WindCon
Condition Monitoring for Wind Farms

2006 Wind Turbine Reliability Workshop
Presented by Harry Timmerman
Product Manager WindCon
2006-10-19
Condition Monitoring
vibration analysis
Wind Energy Industry is different

<table>
<thead>
<tr>
<th>INDUSTRY</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEEL MILL</td>
<td>10 000 US $ / Hour</td>
</tr>
<tr>
<td>PAPER MILL</td>
<td>10 000 US $ / Hour</td>
</tr>
<tr>
<td>POWER PLANT (600 MW)</td>
<td>15 000 US $ / Hour</td>
</tr>
<tr>
<td>CAR PLANT (paint shop)</td>
<td>100 000 US $ total</td>
</tr>
<tr>
<td>PETROCHEMICAL</td>
<td>Millions of US $</td>
</tr>
<tr>
<td>CEMENT MILL</td>
<td>(1 stop = 3 to 4 days)</td>
</tr>
<tr>
<td>FOOD PROCESSING</td>
<td>5000 US $ / Hour</td>
</tr>
<tr>
<td>Offshore Wind Turbine</td>
<td>100 US$ / Hour</td>
</tr>
</tbody>
</table>
ProCon Wind Turbine Root Causes

Unbalance
Alignment errors
Bearing problems
Damage on gear wheels
Bend shafts
Mechanical looseness
Tower vibrations
Blade vibrations
Electrical problems
Resonance problems
System Lay out...

Ethernet TCP/IP

Alarm message generation through SMS and e-mail
iMU 16 channel board

4 x 4
Robustness …..

Lightning protection: EN61000-6-2:1999, EN61000-4-5: 4 kV

Off shore: iMU has Stainless Steel Box IP65, Stainless Steel Sensor IP67

For artic versions temperature range extended to minus 30°C

CE certified according to EN50081-2:1993
Line of command ……

- Reaction time
  - days
  - level

- Minutes
  - level

- Seconds
  - level

Control Room
OPC Server & SCADA

Remote Monitoring Experts

SKF contributions
- SKF Remote Monitoring by experts
- ProCon supervision System
  - iMU (Intelligent Monitoring Unit)

Other Control Rooms

SKF contributions

SKF Remote Monitoring by experts

ProCon supervision System

iMU (Intelligent Monitoring Unit)
Variable Working conditions ......

- WindCon continuously recalculates fault frequencies.

- WindCon can make alarm levels dependent of speed or any other process signal

- Trending based on classes of working conditions.
  (Allianz)
Communication/ GPRS

- TCP/IP
- GPRS
- Internet
- ADSL with fixed IP address
- Windcon Web Application
- ProCon Server
- LAN
- SQL Database
- Internet Modem ISDN
- Relays
- Alarm by SMS and e-Mail
- up to many Wind Turbines

Wind Turbines

2006-10-19 ©SKF Slide 11 [Code] 
SKF [Organisation]
Spectra diagram for point MP8 WEA5 Geno BS EHV3 (1500rpm) -> 4/2/2006 1:00:19 AM; Speed: 1697.1(cpm); Load: 1600.3
<table>
<thead>
<tr>
<th>Alarm Date</th>
<th>Place</th>
<th>Title</th>
<th>Status</th>
<th>Receipt Date</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/9/2003 8:00:02 AM</td>
<td>Getri. AW ENV3 (1080rpm, 200kW)</td>
<td>AW Lager RS 31322, AW Lager RS 30322J2</td>
<td>High Warning</td>
<td>9/19/2003 3:36:34 PM</td>
<td>Demo</td>
</tr>
<tr>
<td>9/6/2003 8:57:56 PM</td>
<td>Getri. AW ENV3 (1080rpm, 200kW)</td>
<td>AW Lager RS 31322</td>
<td>High Warning</td>
<td>9/19/2003 3:37:02 PM</td>
<td>Demo</td>
</tr>
</tbody>
</table>
Compatibility

Gastops:
- Particle counter in the lubrication system.
- Ready and tested, ready for sale.

Vogel:
- Central automated lubrication system.
- Not ready yet.

Insensys:
Equipment Schematic

Insensys WT-1030 measurement system (located in the turbine hub)

SKF WindCon Condition Monitoring unit (located in the turbine nacelle)

Rotor blade data

Internet
Certifying Bodies

- Germanischer Lloyd

Insurance companies

- Allianz, Gothea, Marsh, Royal Sun Alliance.
- SKF is Allianz Certified

IEC Standard 61400-25

- Standard on Condition Monitoring in Wind Turbines.
- IEC task force working on it.
Questions ?