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Fuhrländer

AKTIENGESELLSCHAFT



FL 2500

FL 1500

FL MD 70/77

Fuhrländer wind turbines

2.500 kW - 1.500 kW



Friendly Energy Friendly World

As a pioneer of wind energy utilisation in Germany and a group-independent manufacturer of wind turbines, Fuhrländer has focused its operations towards robust system concepts for more than 15 years. At present turbines range from 30 kW to 2,5 MW. We are constantly

gaining valuable experience due to the close links between development, manufacturing and service. Our customers benefit from sound investments in wind turbines with a high technical availability. Even at difficult locations our wind farms demonstrate their strengths, in reliability and operational safety. People are the focus of our actions in

dealing with customers, suppliers and partners. Support instead of dominance – that is our motto.

Friendly energy is more than merely utilising environmentally compatible energy. It means hope and a future characterised by training, work and added value on site.

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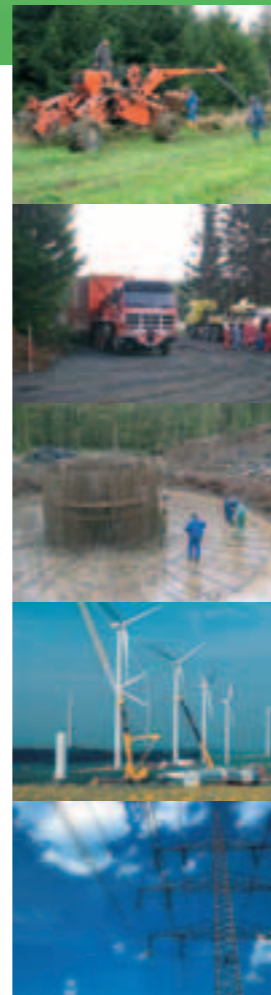
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Turnkey wind parks

Fuhrländer AG established itself a long time ago as international partner for the realisation of turnkey wind parks including grid connection via a substation. We are happy to make our experience from a multitude of different projects available to our customers.

Each location makes different demands to a wind park planner. Legal regulations, specifics of grid connection, feed options, financing and much more must be coordinated.

High flexibility and individual handling from planning to construction to the start up of operation of the turbines characterise our activities and lead to optimum results.



FLAGserv for maximum operational safety

Wind turbines are technically complex systems made up of a variety of mechanical, electrical, electronic and hydraulic components. Fuhrländer developed FLAGserv as an Internet based communications platform, which also functions independently from manufacturers, to maximize the technical availability of our robust wind turbines and to recognise potential faults in the preliminary stages. Furthermore the FL system provides the best possible conditions for documenting data for operation managers, investors and manufacturers.

If faults occur, the wind turbines automatically generate a message to the Fuhrländer data server which informs our



service team online. This allows rapid response and target orientated service activity which puts the wind turbine back on the grid as fast as possible. This condition monitoring allows maintenance with foresight and contributes to the value creation of the turbines.

This means a gain in availability and profitability of the turbine for the investor. The type specific insurance of the reliable FL turbines also supports this concept.



Power: 2.5 MW
 Rotor: Ø 80/90/100 m
 Tower heights:
 65* / 85* m (with 80 m Rotor, IEC Ia)
 85* / 100* / 117** / 141** / 160** m (with 90 m Rotor, IEC IIa)
 85* / 100* / 117** / 141** / 160** m (with 100 m Rotor, IEC IIIa)

* tubular tower ** lattice tower

FL 2500

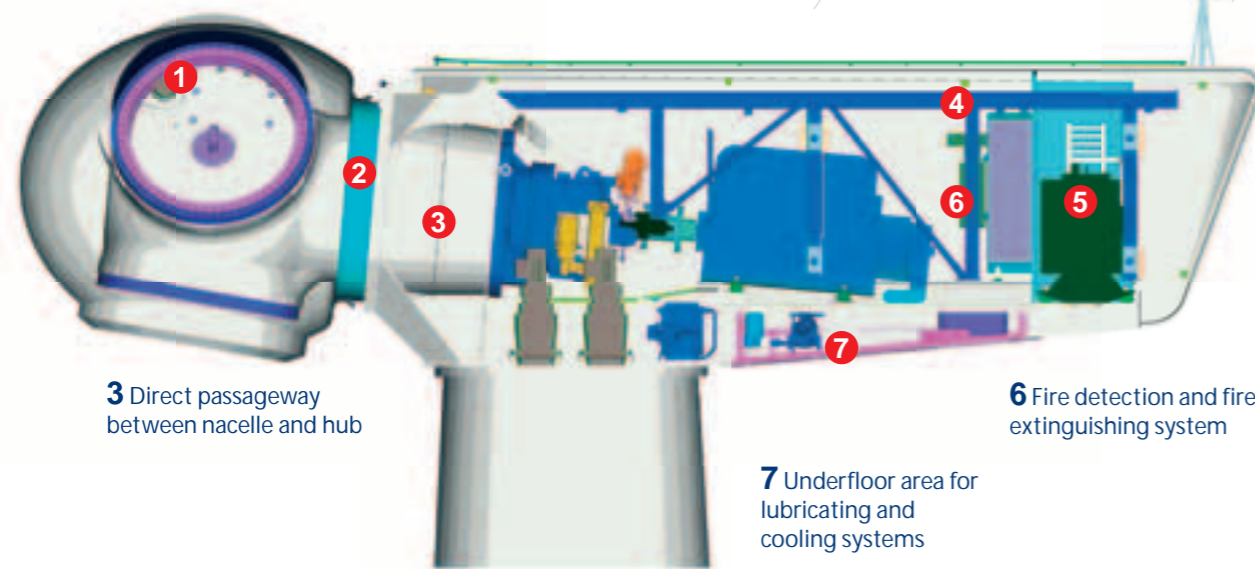
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1 Adjustment of individual blades by means of lithium ion accumulators

2 Large roller bearings to avoid the effects of axial and radial forces on the gear unit

4 Crane system for the replacement of all main components

5 Silicone oil transformer in the nacelle



3 Direct passageway between nacelle and hub

6 Fire detection and fire extinguishing system

7 Underfloor area for lubricating and cooling systems

FL 2500: Even more economic efficiency

The new 2,5-MW turbine with variable speeds sets benchmarks: due to the possible rotor blade sizes of 80, 90 und 100 m it can be harmonized with all locations and wind conditions in the best possible way. Tubular towers of 65, 85 and 100 m as well as lattice towers of up to 160 m create the prerequisite for a high economic efficiency and reliability as to the production of wind power. Thanks to the high hub heights inland locations, e.g. in woodlands, can also be developed even more economically.

The innovative driving conception with the large roller bearing, the shaft coupling and the compact gear unit provides for more safety and a longer life. The same applies to the especially designed hub with its closed operating room.

Thanks to the crane concept permitting the replacement of all main components without an expensive truck-mounted crane the mounting and operating cost can be reduced.

Rotor

Diameter	80/90/100 m
Surface area	5'027 / 6'362 / 7'854 m ²
No. of blades	3
Speed	11.7 ... 20.4 / 10.4 ... 18.1 / 9.4 ... 17.1 min ⁻¹
Power control	pitch

Gear

Design	Combined spur wheel/planet
Stages	3
Multiplication	1:64.3 / 1:72.3 / 1:79.6 (50 Hz)

Generator

Design	Asynchronous machine with slip ring motor
Speed	750 ... 1310 min ⁻¹ (50 Hz)
Voltage (frequency) Converter system	690 V (50/60 Hz) Indirect converter with DC voltage intermediate circuit

Power

Rated output	2,500 kW
at	14.5 m/s; 13 m/s; 11.5 m/s
Start wind	3.5 ... 4 m/s
Stop wind	25 m/s
Survival speed (3-seconds mean)	70 / 59.5 / 52.5 m/s

Tower

Hub height	65* / 85* / 100* / 117** / 141** / 160** m
Design	* tubular tower ** lattice tower*

Weights

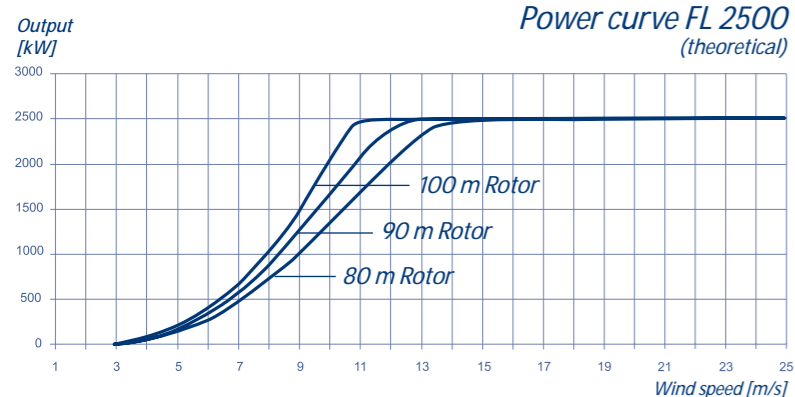
Rotor	48'000 / 50'000 kg
Nacelle	96'000 kg
Tower	170'000 kg ... 350'000 kg

Control

Speed control	Electrical pitch system
Yawing control	4 gear motors
Main brake	independent triple pitch system
2 nd Brake system	Hydraulic disk brake
Monitoring	Fixed network/radio/Vabera

Sound

Sound output level (theoretical)	80 m Rotor (on request) 90 m Rotor 104.6* / 104.11** dB (A) 100 m Rotor 105.1* / 104.6** dB (A) (* tubular tower, ** lattice tower)
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Medium wind speed at hub height [m/s]	80 m Rotor Annual yield [kWh]	90 m Rotor Annual yield [kWh]	100 m Rotor Annual yield [kWh]
10	10'733'000	11'918'000	
9.5	10'083'000	11'289'000	
9.0	9'363'000	10'581'000	11'900'000
8.5	8'580'000	9'800'000	11'144'000
8.0	7'745'000	8'950'000	10'307'000
7.5	6'868'000	8,039'000	9'393'000
7.0	5'964'000	7'081'000	8'409'000
6.5	5'052'000	6'088'000	7'365'000
6.0	4'154'000	5'083'000	6'277'000
5.5	3'295'000	4'093'000	5'170'000
5.0	2'502'000	3'150'000	4'080'000

Yields calculated to IEC 61400-12

Subject to technical alterations. Data can vary depending on components.



Subject to technical alterations. Data can vary depending on components.



Power: 1.5 MW
 Rotor: Ø 70/77 m
 Tower heights:
 65 / 100 m (mit 70 m Rotor)
 61,5 / 100 m (mit 77 m Rotor)



FL 1500

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1 High security due to individual blade adjustment

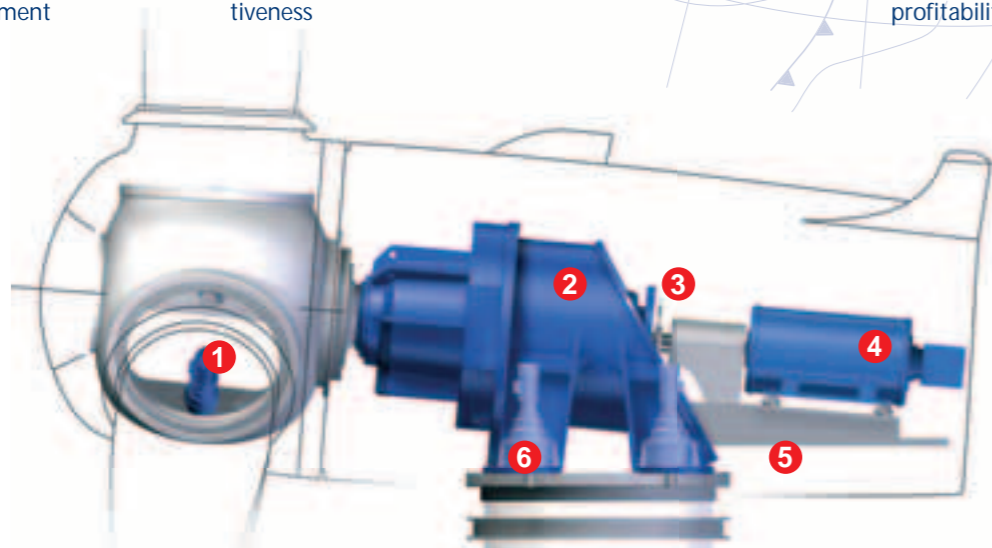
2 Combined planet spur wheel gear for high effectiveness

3 Disk brake as 2nd safety system

4 Variable speed, double-fed asynchronous generator for high profitability

FL 1500: The compact turbine for all situations

Fuhrländer expanded its megawatt class by a compact, pitch controlled turbine, the FL 1500. The turbine adapts to coastal and interior locations due to its different hub heights and two different rotor sizes. Its individual blade adjustment via maintenance-free AC-motors and the integrated free running provide high operational safety. The intelligent torque control ensures a constantly high release of power to the long live, double-fed three phase generator.



6 Four azimuth driving motors for safe and stable wind direction tracking

5 Robust and compact machine support with sound decoupling for the main components

Rotor

Diameter	70 m / 77 m
Surface area	3'848 m ² / 4'657 m ²
No. of blades	3
Speed	11-22 / 9.7-19 min ⁻¹
Power control	pitch

Gear

Design	Combined spur wheel/planet
Stages	3
Multiplication	1:90.038 / 1:104.125

Generator

Design	Double-fed three-phase asynchronous machine
Speed	1000...1800 min ⁻¹
Voltage (frequency)	690 V (50/60 Hz)
Converter system	Puls-width modulated IGBT

Power

Rated output	1,500 kW
at	12 / 11 m/s
Start wind	3.0 m/s
Stop wind	25 / 20 m/s
Survival speed	59.5 / 52.5 m/s

Tower

Hub height	61.5/65/100/114.5 m
Design	tubular tower

Weights

Rotor	32'500 / 34'000 kg
Nacelle	51'000 kg
Tower	93'000...260'000 kg

Control

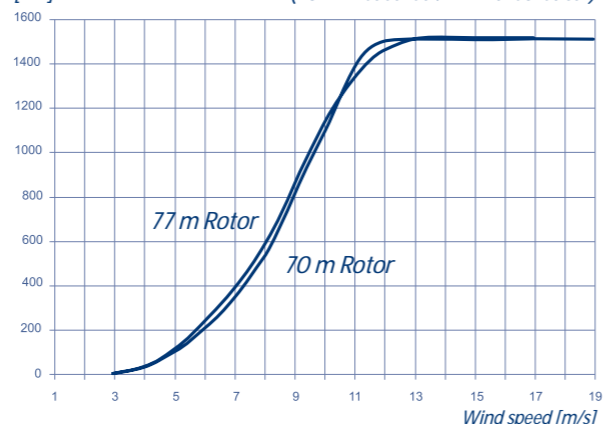
Speed control	Microprocessors
Yawing control	4 gear motors
Main brake	Blade angle adjustment
2 nd brake system	Disk brake
Monitoring	Fixed network/radio/Vabera

Sound

Sound output level	103.3 / 104 dB (A) Measurement of 02.07.03
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Medium wind speed at hub height [m/s]	70 m Rotor Annual yield [kWh]	77 m Rotor Annual yield [kWh]
8.5	6'195'000	
8.0	5'699'000	
7.5	5'122'500	5'296'000
7.0	4'546'000	4'735'000
6.5	3'919'500	4'131'000
6.0	3'293'000	3'502'000
5.5	2'675'500	2'867'000
5.0	2'058'000	2'251'000
4.5	1'542'500	1'683'000
4	1'027'000	1'188'000

Power curve FL 1500
 (70 m measured / 77 m theoretical)



Subject to technical alterations. Data can vary depending on components.





Power: 1.5 MW
 Rotor: Ø 70 m
 Tower heights: 65*/80*/85*/114,5**m
 Rotor: Ø 77 m
 Tower heights: 61,5*/85*/100*/111,5** m

*tubular tower **lattice tower

FL MD 70/77

FL MD 70/77: A concept sets standards

The field-proven concept of the FL MD 70/77 with individual blade adjustment and double-fed asynchronous generator as well as its large rotor stands side by side with the 2 MW-class. Rotors with 70 and 77 m diameters and different tower heights up to more than 100 m allow the optimum adaptation to each location. Robust machine construction in combination with the latest control technology and experienced engineering set standards in this class in terms of profitability and reliability. Therefore, more and more investors are enthusiastic about the FL MD 70/77, which Fuhrländer already exported to countries such as Portugal, Hungary and Japan, also in a 60-Hz version.

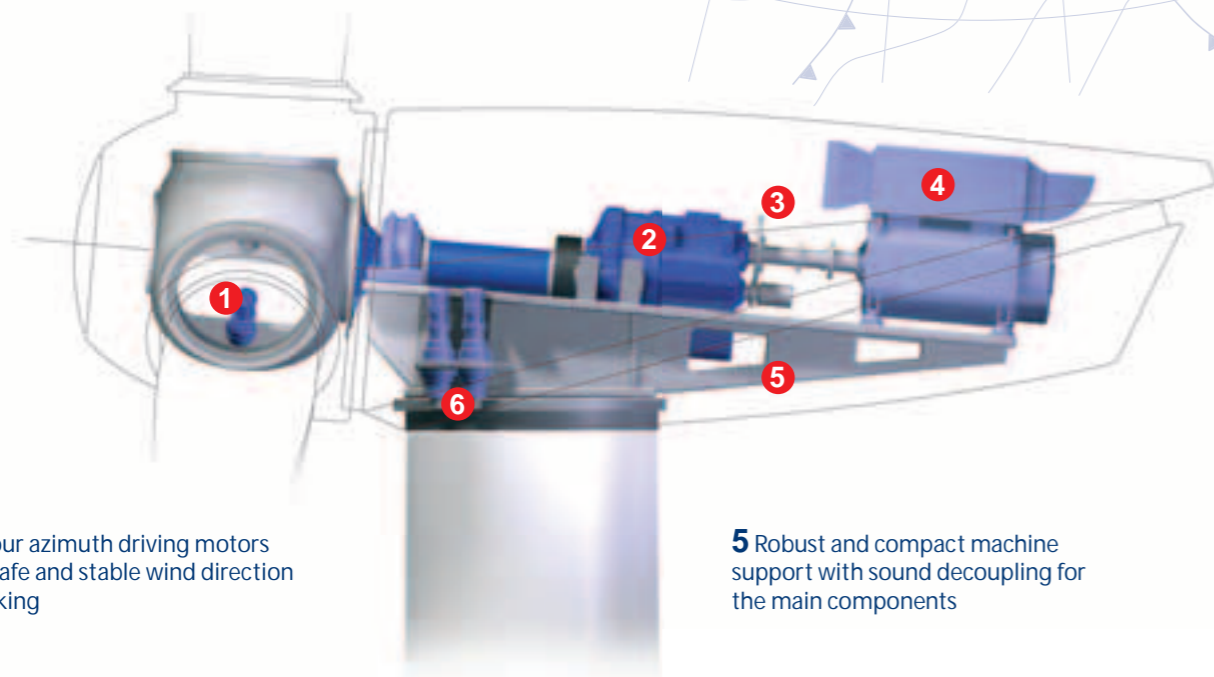
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1 High security due to individual blade adjustment

2 Combined planet spur wheel gear for high effectiveness

3 Large disk brake as 2nd safety system

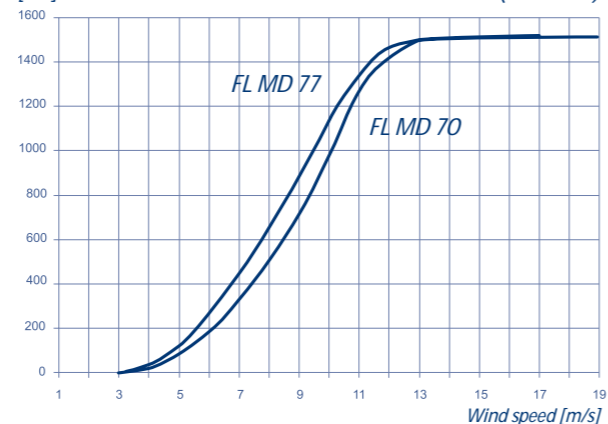
4 Variable speed, double-fed asynchronous generator for high profitability



6 Four azimuth driving motors for safe and stable wind direction tracking

5 Robust and compact machine support with sound decoupling for the main components

Power curve FL MD 70/77 (measured)



Medium wind speed at hub height [m/s]	FL MD 70 Annual yield [kWh]	FL MD 77 Annual yield [kWh]
8.5	5'727'000	
8.0	5'232'000	
7.5	4'669'000	5'351'000
7.0	4'105'000	4'820'000
6.5	3'508'000	4'205'000
6.0	2'910'000	3'589'000
5.5	2'341'000	2'956'000
5.0	1'771'000	2'324'000

Rotor

Diameter	70 m / 77 m
Surface area	3'848 m ² / 4'657 m ²
No. of blades	3
Speed	10-21 / 10-19 min ⁻¹
Power control	pitch

Gear

Design	Combined spur wheel/planet
Stages	3
Multiplication	1:94.7 / 1:104

Generator

Design	Double-fed three-phase asynchronous machine
Speed	1000...1800 min ⁻¹
Voltage (frequency)	690 V (50/60 Hz)
Converter system	Puls-width modulated IGBT

Power

Rated output at	1,500 kW
Start wind	11.6 / 13 m/s
Stop wind	3.0 m/s
Survival speed	25 / 20 m/s
	56 / 50.1 m/s

Tower

Hub height	MD 70 65*/80*/85*/114,5**m MD 77 61,5*/85*/100*/111,5**m
Design	*tubular tower **lattice tower

Weights

Rotor	31'000 / 33'400 kg
Nacelle	56'000 kg
Tower	93'000...260'000 kg

Control

Speed control	Microprocessors
Yawing control	4 gear motors
Main brake	Blade angle adjustment
2 nd brake system	Disk brake
Monitoring	Fixed network/radio/Vabera

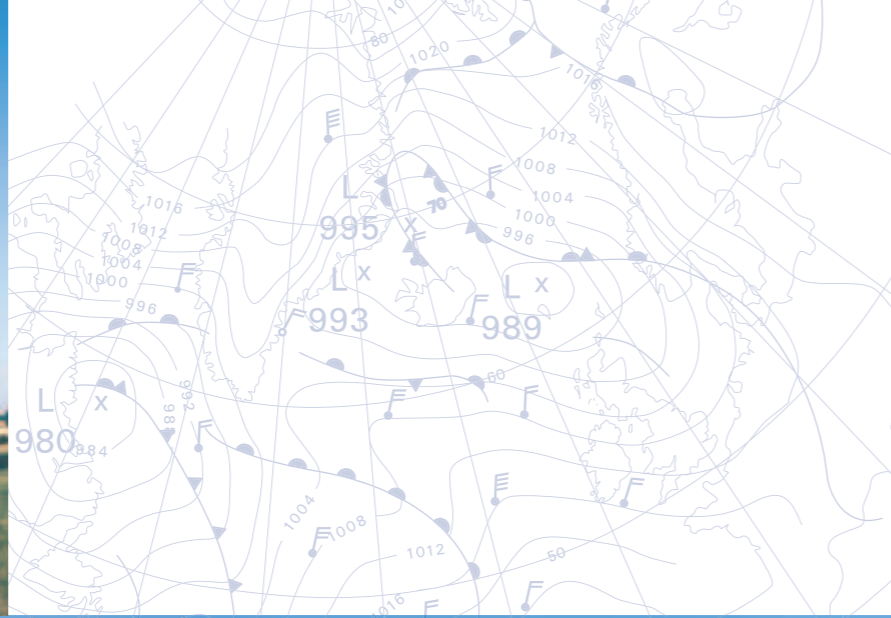
Sound

Sound output level	103.3 / 104 dB (A) Measurement of 25.08.98 / 13.08.02
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Subject to technical alterations. Data can vary depending on components.

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Stand-alone-systeme and Wind-Diesel-combinations

Regional and energy supplies can be realised or stabilised at international locations where there is no electricity supply by way of small and medium-sized wind turbines combined with a small diesel generator. For example the robust FL 100 and FL 250 are ideally suited for supplying self-sufficient units and

for use in extreme conditions. The diesel generator merely provides a reference frequency of 50/60 Hz and the energy supply during low wind periods. The wind turbine supplies more than 70 % of the energy created via this fuel safe system.

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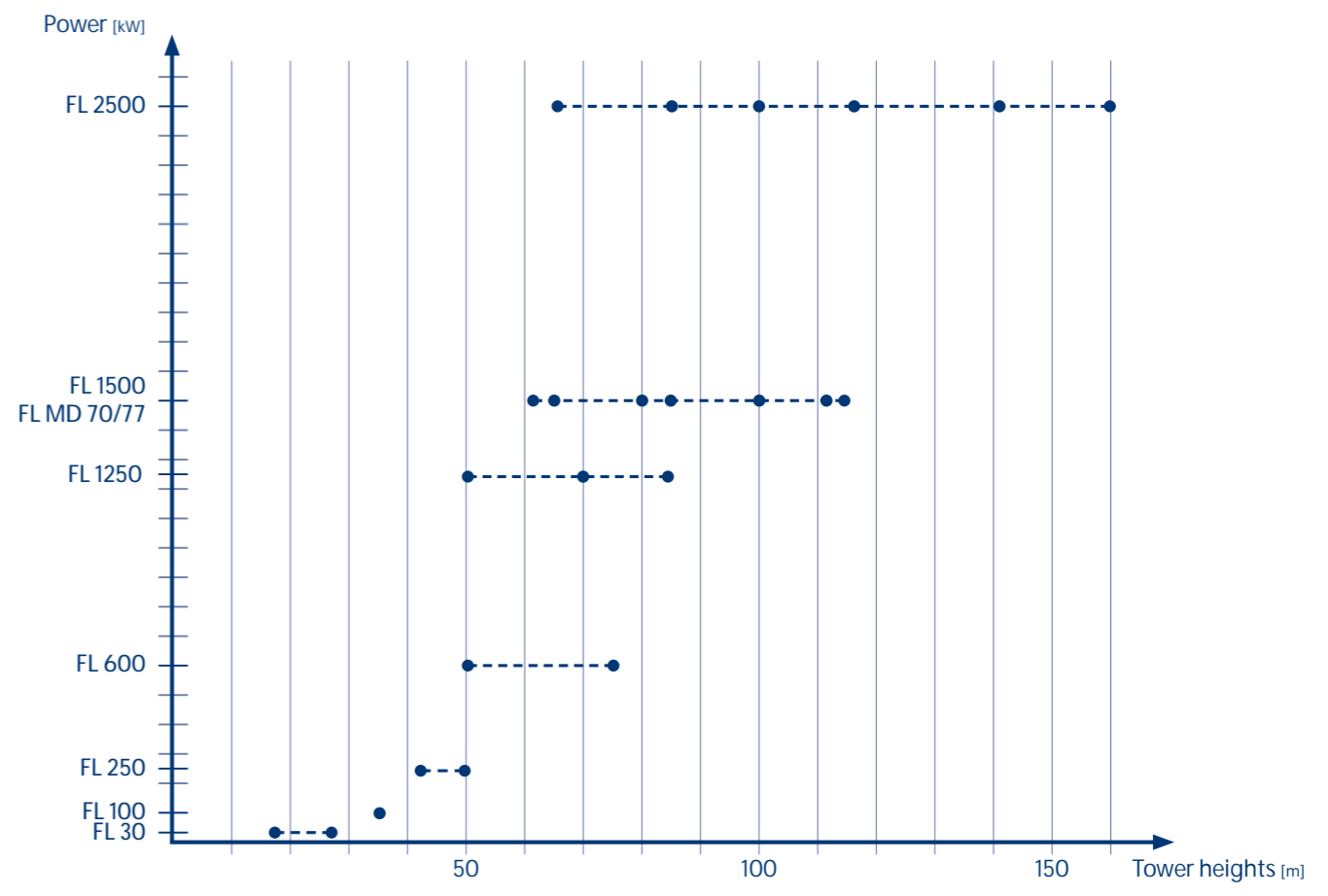
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Salt water desalination and drinking water treatment

Fuhrländer has developed a technology that utilises wind energy to operate filtration plants in particular in regions with an insufficient supply of energy and water. This combination enables drinking water to be extracted very efficiently and independent of raw materials, for example by way of salt water desalination or brackish water treatment. The wind energy created via a FL 250 could produce more than 100,000 m³ of potable water each year and consequently supply several thousand people. Furthermore the surplus wind energy can stabilise the regional power output supply.



The vast FL turbine range



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AKTIENGESELLSCHAFT

Auf der Höhe 4
D-56477 Waigandshain
Fon +49 (0) 26 64.99 66-0
Fax +49 (0) 26 64.99 66-33
mail@fuhrlaender.de
www.fuhrlaender.de