Pitch systems of the future –under all climatic conditions
Pitch Systems of the Future

Pitch systems for wind turbines
Pitch Systems of the Future

Hydraulic

Electric

Wind Power Works
The Fail Safe Principle

Hydraulic Pitch

Electric Pitch

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Electric Pitch System – Challenges

- Batteries - difficult to monitor, low power at low temperature and a frequent need for replacement
- Lubrication of pitch gear is difficult due to small movements
- Complex solution; many components and thus difficult to understand and service
- Backlash between the gears may be a problem
Hydraulic Pitch System – Challenges

- During service and replacement of parts a high degree of cleanliness must be obtained
- Maintenance of the accumulators can be a little difficult
- Leakages can occur, but with the right selection of components and proper service and maintenance this can be avoided

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## Comparing the two Commonly Used Technologies

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## Dimensions & Working Conditions of Wind Turbines

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<th>BOEING 767</th>
<th>2 - 3 MW class</th>
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<tr>
<td>Wing span</td>
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<tr>
<td>51,9 m</td>
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<tr>
<td>Total length</td>
<td>Tower height</td>
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<tr>
<td>61,4 m</td>
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<tr>
<td>even lower</td>
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<tr>
<td></td>
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Reliability – is it Important?

As for aircrafts, reliability in wind turbines is important because:

- If a failure happens, the turbine must be brought to a controlled position – again and again
- Failure means loss of production
- Failure means extra service costs
The Danish Solution

Danish pitch hydraulics work in wind turbines
The Danish Solution

- Majority of hydraulic driven pitch control use Danish pitch technology
- 99% of all OFF SHORE turbines use Danish pitch technology
- Danish pitch technology have more than 25 years of experience
- From the very beginning all Danish wind turbine manufactures have taken advance of Danish pitch technology
Climate Conditions – How to Handle them?

- Normal operation to 30 degrees below zero without any extra heating
- Survival to 40 degrees below zero
- Startup – heating included in the design
- No lubrication or grease is required in hydraulic pitch systems
Flexibility – is it Important?

- Simulation assists in the design phase
- Hydraulics offer easy fine tuning of the prototype through zero series to final serial production
- Before installation:
  - The installation environment may be different than expected
- When installed – fine tuning of the pitch system may be necessary:
  - Extra power may be needed to stop the turbine
  - Extra speed may be required to perform a safe emergency stop
Pitch in Operation

- With hydraulic pitch you meet the requirements for:
  - Accuracy and torque
  - Speed in pitch operation
  - Protection against high wind loads
  - Optimization of power production
  - Limiteded maximum power
  - Performing cyclic pitch (large turbines)
  - Complying with the modern grid demands from the utilities world wide

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Response – are we Fast Enough?

- When using a hydraulic pitch system speed is not a problem:
  - The response time from the valves and the hydraulic accumulators is measured in milliseconds
- The necessary torque to turn the blade is proportional to the pressure in the system:
  - The pressure over the necessary stroke can easily be adjusted and it depends mainly on the size of the accumulators installed
A Crucial Failure in the Pitch System may Cause a “Lost” Turbine
Emergency Stop – is it Safe?

Hydraulic emergency stop

- The hydraulic accumulators store sufficient power to bring the turbine to a safe stop under all wind and temperature conditions
- Only a few valves must de-activate and the turbine perform an emergency stop
- No electrical power is required to perform an emergency stop

Extra feature:

- Short start up time after shut down (1 – 2 minutes), especially important if the grid is weak or many grid failures occurs
Lightning – does it Matter?

All turbines need lightning protection

- The hydraulic system is by nature less sensitive because of the mechanical design
- Only a few electric components can be damaged because of lightning
- If electric components are damaged the result is a full emergency stop
Condition monitoring is also required for the large wind turbines in the future

- Hydraulic components offer standard solutions for condition monitoring:
  - PT100 sensors are already installed
  - Pressure transmitters are already installed
  - Position transducers are already installed
  - Proportional valve reference is already installed
  - Filter monitoring is already installed
  - Easy online particle counting

Hydraulics is the obvious choice for condition monitoring
Hydraulic Maintenance – Key Issues!

Important:
- Education of R&D and service people
- Clean system in operation and during service

Hydraulics offer:
- Easy trouble shooting due to simple setup
- Easy access to spare parts
- Reliable system reduces down time for service
Total Cost of Ownership (TCO) – is it Important?

- Lower overall costs improve return on investment
  - Initial cost (purchase)
  - Service and maintenance cost
  - Costs for unexpected stops (loss of production)
  - Environmental costs
  - Scrapping costs
PITCH – Why do we Recommend Hydraulics?

- Suitable for all climate conditions
- Flexibility in design; e.g. redundancy
- Emergency stop without electrical power
- Few components to protect against lightning
- Condition monitoring is made easy
- A hydraulic system is service friendly
- We believe that total cost of ownership is important
- Hydraulics offer a cheaper lifetime solution
PITCH – Why do we Recommend Hydraulics?

- The more often and more powerful pitch movements are required, the more hydraulic pitch is suitable.

- A hydraulic system is a safe and proven technology and have been used for a far longer period than other systems.

Wind Power Works
AVN Energy, Fritz Schur Energy and Windsyn

Meet us at the Pavilion of Denmark

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