Wind Power Generators
Developments in the market for wind turbine generator systems (WTGS) are extremely dynamic. Apart from high growth rates in China, this trend is reinforced by the commitment of the international community to drastically reduce CO2 emissions over the next few years. Doubts concerning the reliability of nuclear power stations, not to mention the still unresolved issue of waste disposal, are also likely to have an effect on the growth of WTGS.

Today, the highest demands placed on WTGS relate to:

- construction
- cost-benefit ratio
- reliability
While the steadily increasing number of providers puts great pressure on prices, the poor quality of individual components can threaten the existence of these providers.

The cost of replacing a component such as a generator, main bearing or gears can far exceed the price of the component itself.

Great care should be exercised in choosing partners for developing key components such as the generator. LDW is ideally suited for this choice:

- Over 90 years’ experience in developing and producing electrical machines with capacities of up to 50MW or more
- Worldwide round the clock service of the highest standard
- Over 25 years in the development of WTGS generators
- Solutions for all WTGS technologies

LDW shares this experience with our customers on the basis of license agreements. As result our customers have the following benefits:

- Short time to market entry
- Low development risk
- Know-how transfer in terms of
  - Electrical and mechanical design
  - Intensive training and support during start of production and test of complete system

Technology – Licence – Contracts
Electrical concepts for the drive train

A basic distinction is made between double-fed and fully rated converter concepts. The double-fed version (DFIG) \(^1\) was the dominant variant worldwide until 2009. A great advantage was the substantially cheaper converter.

Today’s grid connection conditions are such that energy suppliers have significantly extended the requirements relating to generator converters so that these can no longer be fulfilled by the less expensive DFIG solution. In addition, there is a marked trend towards higher capacities, especially in the offshore sector. The result is that fully rated converter concepts are becoming the standard solution around the globe.

In terms of generators, 3 variants must be distinguished in this regard:

- high generator speed (3-stage gear unit) \(^2\)
- medium generator speed (2-stage gear unit) \(^3\)
- low generator speed (without gear unit, direct drive) \(^4\)

The decision on which drive concept to use generally resides with the company that designs the WTGS. LDW designs the generator variant that best suits the particular approach based on the technical specifications for the generator.

LDW develops and manufactures generators with an output of around 100 units per year. If required, it is possible to agree technology licence contracts with a licence partner for transferring all documentation required for production as well as technical training for the licence partner.
Double-fed asynchronous generators

By far the most common concept applied for economic reasons until recently. The stator is connected directly to the grid and contributes around 2/3 of the rated power. The rotor is designed as a slip-ring rotor and feeds the other third of the rated power into the grid via a converter.

Construction at LDW includes decades of experience in developing and manufacturing slip-ring rotors for challenging applications. The alignment of brushes and sliprings, plus rotor insulation against voltage peaks generated by the converter, and a reliable bearing design - including electrical insulation outside the bearing - are particularly important factors for reliable operation with a minimum of maintenance cost.

Technical data:
- Power range: 1.5 MW to 5.0 MW
- Voltage: 690 V to 3,000 V
- Rotational speed ranges: 1,000 to 2,000 rpm
- Number of poles: 4 and 6 pole
- Performance factor: 0.9 ind. and 0.9 cap.
- Degree of protection: IP 54
- Cooling: Air/Air cooler, Air/Water cooler

Fully rated converter

The above data also applies if a fully rated converter (complete rotational speed control) is used, but the speed adjusts itself to between 1,000 and 1,500 rpm according to the number of poles.
Synchronous generators

Excitation by PM

While concepts with high generator speed (3-stage gear unit) are possible with both asynchronous and synchronous generators, for medium and low speed synchronous generators are the only fit. High rotational speed:
In difference to DFIG the sliprings and brushes are inapplicable. Because of the excitation by PM the efficiency is improved as no excitation power is necessary.

Technical data:
Power range: 2.0 MW to 5.0 MW
Voltages: 690 V to 3,300 V
Rotational speed ranges: 1,000 to 2,000 rpm
Number of poles: 4 and 6 pole
Performance factor: 0.9 ind. to 0.9 cap.
Degree of protection: IP 54
Cooling: Air/Air cooler
Air/Water cooler
Integrated water cooling

Medium rotational speed:

With reference to power-weight ratio this system seems to be the optimum solution between generator and gear box, especially at higher output ratings. Projects where the generator is directly integrated into the gear box without intermediate shaft also show promising results.

Technical data:
Power range: 2.5 MW to 7.5 MW
Voltages: 690 V to 3,300 V
Rotational speed ranges: 250 to 450 rpm
Degree of protection: IP 54
Cooling: Integrated air/water or air/air cooling

Windpowerturbine with 3 MW permanentmagnet synchronous generator
Low rotational speed:

Because some WTGS manufacturers have experienced problems with high servicing costs for gear units, there is an increased demand for gearless drive train solutions.

Direct drive WTGS are generally designed as synchronous generators with PM excitation. The supply situation and the way prices have evolved for magnetic materials have prompted LDW to develop solutions with electrical excitation as well.

For capacities in excess of 2MW, transportation options should also be taken into account. It may be necessary to supply generator components such as the stator in split units.

Generators with internal as well as external rotors are possible.

In this case the generators are an integral part of the way the entire system is designed, which is not the case with drive trains with high rotational speeds.

Technical data:
- Power range: 1.5 MW to 5.0 MW
- Voltage: 690 V to 3,300 V
- Rotational speed ranges: 13 to 30 rpm
- Degree of protection: IP 54
- Cooling: Integrated air/water or air/air cooling
The superior quality of LDW’s machines and drives is founded upon a mix of the latest technology combined with over 90 years of experience.

LDW does not manufacture standard machinery, but rather we produce tailor-made solutions for your individual needs. Our worldwide service guarantees optimum care around the clock.

**DC Machines**
LDW manufactures DC Motors and DC Generators from 10 to 8,000 kW.

**AC Motors**
LDW manufactures asynchronous motors from 225 to 25,000 kW and synchronous motors from 4,000 to 55,000 kVA.

**Synchronous Generators**
LDW manufactured synchronous generators from 4,000 to 55,000 kVA.

**Service & Maintenance**
We offer maintenance, revision, machine optimization, problem analysis and repair for our machines and also for machines of other brands. Spare parts for LDW- and AEG-machines are part of our services as well as training of your staff and extensive diagnostics of your machines.

Contact
Lloyd Dynamowerke GmbH
Hastedter Osterdeich 250
28207 Bremen
Germany

Postal address:
Lloyd Dynamowerke GmbH
PO Box 11 01 60
D-28081 Bremen
Germany

Phone: +49 (0) 421 4589 – 0
Fax: +49 (0) 421 4589 – 260

E-Mail: vertrieb@LDW.de
Internet: www.LDW.de