Data sheet

fos4Blade IceDetection

Fiber optic blade ice detection system

Product highlights
- Certified by DNV GL
- Accredited as "state of the art" ice detection system as requested by authorities
- Pure optical working principle
- No electrical cables or components in blade
- Detection of ice masses <10 kg
- Individual monitoring of each blade
- Easy integration into SCADA systems
- Installation < 1 day
- Ready for operation after automated calibration < 2 weeks
- Low maintenance requirements over the lifetime of the wind turbine.

1 General description
The fos4Blade IceDetection system has been specifically designed to detect icing at a wind turbine’s rotor blade. It is based on our fos4Blade hardware offering reliable operation over the lifetime of a WEC. With the available accessories the system is designed to withstand all environmental conditions impacting the wind turbine. This ensures a reliable operation in any condition with minimal maintenance requirements. All components can be retro-fitted or integrated into series production. The system’s standard data interfaces allow an easy integration of fos4IceDetection into the turbine’s SCADA system.

2 Technical description
fos4Blade IceDetection consists of two main components:
- fos4Acc 2D – fiber optic two-dimensional acceleration sensor (blade mounted)
- fos4Test Wind – Measurement unit (located in hub)

For further details on the technical specifications please refer to the corresponding data sheet. Extensive accessories are available to form a ready to use solution (Heavy duty blade hub connections, offshore ready hub control cabinet with heating system and lightning protection).

The system can easily be complemented with fiber optic strain sensors for blade root bending moment measurement. This allows active load reduction schemes and extended condition monitoring functionality amongst others.

3rd party certification
The hardware components including all accessories are certified according to CE requirements as well as to DIN EN 60068-2-6 Class 3M6 and DIN EN 60068-27. A third party certification for the complete ice detection functionality by Germanischer Lloyd was successfully accomplished in September 2014.

3 Working principle
Within the blade, a fiber optic acceleration sensor is placed as close to the tip as possible. This allows for determining frequency components which depend on the blade’s mass.

If icing occurs, this causes a change in the overall mass of the blade. Hence, a change in the frequency components can be observed which is related to the amount of the additional ice mass.
4 Product specifications

<table>
<thead>
<tr>
<th>General parameter</th>
<th>Unit</th>
<th>fos4Blade IceDetection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. number of equipped blades</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Number of optical 2D acceleration sensors per blade</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Load cycles at nominal acceleration level</td>
<td>cycles</td>
<td>&gt; 10^2</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>°C</td>
<td>-40 ... +45</td>
</tr>
<tr>
<td>Measurement frequency</td>
<td>Hz</td>
<td>500</td>
</tr>
<tr>
<td>Ice mass detection accuracy</td>
<td>kg</td>
<td>10 (typ)</td>
</tr>
<tr>
<td>Initial calibration period</td>
<td>weeks</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>Power supply</td>
<td>V @ 50 Hz</td>
<td>230</td>
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<tr>
<td>Power consumption</td>
<td>Watts</td>
<td>&lt;70/&lt;150</td>
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<tr>
<td>Communication interfaces</td>
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<td>Ethernet, CAN2.0</td>
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<td>Communication protocols</td>
<td></td>
<td>IEC 61400-25, CANopen</td>
</tr>
<tr>
<td>IP Class</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Size of hub control cabinet</td>
<td>mm</td>
<td>480 * 350 * 210</td>
</tr>
<tr>
<td>Weight of hub control cabinet</td>
<td>kg</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2: Product specifications, optical and mechanical parameters, environmental conditions

5 Dimensions

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1. DNV GL certified a system with sensors in 3 blades. The certification is only valid for this specific setup.
2. This is equivalent to more than 20 years life time.
3. Ice mass detection accuracy depends on blade type. It can be increased when blade pitch, rotor speed and temperature are provided and when the ice mass is concentrated towards the blade’s tip.
4. An ice mass can be given after a calibration procedure. If the rotor speed of the wind turbine is < 1.6rpm a wind speed > 3m/s is required.
5. Time to get the system fully operational. Depends on wind speed and temperatures.
6. Also available as 110 V AC version and as 24 V DC version.
7. 150 W is required, when hub control cabinet is heating up using the optional built in control cabinet heating system.