SmartMotor
Smarter Energy Conversion

Mindre pumpekraft – lokal samkjøring med vind

Alexey Matveev

Teknologisk Møteplass Pumpekraft - torsdag 12.5 kl. 10-15 hos Norsk Industri på Majorstuasea

Contents

What is SmartMotor

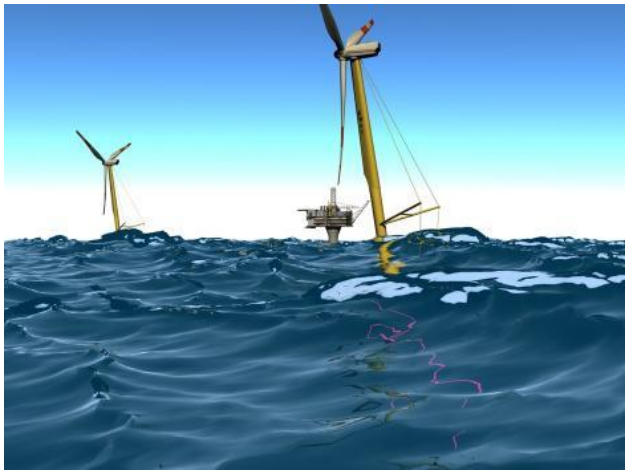
- Established in 1996 in Trondheim, Norway
- One of the largest R&D groups in the world with focus on PM technology

Reference projects

- Low-voltage and medium-voltage machines of MW-class

1.1 MW tidal turbine of Atlantis Resource Corporation (delivered)

0.8 MW propulsion system for Rolls-Royce Marine (in operation)



10 MW offshore wind turbine of SWAY (under construction)

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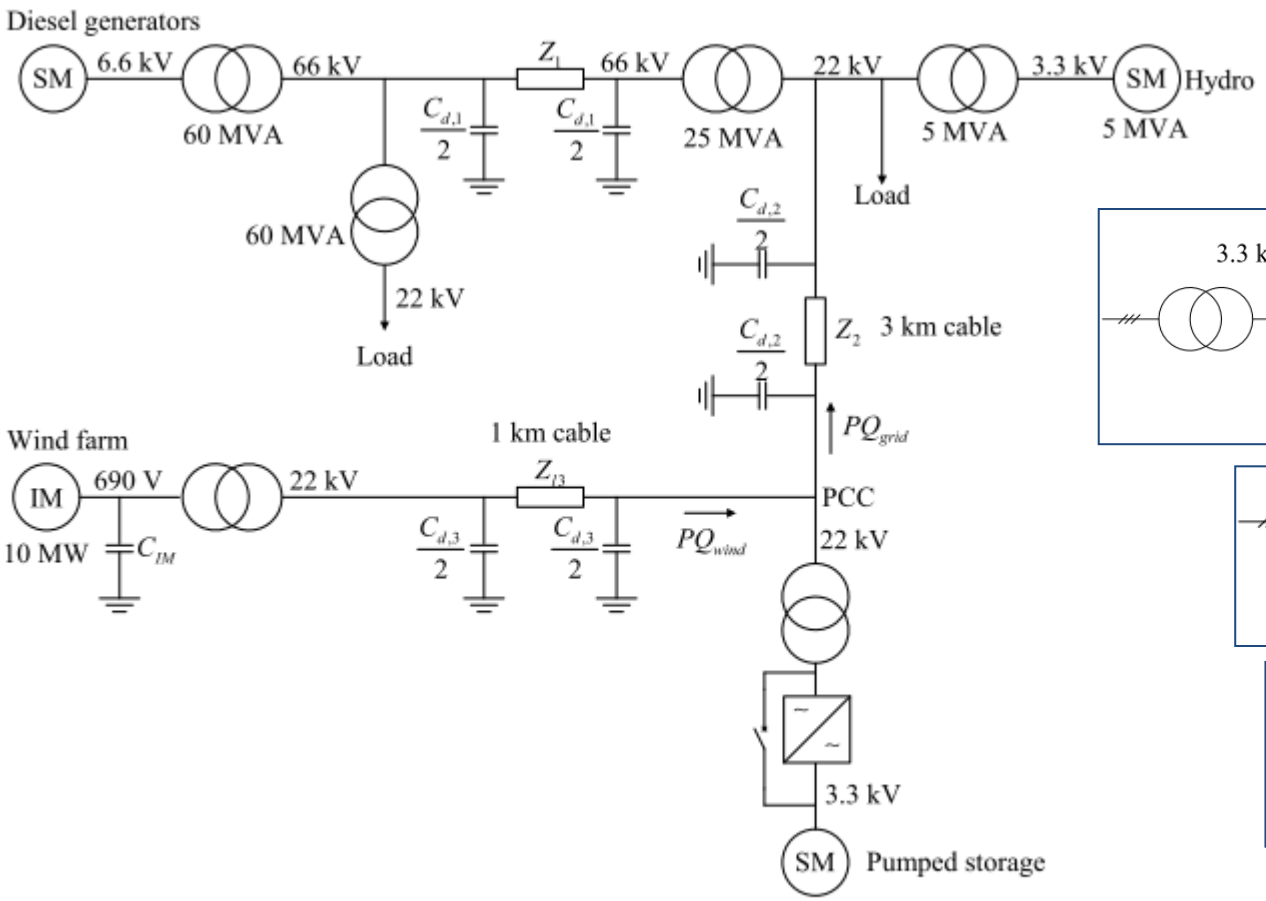
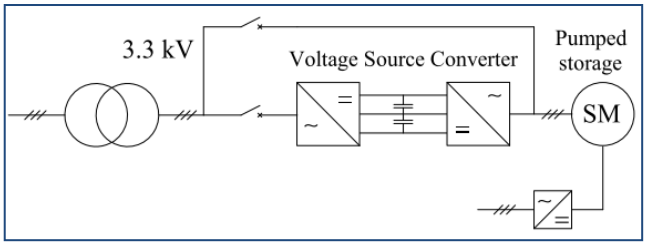
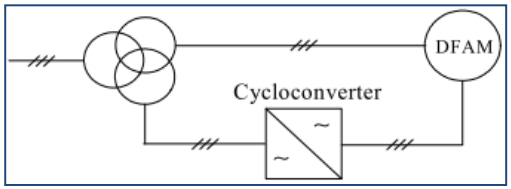
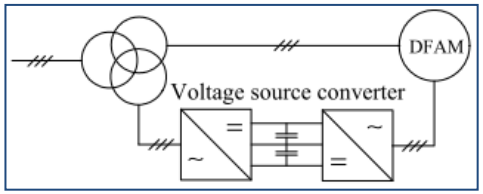
- SmartMotor contribution to the future R&D

Typical local grid model



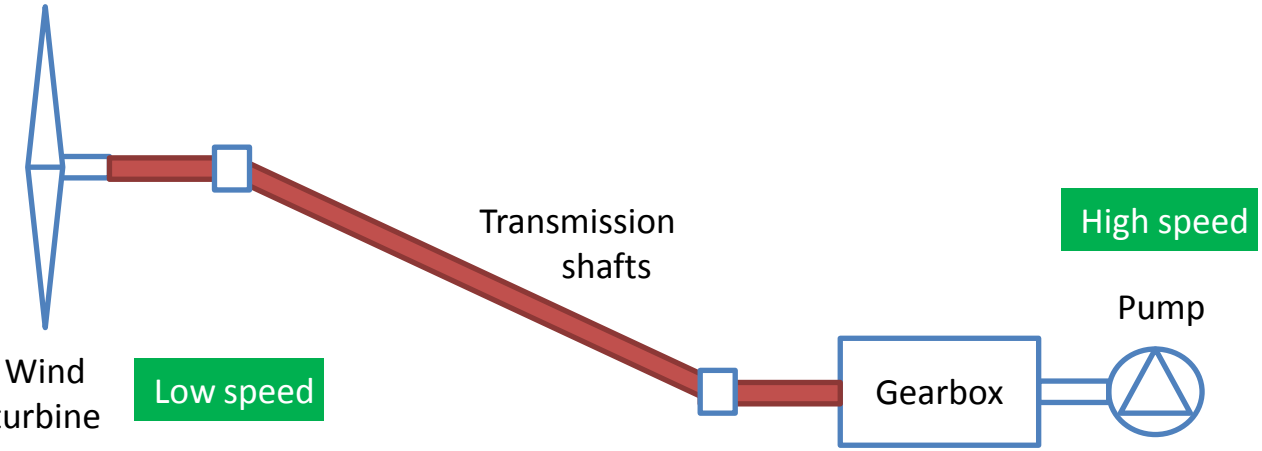


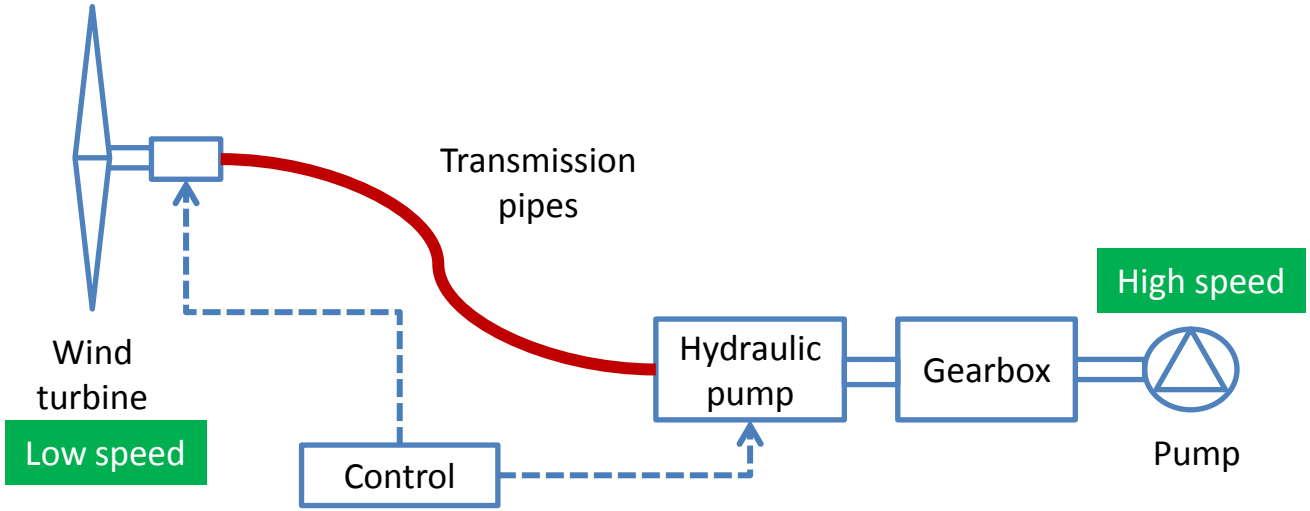




Simplified grid model of the isolated system used for the presented simulations (Suul, 2006)

Mechanical and hydraulic transmission





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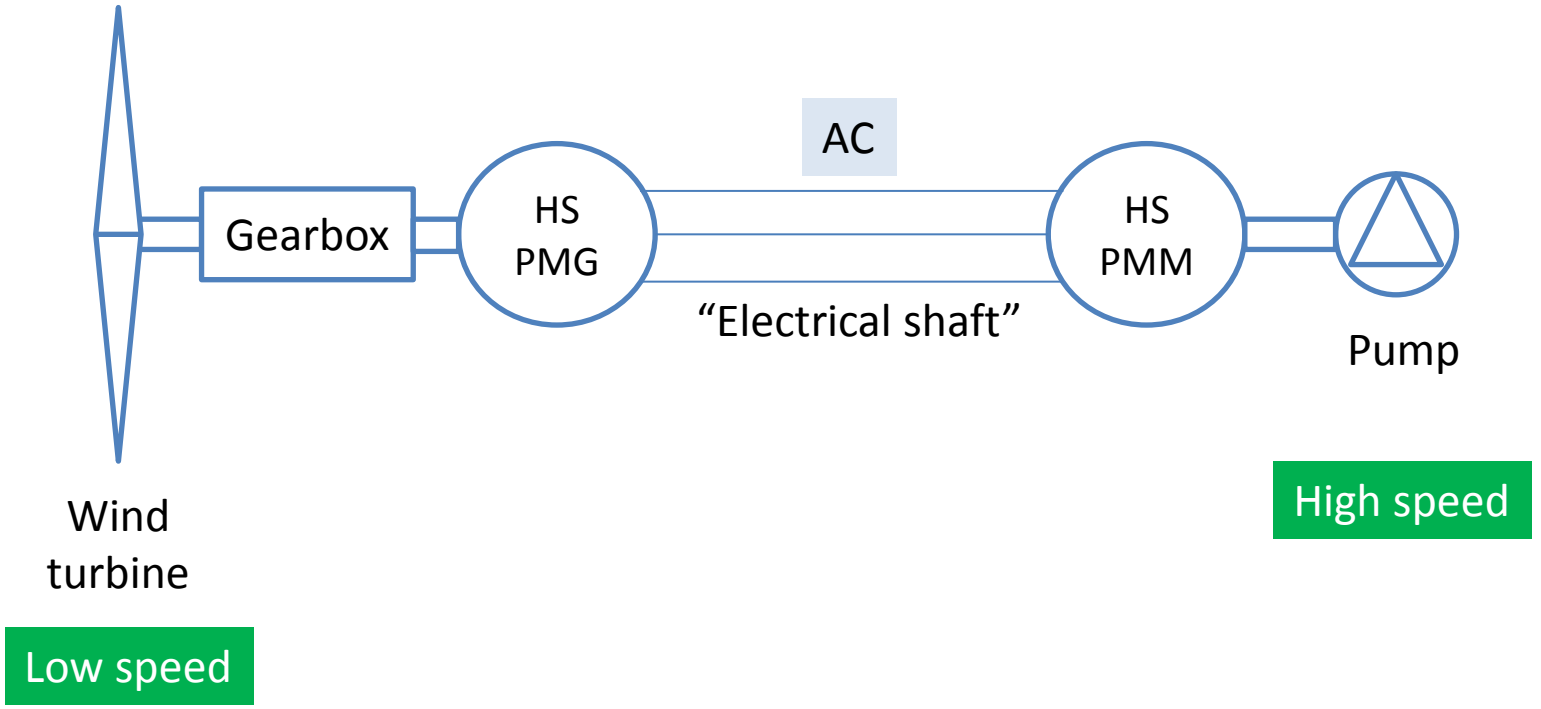
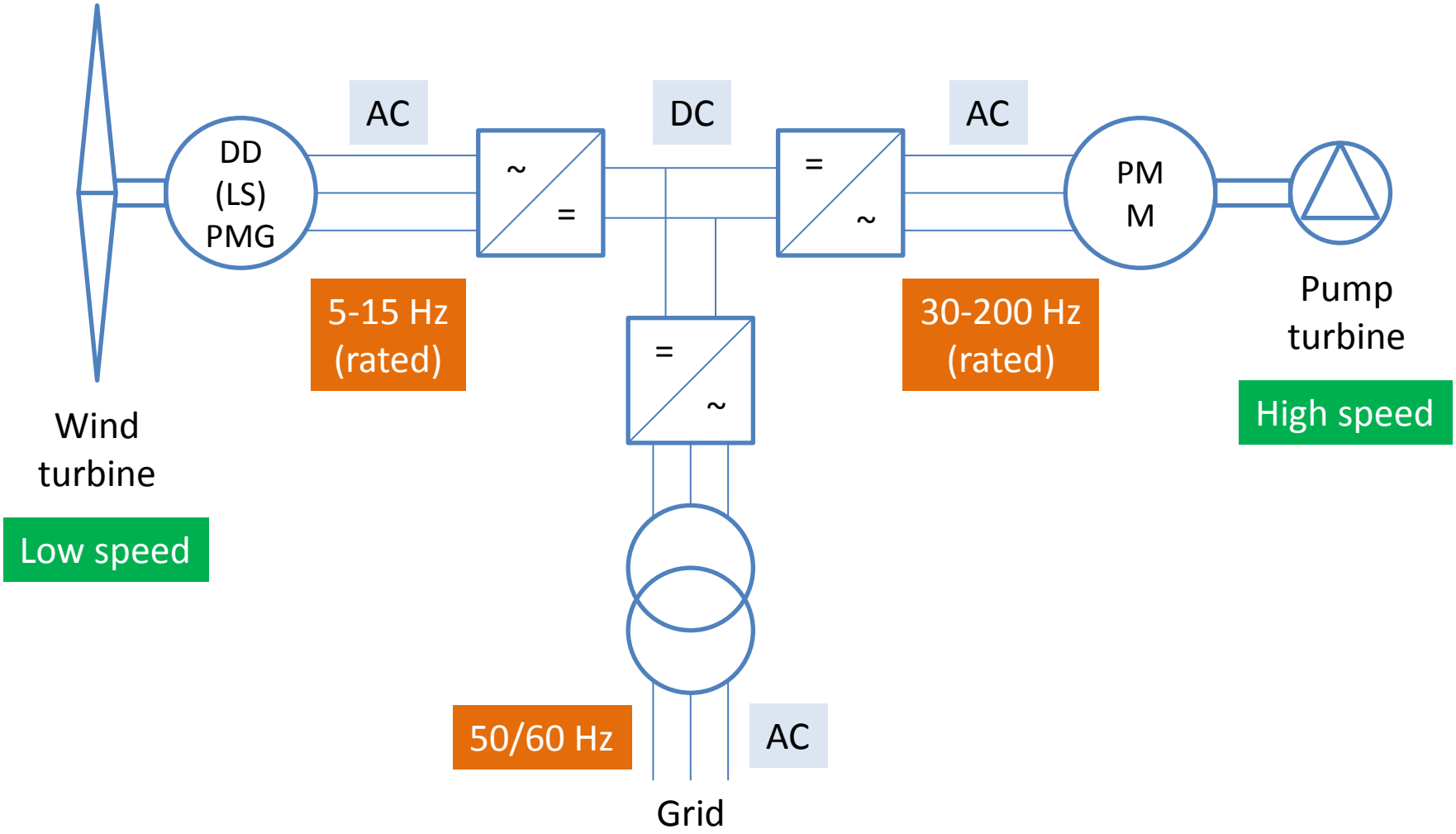
Electric AC transmission



Electric DC transmission



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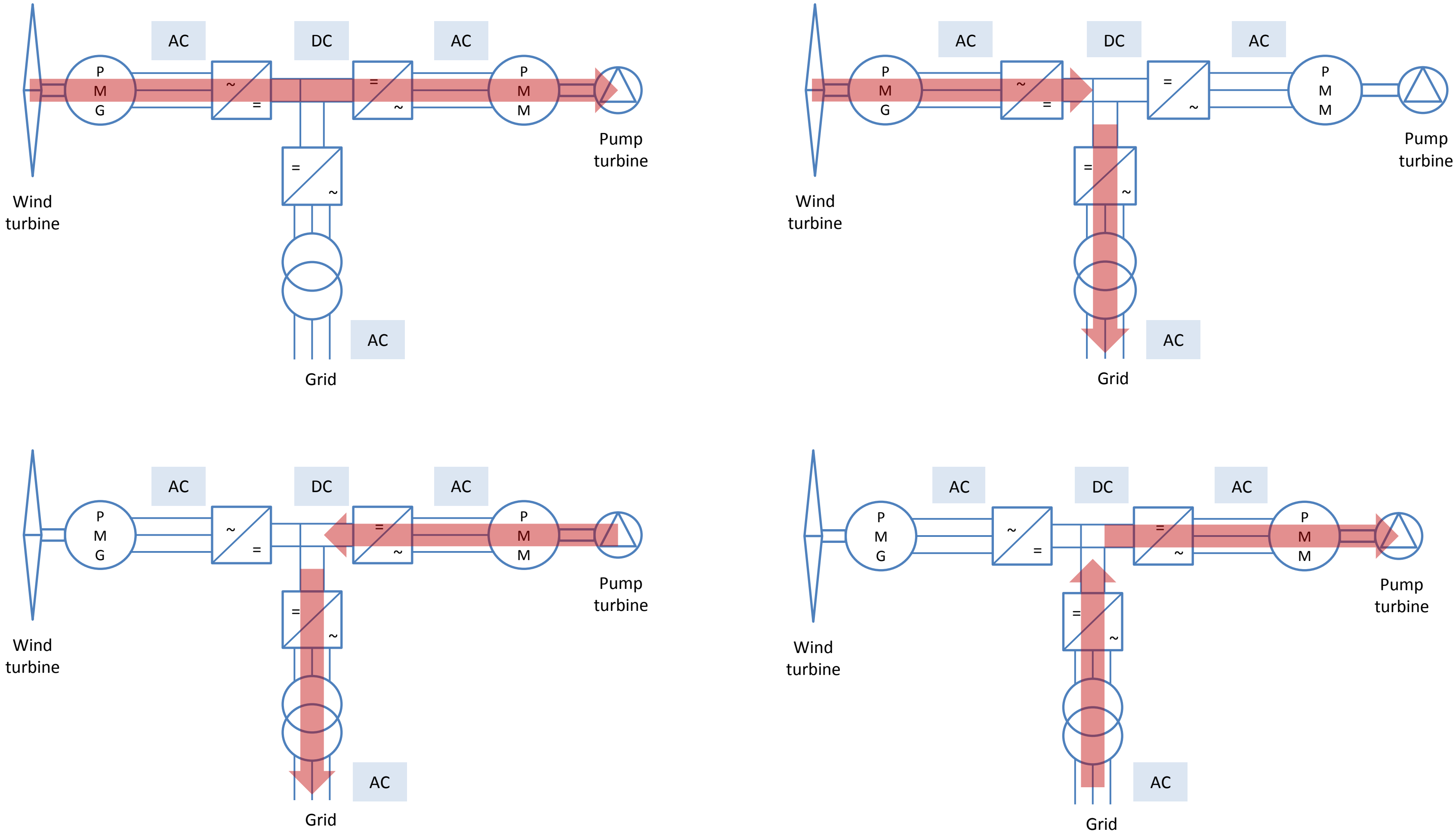
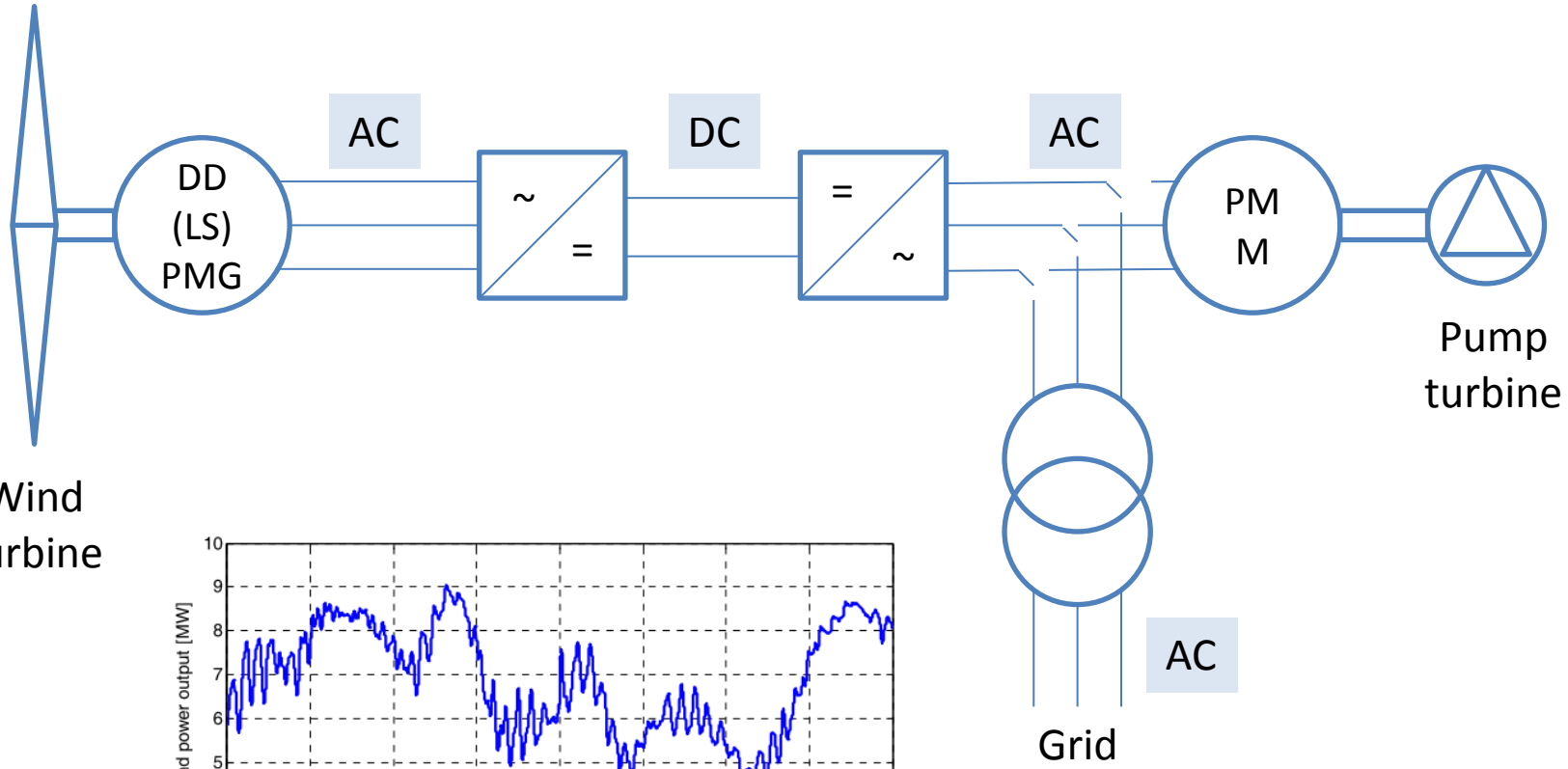
Power flow variants

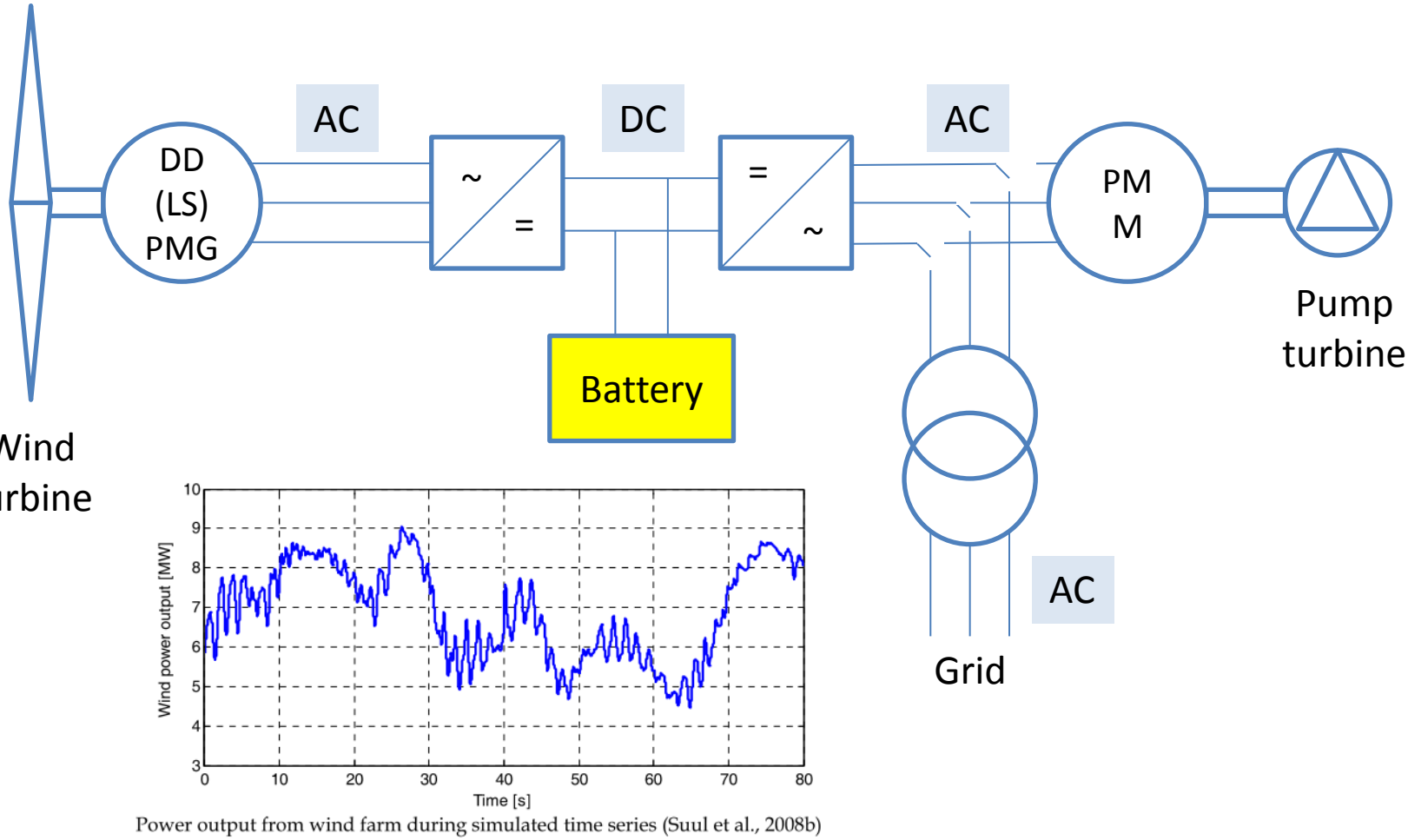


Electric DC or AC transmission



Power output from wind farm during simulated time series (Suul et al., 2008b)

+ electric energy storage?



Power output from wind farm during simulated time series (Suul et al., 2008b)

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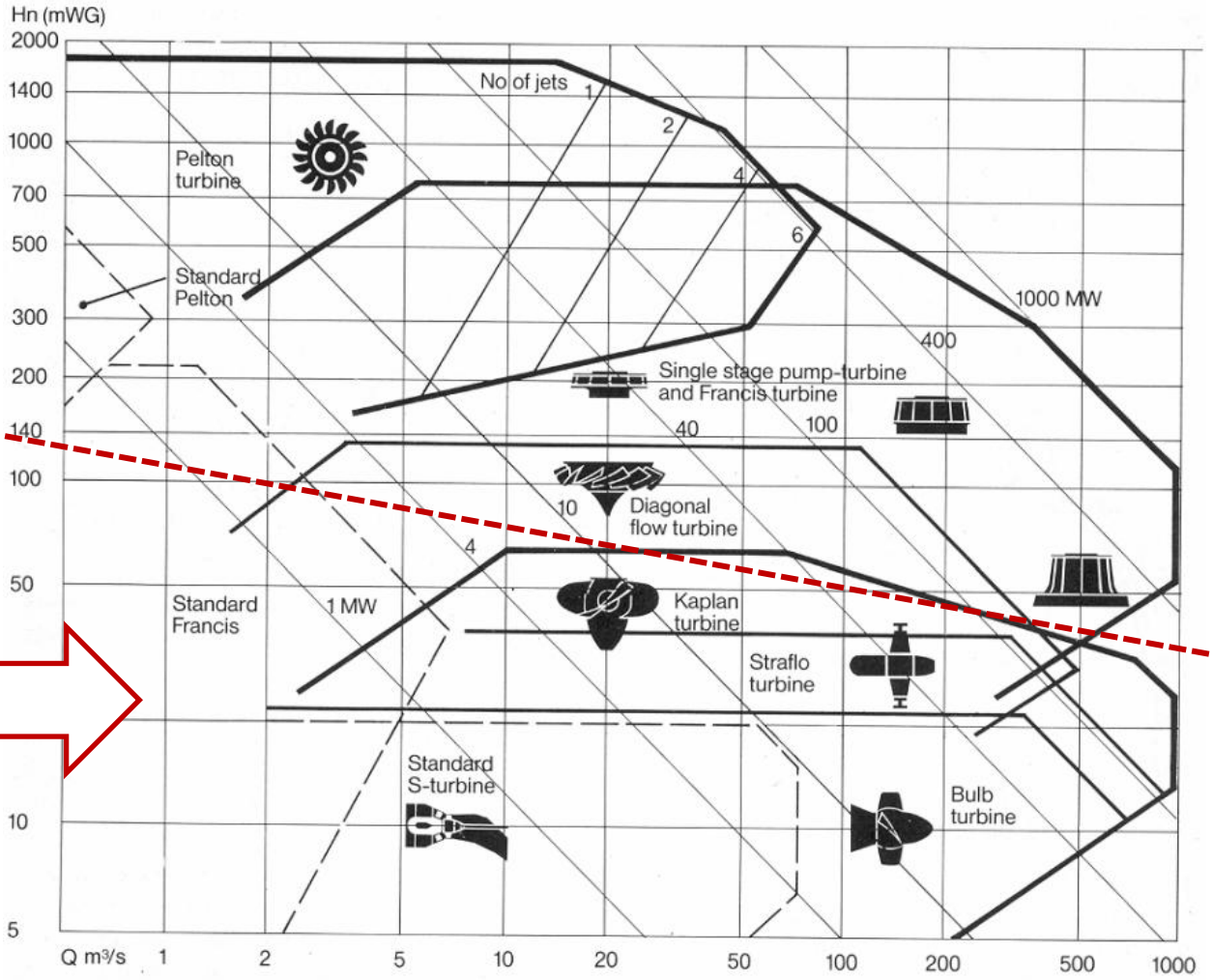
Small hydro research program

DOL SG

PMSG+VSD

Variable speed operation calls for use of VSD



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Commercial generators & converters

- Examples of PM generators and MV and LV converters

ABB

TheSwitch

ABB

TheSwitch

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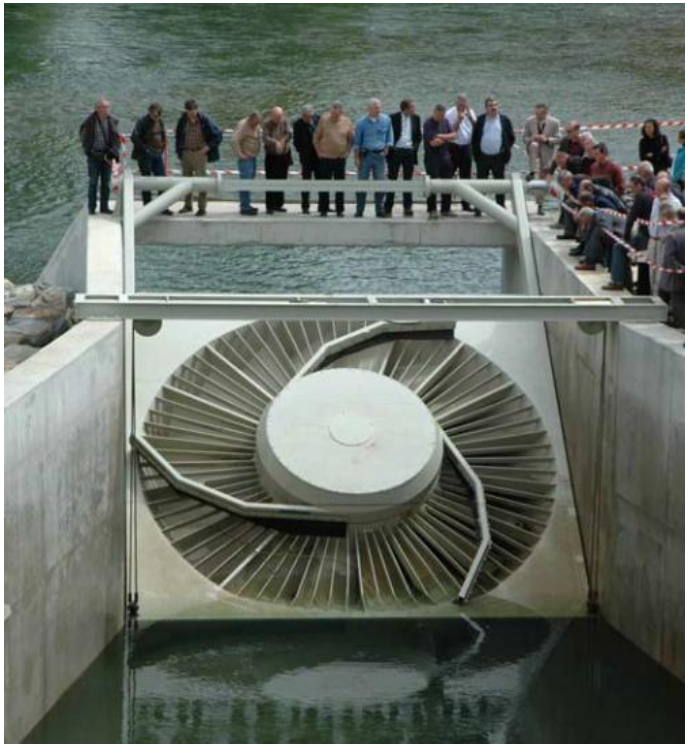
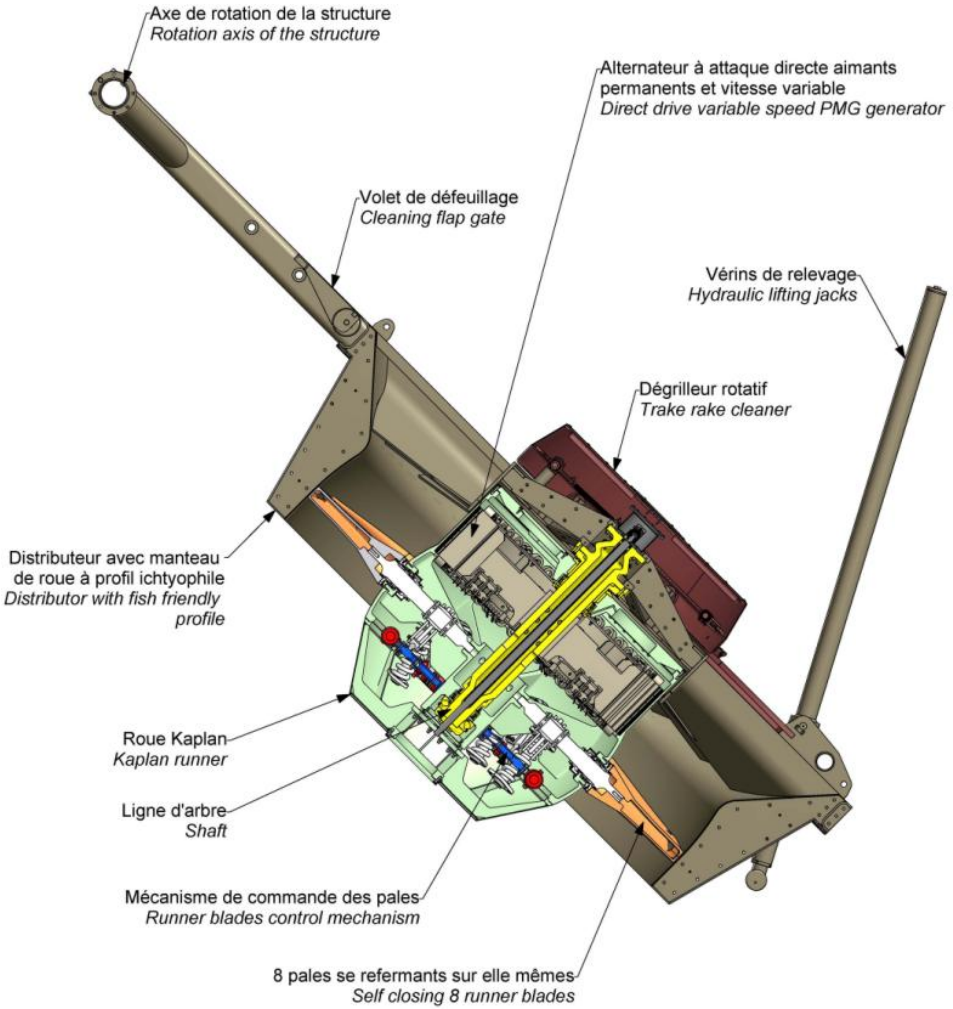
Special PMG. Low-head turbine of VLH



Runaway speed at full opening (75 rpm)and maximum runaway speed (90 rpm)have been exactly as expected.The nominal full output of 438 kW was reached at the expected nominal rotation speed of 37 rpm under the nominal net head of 2,5 m and nominal flow of 22,5 m3/s.



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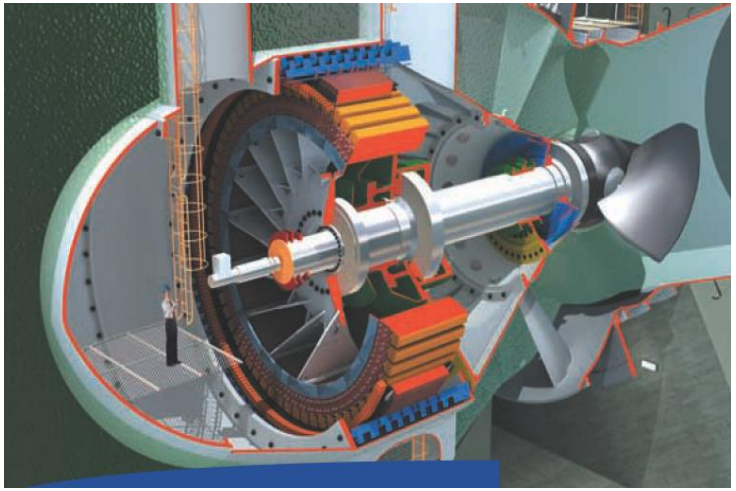
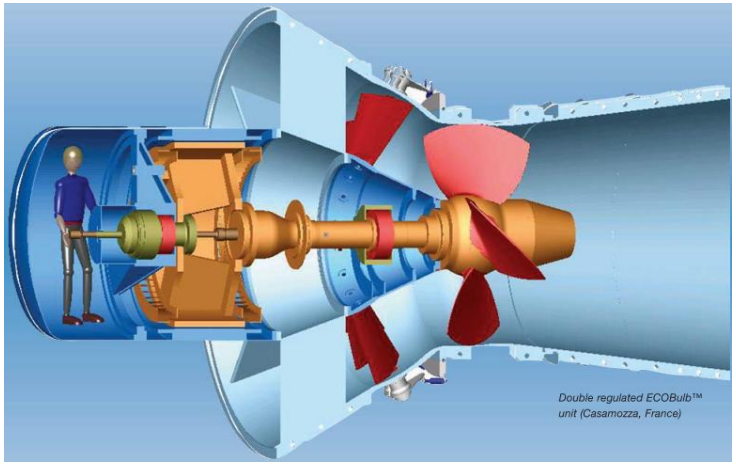
Special PMG. Vatech and Alstom





- Head H between 2 and 15 m
- Flow Q between 15 and 100 m³/s
- Output P between 500 and 5000 kW

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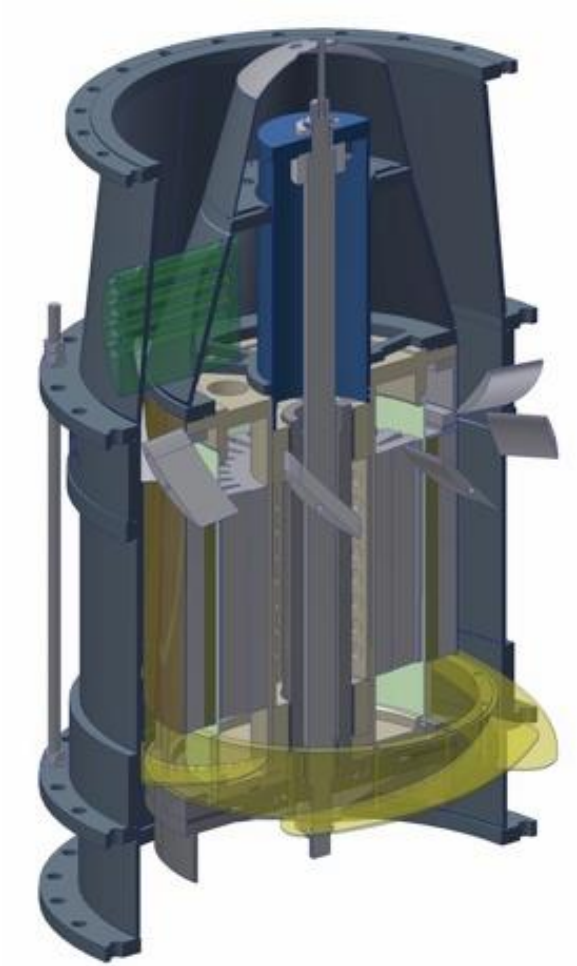
Special PMG. Turbinator of CleanPower



Arbeidsområde	
Fallhøyde	10 - 60 meter
Slukeevne	0,5 - 5 m^3/sek
Effekt	0,1 - 2 MW

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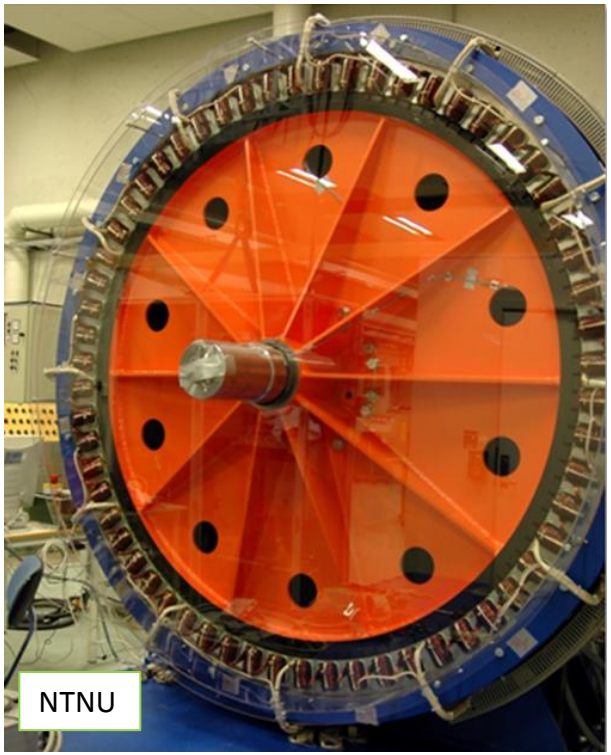
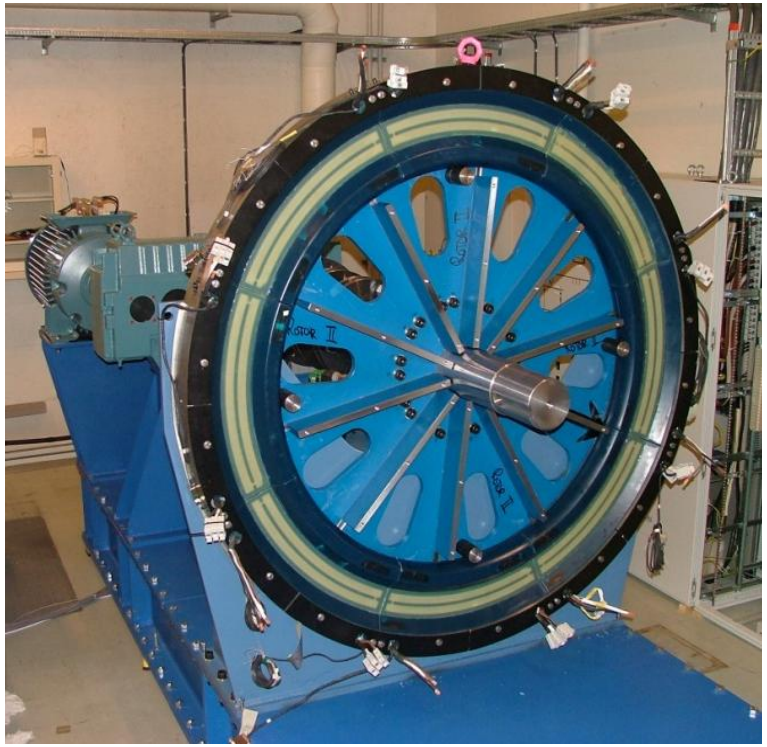
The technologies we believe in

- PM machines with concentrated winding and ironless machines
- Ideal for high-torque applications and mechanical integration





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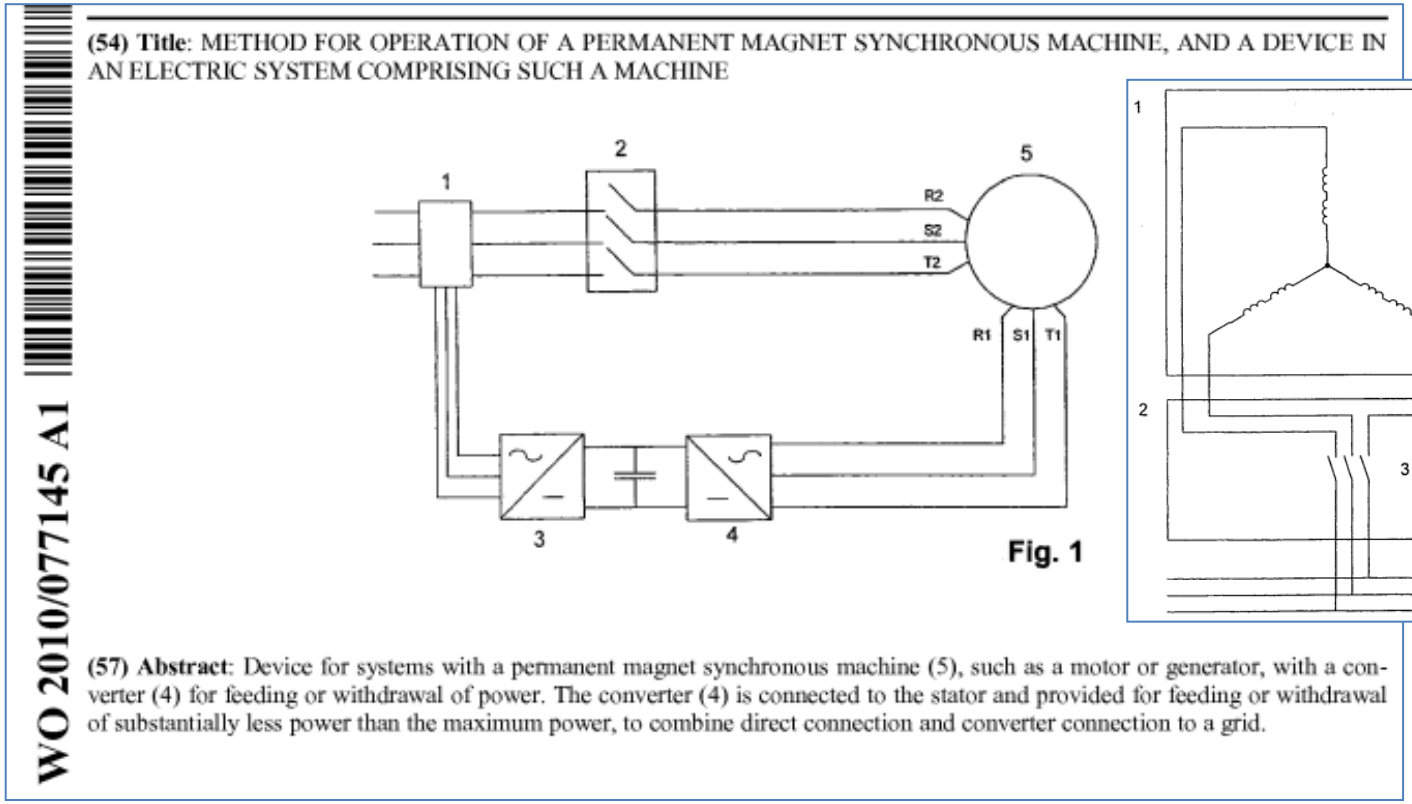
What can be SmartMotor contribution?

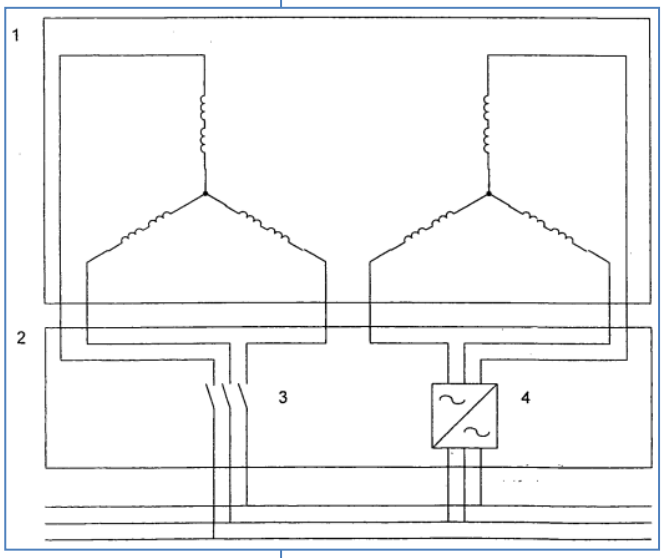
- Patented solution with doubly-fed PM machine
  - Patent NO329244B1



WO 2010/077145 A1

(54) **Title**: METHOD FOR OPERATION OF A PERMANENT MAGNET SYNCHRONOUS MACHINE, AND A DEVICE IN AN ELECTRIC SYSTEM COMPRISING SUCH A MACHINE

Fig. 1



(57) **Abstract**: Device for systems with a permanent magnet synchronous machine (5), such as a motor or generator, with a converter (4) for feeding or withdrawal of power. The converter (4) is connected to the stator and provided for feeding or withdrawal of substantially less power than the maximum power, to combine direct connection and converter connection to a grid.

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What can be SmartMotor contribution?

- Special high-torque generator technology
  - Submerged pressurized PMG
  - Flooded-gap PMG
  - Integrated PMG
  - Water-cooled PMG
  - Flexibility
    - Voltage
    - Speed
    - Power
    - Number of phases (partial converter solutions)

- Converters with AFE
- For: wind turbines electrically integrated with **low-head** pump storages
- Competence in investigation of complete drive trains

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...the end)

Thank you!

Contact information: alexey@smartmotor.no, www.smartmotor.no