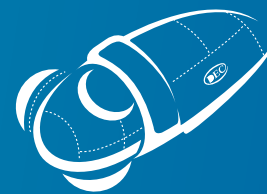




# LARGE CAPACITY DIRECT DRIVE WIND TURBINE



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## 东方风电

绿色动力 驱动未来  
Green Energy Drives Future



# Our Vision

To be the World Leading Wind  
Power Solution Provider







## DONGFANG ELECTRIC CORPORATION

Dongfang Electric Corporation (DEC) is one of the key state-owned enterprises identified by the Party Central Committee and involves the national security and national economy lifeline. DEC is one of the world's largest power generation equipment manufacturer and power plant EPC Contractors.

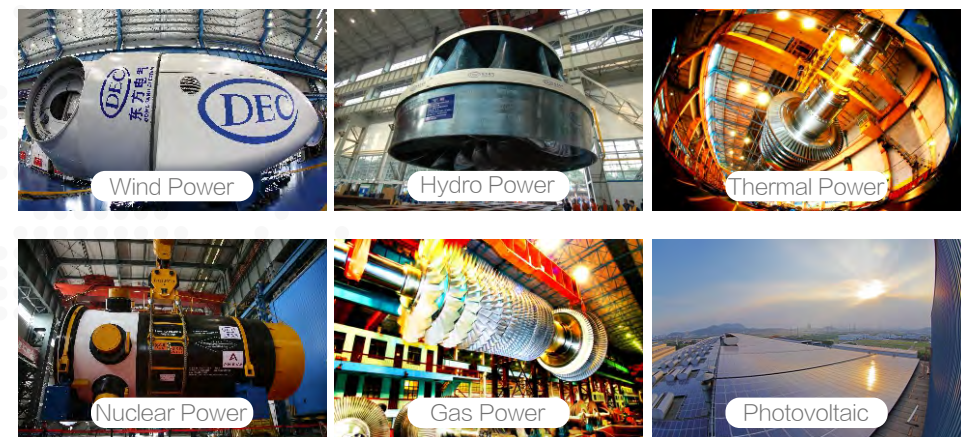
DEC is the first batch of innovative enterprises and national technological innovation demonstration enterprises of China. We have established a multi-level & market-oriented enterprises innovation system for product R&D, which promotes the sustainable and stable development of DEC, and helps the country build "Innovative-oriented Country" and "Advanced Manufacturing Power".

DEC has strong capabilities of R&D and manufacturing of Hydro, Thermal, Nuclear, Gas, Wind and Solar Power generating equipment. DEC product range covers from 1000MW class Hydro-Power Unit, 1350MW Ultra-supercritical Thermal Power Unit, 1000MW-1750MW Nuclear Power Unit, Heavy duty Gas Turbine, Direct-drive and Double-fed Wind Turbine Series, High-efficiency Solar Power Equipment, Hydrogen Fuel Bus, Large-scale Environmental Protection and Water Treatment Equipment, Power Electronics and Control Systems, New Energy Batteries and Energy Storage Systems, Intelligent Equipment, etc.

DEC has vigorously expanded its overseas market and actively participated in the

construction of the "Belt and Road". Large-scale equipment products and services of DEC have been exported to nearly 80 countries and regions, creating several No.1 in the history of China's power generation equipment export. DEC has been selected by ENR as one of the global 250 largest international project contractors for 24 consecutive years.

Looking forward to the future, DEC will adhere to the tenet of "creating value and sharing success", vigorously implement the new development strategy of "12345", build a world-class enterprise with global competitiveness, and drive economic development of China and the world with green power.



# DONGFANG ELECTRIC WIND POWER CO., LTD.

Dongfang Electric Wind Power Co., Ltd (DEW) is a specialized company affiliated to Dongfang Electric Corporation for wind power industry. We are committed to providing customers with the overall & best energy efficiency solution, scientific and customized O&M service solutions. We insist on technological innovation to promote product upgrade and industrial development. We have strong capabilities for R&D, manufacturing of Direct-drive wind turbine, Double-fed wind turbine, blades, generators, control systems and other core components. The wind turbine products cover 1.5MW-4.5S MW series for onshore, 5MW-10MW series for offshore. DEW is the first in China wind power industry to launch 4.5S MW series onshore, 7MW and 10MW offshore wind turbines, as well as Intelligent Wind Farm System (iPACOM) with independent intellectual property rights, to promote energy by full-dimension solution. Until now, we have supplied more than 9000 units of various types of wind turbines for domestic and oversea customers, with accumulative installed capacity more than 14GW.

## Enterprise Development History

- 2004** Dongfang Turbine Co., Ltd. Double-fed Wind Power Technology Developed
- 2008** Dongfang Electric Machinery Co.,Ltd. Direct-drive Wind Power Technology Developed
- 2013** DEC Wind Power Division Established Integrate Double-fed and Direct-drive business into unified management
- 2015** Dongfang Electric Wind Power Co., Ltd. Established Integrate internal wind power industry resource of DEC

**2004**  
Start Manufacturing 1.5MW WTG

## Technology Development History

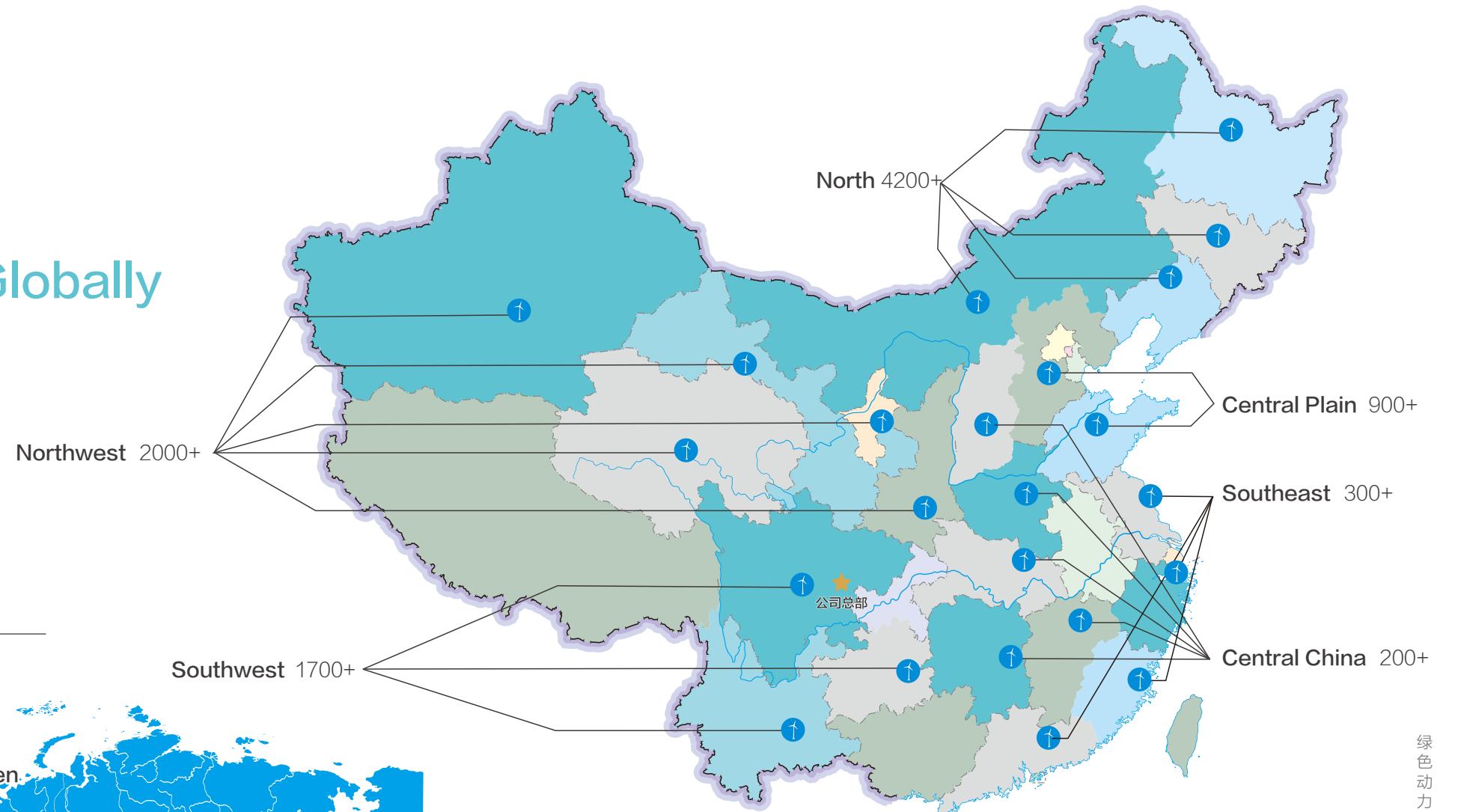
- 2010** 1.5MW Direct-drive onshore WTG developed independently
- 2012** 2.0MW Double-fed & 2.5MW Direct-drive onshore WTG developed independently
- 2013** 3.0MW offshore & 5.0MW offshore WTG developed independently
- 2016** 2.0MW ultra low wind speed WTG developed independently
- 2018** 4MW large capacity onshore WTG developed independently
- 2019** 7MW offshore & 10MW offshore large capacity offshore WTG developed independently



# REFERENCE LAYOUT



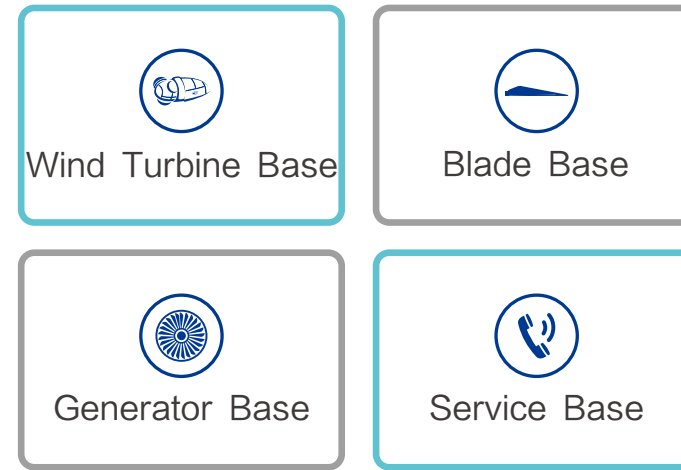
# 9000+ Units Globally



Oversea Project Layout



# INDUSTRIAL LAYOUT





# Onshore

## Large Capacity Wind Turbine





# 3.2SMW Direct-drive Wind Turbine

## Specific for Medium and Low Wind Speed Area

### Feature:

**Applicable Wind Class:** 5.0-7.5m/S

**Unit Capacity:** 3.0-3.2MW

**Rotor Diameter:** 155m

**Tower Height:** Site Specific with Traditional and High Type Option



### Higher Safety and Reliability

- ◆ Direct-drive Technology, Shorter Driven Chain with no High-speed Rotation Components, Higher Reliability
- ◆ No Lubricating oil system for High-speed Driven Chain, No Slip Ring. Decreasing fire hazard, Higher Safety
- ◆ Double safety chain design based on patent technology to eliminate speeding accidents and further improve safety
- ◆ Self-developed electrical system, Mean Time Between Failures (MTBF) is over 2000 hours
- ◆ The patented technology of magnetic steel box protection prevents magnetic steel from demagnetizing and falling off. No replacement of generator



### Excellent Power Generation Performance

- ◆ 155m big rotor diameter, rated power adjustable from 3.0MW to 3.2MW, annual Equivalent Full Load Hours are over 2100h at mean wind speed of 5m/s
- ◆ More than 60 years' experience on R&D and manufacturing of generating equipment, generator efficiency is 1%~3% higher among domestic market
- ◆ High efficiency blade design with additional sawtooth, trailing edge and vortex generator, Cp value is higher than 0.49
- ◆ Self-developed control system perfectly matches the blade to the maximum capture wind energy



### Lower Project Capex

- ◆ Compared to 2.0/2.5MW turbine, the number of units can be reduced by 17~34%, the capex for land acquisition, road construction, equipment installation, transmission line, etc. can be reduced significantly



### Lower O&M Cost

- ◆ Direct drive technology, without regular replacement of gearbox oil, filter element, and carbon brush of generator, less maintenance duration
- ◆ Fewer components, lower failure, shorter downtime due to regular maintenance, less AEP loss
- ◆ Less consumable material to lower O&M cost

## D3000/D3200-155

No.	Item	Unit	Specification
Overall Wind Turbine			
01	Rated Power	kW	3000/3200
02	Cut-in Wind Speed	m/s	2.5
03	Rated Wind Speed	m/s	9/9.5
04	Cut-out Wind Speed(10min)	m/s	20
05	Survival Wind Speed(3s)	m/s	52.5
06	Operation Temp.(StandardAirDensity)	°C	-30~+40°C
07	Survival Temp.(StandardAirDensity)	°C	-40~+50°C
08	Design Lifecycle	Year	≥20(onshore)
Rotor			
01	Rotor Diameter	m	155
02	Swept Area	m <sup>2</sup>	18869
03	Blade Length	m	76
04	Blade Material		GFRP
Gearbox			
01	Gearbox Type		N/A
02	Transmission Ratio		N/A
Generator			
01	Type		Permanent Magnet Synchronous Generator
02	Rated Power	kW	3150/3350
03	Rated Voltage	V	690
04	Insulation Class		F
Converter			
01	Type		Full Power Converter
02	Power Factor		-0.95 ~ +0.95
03	Rated Frequency	Hz	50
04	Rated Output Voltage	V	690
05	Input/output Frequency Range	Hz	±2.5
Yaw System			
01	Yaw Driver		Electric Drive/Four Grade Planetary Reducer
02	Yaw Brake		Electromagnetic Brake+Hydraulic Brake
03	Yaw Speed	° /s	≤0.3
Lightening protection			
01	Design Standard		IEC 61400/24-2010,IEC 62305-2006,GL Guideline
02	Grounding Resistanc	Ω	Power Frequency Grounding Resistance of Unit Turbine≤4
Tower			
01	Type		Steel Conical Tower
02	Hub Height	m	95/140



# 4.0MW Direct-drive Wind Turbine

## Specific for Medium and High Wind Speed Area

### Feature:

**Applicable Wind Class:** 7.5~8.5m/s

**Unit Capacity:** 4.0MW

**Rotor Diameter:** 148m

Meet the requirement of “grid parity” in medium and high wind speed area. Mainly target for oversea high end market and domestic northwest, northeast, and north China



### Higher Safety and Reliability

- ◆ Direct-drive Technology, Shorter Driven Chain with no High-speed Rotation Components, Higher Reliability
- ◆ No Lubricating oil system for High-speed Driven Chain, No Slip Ring. Decreasing fire hazard, Higher Safety
- ◆ Double safety chain design based on patent technology to eliminate speeding accidents and further improve safety
- ◆ Self-developed electrical system, Mean Time Between Failures (MTBF) is over 2000 hours
- ◆ The patented technology of magnetic steel box protection prevents magnetic steel from demagnetizing and falling off. No replacement of generator



### Excellent Power Generation Performance

- ◆ 155m big rotor diameter, 4.0MW Turbine, Max Output can be up-rated in low temp. condition, annual Equivalent Full Load Hours are over 3400h at mean wind speed of 7.5m/s
- ◆ More than 60 years' experience on R&D and manufacturing of generating equipment, generator efficiency is 1%~3% higher among domestic market
- ◆ High efficiency blade design with additional sawtooth, trailing edge and vortex generator, Cp value is higher than 0.49
- ◆ Self-developed control system perfectly matches the blade to the maximum capture wind energy



### Lower Project Capex

- ◆ Compared to 3MW turbine, the number of units can be reduced by 25%, the capex for land acquisition, road construction, equipment installation, transmission line, etc. can be reduced significantly



### Lower O&M Cost

- ◆ Direct drive technology, without regular replacement of gearbox oil, filter element, and carbon brush of generator, less maintenance duration
- ◆ Fewer components, lower failure, shorter downtime due to regular maintenance, less AEP loss
- ◆ Less consumable material to lower O&M cost

## D4000-148

No.	Item	Unit	Specification
Overall Wind Turbine			
01	Rated Power	kW	4000
02	Cut-in Wind Speed	m/s	2.5
03	Rated Wind Speed	m/s	10.3
04	Cut-out Wind Speed(10min)	m/s	20
05	Survival Wind Speed(3s)	m/s	59.5
06	Operation Temp.(StandardAirDensity)	°C	-30~+40°C
07	Survival Temp.(StandardAirDensity)	°C	-40~+50°C
08	Design Lifecycle	Year	≥20(onshore)
Rotor			
01	Rotor Diameter	m	148
02	Swept Area	m <sup>2</sup>	17203
03	Blade Length	m	72.5
04	Blade Material		GFRP
Gearbox			
01	Gearbox Type		N/A
02	Transmission Ratio		N/A
Generator			
01	Type		Permanent Magnet Synchronous Generator
02	Rated Power	kW	4250
03	Rated Voltage	V	720
04	Insulation Class		F
Converter			
01	Type		Full Power Converter
02	Power Factor		-0.95 ~ +0.95
03	Rated Frequency	Hz	50
04	Rated Output Voltage	V	690
05	Input/output Frequency Range	Hz	±2.5
Yaw System			
01	Yaw Driver		Electric Drive/Four Grade Planetary Reducer
02	Yaw Brake		Electromagnetic Brake+Hydraulic Brake
03	Yaw Speed	° /s	≤0.3
Lightening protection			
01	Design Standard		IEC 61400/24-2010,IEC 62305-2006,GL Guideline
02	Grounding Resistanc	Ω	Power Frequency Grounding Resistance of Unit Turbine≤4
Tower			
01	Type		Steel Conical Tower
02	Hub Hight	m	90/95/100



# 4.5MW Direct-drive Wind Turbine

## Specific for Medium and High Wind Speed Area



### Feature:

**Applicable Wind Class:** 7.5~8.5m/s

**Unit Capacity:** 4.2~4.5MW

**Rotor Diameter:** 155m

Meet the requirement of “grid parity” in medium and high wind speed area. Mainly target for oversea high end market and domestic northwest, northeast, and north China

Accumulative orders are over 2600MW



### Higher Safety and Reliability

- ◆ Direct-drive Technology, Shorter Driven Chain with no High-speed Rotation Components, Higher Reliability
- ◆ No Lubricating oil system for High-speed Driven Chain, No Slip Ring. Decreasing fire hazard, Higher Safety
- ◆ Double safety chain design based on patent technology to eliminate speeding accidents and further improve safety
- ◆ Self-developed electrical system, Mean Time Between Failures (MTBF) is over 2000 hours
- ◆ The patented technology of magnetic steel box protection prevents magnetic steel from demagnetizing and falling off. No replacement of generator
- ◆ Increase voltage rating to 1140V to enhance twist cable system safety



### Excellent Power Generation Performance

- ◆ 155m big rotor diameter, rated power can be adjusted from 4.2MW to 4.5MW, annually Equivalent Full Load Hours are over 3500h at mean wind speed of 7.5m/s
- ◆ More than 60 years' experience on R&D and manufacturing of generating equipment, generator efficiency is 1%~3% higher among domestic market
- ◆ High efficiency blade design with additional sawtooth, trailing edge and vortex generator, Cp value is higher than 0.49
- ◆ Self-developed control system perfectly matches the blade to the maximum capture wind energy
- ◆ 1140v three-level converter technology to bring better power quality and generating efficiency by 1~1.5%



### Lower Project Capex

- ◆ Compared to 3MW turbine, the number of units can be reduced by 34%, the capex for land acquisition, road construction, equipment installation, transmission line, etc. can be reduced significantly



### Lower O&M Cost

- ◆ Direct drive technology, without regular replacement of gearbox oil, filter element, and carbon brush of generator, less maintenance duration
- ◆ Fewer components, lower failure, shorter downtime due to regular maintenance, less AEP loss
- ◆ Less consumable material to lower O&M cost

## D4200/D4500-155

No.	Item	Unit	Specification
Overall Wind Turbine			
01	Rated Power	kW	4200/4500
02	Cut-in Wind Speed	m/s	2.5
03	Rated Wind Speed	m/s	10/10.5
04	Cut-out Wind Speed(10min)	m/s	20
05	Survival Wind Speed(3s)	m/s	59.5
06	Operation Temp.(StandardAirDensity)	°C	-30~+40°C
07	Survival Temp.(StandardAirDensity)	°C	-40~+50°C
08	Design Lifecycle	Year	≥20(onshore)
Rotor			
01	Rotor Diameter	m	155
02	Swept Area	m <sup>2</sup>	18869
03	Blade Length	m	76
04	Blade Material		GFRP
Gearbox			
01	Gearbox Type		N/A
02	Transmission Ratio		N/A
Generator			
01	Type		Permanent Magnet Synchronous Generator
02	Rated Power	kW	4350/4660
03	Rated Voltage	V	1140
04	Insulation Class		F
Converter			
01	Type		Full Power Converter
02	Power Factor		-0.95 ~ +0.95
03	Rated Frequency	Hz	50
04	Rated Output Voltage	V	1140
05	Input/output Frequency Range	Hz	± 2.5
Yaw System			
01	Yaw Driver		Electric Drive/Four Grade Planetary Reducer
02	Yaw Brake		Electromagnetic Brake+Hydraulic Brake
03	Yaw Speed	° /s	≤0.3
Lightening protection			
01	Design Standard		IEC 61400/24-2010,IEC 62305-2006,GL Guideline
02	Grounding Resistanc	Ω	Power Frequency Grounding Resistance of Unit Turbine≤4
Tower			
01	Type		Steel Conical Tower
02	Hub Hight	m	93.5/95/100



# Offshore

## Large Capacity Wind Turbine



# 7.0MW Direct-drive Offshore Wind Turbine

## Tailored for Medium and Low Wind Speed Area

### Feature:

**Applicable Wind Class:** 7.0~8.5m/s

**Single Capacity:** 7.0MW

**Rotor Diameter:** 186m

Biggest unit capacity, biggest rotor diameter applicable for medium and low wind speed offshore area. Typhoon resistance offshore wind turbine. Target for most of sea area in China with low average wind speed. Strong resistance to salt spray and corrosion condition



### Higher Safety and Reliability

- ◆ Direct-drive Technology, Shorter Driven Chain with no High-speed Rotation Components, Higher Reliability
- ◆ No Lubricating oil system for High-speed Driven Chain, No Slip Ring. Decreasing fire hazard, Higher Safety
- ◆ Double safety chain design based on patent technology to eliminate speeding accidents and further improve safety
- ◆ Self-developed electrical system, Mean Time Between Failures (MTBF) is over 3000 hours
- ◆ The patented technology of magnetic steel box protection prevents magnetic steel from demagnetizing and falling off. No replacement of generator
- ◆ Fully sealed structure prevents salt spray and corrosion, internal forced convection and external air-to-air cooler ensure effective cooling
- ◆ Active typhoon resistance strategy, backup power solution, withstand 77m/s typhoon
- ◆ Dual-circuit electrical system, multiple redundant design of electrical control system, single circuit can be operated independently



### Excellent Power Generation Performance

- ◆ 186m big rotor diameter, 7.0MW single capacity, annually equivalent hours are over 3400h at the wind speed of 7.5m/s
- ◆ More than 60 years' experience on R&D and manufacturing of generating equipment, generator efficiency is 1%~3% higher among domestic market
- ◆ High efficiency blade design with additional sawtooth, trailing edge and vortex generator, Cp value is higher than 0.49
- ◆ Self-developed control system perfectly matches the blade to the maximum capture wind energy
- ◆ 1140v three-level converter technology to bring better power quality and generating efficiency by 1~1.5%



### Lower Project Capex

- ◆ Compared to 5~6MW turbine, the number of units can be reduced by 14~29%, the project capex can be reduced by 600~1200RMB/kW



### Lower O&M Cost

- ◆ Direct drive technology, without regular replacement of gearbox oil, filter element, and carbon brush of generator, less maintenance duration
- ◆ Fewer components, lower failure, shorter downtime due to regular maintenance, less AEP loss
- ◆ Less consumable material to lower O&M cost
- ◆ Electrical parts(converter/transformer) placed in the tower base for maintenance convenience
- ◆ The regular inspection interval is extended to one year with less workload and AEP loss

## D7000-186

No.	Item	Unit	Specification
Overall Wind Turbine			
01	Rated Power	kW	7000
02	Cut-in Wind Speed	m/s	3
03	Rated Wind Speed	m/s	10.5
04	Cut-out Wind Speed(10min)	m/s	25
05	Survival Wind Speed(3s)	m/s	77
06	Operation Temp.(StandardAirDensity)	℃	-10~+40℃
07	Survival Temp.(StandardAirDensity)	℃	-20~+50℃
08	Design Lifecycle	Year	≥25(onshore)
Rotor			
01	Rotor Diameter	m	186
02	Swept Area	m <sup>2</sup>	27171
03	Blade Length	m	91
04	Blade Material		GFRP
Gearbox			
01	Gearbox Type		N/A
02	Transmission Ratio		N/A
Generator			
01	Type		Permanent Magnet Synchronous Generator
02	Rated Power	kW	7500
03	Rated Voltage	V	1140
04	Insulation Class		F
Converter			
01	Type		Full Power Converter
02	Power Factor		0.95~0.95
03	Rated Frequency	Hz	50
04	Rated Output Voltage	V	1140
05	Input/output Frequency Range	Hz	±2.5
Yaw System			
01	Yaw Driver		Electric Drive/Four Grade Planetary Reducer
02	Yaw Brake		Electromagnetic Brake+Hydraulic Brake
03	Yaw Speed	° /s	≤0.25
Lightening protection			
01	Design Standard		IEC 61400/24-2010,IEC 62305-2006,GL Guideline
02	Grounding Resistanc	Ω	Power Frequency Grounding Resistance of Unit Turbine≤4
Tower			
01	Type		Steel Conical Tower
02	Hub Hight	m	115



# 10MW Direct-drive Offshore Wind Turbine

## Tailored for High Wind Speed Area

### Feature:

Applicable Wind Class: 8.5~10m/s

Unit Capacity: 10MW

Rotor Diameter: 185m

Biggest single capacity, biggest rotor diameter in China applicable for high wind speed offshore area. Typhoon Resistance Offshore Wind Turbine



### Higher Safety and Reliability

- ◆ Direct-drive Technology, Shorter Driven Chain with no High-speed Rotation Components, Higher Reliability
- ◆ No Lubricating oil system for High-speed Driven Chain, No Slip Ring. Decreasing fire hazard, Higher Safety
- ◆ Double safety chain design based on patent technology to eliminate speeding accidents and further improve safety
- ◆ Self-developed electrical system, Mean Time Between Failures (MTBF) is over 3000 hours
- ◆ The patented technology of magnetic steel box protection prevents magnetic steel from demagnetizing and falling off. No replacement of generator
- ◆ Fully sealed structure prevents salt spray and corrosion, internal forced convection and external air-to-air cooler ensure effective cooling
- ◆ Active typhoon resistance strategy, backup power solution, withstand 77m/s typhoon
- ◆ Dual-circuit electrical system, multiple redundant design of electrical control system, single circuit can be operated independently
- ◆ Double-drive motor pitch technology to reduce the wear and prolong the life of pitch bearings
- ◆ Increase voltage rating to 3150V to enhance twist cable system safety



### Excellent Power Generation Performance

- ◆ 185m big rotor diameter, 10.0MW unit capacity, biggest rotor diameter of the same capacity class
- ◆ More than 60 years' experience on R&D and manufacturing of generating equipment, generator efficiency is 1%~3% higher among domestic market
- ◆ High efficiency blade design with additional sawtooth, trailing edge and vortex generator, Cp value is higher than 0.49
- ◆ Self-developed control system perfectly matches the blade to the maximum capture wind energy
- ◆ Medium voltage with IGCT, the generating efficiency is 1%~3% higher than low voltage design



### Lower Project Capex

- ◆ Compared to 7~8MW turbine, the number of units can be reduced by 25~30%, the project capex can be reduced by 800~1400RMB/kW



### Lower O&M Cost

- ◆ Direct drive technology, without regular replacement of gearbox oil, filter element, and carbon brush of generator, less maintenance duration.
- ◆ Fewer components, lower failure, shorter downtime due to regular maintenance, less AEP loss
- ◆ Less consumable material to lower O&M cost
- ◆ Electrical parts(converter/transformer) placed in the tower base for maintenance convenience.
- ◆ The regular inspection interval is extended to one year with less workload and AEP loss

## D10000-185

No.	Item	Unit	Specification
Overall Wind Turbine			
01	Rated Power	kW	10000
02	Cut-in Wind Speed	m/s	3
03	Rated Wind Speed	m/s	12
04	Cut-out Wind Speed(10min)	m/s	25
05	Survival Wind Speed(3s)	m/s	77
06	Operation Temp.(StandardAirDensity)	°C	-10~+40°C
07	Survival Temp.(StandardAirDensity)	°C	-20~+50°C
08	Design Lifecycle	Year	≥25(onsshore)
Rotor			
01	Rotor Diameter	m	185
02	Swept Area	m <sup>2</sup>	26742
03	Blade Length	m	90
04	Blade Material		GFRP
Gearbox			
01	Gearbox Type		N/A
02	Transmission Ratio		N/A
Generator			
01	Type		Permanent Magnet Synchronous Generator
02	Rated Power	kW	10500
03	Rated Voltage	V	3150
04	Insulation Class		F
Converter			
01	Type		Full Power Converter
02	Power Factor		0.95~0.95
03	Rated Frequency	Hz	50
04	Rated Output Voltage	V	3100
05	Input/output Frequency Range	Hz	±2.5
Yaw System			
01	Yaw Driver		Electric Drive/Four Grade Planetary Reducer
02	Yaw Brake		Electromagnetic Brake+Hydraulic Brake
03	Yaw Speed	° /s	≤0.25
Lightening protection			
01	Design Standard		IEC 61400/24-2010,IEC 62305-2006,GL Guideline
02	Grounding Resistanc	Ω	Power Frequency Grounding Resistance of Unit Turbine≤4
Tower			
01	Type		Steel Conical Tower
02	Hub Hight	m	115





Build the Pillar of a Great Power  
Leading the Development of Wind Power

