ECE 333

Green Electric Energy

Lecture 9-1

Wind Generator Types

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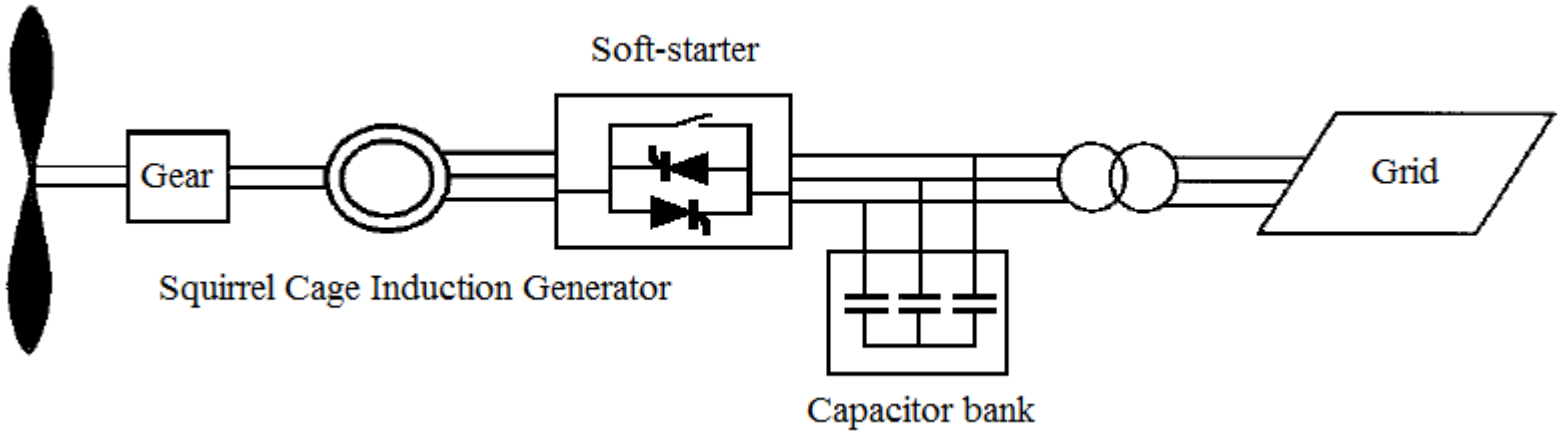
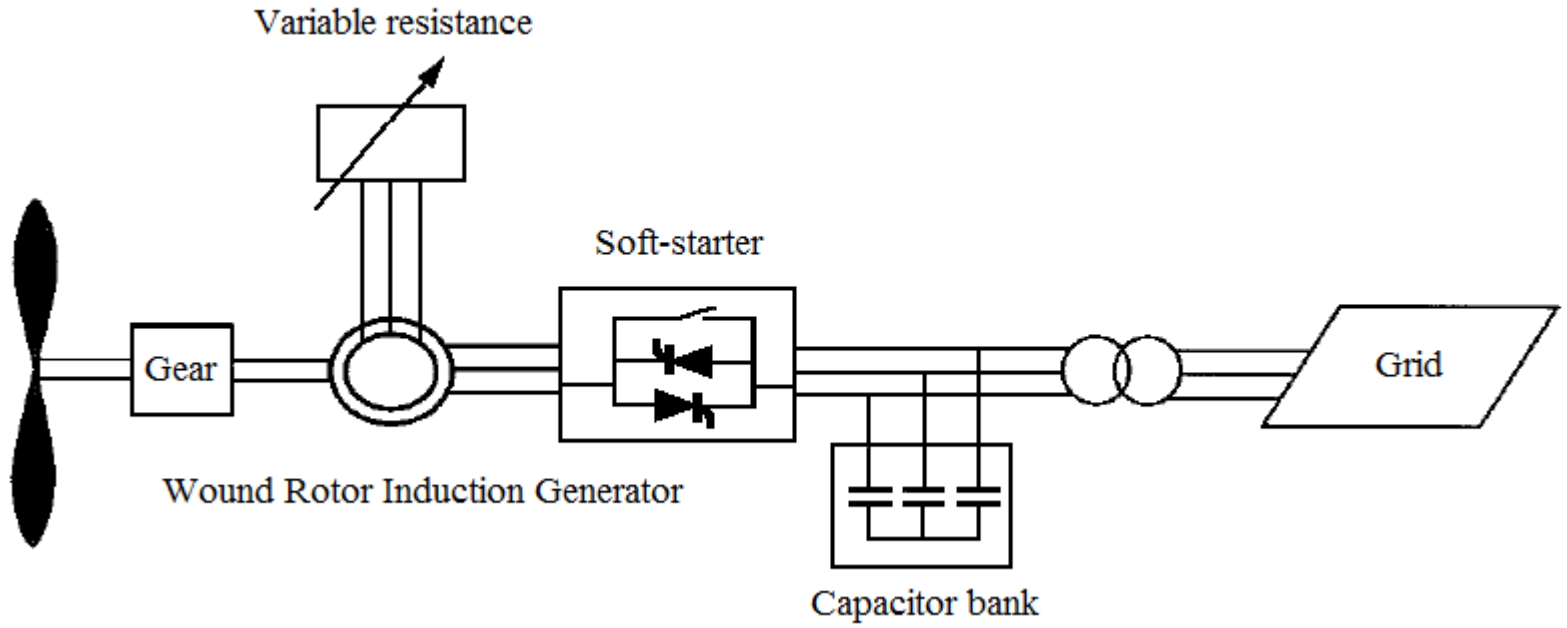
WECS Type A



- It is based on an induction generator connected with a fixed-speed wind turbine.
- This design needs two additional components for grid connection:
  - A soft-starter to decrease current transients during startup phase.
  - A capacitor back to compensate for reactive power.

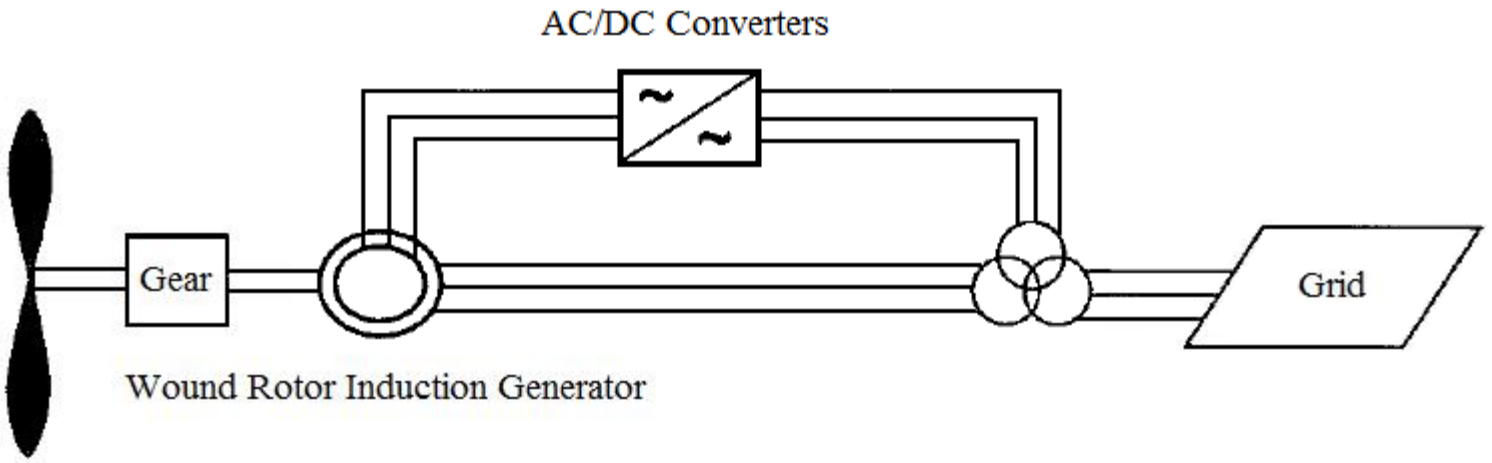
- Thanks to the capacitor back, the generator can work closely to a zero value generation or consumption of reactive power.
- Unfortunately this type of compensation does not allow flexible reactive power control.

WECS Type B



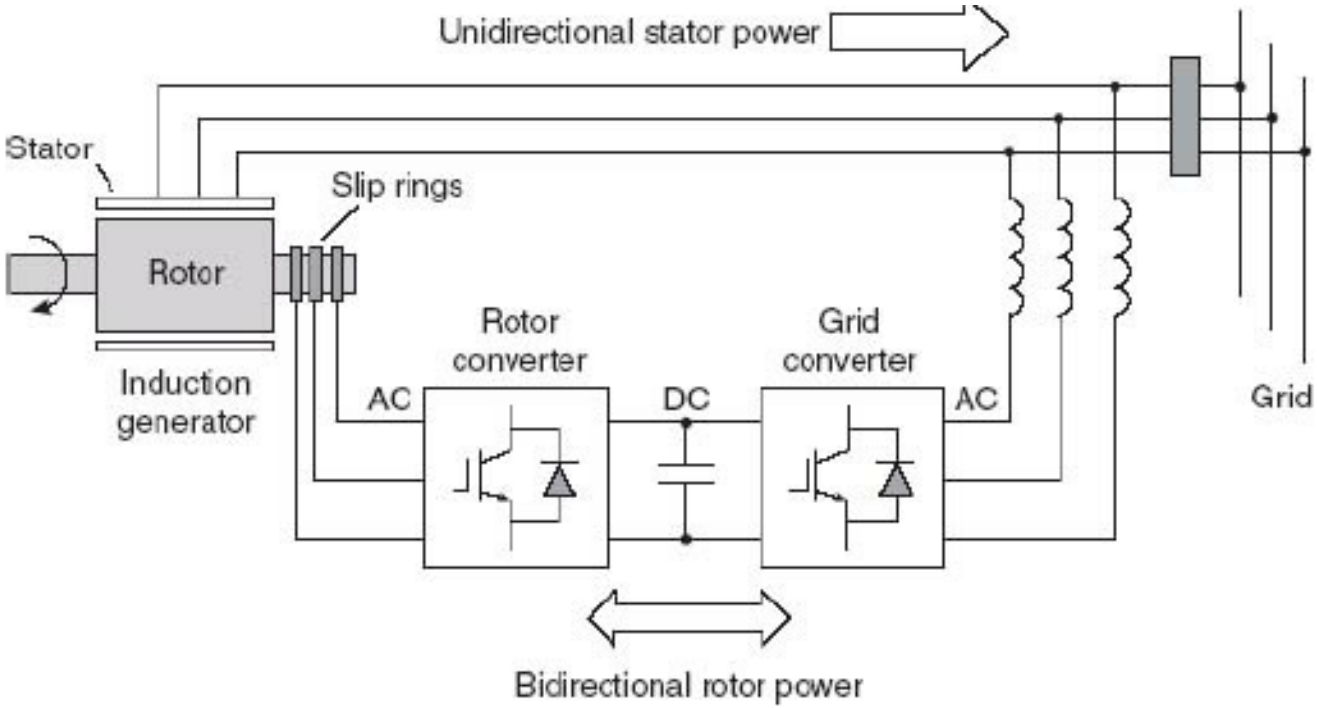
- The type B WECS (introduced by Vestas) generator is designed to work with limited variable speed wind turbine.
- With the variable resistor in the rotor, it is possible to control power output.
- The capacitor bank and soft-starter role is analogous to the type A design.

WECS Type C



- This design uses two AC/DC converters with a capacitor between them to control the WECS. These converters are rated at 25% of total generator power.
- The wound rotor induction generator configuration is also known as a doubly fed induction generator (DFIG).
- The term “doubly” comes from the fact that the rotor winding is not short-circuited (as in classical “singly-fed” induction machine), but a voltage is induced from the rotor-side converter.
- Depending on the operating scheme, they can keep a constant value of reactive power or keep the terminal voltage constant.
- The most widespread WECS.

WECS Type C

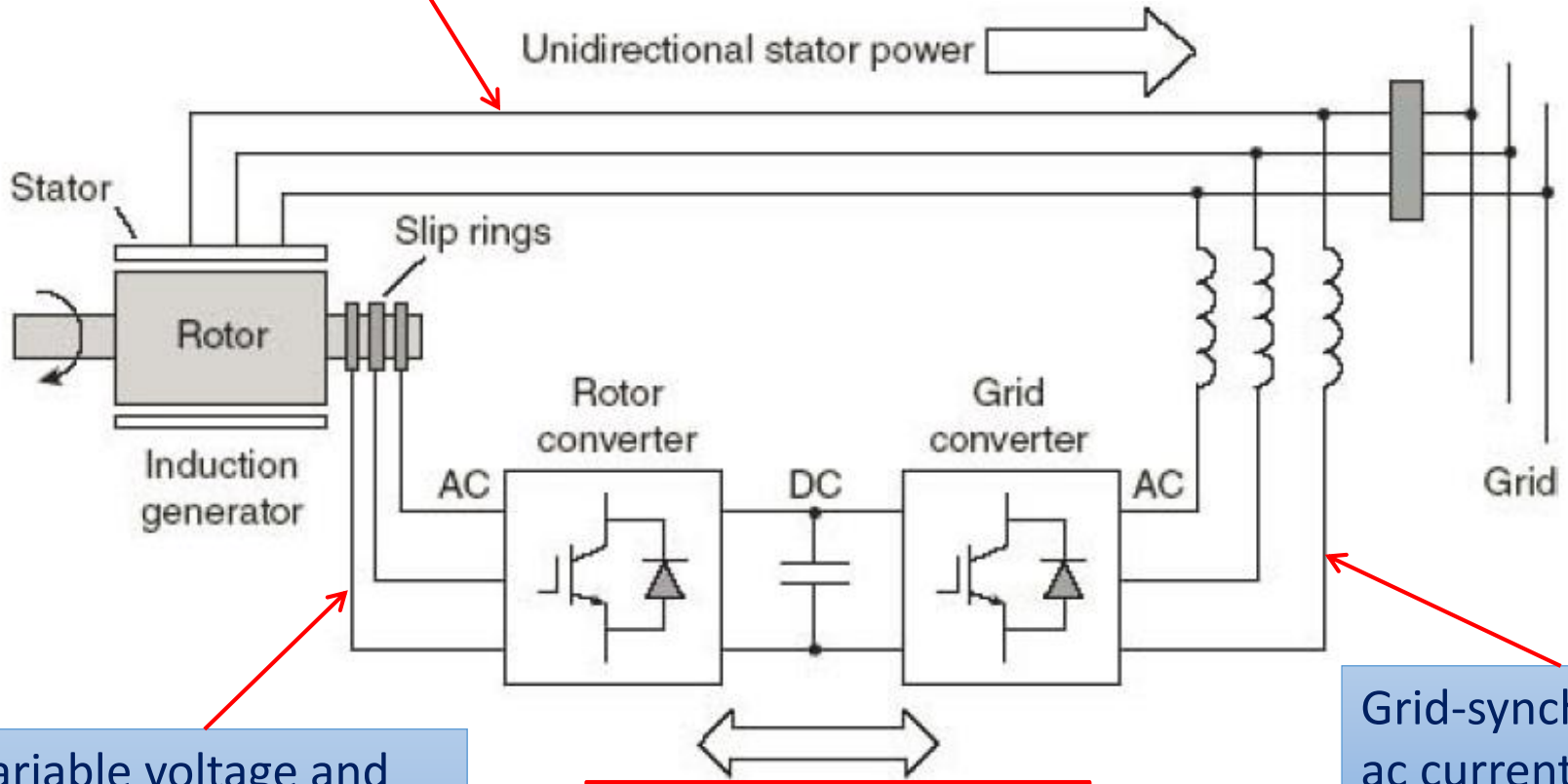


- Turbine spins slower than synchronous speed, rotor takes power from the grid
- Turbine spins faster than synchronous speed, rotor adds power to the grid

Doubly-Fed Induction Generator (DFIG)

Grid-synchronized ac currents

Figure 7.12

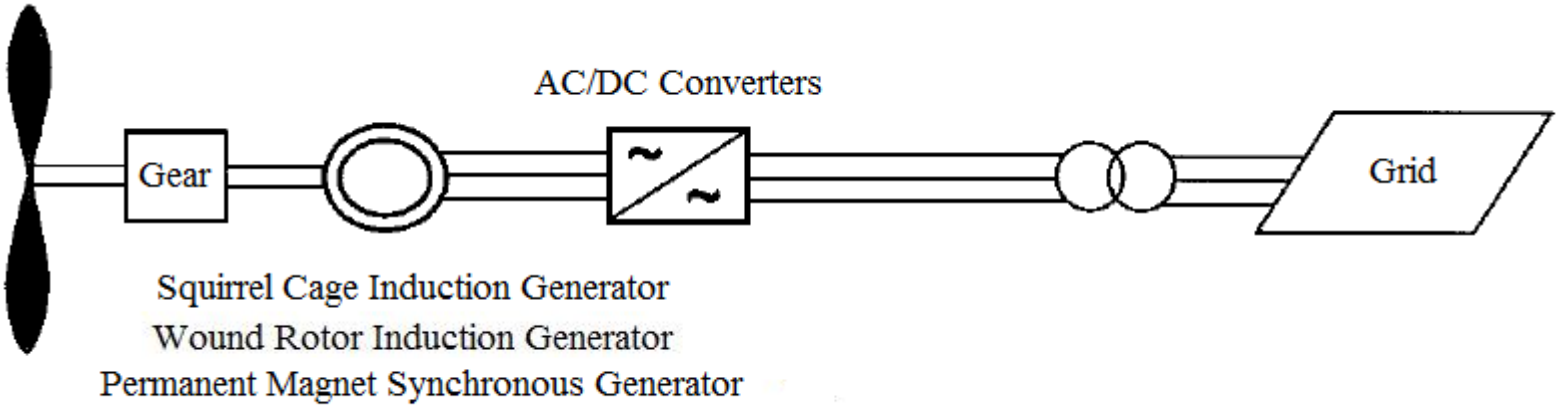


Variable voltage and variable frequency ac currents

Grid-synchronized ac currents

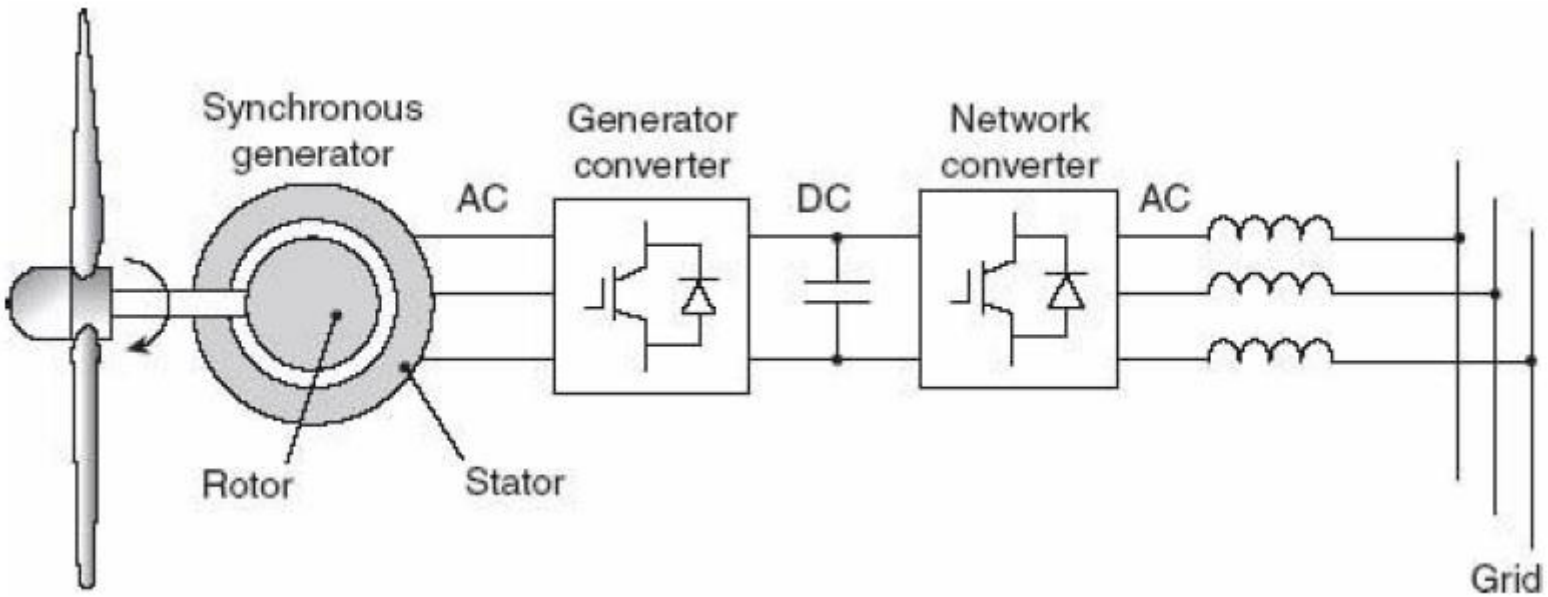
Key feature

WECS Type D



- The type D design uses a full-scale frequency converter with different types of generators.
- The most common one is the permanent magnet synchronous generator (PMSG).
- This design allows full control over active and reactive power production and has a high wind energy extraction value.
- Full power control improves power and frequency stability in the grid and reduces the short circuit power.
- Most type D designs do not need a gearbox, which is a great advantage

WECS Type D



- Motor spins at optimal rate
- Generator converter converts to DC Bus
- Network converter provides power to grid at grid frequency, voltage