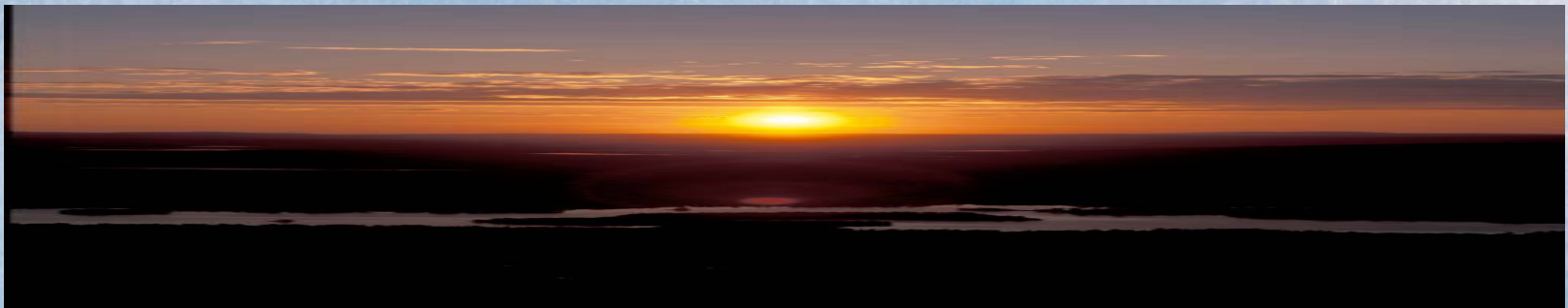




Full-scale experiments for the development of dynamic models (V-161)

J-O Aidanpää, M.J. Cervantes



Background

The group in Luleå is working with rotor-fluid interaction in hydropower applications and is therefore interested to build up similar knowledge in wind power applications.

Today a large number of wind power plants are planned in northern Sweden and we believe that knowledge is needed to understand the loads in cold climate

The result will give increased knowledge on how to operate wind power plants in cold climate in order to avoid failures and maximize power output

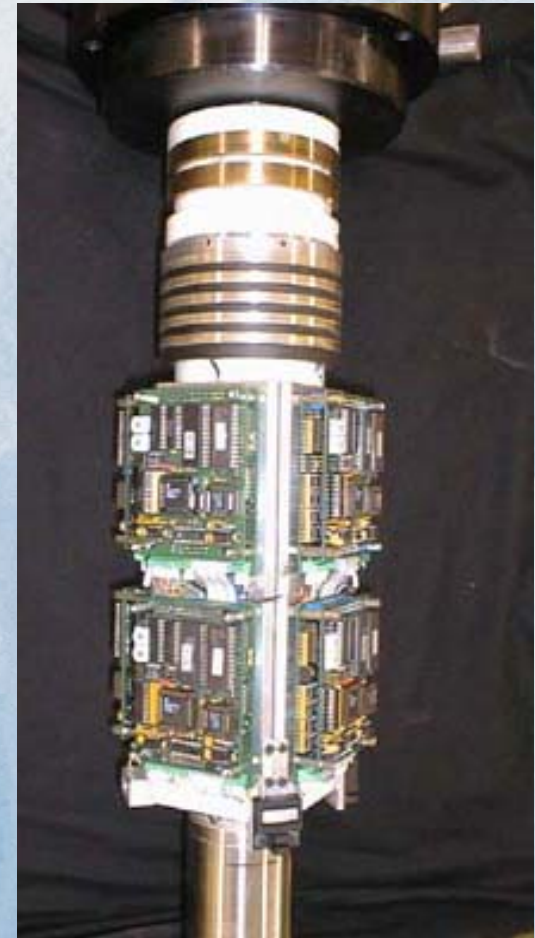
Project description

Goals:

- Build a test turbine in Porjus (23kw).
- Determination of the parameters necessary for the development of dynamic models and measurements methods.
- Implement and test the measuring methods.

Objective:

- Seek partners for the next step: find an appropriate wind turbine (>2 MW) for full-scale experiments and development of dynamic models.



Project information:

Start: January 2008

Period: 1 year

Budget: 1 300 ksek

Working force:

- Ass. Prof. Jan-Olov Aidanpää (rotor-dynamic)
- Ass. Prof. Michel Cervantes (turbine)
- Stig Eklund, Vattenfall
- Fredrik Larsson, SKF

Project finance:

- *LTU* : 240 ksek
- *SKF* : 200 ksek
- *Vattenfall* : 370 ksek
- *Energimyndigheten* : 520 ksek
- TOTAL:** : **1330 ksek**

The parameters to be measured should give information about the forces, torques and displacements involved.

Propeller to gear-box

Axial force (1 ½ bridge)

Bending (2 ½ bridge)

Torsion (1 ½ bridge)

Displacement (2 to 4 sensors)

Gear-box to generator (similar to above)

Other

Wind velocity along the blade (this measurement will certainly not be performed during 2008)

Power

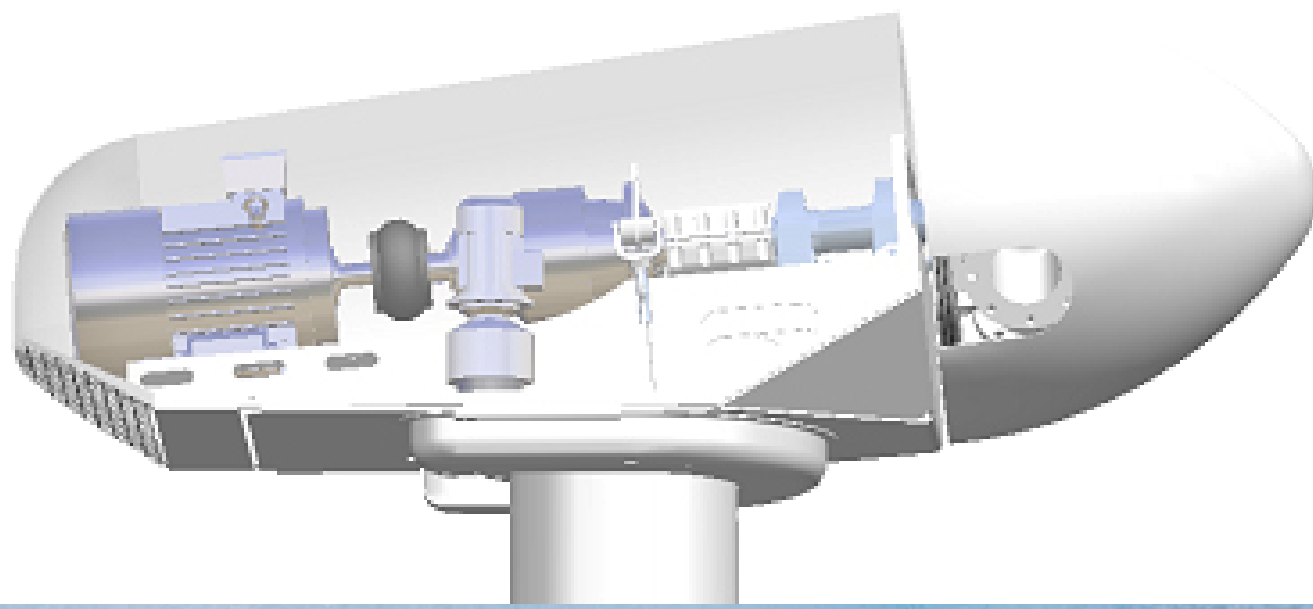
Gear box oil temperature

A wireless system from load Indicator System AB will be used to transmit the signals from the rotating sensors. The system comports 8 channels. The signal from the sensors will be digitalized with several SKF Mascon 16W systems. The system allows the digitalization of 16 signals simultaneously. Several of them will be used.

The installation of the wind turbine should start during August 2008. Preliminary measurements will start during September 2008.

Discussion with SKF and Vattenfall have initiated for the continuation of the project beyond 2008.

| | |
|----------------------------|--|
| Rotordiameter: | 11 meter |
| Rotationshastighet: | Max 75 rpm |
| Nav: | Stålgjutgods |
| Växellåda: | Planetväxel |
| Bromssystem: | Lamellbroms och parkeringsbroms |
| Generator: | Asynkron eller synkron 400 volt-amp, 22 kW 50 hz |
| Vridsystem: | Vindriktningsgivare och microprocessor (PLC), vridmotor 0,5 kW |
| Maskinhus: | Galvaniserade stålplåtssektioner och glasfiberarmerad plast |
| Torn: | Ståltorn, koniskt med utvändigt steg och fallskena |
| Nätanslutning: | 3x400 volt/50 hz. |
| Kontrollsystem: | Datorstyrt med microprocessor (PLC) |
| Rostskydd: | Allt stål är varmgalvaniserat eller blankförzinkat |





Next project:

Active load control on large wind turbines
(2009)

Future project objectives:

- Implement the measuring technique developed during V-161 on a large (>2 MW) full-scale wind turbine. (Parameters to be measured are forces, torque and displacements)
- Development of a dynamic model with application to wind power. Validation of the model with the above mentioned experiments.
- Development of an active system (boundary layer control) to remedy the large wind fluctuations believed to be the main source of problems in wind turbines. Sensors mounted on the blades will measure locally along the blade the wind velocities.
- Validation of the active system at Porjus and then on the 2 MW machine with the help of above implemented system.