Technical Specification

DeWind D8.2

2000kW Wind Turbine

2026 McGaw Avenue, Irvine, California, 92614, USA

1 Design of the wind turbine

The DeWind D8.2 is a three-blade upwind turbine with pitch control and horizontal axis. The turbine has a rated power of 2000 kW and can be supplied with different hub heights to suit the particular site conditions and planning requirements.

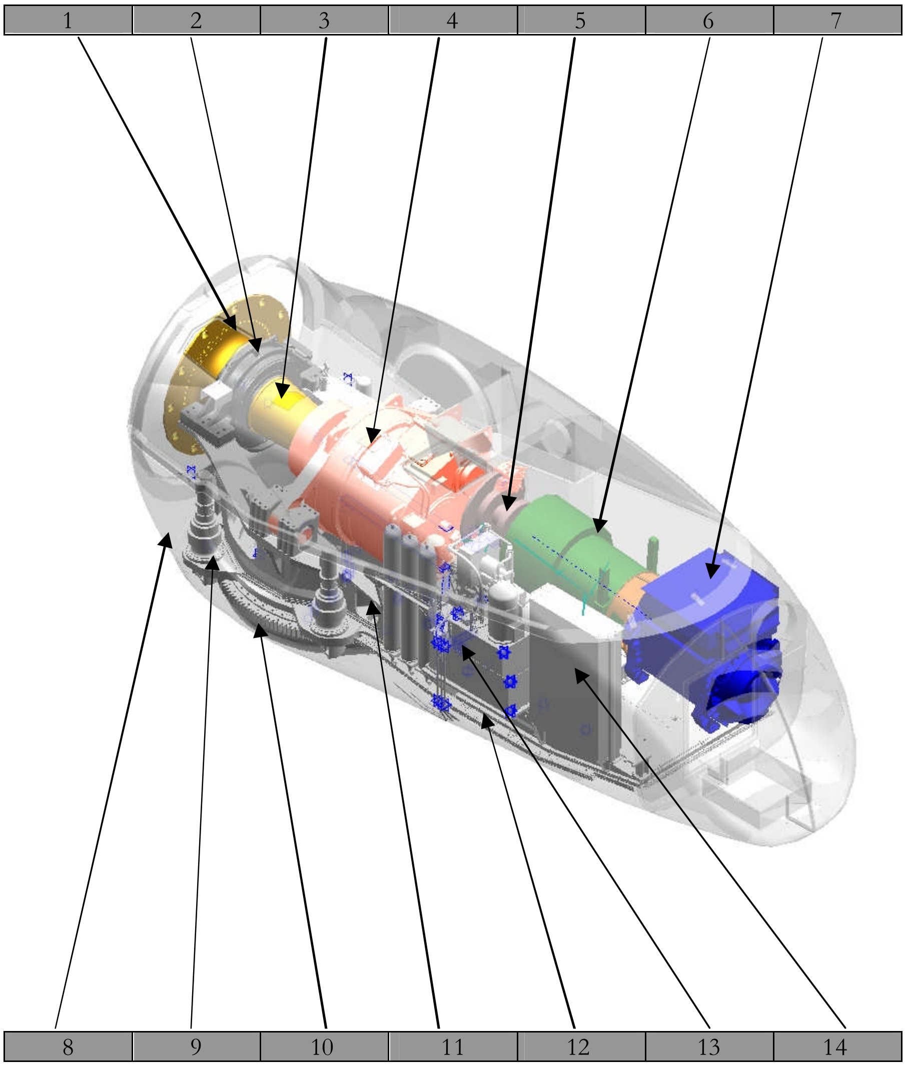
The outstanding features of the DeWind D8.2 are effective utilization of the available wind, quiet operation, good grid compatibility, longevity and attractive design. The turbine operates with variable rotor speed and is thus capable of producing electric power efficiently at low wind speeds, and utilizing the energy of gusts without overloading the grid or turbine components. The combination of a Voith Torque Converter and synchronous generator enable connection of the turbine to most power supply networks.

Table 1. General technical data

	Unit	**Value**	
Type		Variable speed horizontal axis wind turbine with 3-blade rotor, synchronous generator and pitch control	
Rated power	kW	2000	
Rotor diameter	M	80	80
Hub height	M	80	100
Wind class IEC		I/II	III
Power control		via common pitch control	
Cut-in wind speed	m/s	3	
Nominal wind speed	m/s	13.5	
Shutdown wind speed	m/s	none	
Survival wind speed	m/s	57.4	49.8
Rated speed rotor	1/min	18.0	
Speed range rotor	1/min	11.1 – 20.7	
Speed control		via common pitch control	
Speed limitation		Common pitch control and single blade pitch control	
Main braking system		2 separate safety systems consisting of common pitch control and single blade pitch control	
Service brake		Disc brake	
Lightning protection		Lightning arrestor built into the rotor blades	

Note: Our range of products is subject to a program of continuous development; the equipment supplied may vary in detail from this specification.

Main Nacelle Components



1	Rotor Locking Device	8	Nacelle Housing
2	Main Bearing	9	Yaw Drive
3	Rotor Shaft	10	Yaw Bearing
4	Gearbox	11	Base Frame (front part)
5	Coupling and Brake	12	Base Frame (rear part)
6	WinDrive	13	Hydraulic Unit
7	Generator	14	Control Cabinet

2 Main shaft

The main shaft of the DeWind D8.2 is forged of high-grade heat-treated steel and supported at the shaft end by a robust spherical roller bearing that absorbs all rotor forces. Connection to the gearbox is by a clamp ring. Within the gearbox, the main shaft is mounted in a cylindrical roller bearing.

The main shaft is hollow inside. The pressure and return piping for the pitch cylinders in the rotor hub as well as the electrical connections to the pitch angle limit switches are installed through the middle of the main shaft.

3 Rotor

The rotor consists of a highly tensile cast iron hub to which are fixed three rotor blades pivoted about their longitudinal axis. The equipment for the hydraulic pitch control system is accommodated inside the rotor hub.

The aerodynamically and acoustically optimized rotor blades are manufactured of carbon and glass fiber reinforced plastics and have an integrated lightning protection of laminated aluminum section. They are bolted to the rotor hub. The hub is protected against environmental influences by a GRP spinner. Spinner, blades and hub are painted Light Grey (RAL 7035).

Table 2. Technical data - rotor

	Unit	Value
Rotor diameter	m	80
Number of rotor blades	piece	3
Swept area	m^2	5027
Length of blades	m	39,1
Hub material		Ductile cast iron
Blade material		CFP / GFP
Weight per blade	t	6.2
Weight of the complete hub without blades	t	19.0

4 Pitch system

The task of the pitch control system is to match the rotor blade position to match the available wind. Thus, aerodynamically flow conditions are always optimized on the rotor blades; a prerequisite for quiet and effective operation minimizing wind turbine structural loadings. At and above nominal rated wind speed, the power output is limited to rated power. At high wind speeds, the pitch system acts as the aerodynamic main brake.

Two hydraulic systems that are independent of each other control the adjustment of the blades. The first system is for common pitch control. It consists of three hydraulic cylinders arranged in the hub, which move the rotor blades together via a linking mechanism. Hydraulic accumulators accommodated in the nacelle give a back-up operational capability of the braking system in the unlikely event of failure of the hydraulic unit.

The second system is for single pitch control. To accomplish this, each rotor blade uses its own adjusting cylinder (safety cylinder) that moves the rotor blade independently of the other pitch cylinders. Each of these safety cylinders is backed up by its own hydraulic accumulator so that in the event of failure of the main hydraulic system the blade can always be moved into the feathered position.

Table 3. Technical data - pitch system

	Unit	Value
Arrangement		In the centre of the rotor hub
Drive		Hydraulic
Function		Single pitch control and central pitch control
Maximum pitch control speed single pitch control	°/s	
Maximum pitch angle single pitch control	°	46
Maximum pitch control speed common pitch control	°/s	
Maximum pitch angle common pitch control	°	45
Maximum pitch control speed in total	°/s	
Maximum pitch angle in total	°	91

5 Main Gearbox

The D8.2 wind turbine is equipped with a two-step high performance gearbox. The first step is a planetary gear; the other step is spur gears. Using this combination ensures, compact construction and high efficiency. The helical gearing minimizes the noise level. The noise is reduced further by using rubber mountings to isolate the structure-borne noise of the gearbox from the mainframe.

In order to maintain the temperature of the gear oil within an optimum range, it is cooled during operation. The gear oil is also passed through a full-flow filter to ISO/DIS 4406 15/12 in order to minimize wear.

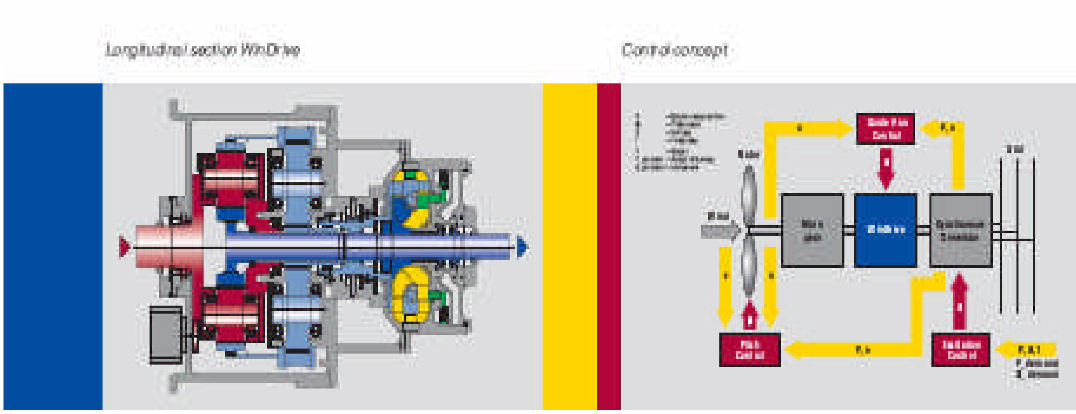
The gear oil is preheated ready for start-up in cold weather by an immersion heater rated at 1.5 kW.

Table 4. Technical data - gearbox

	Unit	Value
Construction		Two-step planetary gear with helical gearing
Reduction ratio		1:25
Nominal mechanical power	kW	2,160
Rated input torque	kNm	1,120
Rated output torque	Nm	11,800
Max. braking torque	Nm	16,940
Lubrication		Force-feed and oil bath lubrication
Amount of oil	L	approx. 420
Weight	T	19.0

6 WinDrive® Torque Converter

WinDrive is a torque converter combined with a planetary gear designed as a superimposed gear in conjunction with a hydraulic coupling. As a fluid machine, the output characteristics of the torque converter are complementary with those of the wind rotor, and help damp any shocks due to grid faults or disturbances. The torque converter covers a wide speed range, allowing a constant output speed of 1800 rpm to the Generator, regardless of the main rotor speed. The WinDrive unit is close coupled to the Synchronous Generator to minimize torsional vibrations & misalignment.



7 Synchronous Generator

The rated 2MW Electrical Power of the D8.2 is produced by a conventional well proven 4 pole brushless synchronous generator running at 1800rpm.The Generator has Air to Air cooling and IP54 protection. Generation Voltage can be 4.16KV to 13.8KV and the power is taken down the Tower by a flexible 3 core cable to the necessary switchgear. The Generator is generously rated to allow excellent transient behavior during Grid disturbances. Normal operation from 0.9 lead to 0.9 lag is at the generator's peak efficiency.
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Table 5. Technical data -generator

	Unit	Value
Rated power	kW	2000
Construction		4 pole Synchronous generator
Cooling		Air/Air Heat exchanger
Rated voltage	V	13,800
Rated current I_n	A	84
Frequency	Hz	60
Synchronous speed	1/min	1800
Protection class generator		IP 54
Weight	T	7

8 Grid connection

The generator output at 13,800V can be connected directly to the grid or be combined with other turbines and stepped up to a higher voltage.

A full Protection, Control and synchronizing system is included that allows correct operation of the turbine at all times and meets the requirements of Grid Codes, including fault ride through.

9 Braking system

The pitch control system acts as the speed control method and also as the main aerodynamic brake of the DeWind D8. By turning the rotor blades out of the wind, the turbine will be slowed down as part of the shutdown procedure as necessary in case of failure. Two pitch systems that are independent of each other are used.

The first braking system is the common pitch control. This system adjusts the three rotor blades simultaneously via a linking mechanism. It is backed up by accumulators located in the nacelle so that in case of failure of the main hydraulic pumps the wind turbine can be brought to a safe condition.

The second braking system is by single blade pitch control. It consists of three hydraulic cylinders that each moves one blade. The three cylinders operate independently of each other so that also in case of failure of one cylinder the remaining ones can still operate. Each cylinder is protected by its own accumulator so that the wind turbine can be slowed down if the hydraulic system of the wind turbine should fail.

A hydraulically actuated disc brake mounted on the high-speed shaft between gearbox and generator acts as a service brake. It can be used at wind speeds up to 15 m/s (10 min mean value) in order to support the braking effect of the hydraulic braking systems. The disc brake is used as the primary braking during fault ride through and also used to lock the rotor during inspection and service operations.

10 Hydraulic system

A hydraulic unit supplies oil at high pressure to the pitch control systems, the yaw brakes and the service brake.

The hydraulic system comprises the oil tank, pumps, distribution unit, hydraulic piping, valves, filters, cylinders and accumulators. The supply lines of the pitch cylinder are led through the hollow main shaft with a rotating union for the transition of the hydraulic pipelines from the fixed to the rotating part of the shaft.

In order to maintain the high degree of purity of the hydraulic oil, a pressure filter is provided in the supply piping to the pitch systems. Additionally, the oil circuits are flushed periodically and before each start, so that fresh filtered oil is pumped from the tank into the oil circuits of the pitch control system.

The pumps used are two gear wheel pumps driven by electric motors, one pump each supplying one of the pitch systems. The power supply for the pumps is not shutdown under fault conditions i.e. they will not be switched off following an emergency stop of the wind turbine so that the hydraulic system remains operational.

The hydraulic system is equipped with several accumulators that are independent of each other in order to bring the wind turbine into a safe condition in case of power failure. Accumulators in the nacelle supply the common pitch control, the yaw brakes and the service brake. Three further accumulators are accommodated inside the rotor hub to protect the single blade pitch control system.

The valves are controlled electrically by the operation monitoring system. The oil pressure in the hydraulic system is continuously measured and monitored by the control system.

Two pumps with a maximum output of 98 l/min provide a maximum pressure of 165 bars; the hydraulic system contains 300 l in total. The combination of the main filter system and a bypass filter system for the hydraulic oil exceeds the requirements of ISO 4406 class 17/15/12.

11 Nacelle

The nacelle consists of the mainframe and the paneling. The main components of the system are mounted onto the mainframe. These are the drive train, with bearing, the shaft and the gearbox, the generator, cooling system, hydraulic system, yaw drives, brakes and the control electronic cabinets. The mainframe of the DeWind D8 is a combination of light ductile cast iron and a welded steel structure. This ensures high stiffness and light weight. Elastomeric damping elements separate the main system components from the mainframe and act as structure-borne sound isolators.

Access panels in the nacelle roof can be opened for access to the rotor hub and the meteorological measurement sensors for servicing.

The nacelle was designed by Porsche Design in Germany. The nacelle housing is painted Light Grey, RAL 7035, the nacelle cover Silver Grey, RAL 7001.

11.1 Nacelle Entrance

The top platform of the tower is located directly underneath the nacelle. From this platform it is possible to access the nacelle via a short ladder without using safety belts.

11.2 Nacelle Crane

A chain hoist is fitted inside the roof in the rear area of the nacelle. Loads handled by this hoist can be raised from or lowered to ground level through a trap door in the nacelle base.

Table 6. Technical data - mainframe

	Unit	Value
Construction		Welded box construction/ductile cast iron
Material		Steel
Weight	t	8.9

Table 7. Technical data - nacelle paneling

	Unit	Value
Material		GFP
Weight	t	2.3

12 Yaw System

Two wind vanes on the nacelle roof measure the wind direction and transmit the measured values to the control system. As soon as the position of the nacelle deviates from the actual wind direction by a certain amount depending on the wind speed, the yaw drives will be activated. There are four electrically operated gear motors, meshed with a fixed sprocket wheel on the top of the tower, that adjust the nacelle to follow the actual wind direction.

Shaft brakes are integrated in the yaw drives. These act permanently when the yaw drives are not in use and are only released when the yaw drives are energized. In addition, hydraulic brakes are fitted independent of the yaw motor brakes.

Two sensors in the tower top record the number of revolutions of the nacelle in one direction. Once the nacelle has performed more than 2 revolutions in one direction, the turbine will be shut down, the nacelle turned back and the turbine restarted. This prevents excessive twisting of the power and control cables.

Table 8. Technical data – yaw system

	Unit	Value
Yaw bearing		Ball bearing (four-point bearing)
Weight	t	1.5
Yaw drives		4 electrical gear motors
Adjusting speed	°/s	0.5
Number of brakes		10

13 Tower

The towers of the D8.2 series consist of several steel sections that are connected together by bolted flanges. A climbing system is installed enabling safe climbing of the ladders inside the tower. The electrical and control cables are installed from the nacelle to ground level inside the tower.

Externally, a three-coat anti-corrosion protection painting system to DIN EN ISO 12944 is used. Inside the tower, a two-coat system is used. The color of the coating is Light Grey (RAL 7035).

Alternative tower configurations can be provided using other tower materials and designs.

14 Electric installation

Lighting systems, power sockets, and if required, aircraft warning light(s), are installed in the D8.2 wind turbine. Electrical distribution for tower auxiliaries is located in the tower base control panel.

Electrical distribution for auxiliaries within the nacelle is included in the nacelle control panel.

15 Foundation

The DeWind D8.2 uses foundations which are designed to suit the local ground conditions. A steel foundation section is embedded in the foundation. The tower is bolted to this.

16 Control

The wind turbine is equipped with the eOS system that carries out all monitoring, control and regulation tasks. This computer is an industrial PC using a conventional MS Windows® operating system.

Ethernet connections using optical fiber cables are mainly used for data transmission in the wind turbine and within the wind farm. The wind turbine is always maintained in an optimum operating state, the system components and the operating parameters being continuously monitored.

Some basic functions, such as start, shutdown and yaw can also be carried out locally by an operator or via remote data transmission. Access to the control functions is protected by means of a security system. Different access levels are protected by passwords.

Two Displays to monitor the turbine are installed, one in the nacelle and one in the bottom of the tower.

The protection class of the Control Cabinet is IP 54.

17 Remote monitoring, remote data transmission

For remote monitoring and retrieval of operating data, the wind turbine is connected with the DeWind monitoring centre via the telephone network. For data transmission, VPN protocol is used.

The information supplied by the wind turbine is recorded in a central database in the monitoring centre where faults are analyzed. In the event of failure, the service team is informed so that the failure can be quickly remedied.

Using the appropriate password, it is possible to retrieve operating data via the telephone connection, such as:

- Daily data production
- Monthly data production
- Annual data production
- Logbooks
- Record of all events

18 Lightning protection

Lightning protection of the DeWind D8.2 is by a discharge system. If lightning should strike a rotor blade, the lightning arrestors integrated in the blades will lead the energy via a combination of sliding contacts and air gaps via the spinner directly onto the nacelle and by a similar arrangement on to the earthed steel tower and to the ground.

19 Dimensions and weights

Table 9. Dimensions and weights

	Unit	Value	Value
Hub height	m	80	100
Tower height	m	76	96
Tower base diameter	m	4.2	4.3
Tower top diameter	m	3.0	3.0
Tower weight	t	155.21	285
Weight of complete rotor	t	35.75	35.75
Weight of complete nacelle	t	98.95	98.95

DeWind reserves to change the technical specification from time to time as part of it's continues product improvement plan.

20 Temperature Range

The DeWind D8.2 is designed to operate in a standard temperature range of -20 to +40 C. Extended range packages are available on request.

21 Power Curve

Speed m/s	Power kW
3	0
4	5
5	81
6	245
7	454
8	706
9	1001
10	1325
11	1659
12	1860
13	1970
14	1998
15	2000
16	2000
17	2000
18	2000
19	2000
20	2000
21	2000
22	2000
23	2000
24	2000
25	2000