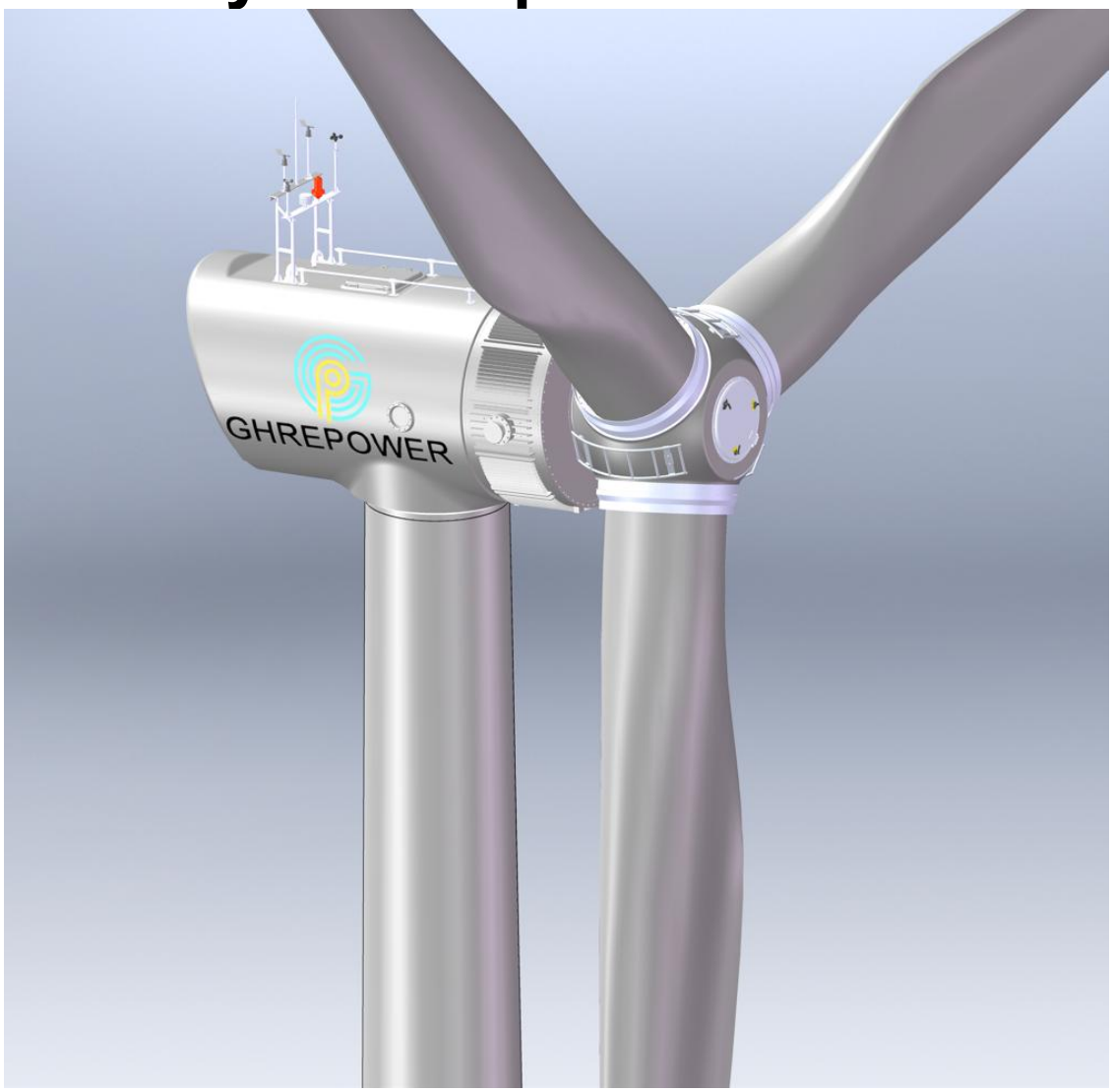
GP42-300
GP42-400
Wind Turbine Generator System Specification



Shanghai Ghrepower Green Energy Co., Ltd

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1. Wind Turbine Generator System Overview

1.1 System Characteristic

- Low-speed permanent magnet generator, direct drive gearless transmission design.
- Active pitch control technology ensures output power stability in strong wind.
- Multiple safety protection for individual pitch, mechanical, electromagnetic brakes and active yawing.
- Equipped with low-speed magnet generator with full-power converter, suitable for multinational grid -tie system.
- Direct 400V to grid and connect to the nearby load distribution system, which is self-supply, self-consumption and sufficient electricity connected to grid, for efficient energy transmission.
- SCADA remote monitoring system is the feature of real-time monitoring, report statistics, fault diagnosis and integrated operation & maintenance management.
- Suitable for industrial park, seaport, oil-field, mine, village, expressway service area, etc.

1.2 Wind Turbine Brief Introduction

1.2.1 Overall appearance of WTG

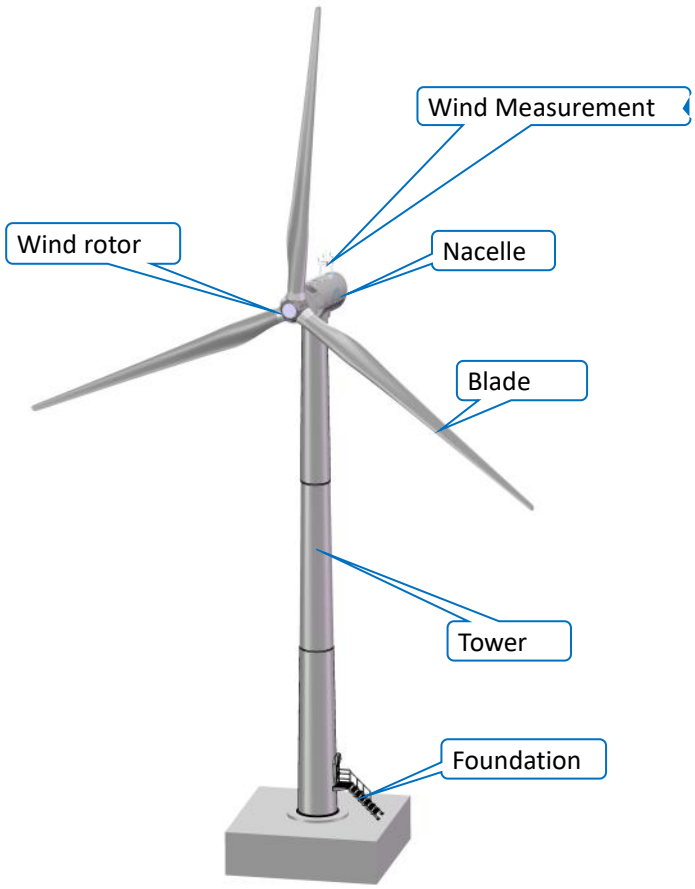


Figure 1 GP42 wind turbine generator system outline diagram

1.2.2 Wind rotor

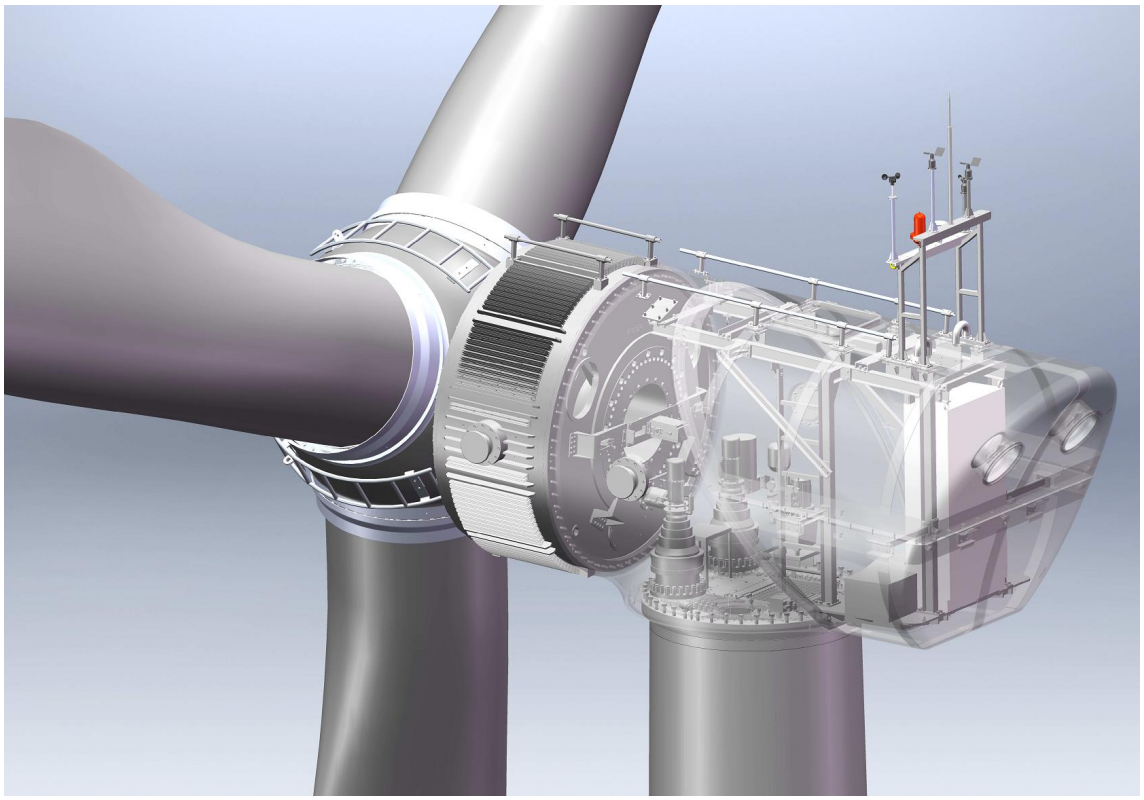
The wind rotor is used to convert the kinetic energy of the air into the mechanical energy of wind rotor. The wind turbine adopts a three-blade, upwind type which is actively adjusted through

pitch mechanism. The blade material uses reinforced fiber glass.

1.2.3 Nacelle

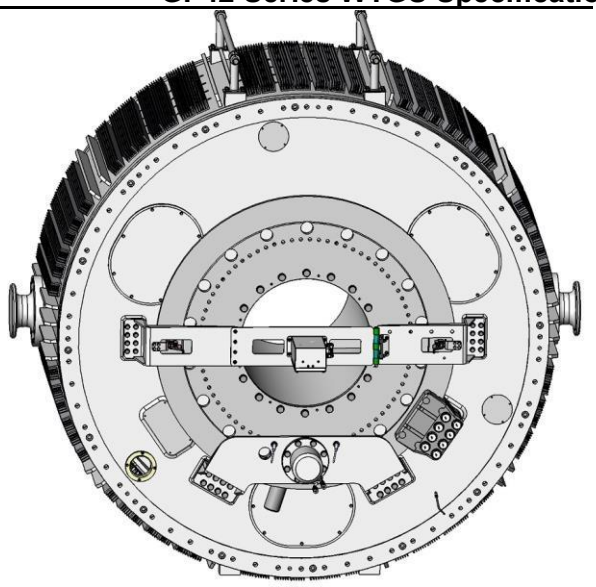
The nacelle is connected to generator and tower, which contains yawing transmission system, damper control system, wind turbine control system, sensors, wind measurement system, aviation

warning system, staff passage, etc., as shown in the figure,



1.2.4 Three-blade independent pitch mechanism

Pitch of WTG adjusts the windward angle of blades, and its main functions are power adjustment and rotation speed control. It mainly includes hub, pitch reducer, drive motor, pitch controller, angle speed detection device, etc. The hub adopts a spherical structure, which has good castability and high strength, as shown in the left picture below:



1.2.5 Generator & braking system

The generator converts the mechanical kinetic energy of wind rotor into electrical energy. It is composed of stator, rotor, brake disc, braking system and detection device. The main shaft of WTG is braked to realize blade braking, which is composed of brake disc and hydraulic braking system, as shown on the right above. As shown in the figure.

1.2.6 Yawing system

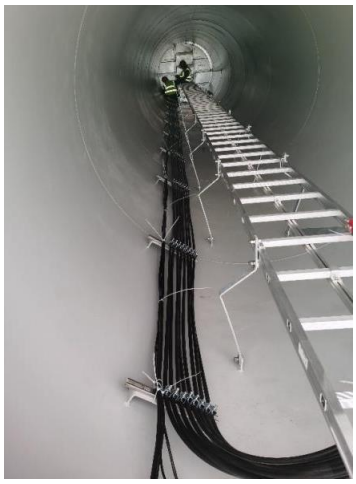
Wind turbine adopts active yawing to direct wind and consists of three yaws drive devices, yaw angle detection device, twisting detection device and hydraulic brake. Yaw braking is accomplished by a yaw reduction motor, which uses an electromagnetic brake.

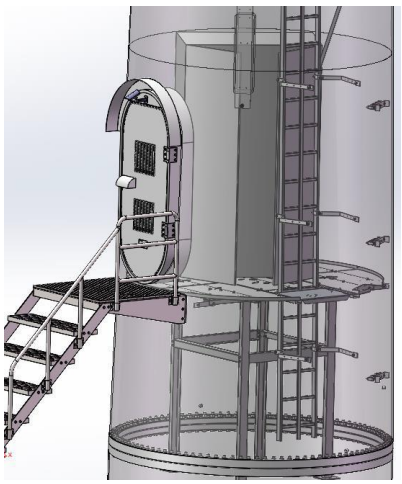
1.2.7 Lubrication system

The lubrication system of WTG consists of automatic lubrication and manual lubrication. The yaw pivotal bearing and the front and rear main shaft lubrication of the generator are independent automatic lubrication systems. The three independent pitch bearings are independent lubrication systems and each bearing position is equipped with waste oil collection bottle.

1.2.8 Tower

Tower mainly plays the role of supporting nacelle, generator and wind rotor. It consists of tower itself, ladder, lighting and ladder safety protection devices. Each floor of tower is equipped with a platform for installation and rest, etc.





2. System technical parameter

2.1 Wind turbine generator system parameter

Manufacturer	**Shanghai Ghrepower Green Energy Co., Ltd.**	
Country of origin	China	
Parameter	Specs	
System model	GP42-300	GP42-400
Device model	FD42-300	FD42-400
Design standard	IEC61400-1	
Design class	SWT Class ⅢA	
Type	Permanent magnet direct drive, three blades, horizontal axis,	
Design class	20 years	
Rotor diameter	42m	
Hub height	51m	
Tower type	Tubular column	
Performance		
Power regulation	Individual pitch control	
Rated power	300kW	400kW
Swept area	4.61 m^2/kW	3.46 m^2/kW
Rated rotation speed	35rpm	36rpm
Max rotation speed	41rpm	
Cut-in wind speed	3m/s	
Rated wind speed	11m/s	12m/s
Cut-out wind speed	20m/s(10min)，24m/s(10s)	
Survival wind speed	52.5m/s	

2.2 Wind turbine component parameter

Weight	
Blade	3*1.3t
Nacelle & generator	28t@37m /38t@49m
Tower	42t@49m

Brake system	
Aerodynamic brake	Active pitch control
Mechanical brake	Mechanical main-shaft brake
Electromagnetic brake	Electronic dump load control
Yawing & untwisting	
Yawing mode	Electric
Untwisting mode	Auto untwisting
Angle of twisting	±1080°(±3 circles)
Control system	
Control system	Industrial PLC controller
Inverter type	Full-power inverter
Monitoring	SCADA Cube 3.0
Generator	
Generator type	Permanent magnet
Drive mode	Direct box (gearless box)
Rated voltage	400Vac
Insulation grade	F class
Blade	
Blade material	Fiber Reinforced Plastics (FRP)
Blade length	20 m
Blade quantity	3
Tower	
Surface treatment	Anti-rust painting
Height	49m
Other	
Noise level	<58dBA (@60m)
Device position	Converter is placed into the bottom of tower. Others are placed inside of nacelle.
Lightening protection	Lightning receptors for blade tip connected to earth through loop. Anemometer and wind vane with separate lightning receptors.

2.3 Environment request

Environment temperature	
Working environment	-20°C ~ +50 °C
Storage environment	-30°C ~ +60 °C
Relative humidity	≤95 %
Elevation	≤2000m, > 2000m, derating operation
Generator protection class	IP54、ISO 12944-2 C5
Other environment request	Conform to standard of EC 60721-2-1
Ground resistance	≤ 4Ω

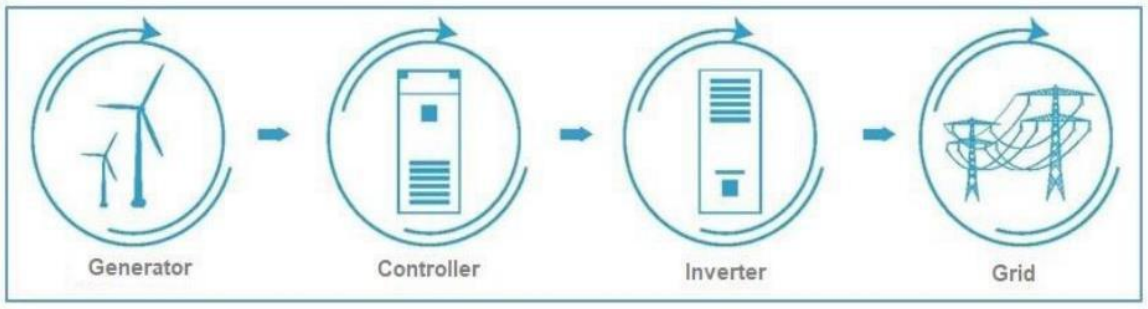
2.4 Grid connection request

Grid connection request	
On-grid voltage range	400V±15 %
Allowable frequency range	47.5 Hz ~52.5 Hz
Allowable voltage unbalance	≤3%
Interruption duration	≤7 days
Grid connection access standards	Distribution grid connection series GB standard
Auxiliary power supply	
Normal operation	≤6kW, 3P5L
Standby power	≤1.8kW
PCS standby consumption	≤0.6kW

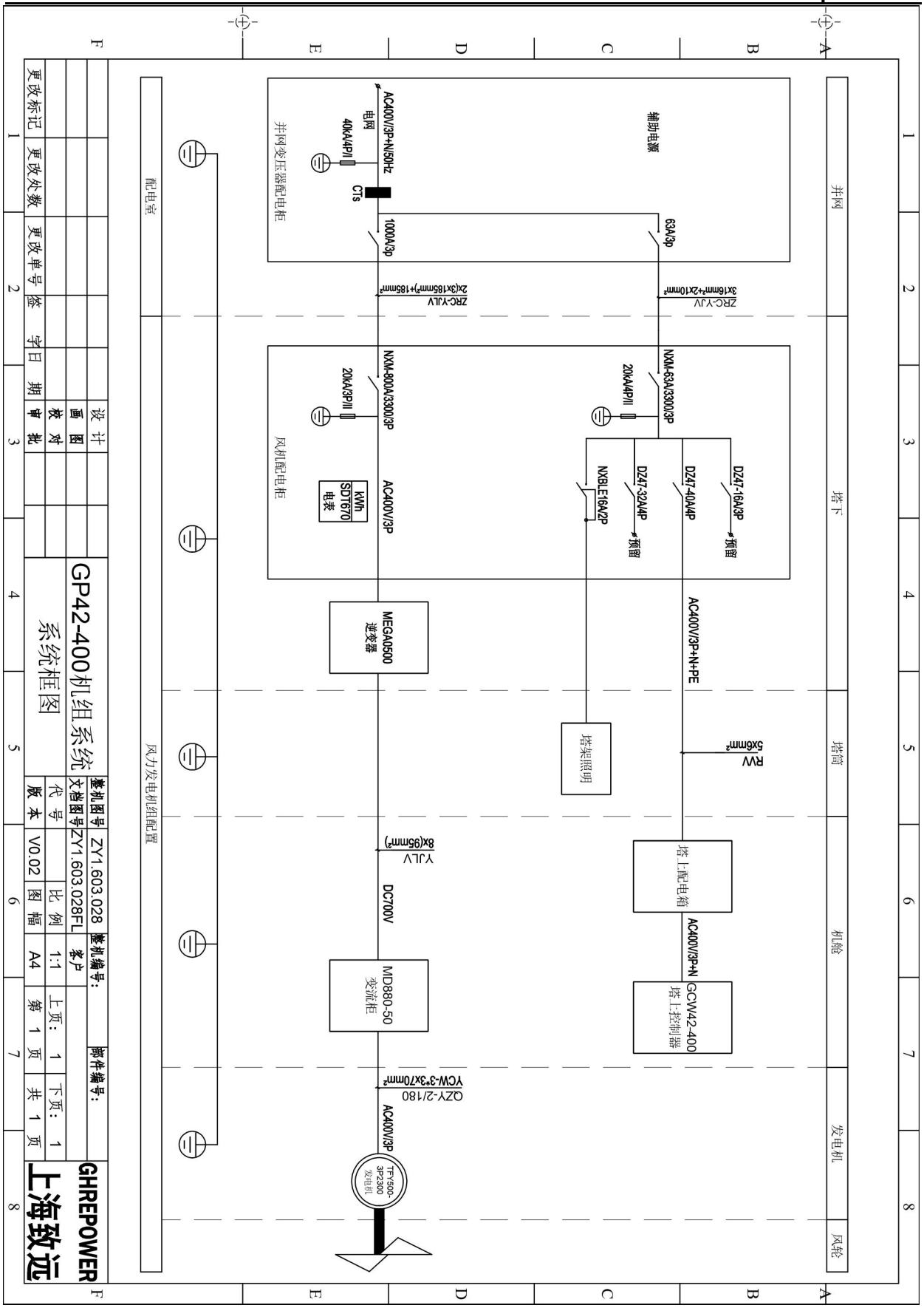
3. System configuration

3.1 System connection diagram

Wind turbine generator system is composed of wind turbine generator, on-grid controller and on-grid inverter. (see the following photo)



3.2 System electrical drawing



更改标记	更改处数	更改单号	签字	日期	设计	画图	校对	审批

GP42-400机组系统

系统框图

签机图号	ZY1.603.028	签机编号：	部件编号：
文档图号	ZY1.603.028FL	客户	
代号		比例	1:1
版本	V0.02	图幅	A4
		第 1 页	上页： 1
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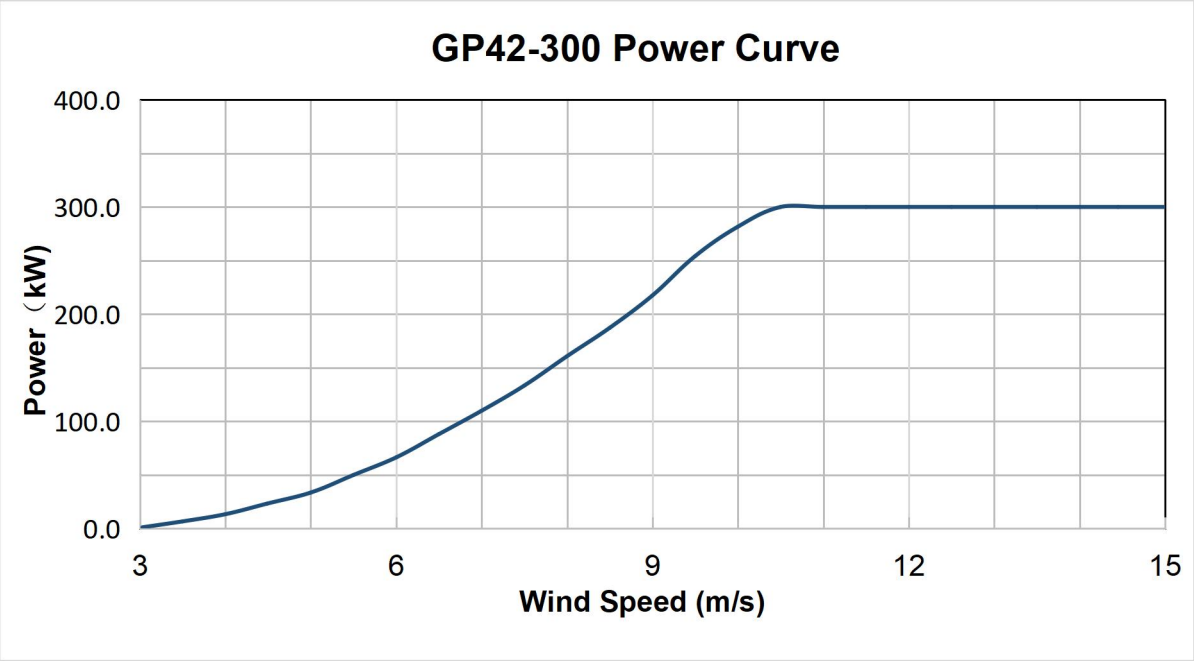
4. Performance

4.1 GP42-300 power curve

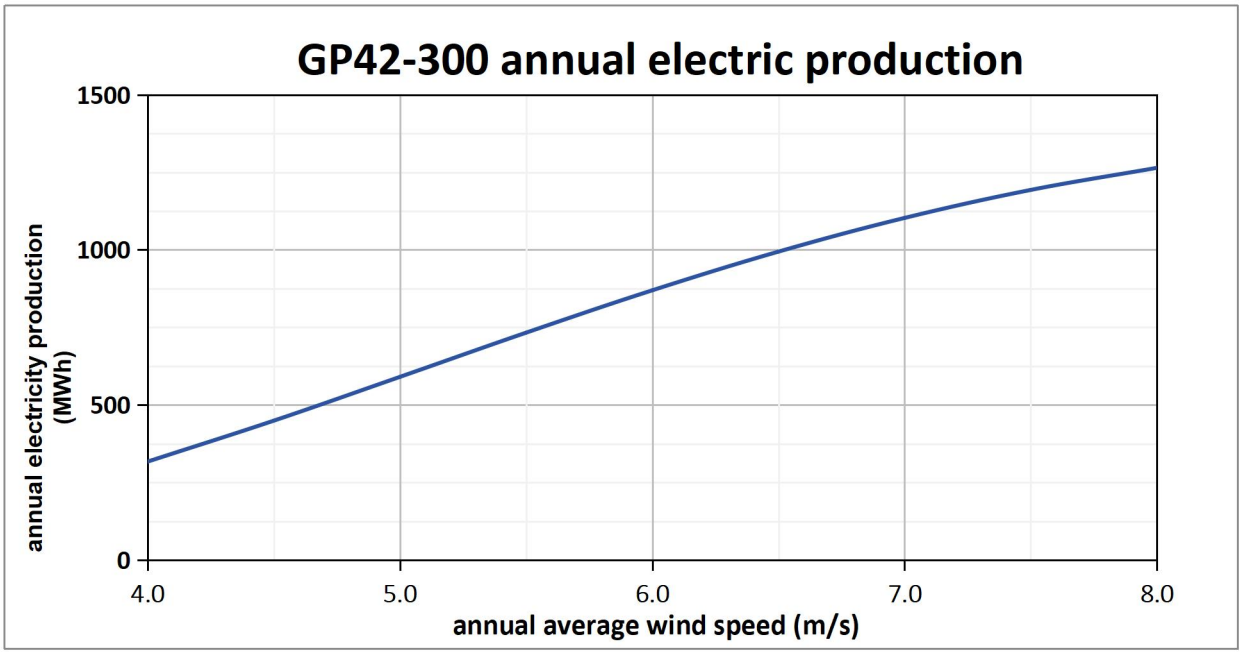


wind speed (m/s)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
power(kW)	1.2	6.7	13.4	23.3	33.6	50.0	66.4	88.1
wind speed (m/s)	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
power(kW)	109.9	133.4	160.8	187.3	217.5	254.2	281.6	300.0
wind speed (m/s)	11.0	11.5	12.0	12.5	13.0	14.0	15.0	……
power(kW)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	……

Usage instruction for power curve:

1. Data source:data source of power curve listed on the table is the result of calculation based on the theoretical aerodynamic efficiency data of blades and efficiency of each component of wind turbine generator system, which is equivalent to the data under standard air density (1.225g/L).
2. Reference standard: IEC 61400-12-1, all data sources are 10-minute averages.
3. Application concern: when evaluating the site, power curve needs to be converted according to the actual air density of the site location. For related conversion methods, please refer to IEC 61400-12-1.

4.2 GP42-300 annual electric production

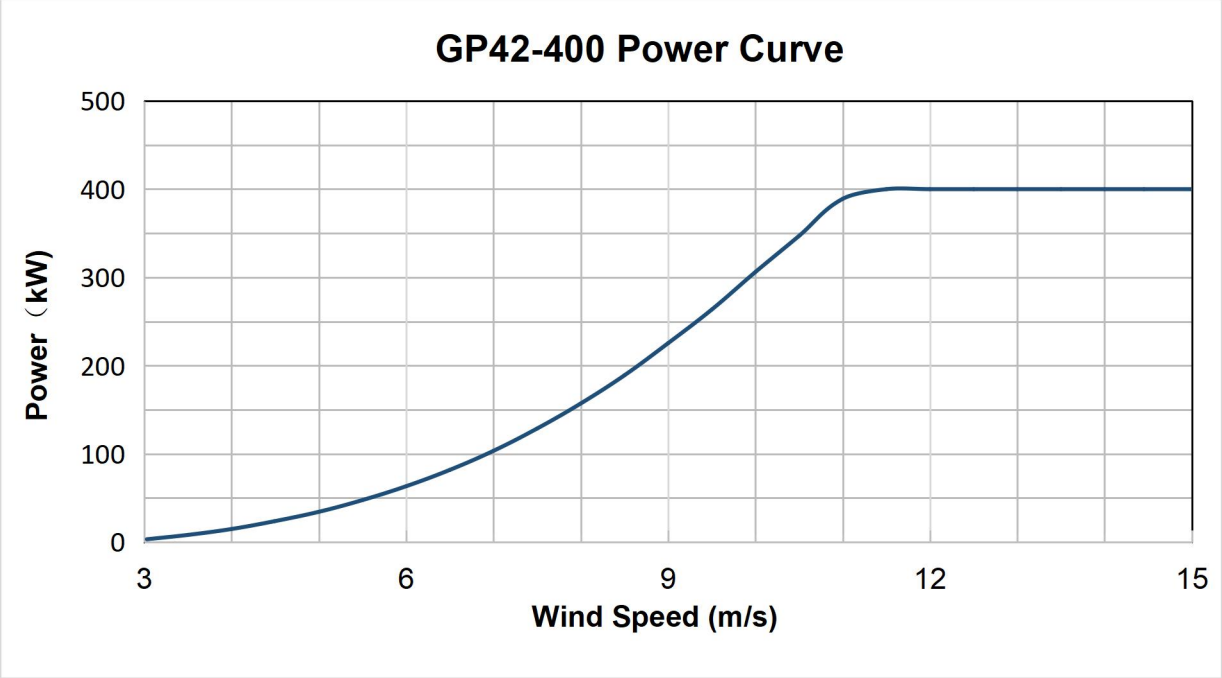


annual average wind speed (m/s)	4.0	4.5	5.0	5.5	6.0	6.5	7.0
annual electricity production (MWh)	317	449	591	733	870	994	1103
annual electricity production (10MWh)	31.7	44.9	59.1	73.3	87.0	99.4	110.3
equivalent hours (h)	1058	1498	1968	2443	2899	3314	3677

Usage instructions for electricity generation:

1. Data source: the electricity generation is a theoretical value calculated according to calculation method of IEC 61400-12-1 based on the above power curve.
2. Reference standard: IEC 61400-12-1, assuming that the wind distribution is Rayleigh distribution.
3. Application concerns: actual electricity generation of WTG is related to factors such as site temperature, altitude, wind distribution, nearby obstacles, over-limit environment, and grid transmission conditions.

4.3 GP42-400 power curve

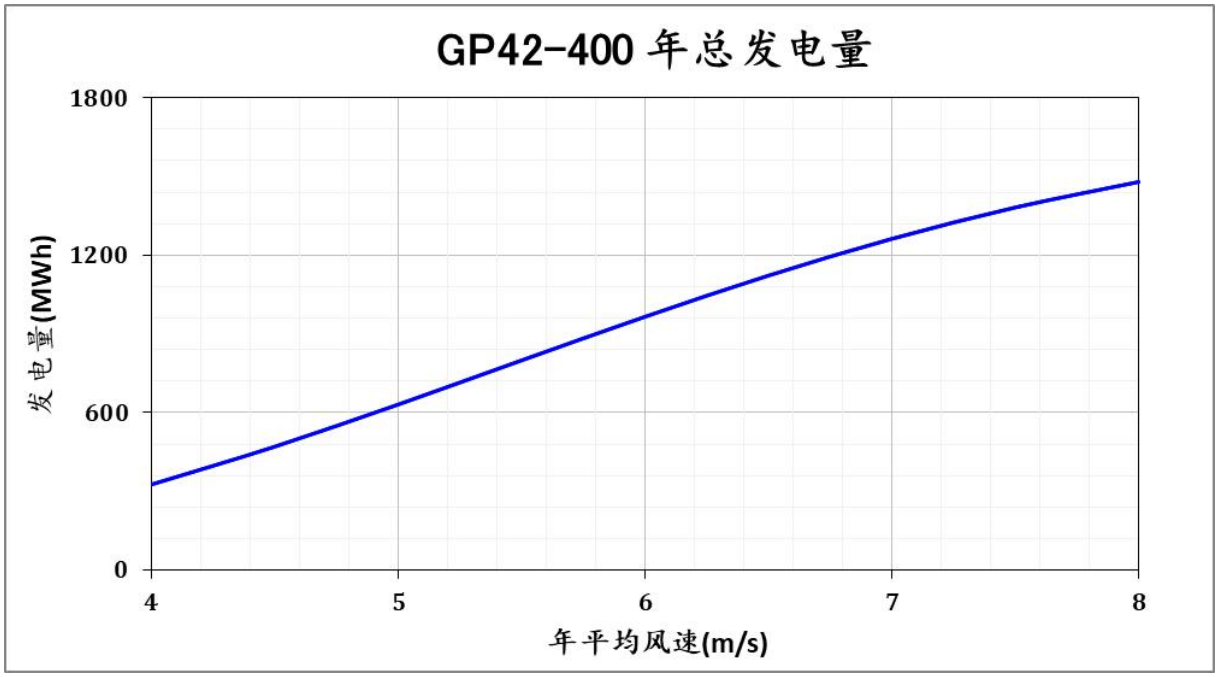


wind speed (m/s)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
power(kW)	1.3	6.7	15.1	25.5	37.7	52.9	72.5	98.5
wind speed (m/s)	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
power(kW)	122.8	152.6	182.7	217.1	249.4	286.3	317.8	351.2
wind speed (m/s)	11.0	11.5	12.0	12.5	13.0	14.0	15.0	……
power(kW)	373.4	387.5	397.5	400.0	400.0	400.0	400.0	……

Usage instructions for power curve:

1. Data source: data source of power curve listed on the table is the result of calculation based on the theoretical aerodynamic efficiency data of the blades and the efficiency of each component, that is equivalent to the data under standard air density (1.225g/L).
2. Reference standard: IEC 61400-12-1, all data sources are 10-minute averages.
3. Application concern: when evaluating site, power curve needs to be converted according to the actual air density at the site. For relevant conversion methods, please refer to IEC 61400-12-1.

4.4 GP42-400 annual electric production

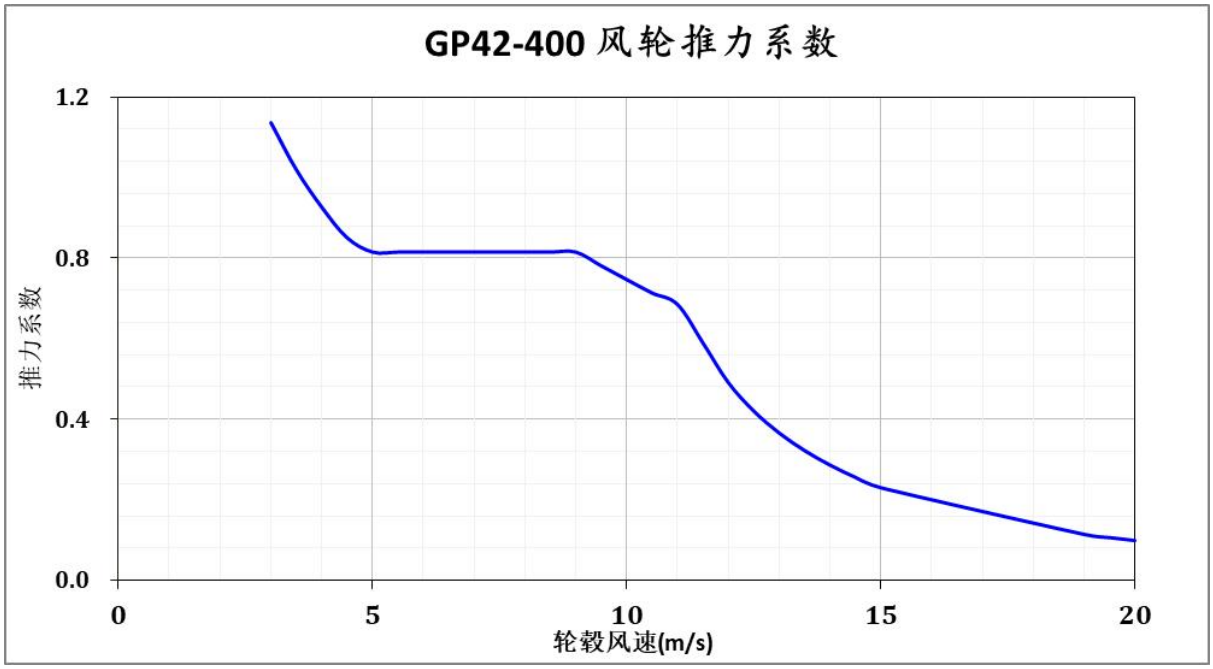


annual average wind	4.0	4.5	5.0	5.5	6.0	6.5	7.0
annual electricity production (MWh)	326	471	631	799	965	1122	1262
annual electricity production	32.6	47.1	63.1	79.9	96.5	112.2	126.2
equivalent hours (h)	816	1177	1578	1998	2413	2804	3154

Usage instructions for electricity generation production:

1. Data source: electricity generation production is a theoretical value calculated according to the calculation method of IEC 61400-12-1 based on the above power curve.
2. Reference standard: IEC 61400-12-1, assuming that the wind distribution is Rayleigh distribution.
3. Application concerns: actual power generation production of WTG is related to factors such as site temperature, altitude, wind distribution, nearby obstacles, over-limit environment, and grid transmission conditions.

4.5 Thrust coefficient



Wind speed (m/s)	Thrust coefficient	Wind speed (m/s)	Thrust coefficient	Wind speed (m/s)	Thrust coefficient	Wind speed (m/s)	Thrust coefficient
3.0	1.1367	6.5	0.8149	10.0	0.7467	13.5	0.3212
3.5	1.0196	7.0	0.8150	10.5	0.7132	14.0	0.2851
4.0	0.9266	7.5	0.8150	11.0	0.6847	14.5	0.2547
4.5	0.8503	8.0	0.8150	11.5	0.5892	15.0	0.2288
5.0	0.8149	8.5	0.8150	12.0	0.4903	19.0	0.1127
5.5	0.8150	9.0	0.8149	12.5	0.4196	19.5	0.1046
6.0	0.8149	9.5	0.7807	13.0	0.3649	20.0	0.0973

Thrust coefficient illustration:

1. Data source: thrust coefficient is a theoretical value obtained by Bladed software based on WTG data simulation.

2. Reference standard: IEC61400-1, thrust coefficient is the steady-state operating value of WTG.

3.Application concerns: actual thrust coefficient is related to factors such as s instantaneous wind speed, instantaneous rotational speed, pitch angle, blade surface roughness, and environment.

5. Electronic control system

Wind turbine generator control system includes the core control unit of WTG, pitch drive control, yaw drive control, environmental monitoring, human-computer interaction, and power conversion, that realizes automatic operation control of WTG and maximizes wind energy. Utilization and processing and recording of various events have the following characteristics,

1 Hardware stability & reliability: PLC-based distributed control system, using mature CANopen and EtherCAT buses for system connection.

2 software maturity & completeness：standard wind turbine code library and control strategy with superior performance in electricity generation efficiency improvement and load control.

3 Pitch control flexibility: use different control strategies under different working conditions such as light wind start-up section, rated wind speed section, strong wind control section, wind speed over-limit, etc. to maximize the wind energy utilization and safe operation of WTG.

4 Wind MPPT : combined with real-time air density and dynamically adjust the torque control parameters to ensure MPPT of wind energy Cp.

5 Intelligent yawing strategy: intelligent untwisting and wind-direction strategies balance wind-direction accuracy and action frequency to improve wind-catching ability.

6 Comprehensive protection: complete wind turbine protection system with multi-level protection strategies to maximize utilization.

7 Load optimization control: flexibility control, tower resonance zone vibration isolation, strong wind speed suppression, pitch rate flexible adjustment, etc.

8 Intelligent monitoring & diagnosis: complete status code, protection logic and user rights management to maximize safety of WTG.

9 Efficient operation & maintenance troubleshooting: abundant operation, failure, operation logs and failure recording records enable efficient operation & maintenance troubleshooting.

10 Abundant environmental monitoring: WTG has various monitoring functions such as wind speed, wind direction, air pressure, temperature, humidity, vibration, etc.

11 Convenient monitoring & debugging: real-time data monitoring and display of WTG, and LoT operation screen realizes the simultaneous uploading of operating data to the cloud.

12 Simple power grid connection: using a converter that meets the grid standards, which can be directly connected to the low-voltage 400V distribution network.

5.1 On-grid controller

Control parameter	
Master controller	Industry PLC controller
Yawing speed	0.55 °/s
Yawing accuracy	≤3.2°
Way of pitch	Three-blade independent pitch
Pitch speed	≥8°/s
Pitch accuracy	≤0.2°
Pitch backup power	Super capacitor
Display & Communication	
Display panel	LCD/ touch screen
Communication interface	RS485、RJ45 internet access

5.2 On-grid converter

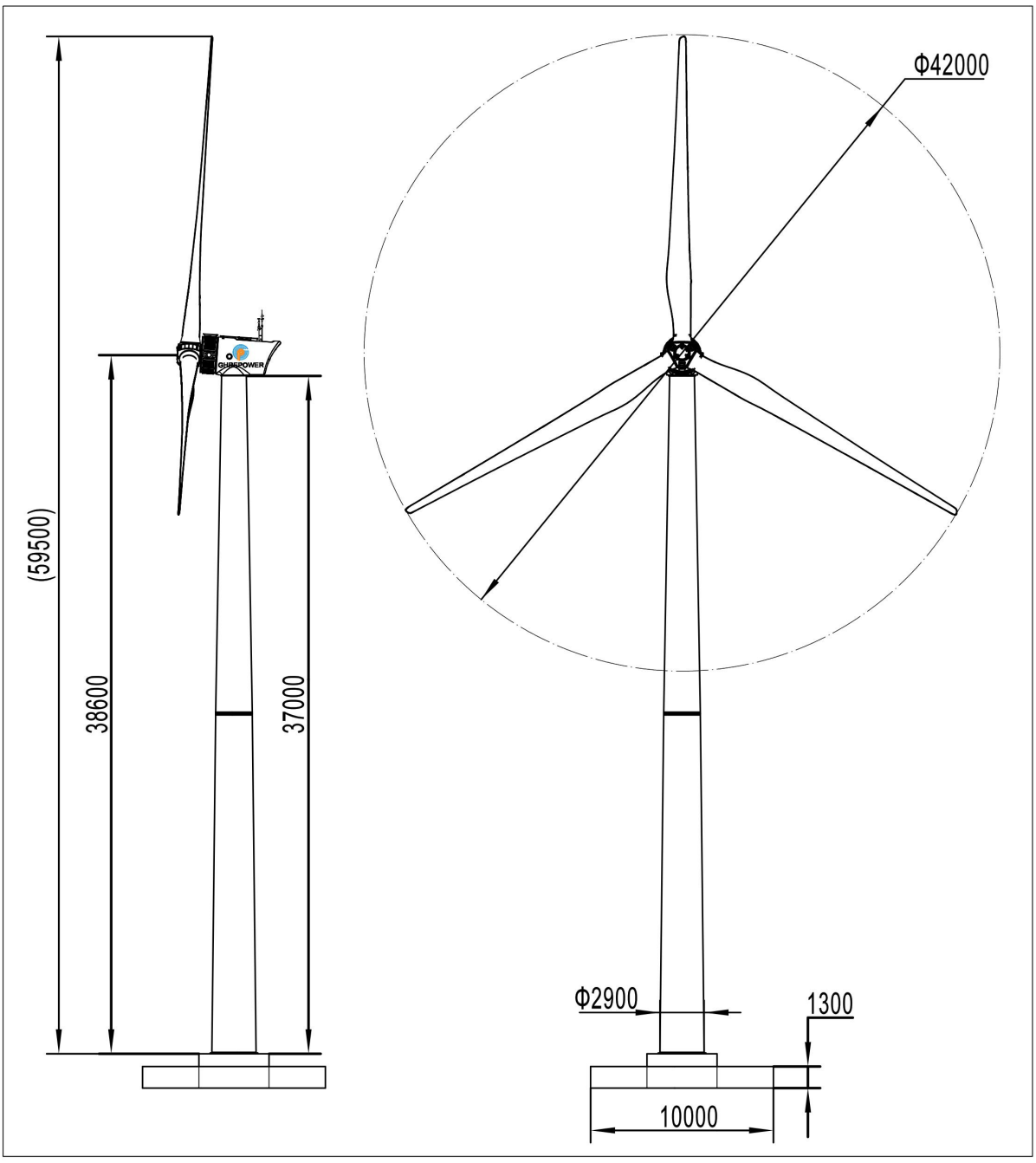
System model	GP42-300	GP42-400
Generator side parameter		
Generator side working voltage range	3 phase 200~460Vac	
DC bus working volage range	600～720Vdc	
Brake unit configuration	Built-in control and dump-load resistors	
Network side parameter		
Rated output power	300kW	400kW
Rated grid voltage	400Vac±15%　3 phase 3 lines	
Rated working frequency	50/60Hz ± 5%	
Power factor (PF)	>0.99 (0.85L~0.85C adjustable)	
Maximum inverter efficiency	≥97%	
Harmonic content (THD)	Total　current harmonics <5%, each time <3%	
Grid-tie protection function	Overvoltage, undervoltage, overfrequency, underfrequency, unbalance protection, etc.	
Other grid-tie functions	Low voltage ride through, islanding protection	

6. Tower & Foundation

Tower model	FD42-300	FD42-400
Height	37m	49m
Section	2	3
Thickness	10mm/12mm/14mm	10mm/12mm/14mm
Weight	28t	38t
Flange diameter	1620mm(upper) / 2900mm(bottom)	
Surface treatment	Painting	
Base reference value	Φ10mx1.3m	Φ11.5mx1.4m

Foundation construction needs to go through start-up procedures, bring in machine tools and materials, excavation and leveling of the foundation pit, excavation of cable trenches and masonry manholes, pre-embedding of ground rods and cushion formwork and pouring (C25), installation of foundation sections (crane 25 tons), the production and binding of embedded parts, formwork cutting and supporting, foundation pit pouring (C35), and foundation maintenance will take at least 20 days.

6.1 Overall appearance diagram（37m）

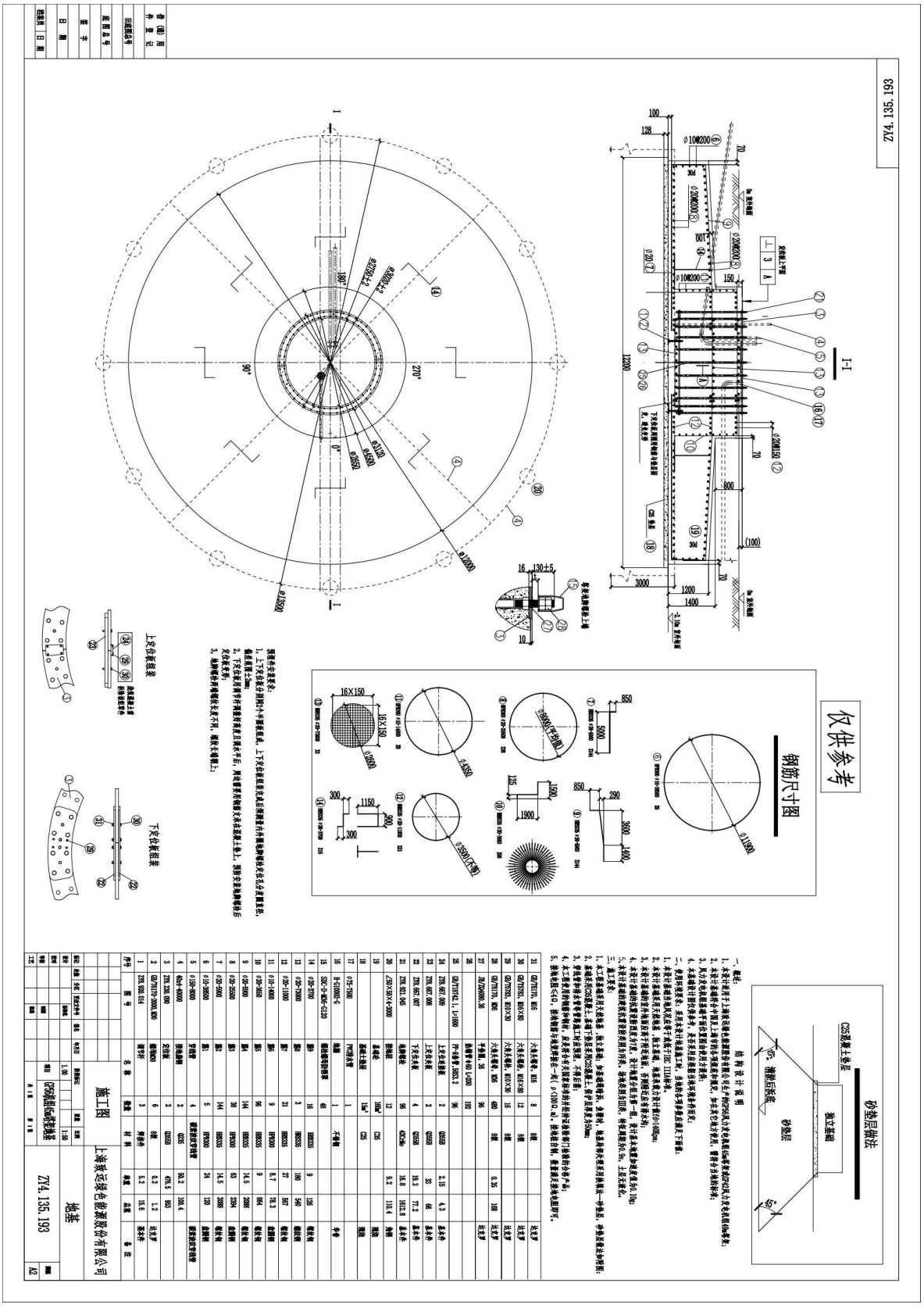


Upper foundation load

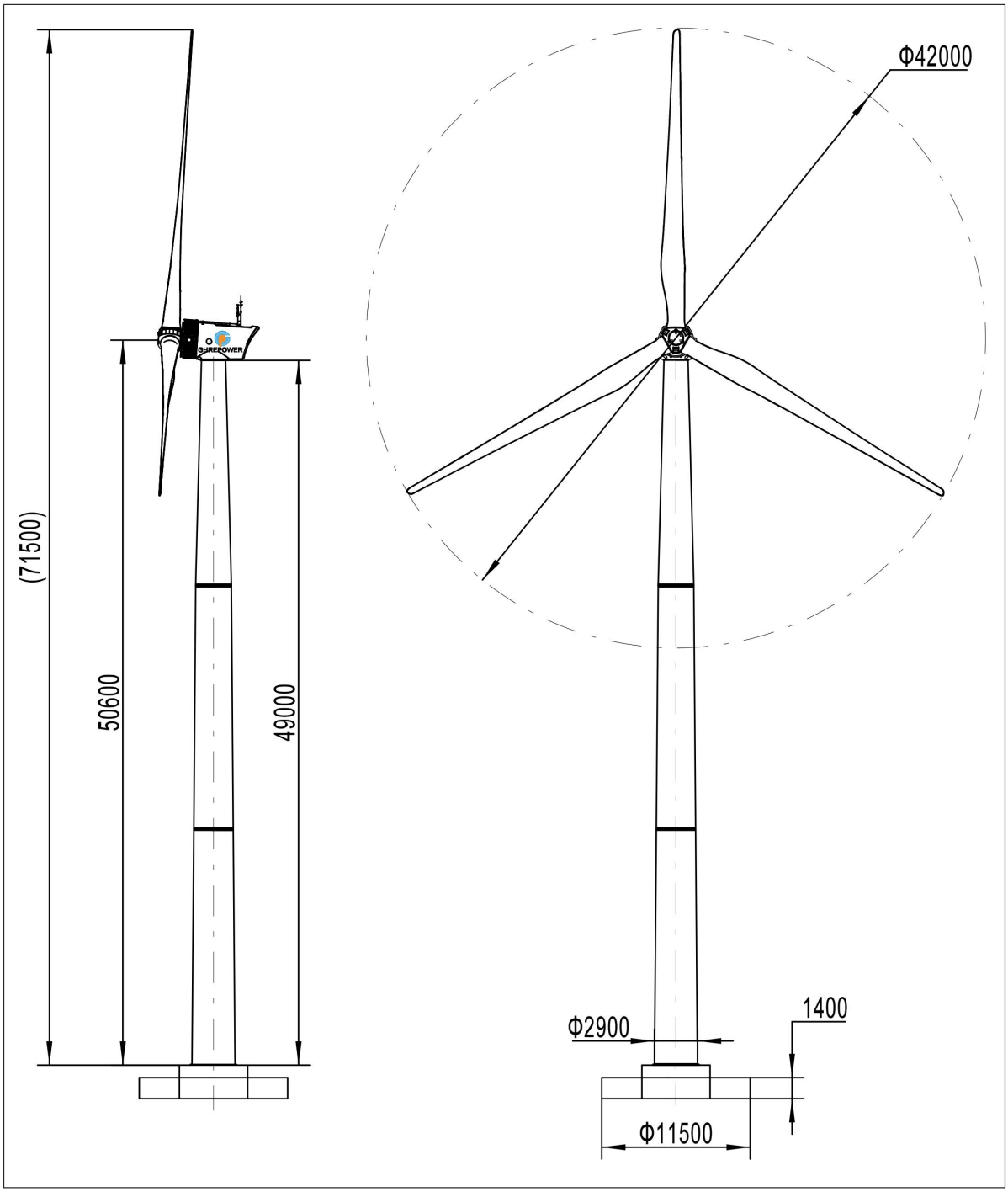
Load case	Tower Mxy	Tower Mz [kNm]	Tower Fxy [kN]	Tower Fz [kN]	Safety factor
Normal run load case	1656	173	53	-527	1.0
Ultimate load case	9257.9	452.3	245	-569.1	1.1

Note: The above loads all include load safety factors, please see relevant documents for detailed data.

6.2 Reference foundation（37m）



6.3 Overall appearance diagram（49m）

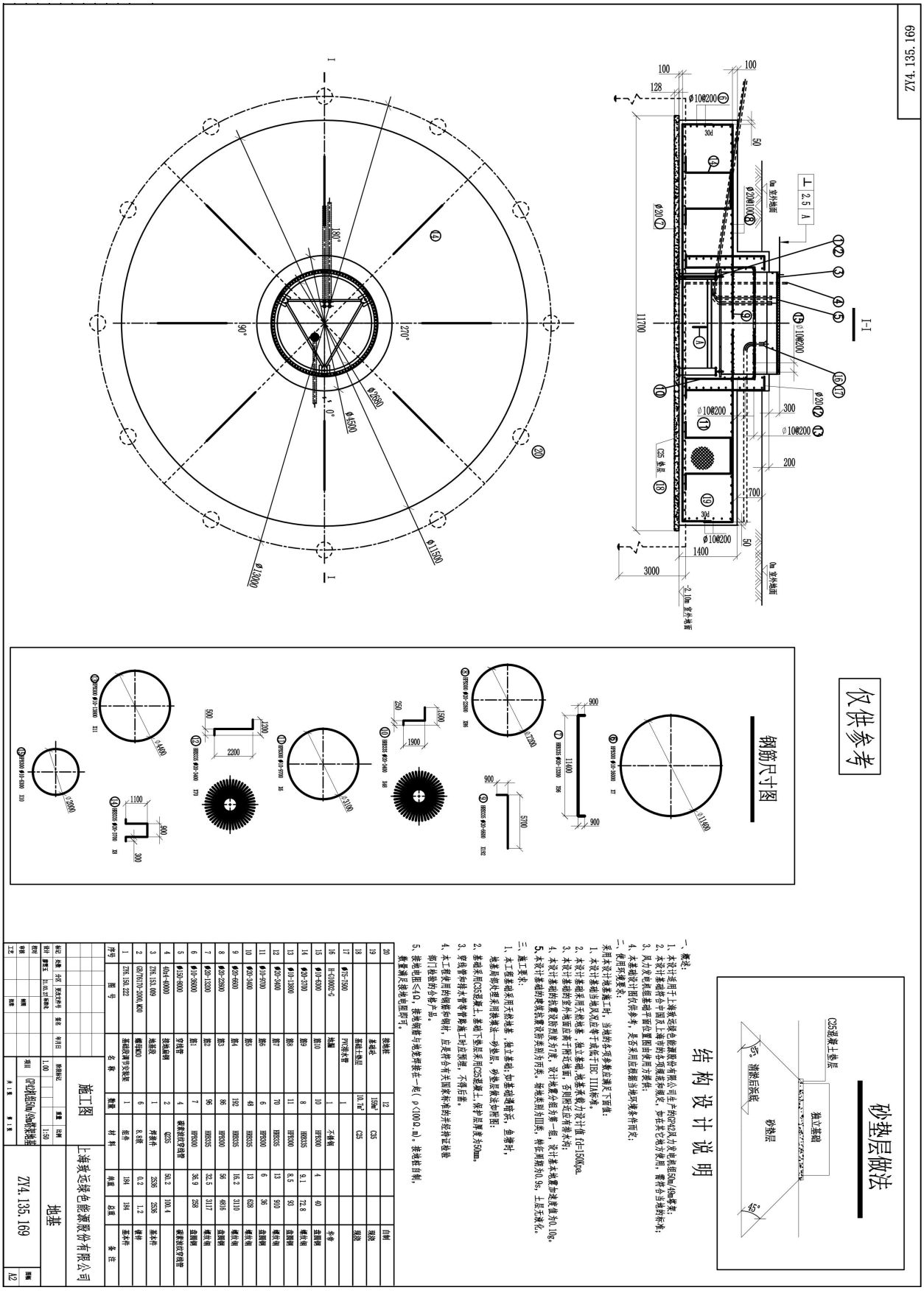


Upper foundation load

Load case	Tower Mxy [kNm]	Tower Mz [kNm]	Tower Fxy [kN]	Tower Fz [kN]	Safety factor
Normal run load case	2302	166	54	-627	1.0
Ultimate load case	10778	-74	263.4	-850	1.35

Note: The above loads all include load safety factors, please see relevant documents for detailed data.

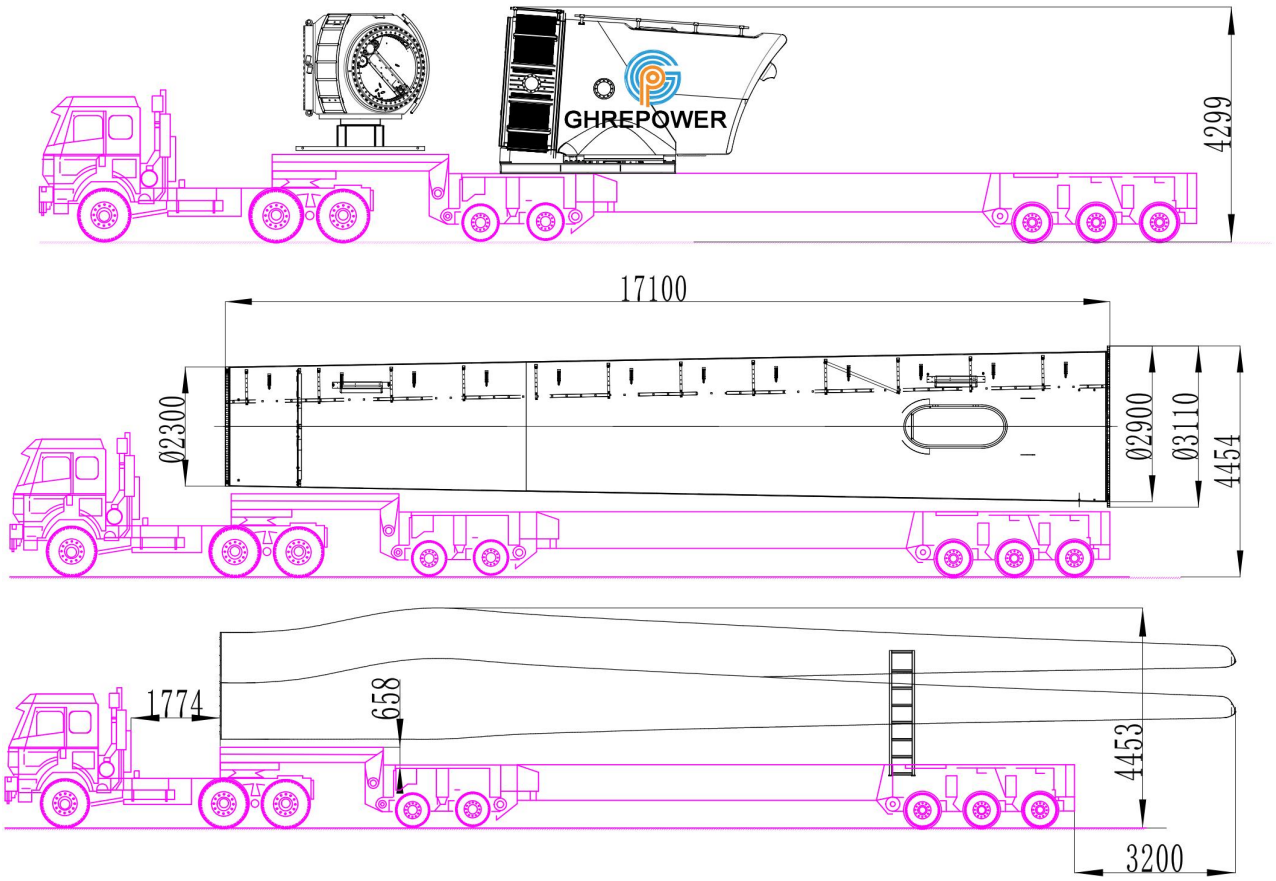
6.4 Reference foundation（49m）



7. Wind turbine transportation

The main components of WTGS are listed and the loading diagram as follows:

No.	Item	Weight (t)	Dimension (m)	Vehicle	Time
1	Ground cage & related accessories	2.5	bulk packaging	Ordinary vehicle	1
2	Nacelle & converter	22	5.0m*2.8m*3.2m	17.5m platform lorry	1
3	Hub	3.0	1.9m*1.9m*2.5m		
4	Blade	4.0	20.3m*2.6m*2.8m	17.5m platform lorry	1
5	Each section of tower (small parts assembly)	8~16	18.4* ϕ 2.9	17.5m platform lorry	2



8. Hoisting request

In order to ensure the hoisting time, tower hoisting and wind rotor assembly are carried out simultaneously. The requirements for the site are very strict. It is necessary to ensure that there is space for placement and installation of components. The flat area of the site should be wider to facilitate the layout of hoisting installation. The tower needs to be placed in a flat area 20 meters long and 10 meters wide, and the blades need to be placed in a flat area 50 meters long and 40 meters wide for assembly of the wind wheel.

The road needs to ensure the passage of 17.5-meter flatbed vehicles. The turning radius is greater than 20m. The geology must not be soft, otherwise it needs to be paved with sand and gravel.

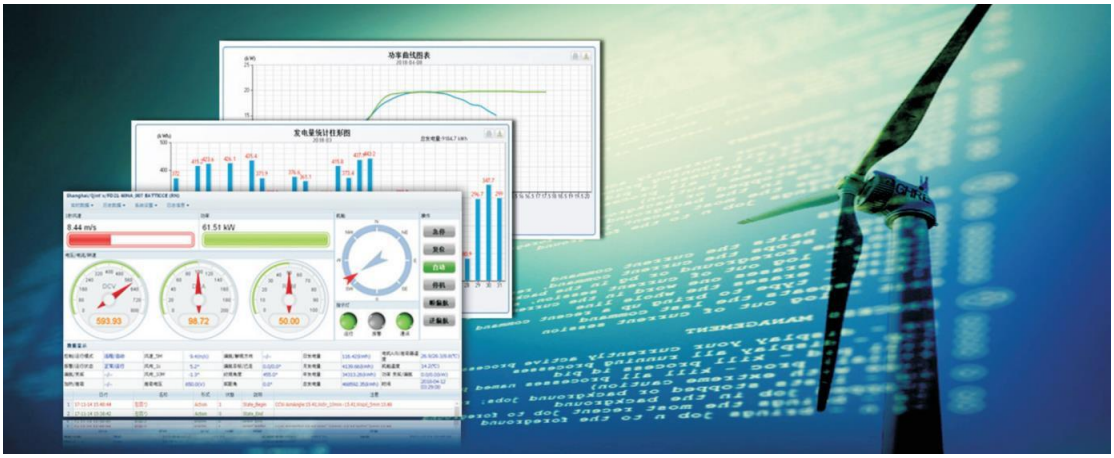
The list of main tool requirements for each stage of hoisting is as follows:

No.	Name	Specs	Qty	Time	Function
1	Crane	75T	1 pcs	2 days	unloading & blade assembly
2	Crane	260T	1 pcs	2 days	Tower & wind rotor assembly

9. SCADA remote monitoring

Remote monitoring system CUBE3.0 with system functions & features:

- Data transmission: data connection and interaction can be carried out through wired/wireless networks and access method is flexible and convenient.
- Real-time monitoring: log on the web page anytime & anywhere to observe and analyze real-time operation status.
- Data logging: record various operation information, meteorological, grid data, electricity generation and other types of data.
- Report analysis: statistics of each monitoring quantity and fault records can be made by day, month and year and reports can be generated.
- Failure alarm: failure information can be notified to operation and maintenance personnel in a timely manner by pre-classifying various types of failures.
- Operation & maintenance management: record each operation & maintenance information and provide operation and maintenance status reminders according to maintenance requirements.
- Safety and reliability: the server is built on a third-party cloud platform, which the network service is safe and reliable.



Add: No. 58,Tongju Rd, Songjiang District, Shanghai City, China

Tele: 0086-21-37832332

Fax: 0086-21-37832356

E-mail: info@ghrepower.com

Web: www.ghrepower.com