SUNEC

CHINA SUNEC ENERGY (PRIVATE) LIMITED

HOUSE 49, STREET 23, SECTOR F-10/2, ISLAMABAD, PAKISTAN
TELLEPHONE +92 (51) 8318868 FAX +92 (51) 8318869

REF: CSEPL/NEPRA/01
09 Feb. 2015

The Registrar,
National Electric Power Regulatory Authority,
NEPRA Tower, Attaturk Avenue,
Sector G-5/1, Islamabad.

Subject: **LICENSEE PROPOSED MODIFICATION IN GENERATION LICENSE NO.WPGL/29/2014**

Dear Sir,

China Sunec Energy (Private) Limited is developing a 50 MW wind power Project at Jhimpir, District Thatha, Sindh. The project was envisaged to be developed installing VESTAS V90-2.0MW. However, due to certain factors beyond the control of the sponsors, the project will now be developed with GOLDWIND GW77/1500.

In view of the above, We are now submitting a Licensee Proposed Modification (LPM) Pursuant to Regulation 10 (2) of the NEPRA Licensing (Application and Modification Procedure) Regulations 1999 (the Regulations).

We are enclosing herewith a Bankers Cheque No.01101392 dated 06/02/2015 Amounting to Rs. 73,000/- drawn on Soneri Bank Limited as modification fee in Generation License.

In the light of above mentioned facts, it is requested to please process our LPM for change of WTG and allow us to develop the project with GOLDWIND GW77/1500 Machines/equipment

Yours Faithfully,

(LIU MINGYI)
Chief Executive Officer.

ENCL:- Original bankers cheque for Rs.73,000/- as modification fee.
Certificate of Incorporation.
Power of Attorny in favor of Mr. Liu Mingyi.
Board Resolution
Technical description of Goldwind Turbines.

E-MAIL csepl@188.com

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IMPACT OF MODIFICATION

TEXT OF PROPOSED MODIFICATION

Vestas Turbines are now to be replaced with GOLDWIND GW77/1500.

REASONS IN SUPPORT OF MODIFICATION

China Sunec energy (Private) Limited established in Pakistan with foreign investment from CHINA. For financing from China, Company prefer Chinese product.

IMPACT OF THE PROPOSED MODIFICATION

a. *There will be no impact on Tariff.*
b. *There will be no impact on quality of services.*
c. *There will be no impact on the obligations of the Company under the License.*

CHANGES TO LAYOUT OF THE GENERATION FACILITY

The micro siting has been changed. The plant will consist of 33 x 1.5 MW turbines. Previously it was consist of 25 x 2 MW turbines.

INTERCONNECTION ARRANGEMENTS

No changes.

CHANGES TO THE POWER CURVE

Changes to the power curve are mentioned in Turbines Description.

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CORPORATE RESOLUTION

This is to certify that at board of Director Meeting of **CHINA SUNEC ENERGY (PRIVATE) LIMITED** (the **"Company"**), a Company duly incorporated under the Companies Ordinance, 1984, convened on Thursday the 02 Feb. 2015 at Company's registered office situated at House No. 49, St# 23, F-10/2, Islamabad the following resolution was passed and duly adopted as resolution in conformity with the provisions of the Companies Ordinance, 1984 and the Memorandum and Articles of Association of the Company in full force and effect.

RESOLVED that the Company hereby approves to file an application for amendment of Generation License (the "Application") with the National Electric Power Regulatory Authority (**"NEPRA"**) for amendment of generation license for the company's 50 MW wind energy power project at Jhimpir, Sindh.

FURTHUR RESOLVED that the company hereby authorizes Mr. LIU MINGYI having Passport# G55745759 being the CEO/Director of the company to sign singly the Application and any documentation ancillary thereto. Furthermore, the company hereby authorizes him to do all acts and things necessary for the processing completion and finalization of the application as he may deem fit on behalf of the Company.

Certify that the foregoing is a full, true and correct copy of the resolution passed in the Board of Director Meeting which was duly called and held in all respect as required by law and by the Articles of Association of the Company at the office thereof on 02 day of Feb. 2015.

Certify that the said resolution is still in force and has not been amended and that the authorized CEO/Director is authorized to do necessary documentation for the company pursuant to this resolution.

MR. LIU MINGYI
CEO/Director

MR. LIU SHUAI
Director.

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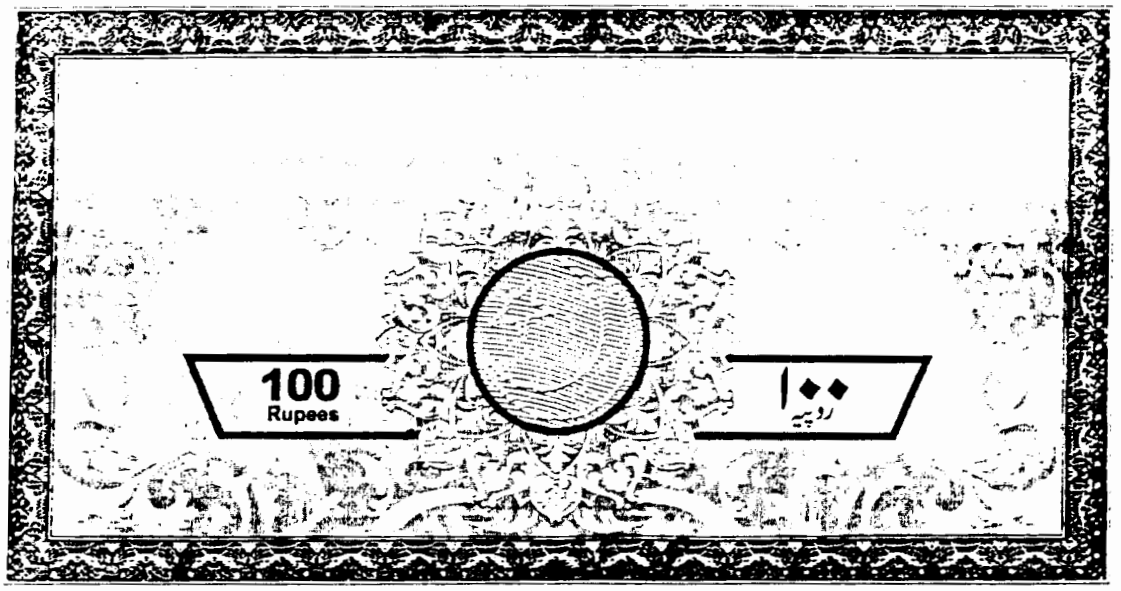

POWER OF ATTORNEY

TO WHOM IT MAY CONCERN

Pursuant to the resolution passed in the Board of Directors meeting of **M/S CHINA SUNEC ENERGY (PRIVATE) LIMITED** held on 02 February 2015, the company hereby authorizes **Mr. LIU MINGYI** bearing Passport number **G 55745759** to file an application for amendment of Generation License (the "Application") with the National Electric Power Regulatory Authority (**"NEPRA"**) for amendment of Generation License No. WPGL/29/2014 for company's 50 MW wind energy power project at Jhimpir District Thatha, Sindh (the "Project") and to sign singly and negotiate and to do all acts and things that are necessary and required in relation for filing the application with NEPRA as he may deem fit on behalf of the Company.

LIU SHUAI
DIRECTOR
CHINA SUNEC ENERGY (PRIVATE) LIMITED.

ATTESTED

Notary Public

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

Company Registration Office

Islamabad

CERTIFICATE OF INCORPORATION

[Under Section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. 0072832

I hereby certify that "CHINA SUNEC ENERGY (PRIVATE) LIMITED" is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by shares.

Given under my hand at Islamabad this Seventeenth day of June, Two Thousand and Ten.

Fee Rs.1,014,500/-

(Muhammad Anas Noman)
Joint Registrar of Companies

CERTIFIED TRUE COPY

No. JRI 1612

CHINA SUNEC ENERGY (PVT) LTD

GOLDWIND

GW77/1500 Technical Description

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GW77/1500 Technical Description

1. General Information

The Goldwind GW77/1500 wind turbine is a gearless wind energy converter and is equipped with a three-blade rotor, pitch control with a rated output of 1500 kW. This converter generates electric current that is fed directly into the public grid. Optimum aerodynamic rotor efficiency, at every wind speed, is achieved by using variable speed technology.

Highlights:

Highly efficient multipole generator

- Direct coupling of the multipole generator to the rotor
  - No gearbox required
  - Practical application of advanced technologies
- Synchronous generator with permanent magnet excitation
  - High efficiency, particularly at partial load
  - No energy losses because of an external excitation
  - No slip rings for external excitation needed
- External runner concept
  - Compact design, small generator diameter
- Passive air-cooling system
  - Highly efficient cooling without any additional energy

Blade pitch system and safety system

- Blade pitch system with tooth belts
  - Lubrication not required
  - Minimum play in blade drive tracks
  - Minimum wear
  - Maintenance free
- Double-layer capacitor for emergency re-pitching
  - No heavy lead-gel accumulators required
  - Brush-less pitch motor
  - Increased lifetime
  - Maintenance free

2. Design Tower Head

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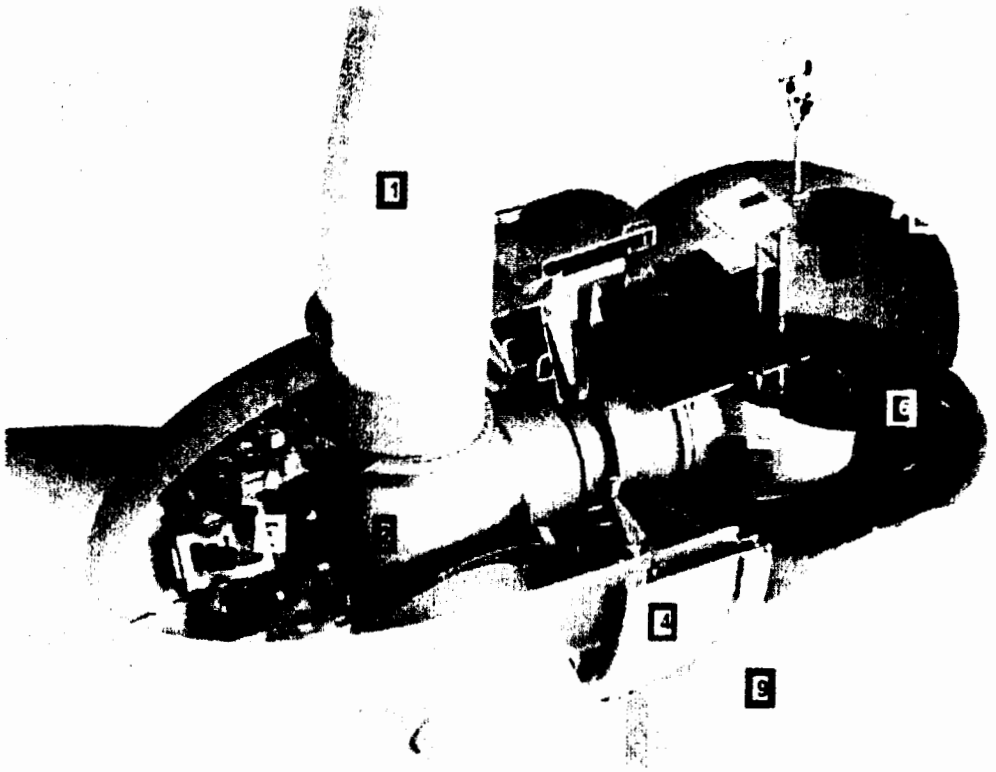

1	**Rotor blade**	6	**Yawing system**
2	**Casted hub**	7	**Wind measurement system**
3	**Blade pitch system**	8	**Machine base**
4	**Generator-rotor**	9	**Tower**
5	**Generator-stator**	10	**Auxiliary crane**

Rotor

The Goldwind GW77/1500 aerodynamic rotor blades convert translational air motion into a motion of the rotor. This motion is initiated by aerodynamic lift forces.

The wind energy converter GGoldwind GW77/1500 has a three-bladed rotor that is equipped with active blade pitch system. The rotor are made of reinforced fibreglass, have a rotor diameter of 77 m, and a swept area of 4654m2. The blades possess integrated lightning protection. Potential lightning strikes will be conducted from the rotor blade through the casted parts and the tower to the foundation.

Each rotor blade has a pitch bearing that connects the blade to the casted hub. The rotor blades will be automatically pitched according to the wind speed, to limit the rotor power output or to brake the rotor down wear-free. For maintenance, the rotor can be locked.

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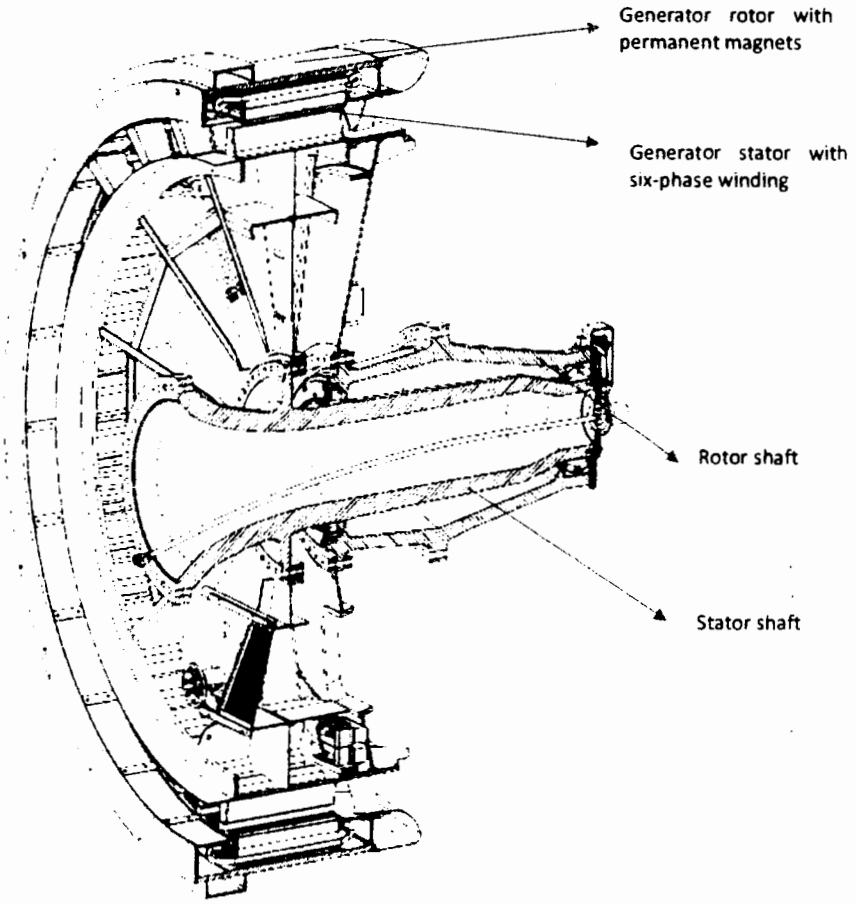
Multipole Synchronous Generator

The generator converts the rotational energy of the rotor into electrical energy. It is a multipole synchronous generator with permanent magnet excitation. The turbine rotor drives the generator rotor directly (i.e. no gearbox).

The generator consists of the following components:

- Generator stator with six-phase winding
- Generator rotor with permanent magnets

The generator is fully maintenance and wear-free (with the exception of the main bearing).



Frequency Converter

The connection to the public grid is done by a frequency converter system and a transformer. The frequency converter has been specially designed for the use together with synchronous generators.

It allows a complete separation of the generator operation from the grid conditions. So variable

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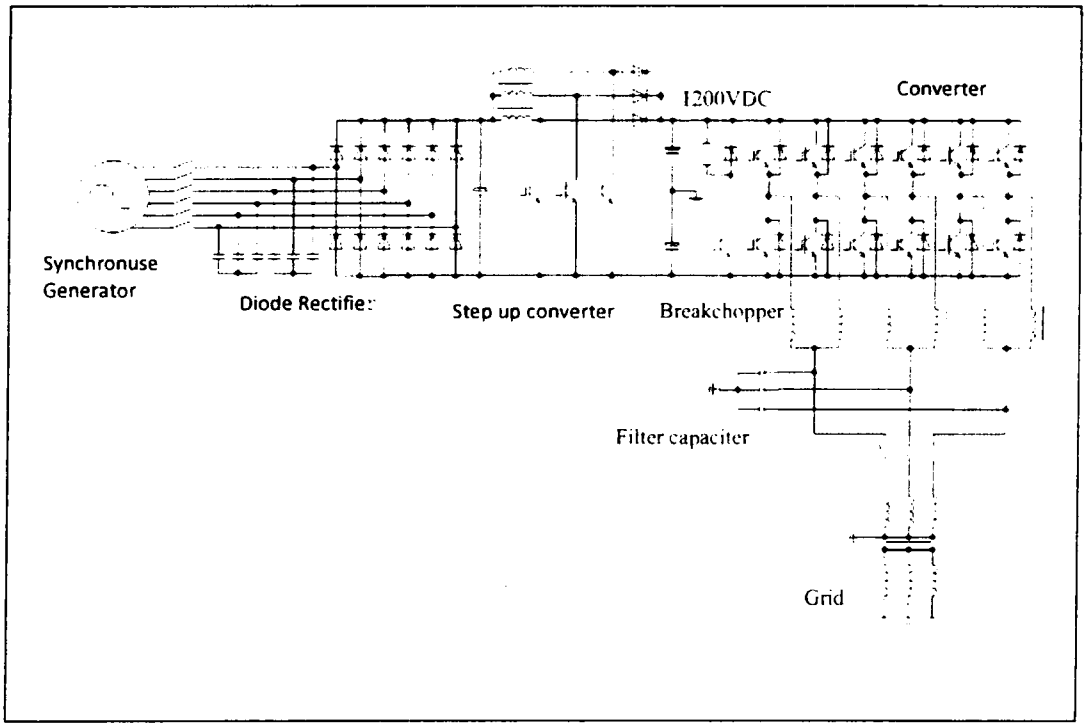
speed operation of generator, in a speed range of 9 to 17.3 rpm , is possible. This provides a better energy yield at partial load. At rated load and above the structural loads on the turbine are reduced by this technology. At the generator output side, a 12 – pulse uncontrolled rectifier with a subsequent step-up converter is used to avoid voltage peaks (du/dt loads) in the generator windings, which has a very simple, but robust layout.

In the grid-side converter part, two separate IGBT-twigs per phase are used, which reduce harmonics.



The whole converter system is air-cooled or water-cooled.

Blade pitch and brake system

The blade-pitch system of the Goldwind GW77/1500 allows each blade to be pitched independently. This provides power control and aerodynamic braking capabilities for the wind energy converter. At rated wind speed and above the power input of the rotor will be limited by the pitch system to 1,500 kW. This feature avoids overloading of generator and converter system. The controller monitors power output, blade pitch angles and wind conditions as well as variable speed operation to ensure optimal operating performance.

The three blade pitch mechanisms of the turbine also serve as a rotor brake. Moving the rotor blades into feathering position reduces the rotor torque and acts as a brake.

The blade pitch system consists of three independent electrical drive trains with energy storage and a tooth belt power train. Each drive train consists of a three phase brush-less motor, a converter, a power supply unit, a position sensor and a capacitance storage system.

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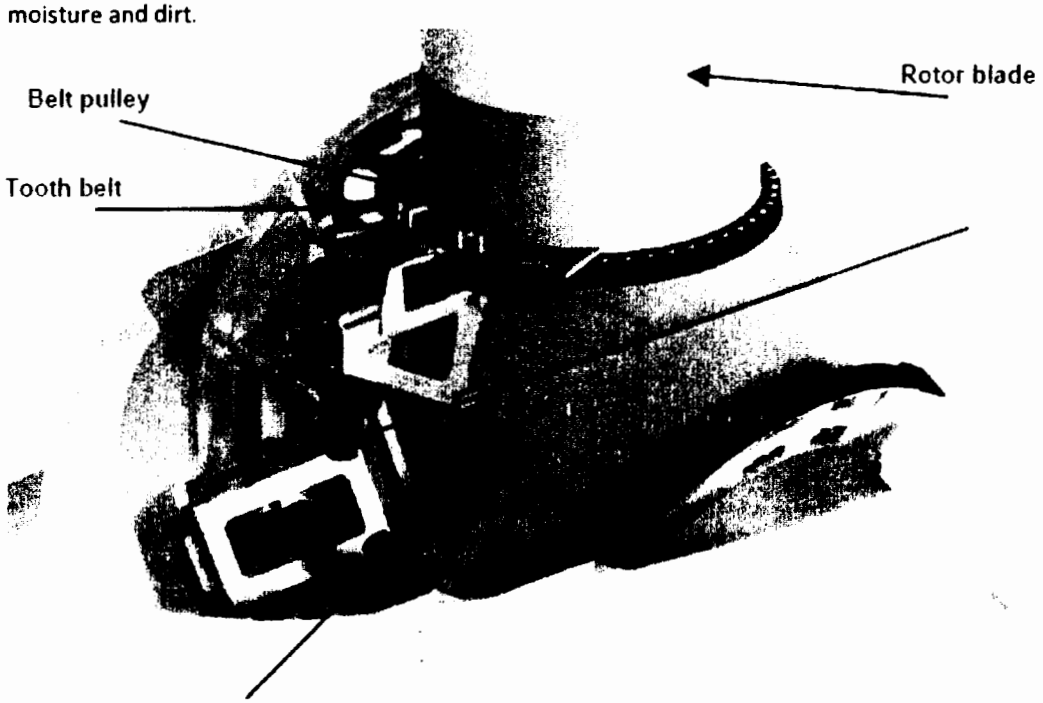
The capacitors eliminate the need for heavy and lead accumulators. The drives used work brush-less. All signals are transmitted by a DC-isolated profibus port, which is protected against over-voltage. Unique to the Goldwind GW77/1500 is the tooth belt transmission between the drive motor and rotor blade. This connection is insensitive to shock loading because, as opposed to gear transmission, several teeth are always in contact. The tooth belt does not require lubrication and is insensitive to moisture and dirt.



Blade pitch system

Nacelle Design

The nacelle has to transmit all static and dynamic loads of the rotor and the generator to the tower. In addition, the nacelle houses the control cabinet, the service crane, the yawing system, and supports the wind monitoring system (anemometer / wind-vane). Essentially, the housing consists of three parts: a casted part for transmission, a walk able base platform, and a shell made of reinforced fibreglass.

The casted part is connected to the tower via a yaw bearing, that also forms the connection between tower and rotor resp. generator. The generator-stator and the axis with the bearing are fixed to the casted part, whereas the generator-rotor and with it the machine-rotor are connected pivot-able to the axis. All necessary system components are mounted to the platform that is fixed to the casted part. The shell protects the sensitive components against weather.

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The yawing system is screwed directly to the casted part. The nacelle can be reached via a ladder from the highest tower platform. There is enough room for the service staff and all components can be reached easily . A hatch in the bottom of the shell on the opposite side of the machine-rotor allows loads to be lifted into the nacelle with the service crane.

Yawing System

The yawing system aligns the rotor with the wind direction, which is given by a wind vane installed on top of the nacelle. This wind data provides the basis for yaw corrections via electrical operated yaw motors. These motors are geared to the external teeth of the yaw bearing between the tower and the cast machine base.

The nacelle is held in its position by hydraulic operated brake callipers, that hold a brake disk which is connected with the tower. At high wind speeds, the nacelle is adjusted to the wind direction even if the wind energy converter is stopped to reduce the occurring loads.

Control System

The Goldwind GW77/1500 has a microprocessor based control unit that independently adjusts and controls the turbine's operating parameters. As such, outside data entry or control is not required.

The control unit uses sensors to retrieve information about external conditions (wind speed, wind direction) and all operating parameters of the wind energy converter (power, rotor speed, blade pitch). Basing on this data, the plant management controls the turbine to optimize energy yield and to ensure safe turbine operation. At partial load the rotor speed is adjusted by modifying the generator output. At rated load and above the nominal power capacity is achieved with blade pitch adjustment.

As such, gusts can be converted into an increased rotational speed rather than increasing torque. The latter behaviour is typical for conventional fixed speed technology. The Goldwind GW77/1500 is able to "absorb" wind speed changes and act as an energy cache memory. The turbine operates in a wind speed range of 3 m/s to 22 m/s. The wind turbine automatically stops operating outside this velocity range.

External monitoring of the operating performance of the turbine is possible by a PC modem and a telephone connection. Thus, all operating data, records and turbine conditions can be retrieved.

Tower

The steel tower supports the nacelle and the rotor and transfers the loads and forces of the turbine into the foundation.

The tower consists of segments held together by screw flange connections. It is connected to the foundation by the foundation insert. The yaw bearing is screwed directly on the top tower flange.

The control cabinet, converter, transformer and the medium voltage switchgear are mounted at the tower base. The tower is equipped with an internal cat ladder c/w a fall guardrail. Relax or safety platforms are installed at regular distances in the tower. The top platform has a cat ladder allowing access to the nacelle. The tower and the nacelle are lighted. In case of power failure, an emergency

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light ensures good working conditions.

Inside the tower there are also power and signal cables. The signal cables are trouble-free optical fibre. The cables hang in the upper section to allow the yawing of the nacelle and after several yaw rotations the wind energy converter will automatically untwist the cables. The base of the tower is accessible from outside by a stair and a door.

Foundation

The foundation secure and stabilize the WEC. It is designed as so-called raft or floating foundation. The rotor loads are transferred by the tower and the tower section to the foundation. The foundation section is a short steel tube which is integrated in the foundation. The upper layer of the steel reinforcement at the concrete runs through radial holes in the foundation section.

3. Technical parameters

Goldwind GW77/1500wind turbine technical specification

	TYPE	GOLDWIND GW77/1500
Operation parameters	Rated power	1500 kW
	Cut-in wind speed	3 m/s
	Rated wind speed	11m/s
	Cut-out wind speed	22 m/s（10Min）、32 m/s (5S)
	Survival wind speed（3s）	59.5m/s (IEC IIA)
	Design lifetime	≥20year
	Operating ambient temperature	-30° C to +40° C
	Standby ambient temperature	-40° C to +50° C
Rotor	Rotor	
	Diameter	77 m
	Swept area	4654m^2
	Speed range	9～17.3 rpm
	Number of blades	3
	Blade type	LM37.3P or similar
Generator	Type	Multipole synchronous generator,permanent magnet excited
	Rated power	1500 kW
	Design	Direct drive
	Rated current	660 A
	Rated rotation speed	17.3 rpm
	Protection class	IP23
	Insulation category	F
Converter	Type	IGBT-converter
	Protection class	IP54
	output power factor regulated	-0.95～+0.95

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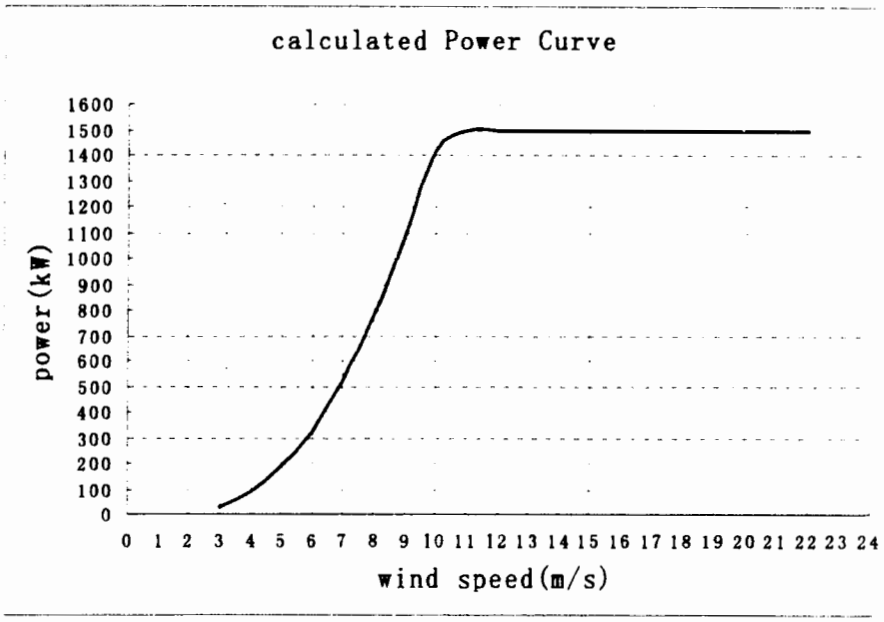
	range	
	Rated output voltage	620/690V
	Rated output current	1397/1255A
Yawing system	Design concept	electrical drive motor
	Rated of movement	0.45°/sec
	Yawing system	Brake 10-hold
Brake system	Aerodynamic braking	blade pitch triple-redundant
	Mechanical braking	hydraulic-brake system braking
Control system	Type	PLC
Lighting protection	Design Standards	According to IEC1024-Ⅰ,comply with GL standard
	earth resistance	≤4Ω
Tower	Type	steel tube
	Hub height	85 m

4. Power curve and Thrust coefficient curve

Air density: 1.225 kg/m3 (static state calculation power curve)

P=1.225kg/m3	
wind (m/s)	power (kW)
3	19.64
4	74.5
5	153.95
6	272.05
7	437.33
8	658.07
9	932.21
10	1215.71
11	1492.35
12	1500
13	1500
14	1500
15	1500
16	1500
17	1500
18	1500
19	1500
20	1500
21	1500
22	1500



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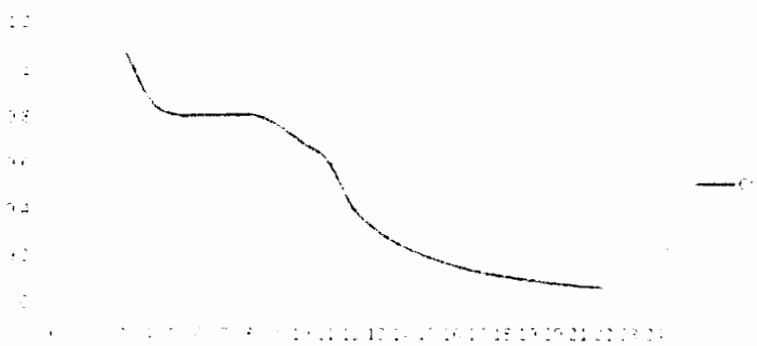
P=1.225kg/m3	
wind (m/s)	Ct
3	1.06686
4	0.86499
5	0.80723
6	0.80727
7	0.80725
8	0.80726
9	0.76413
10	0.6882
11	0.6119
12	0.40878
13	0.30794
14	0.2417
15	0.19476
16	0.16006
17	0.13361
18	0.11305
19	0.09672
20	0.08361
21	0.07293
22	0.06414

Thrust coefficient Ct



Wind speed m/s

5. Certification and test repot

Wind turbine Design Dssessment

Type	Power(kW)	HH(m)	WEA-Class	Blade	Certification	state
GW 77/1500	1500	65.0	IEC IIA	LM 37.3	CGCC	done
		61.5	IEC IIA	LM 37.3	TÜV-Nord	done
			IEC IIIA	LM 37.3	TÜV-Nord	done
		85.0	IEC IIA	LM 37.3	TÜV-Nord	done
			IEC IIIA	LM 37.3	TÜV-Nord	done
		100.0	IEC IIIA	LM 37.3	TÜV-Nord	done

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Wind turbine performance test repot

Type	Power	Test Item	Standard	Testing Organization
GW 77/1500	1500	Measurement of power curve of wind turbine	IEC61400-12-1	WINDTEST
		Measurement of electrical characteristics of wind turbine	IEC61400-21	WINDTEST
		Acoustical emissions of wind turbine	IEC61400-11	WINDTEST

6. GW1500kw WTG transportation requirement

		Weight (kg)	Dimension(mm)	Truck	Crane	Note
Nacelle		12765	4050×3900×3770	>35T	>50T	
Generator		45900	5002×4982×3410	>45T	>100T	
Hub		14190	4500×4000×3500	>35T	>50T	
Blade		5750(each piece)		>10T	>20T	Need special truck, the length is 31m
Tower	85m(HH)	22350.9	Ø2570x Ø3295x22480	>40T	>50T	Need special truck
		33757.3	Ø3295x Ø4200x22090	>50T	>100T	Need special truck
		37666.3	Ø4200x Ø 4200x18520	>50T	>100T	Need special truck
		54576.9	Ø4200x Ø4200x18710		>100T	Need special truck
	65m(HH)	22928	Ø2583x Ø3238x25000	>40T	>50T	
		31975	Ø3238x Ø3824x22800	>50T	>100T	
		38285	Ø3824x Ø4200x15000	>50T	>100T	

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