen Projekte wird mehr als 3.000 Megawatt betragen. Drei weitere Parks wurden für den niederländischen Teil der Nordsee beantragt. „BARD Offshore 1“ wird der erste kommerzielle Offshore Windpark in Deutschland sein.

BARD 5.0 Offshore Windenergieanlage

Voith WinDrive

Voith Turbo

VOITH

Projektreport 2009

Voith Turbo Wind GmbH & Co. KG

Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) übernimmt DeWind von Composite Technology Corporation (CTC)

September 2009

Der weltweit zweitgrößte Schiffbauer DSME steigt mit der Übernahme von DeWind in das Windenergieanlagen-Geschäft ein. Voith Turbo freut sich über die neue Partnerschaft und verspricht für das Erreichen der hochgesteckten Wachstumspläne volle Unterstützung.

Composite Technology Completes Sale of Turbine Business to DSME

Daewoo Shipbuilding & Marine Engineering to Accelerate Growth Plans of DeWind

IRVINE, CA--(Marketwire - September 08, 2009) - Composite Technology Corporation (CTC) (OTCBB: CPTC) is pleased to announce that its subsidiary DeWind Inc. has completed a sale of substantially all of its operating assets and liabilities, including its subsidiaries and certain assets of DeWind Ltd., to Daewoo Shipbuilding & Marine Engineering Co., Ltd. (DSME) of Korea.

Following the terms of the asset purchase agreements, the sale price was $46,500,000 for substantially all of the operating assets and liabilities of DeWind Inc., and $3,000,000 for certain assets of DeWind Ltd. The transaction has certain post-closing adjustment provisions effective over various time periods and portions of the sales price are held in escrow pending such adjustments. CTC and its subsidiaries are no longer in the business of developing or manufacturing wind turbines and most of the DeWind employees transferred to DSME.

"This transaction will help DSME enter the global wind energy market and to establish a strong presence in that market. We will leverage DSME's world class engineering and manufacturing capabilities and DeWind's technology and experience to become one of the world leaders in the wind energy sector," said Sang Tae Nam, President and the CEO of DSME.

Benton H Wilcoxon, Chairman and CEO of CTC, stated, "I am very pleased that the DeWind turbine business and its employees have found such an excellent home in DSME. I have been very impressed by the leadership of DSME and in particular their development plans for the business. CTC will now focus its resources and attention on its business of innovative high performance energy efficient electrical transmission products."

RBS Securities, an affiliate of The Royal Bank of Scotland Plc, acted as exclusive financial advisor to DeWind. Milbank, Tweed, Hadley & McCloy LLP acted as legal counsel to CTC and DeWind. Macquarie Securities Korea Limited acted as financial advisors to DSME. Reed Smith LLP acted as U.S. legal counsel to DSME, and Shin & Kim acted as Korean legal counsel to DSME.

The closing of the asset sale transaction will be described in a Form 8-K to be filed with the Securities and Exchange Commission (SEC).

About DSME:

Daewoo Shipbuilding & Marine Engineering Co., Ltd. (DSME) is the world's second largest shipbuilder with an annual capacity of 75 vessels and 7-8 large scale offshore structures such as semisubmersibles and Floating Production Storage & Offloading ("FPSO") and has the largest market share in Liquified Natural Gas Carrier, Very Large Crude Carrier and semi-submersible drilling rigs. DSME product portfolio includes commercial ships such as LNG carriers, oil tankers, containerships, Liquified Petroleum Gas carriers, pure car carriers, offshore structures such as FPSO vessels, drilling rigs, drillships and fixed platforms; and naval vessels including submarines, destroyers, rescue ships and patrol boats.

DSME, originally established as Okpo Shipyard on Geoje Island, South Gyeongsang Province in 1973, was spun off from the Daewoo conglomerate in 2000. The government-run Korea Development Bank and KAMCO currently own 50% in DSME. DSME maintains order backlog totaling US$ 39 billion representing 206 ships as of April 30, 2009. In 2008, DSME achieved KRW 1.0 trillion in operating profit and KRW 0.4 trillion in net profit through sales of more than KRW 11.1 trillion. New orders amounted to US$ 11.6 billion in 2008.

For more information about DSME, please visit our website at www.dsme.co.kr