

Recent development on blade-mounted and nacelle-mounted ice detectors

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Content of the presentation

1. History and present status of Labkotec Ice detectors
2. New generation Blade-mounted Ice detectors
3. Nacelle-mounted Ice detectors
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History of the blade-mounted ice detector 1994

First ever blade-mounted Ice detector was delivered by Labko Oy (nowadays Labkotec Oy) to Finland, Pyhätunturi, 1994.

→ Start blade heating



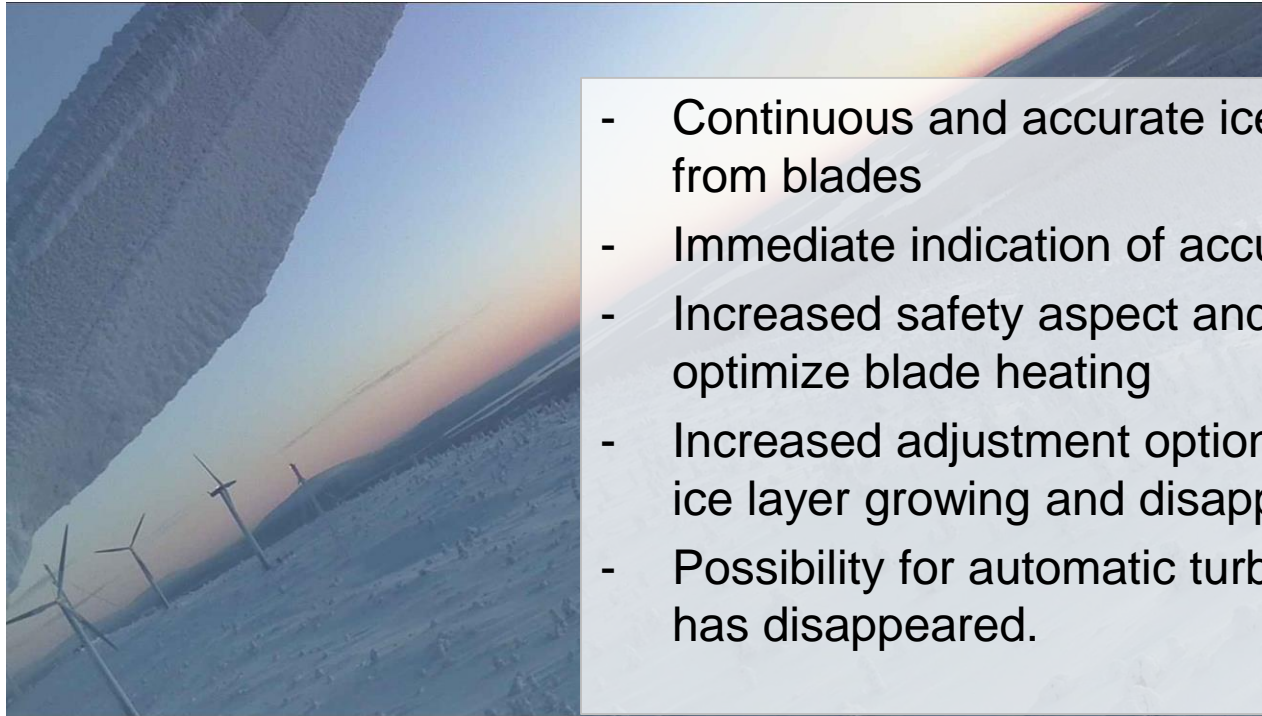
Figure BF. The first blade mounted ice detector delivered by Labko Oy. Pyhätunturi test station 1994.

Status of the blade-mounted ice detectors

- Labkotec is developing new generation ice detection system
- Ice sensors are mounted on the turbine blades
- Direct ice accumulation measurement and ice detection from the blades
- Radio communication between the sensors and the control unit.



Benefits of the blade-mounted ice detection



- Continuous and accurate ice detection directly from blades
- Immediate indication of accumulated ice
- Increased safety aspect and possibility to optimize blade heating
- Increased adjustment options when monitoring ice layer growing and disappearing
- Possibility for automatic turbine start-up after ice has disappeared.

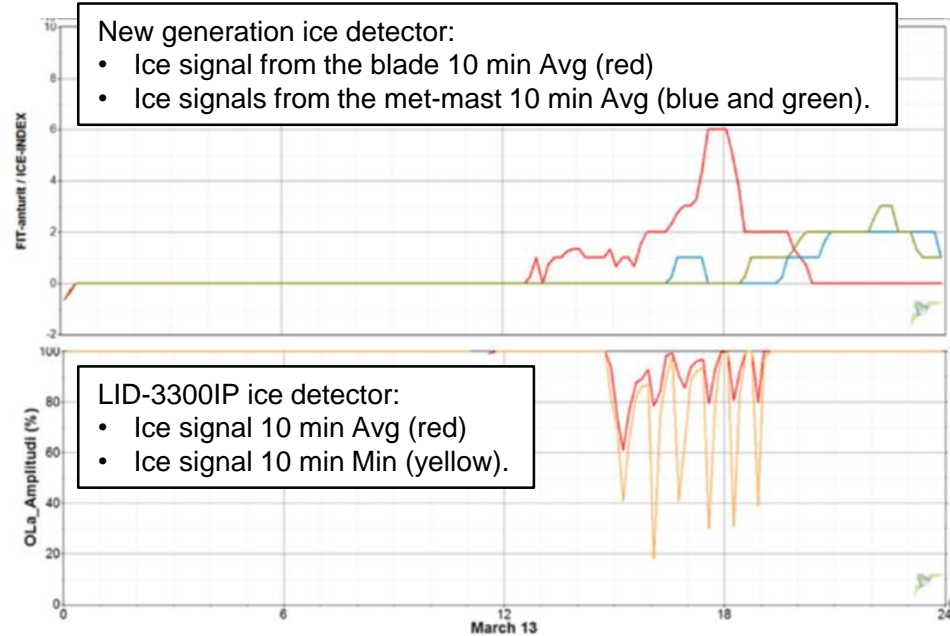
Specification of the blade-mounted ice detection



- Reliable ice detection in different icing conditions
- Wide sensor area for detecting ice during blade pitching
- Reliable radio communication between the control unit and ice sensors in spite of blade pitch and position
- Replaceable modular parts in order to extend ice sensors' life time
- Resistant against sand, dirt and hailstorm
- **Control unit compatibility with nacelle-mounted LID-3300IP sensor LID/ISD.**

Testing of the blade-mounted ice detector

- Labkotec is developing an ice detector for wind turbine blade
- Tests have been going on since 2011:
 - In-house icing laboratory
 - Weather chamber
 - Icing wind tunnel
 - Met-mast and station
 - Wind turbines
- Field test experiments (picture):
- Blade-mounted reacts first for icing.



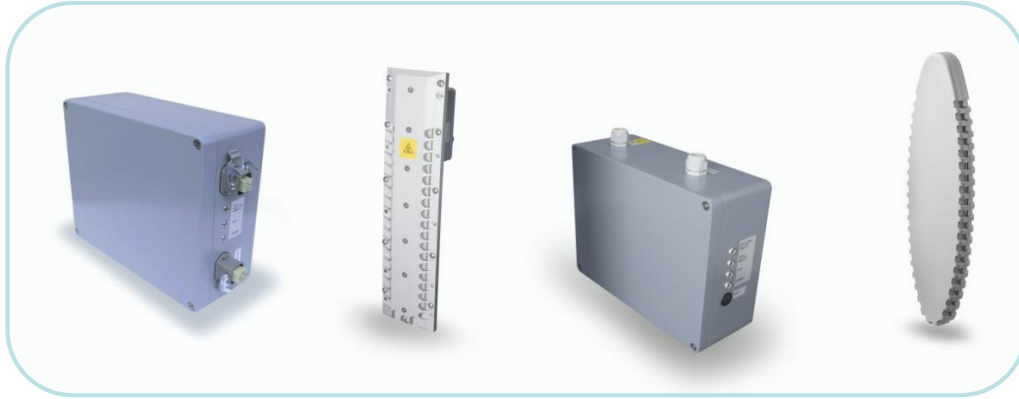
Blade-mounted ice detection field testing results since 2012

- ✓ Detection of the ice on the blade surface
- ✓ Monitoring the ice layer while it's growing
- ✓ Monitoring the ice layer while it's disappearing.

=> All OK!



History of the nacelle-mounted ice detectors



	LID-3210C Control Unit and Ice Sensor	LID-3210D Control Unit with <ul style="list-style-type: none"> - Ice Alarm LED - Test button 	LID/IS Ice Sensor <ul style="list-style-type: none"> - Sensitivity improved 	LID-3300IP Control Unit <ul style="list-style-type: none"> - Web server (remote access) LID/ISD Ice Sensor <ul style="list-style-type: none"> - Sensitivity further improved
1994 ->	2002..2008	1Q/2008...2014	4Q/2008..2014	1Q/2010..

Status of the LID-3300IP

New enclosure design:

- Hinges added to enclosure to ease installation and maintenance

New software version:

- Log file for easier diagnostics and troubleshooting.



Testing and certification of ice detectors

Challenge:

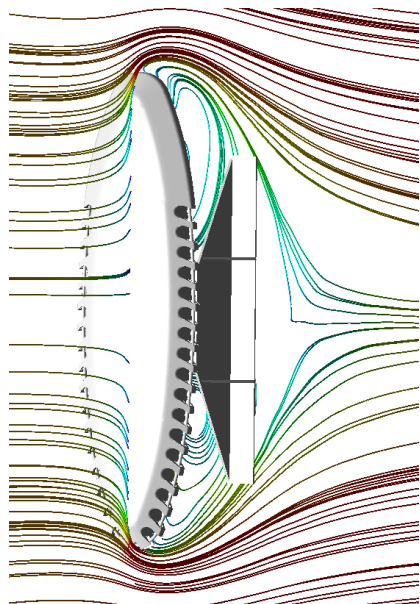
Lack of standards, published best practices and test methods for icing and ice detection testing.

Consequences:

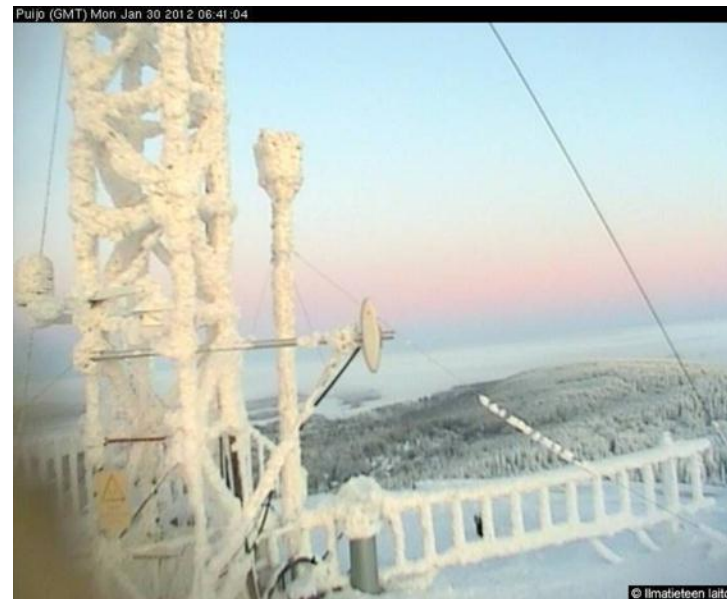
In-house methods need to be used to verify and improve the functionality of nacelle and blade-mounted ice detectors.

Without any related standards, methods have to be certificated by neutral third party like GL Renewables.

Development - simulations and field tests

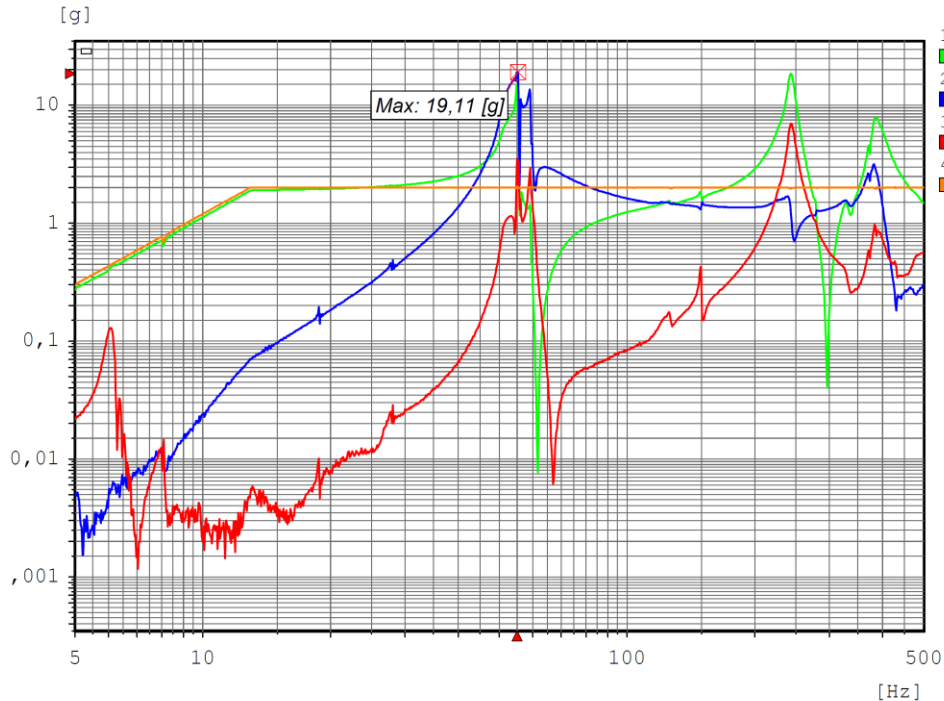


Optimizing design simulations
with CFD and Ansys



Puijo meteorological
station, Finland 2009-2016

Development - vibration tests



Test methods:

- Sinusoidal vibration, IEC 60068-2-6, Test Fc (2007-12)
- Vibration, broad-band random, IEC 60068-2-64, Test Fh (2008-04)
- Shock, IEC 60068-2-27, Test Ea (2008-02)

Summary:

- Operated normally during and after the tests.

Component Certificate

CC-GL-013A-2014 GL Renewables Certification (GL RC)

Normative references:
GL Rules and guidelines –
IV Industrial Services-Part 1
“Guideline for the the Certification of Wind Turbines”,
edition 2010.

Ice Detector LID-3300IP has been assessed by GL Renewables Certification (GL RC), concerning the Design, the “Implementation of the design requirements in Production and Erection” IPE, the prototype Testing and manufacturer’s quality system.

The GL certificate is valid for Ice Detectors with Software version of v1.30 and newer.



LID-3300IP

GL certificate:

- “Safe to use in wind turbine”
- “Detects in-cloud and freezing rain ice”.

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Certificate



Certificate no.

CU 72131267 01

License Holder:

Labkotec Oy
Myllyhaantie 6
FI-33960 Pirkkala
Finland

Manufacturing Plant:

Jotel Oy
Ilkontie 1
36241 Kangasala
Finland

Test report no.: USA-AF 31282519 001

Client Reference: Jarkko Latonen

Tested to:

UL 61010-1:2004 R10.08
IEC 61010-2-010:2003
CAN/CSA-C22.2 NO. 61010-1-04+GI1 (R2009)
CAN/CSA-C22.2 NO. 61010-2-010-04 (R2009)

Certified Product: Ice Detector for Wind Turbines

License Fee - Units

Model Designation: 1) Control Unit: LID-3300IP 7
2) Ice Sensor Unit: LID/ISD Ice Sensor

Rated Voltage: 1) AC 230V, 50/60Hz (Load: AC 230V)
2) AC 230V

Rated Power: 1) 7VA (Load: 350W)
2) 350W

Protection Class: I
Ingress Protection: IP65

Special Remarks: To be installed with an AC 230V wind turbine power system only.

Appendix: 1, 1-5

Licensed Test mark:



Date of Issue
(day/mo/yr)
26/04/2013

LID-3300IP

UL/CSA certificate:

- "Safe to use in wind turbine"
- Now selling also in the USA and Canada.

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Summary

- Labkotec is a pioneer and market leader in wind turbine ice detection.
- Labkotec has and will introduce new innovations for ice detection regardless of the fact that no standards, published best practices or test methods exist for icing or ice detection testing
- Labkotec is developing blade-mounted Ice detector to detect ice directly on wind turbine blades.