

Generators

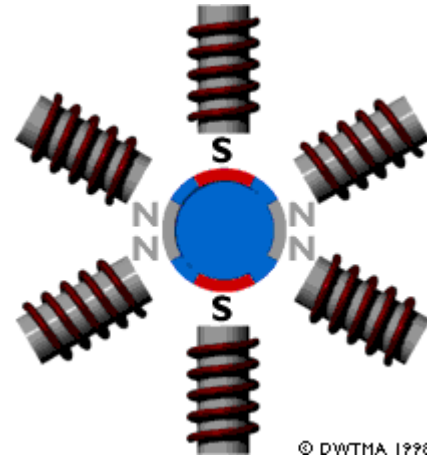
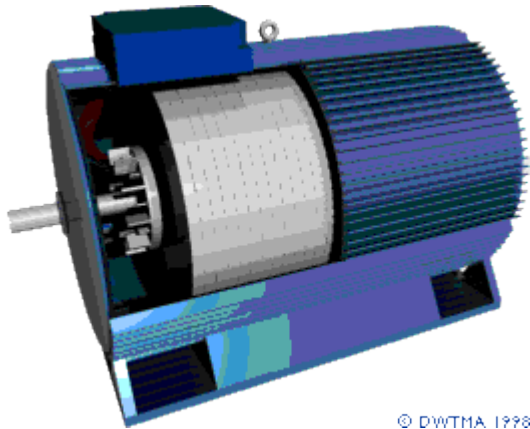
Omagh College

Principles

- All based on induction
- Electro or permanent magnets
- Power = speed x torque
- Direct or indirect grid connection
- Mostly without slip rings (less maintenance)

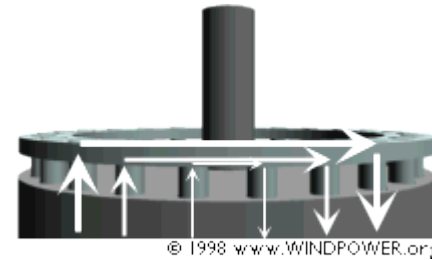
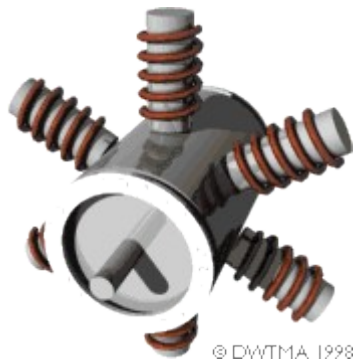
Synchronous machines

Rotating stator field keeps rotor speed constant

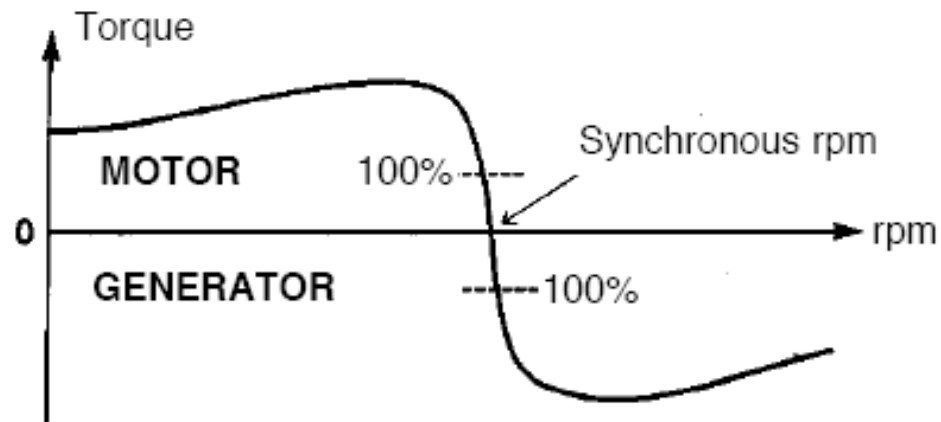


Asynchronous machines

Rotating stator field turns the rotor with a certain slip



Torque curve



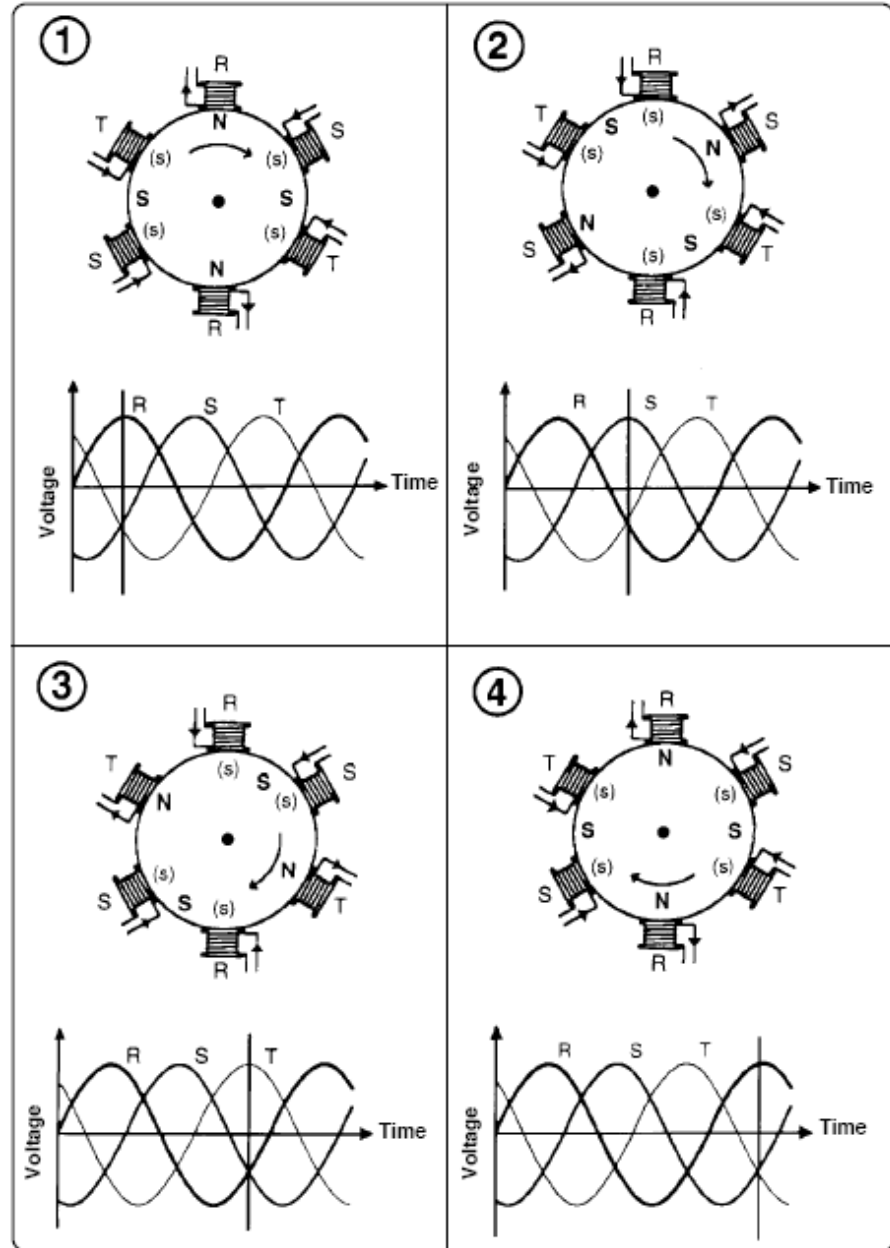
The steep part of the curve explains how an asynchronous generator can keep the rotor speed almost constant

Pole number

- 2 = 3000 rpm
- 4 = 1500 rpm
- 8 = 750 rpm etc


- Some machines can change number of poles, and so optimise the rotor speed
- Multipole generators may be connected directly to the propeller

3-phase generators are used in almost all wind turbines



4 situations of the rotation magnetic field

- **P**ermanent **M**agnet **G**enerators directly coupled to the main shaft are common on small wind turbines.
- Produces "wild" AC current (variable frequency)
- A few manufacturers use brushless DC generators



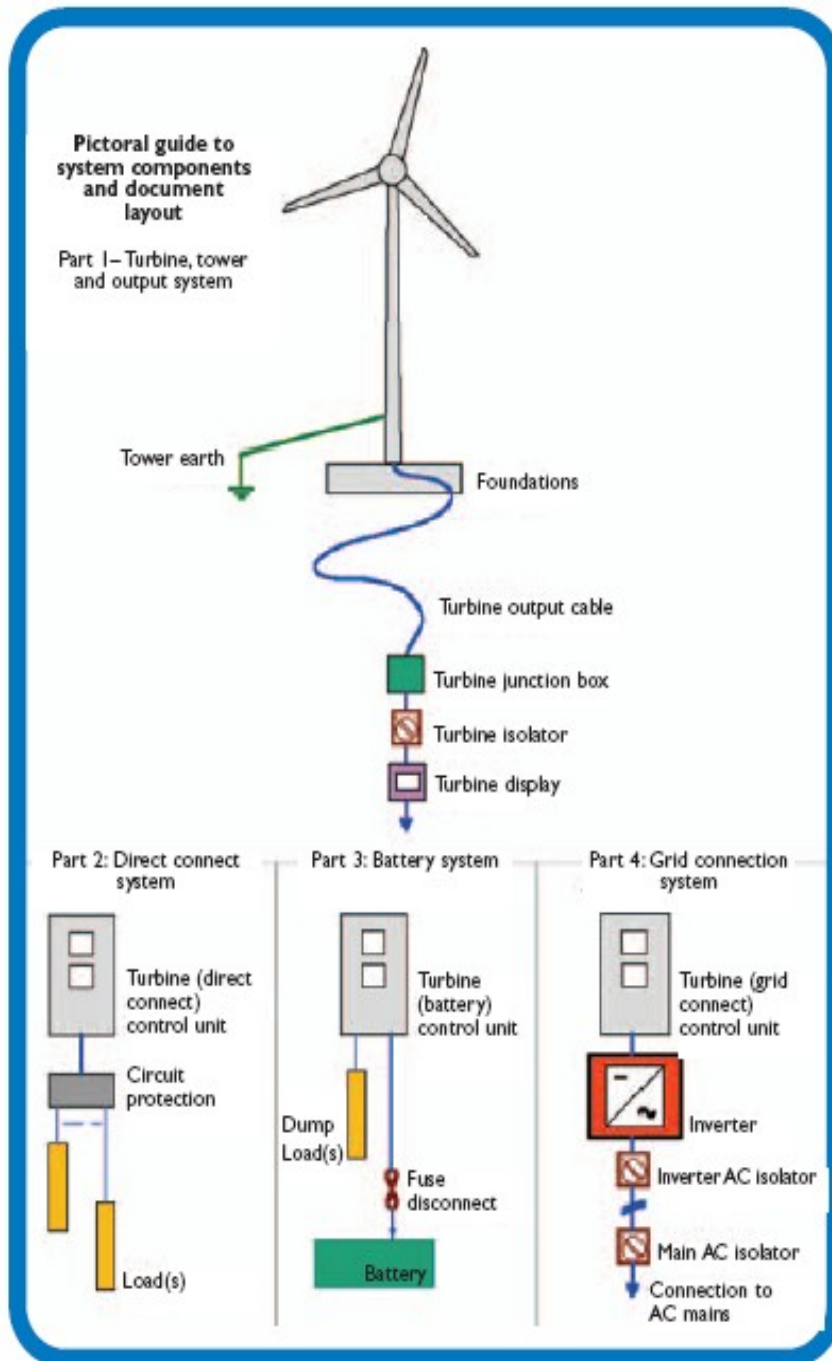
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Direct grid connection with asynchronous generator (larger machines)

Indirect grid connection with synchronous or asynchronous generator (smaller machines)

Power quality issues (Grid)

- Voltage surges (if cut-in is not soft enough)
- Increased voltage level in weak grids
- Reactive power consumption
- Noise from electronic controls
- Same impact as corresponding motor load