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General Specification

Nacelle Ice Detection

V105/V112/V117/V126/V136 – 3.45/3.6 MW

V117/V136/V150 – 4.0/4.2 MW

V150/V162 – 5.6 MW



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1 Introduction

This document describes the Nacelle Ice Detection system for the following turbines:

V105/VV112/V117/V126/V136 - 3.45/3.6MW

V117/V136/V150 - 4.0/4.2 MW

V150/V162 - 5.6MW

2 General Description

The Nacelle Ice Detection system is based on Labkotec's LID-3300IP Ice detector. It is mounted in the nacelle and the sensor is mounted on the coolertop. The system is used to detect freezing rain/ice as described below. The Ice Detection system is connected to the WTG controller of the turbine and can optionally be configured to stop the turbine when a certain level of ice is present.



Figure 1- Nacelle Ice Detection system

The system consists of an ICE SENSOR NID and a CONTROL BOX NID. CONTROL BOX NID contains the LID-3300IP Control Unit with front panel that has LED indicators for Power, Ice Alarm, Heating and Fault.



Figure 2 – CONTROL BOX NID

ICE SENSOR NID is placed on the cooler top. The ice sensor body includes a 350W heating element to be able to De-ice the sensor prior to detection.

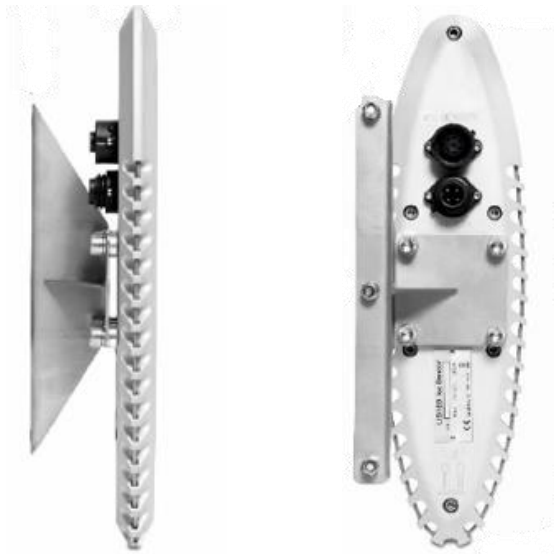


Figure 3 – LID ICE SENSOR NID

3 Operational Strategy

The overall control strategy of the Nacelle Ice Detection system is to provide continuous measurements of ice conditions on the nacelle. The Ice detection is based on an ultrasonic principle. Ultrasonic signal attenuates when ice is accumulated on the sensor wire.

The Ice Sensor NID consist of two transducer elements, where one element generates ultrasonic vectors, which are detected by the second element. By measuring the attenuation levels, icing between the two elements can be detected.

The ultrasonic signal is transmitted along a thin thread at one end and the intensity of the ultrasonic signal having passed through the thread is measured at the other end. If the thread is covered with a water layer, the ultrasound will not be attenuated, however if the water freezes, the ultrasound cannot propagate in the thread, but will be abruptly attenuated. If the thread is covered with a sludge, the ultrasound will be somewhat attenuated to a kind of intermediate level at which detection of sludge is also possible. A viscosity difference exists between ice and water, and thus the intensity of the ultrasound having passed through the thread will also be different.

This ultrasonic sensor is comprised of a measuring transducer, a thread-like acoustic waveguide having an ultrasonic transmitter at one end, an ultrasonic receiver at other end, and a device which comprises electronic components for measuring the intensity and the attenuation of an ultrasonic pulse having passed through the transducer thread in the case of ice formation. Electric resistance of the thread is measured simultaneously with the measurement of the attenuation of the ultrasound. With the help of measured resistance, the amount of required heating for the thread can be provided optionally to melt the surrounding ice, whereby the ultrasound intensity resumes its initial level.

During icing conditions the ultrasonic signal amplitude will start to decrease, and the ice alarm will make the turbine stop. If the Turbine have a blade heating system available, the NID can trigger a de-icing mode. Blade heating systems needs to be purchased separately, which is turbine type dependent. Also, just at the right time when the ice is detected the sensor start heating itself to melt the detected ice. After a set delay, the alarm will go off and turbine will start functioning again, in case if turbine is configured to stop, when ice is detected. (see Figure 4).

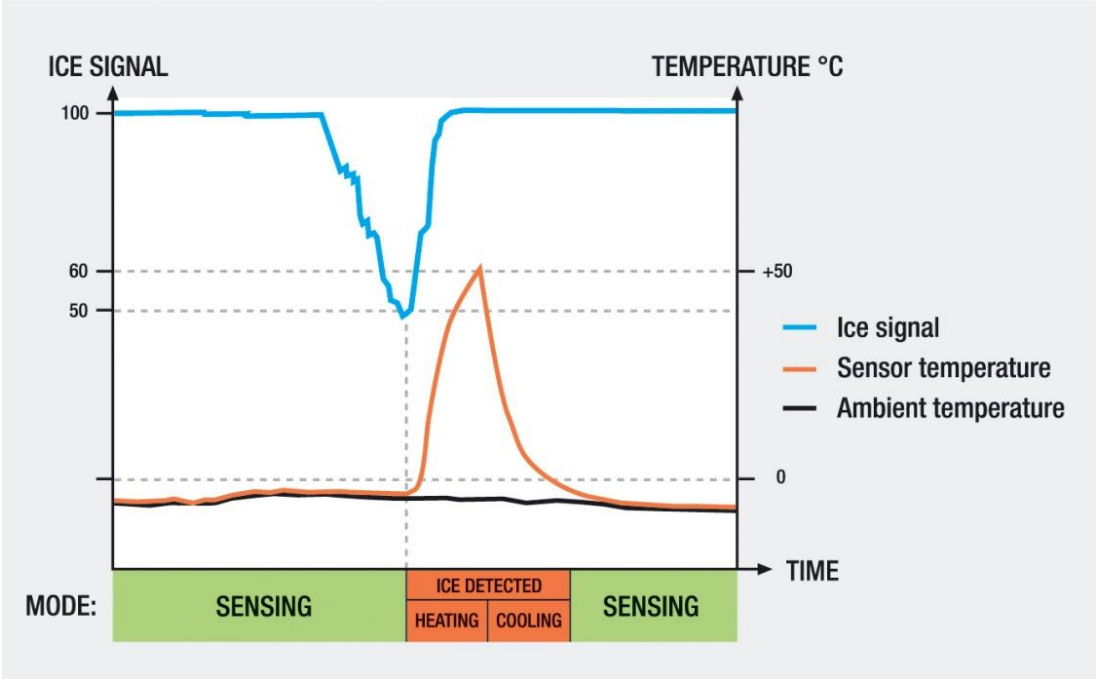


Figure 4 – Working cycle of detector

This ice detector is based on longitudinal wire waves. It is reasonably easy to adjust the parameters of the device to correspond with different icing climates

Nacelle Ice Detection system provides the current status of the nacelle to the turbine control system via a signal. The control system is responsible for ensuring that either the turbine control system (automatic) or an authorized person (manual) evaluates the Nacelle Ice Detection information and, if necessary, shuts down the turbine in the case of ice or another problem and starts it back up once the ice has been removed or the problem has been rectified.

- Ice detection of the Ice Detector is based on measuring the strength of an ultrasonic signal in a special sensor wire.
- During icing conditions the signal amplitude will start to decrease → ice alarm signal at the given alarm level (set by parameter P00).
- Right after the ice is detected, the sensor starts heating itself to melt the detected ice.
- After a set delay and cooling periods, the ice alarm signal will go off and sensor is ready to detect icing conditions again.

Ice Detector gives an ice warning from the very early phase of ice build-up.

Output signals	
Ice state	1 = Ice, 0 = No ice
Fail state	1 = Fail, 0 = No fail (OK)

The turbine can be configured to one of two:

- When an alarm is triggered, the alarm is logged in the turbine event log and the turbine alarm log, and the turbine is shut down.

The alarm can be reset in the turbine.

- When an alarm is triggered, the alarm is logged in the turbine event log, and the turbine keeps operating.

4 Technical Data

Electrical Data	
Power supply	230 VAC $\pm 10\%$, 50/60 Hz
Power consumption:	
Sensing mode	7 W
De-icing mode	350 W
Weight:	
Control Box NID	7,9 kg (with Control Unit 800g)
LID Ice Sensor NID	1,3 kg (without brackets)

Environment	
Temperature range, operational	-40°C to +60°C

5 NOTICES AND DISCLAIMER

- Recipient acknowledges that this document is subject to change without notice and for recipient's informational purposes only and does not create or constitute a warranty, guarantee, promise, commitment, offer for sale or other representation by Vestas Wind System A/S and/or any of its affiliates (Vestas) whether express or implied, all of which are hereby expressly disclaimed by Vestas except to the extent expressly provided and agreed to by Vestas in a written contract with recipient.
- The Nacelle Ice detection system is designed to detect the presence of freezing rain icing conditions only. Other types of icing conditions (e.g. rime) are not included.
- The Nacelle Ice detection system is a nacelle-mounted system which detects the presence of freezing rain icing conditions and is based on an ultrasonic principle. Ultrasonic signal attenuates when ice is accumulated on the sensor wire.
- Accordingly, the presence of freezing rain icing conditions at other parts of the turbine (other than the Ice sensor NID location) may not be detected unless such conditions are also so present at the sensor.

Although the Ice sensor used in the ice detector system has the de-icing capability described above in section **Error! Reference source not found. Error! Reference source not found.**, p. **Error! Bookmark not defined.**, the ice detector

system is not a de-icing system or solution. The use of, or reliance on, the ice detector system as a de-icing solution is at recipient's own risk.

- Although the detection of the presence of freezing rain icing conditions may coincidentally support to reduce the risk of ice drops and/or ice throws, the ice detector system is not designed to do so. Any use of, or reliance on, the system for such purpose is at recipient's own risk.
- See the proprietary notice set forth on the front page of this specification.