

# Vestas De-icing Solution



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# Agenda

- Vestas de-icing status
- Testing of de-icing systems
- Project plan for new de-icing solution

# De-icing & Ice Detection

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## BACKGROUND

Ice on the blades creates two kinds of risks:

- Health and safety due to ice throwing
- Economical risk due to production loss and business case uncertainty.

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## TECHNICAL EVALUATION

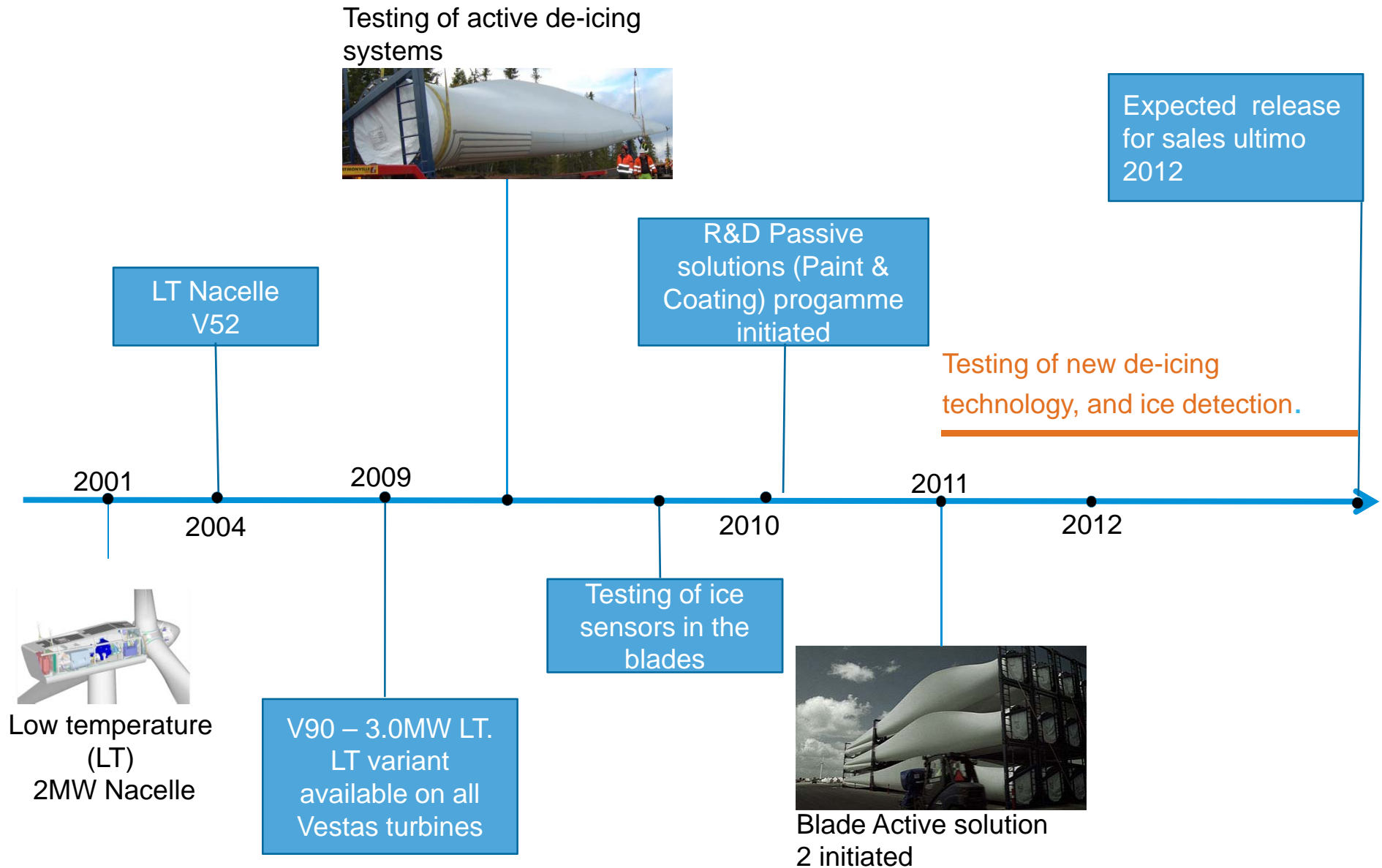
### Ice detection:

An ice sensor solution would mitigate the HSE. However ice throws are still a serious risk as ice detection systems only stops the turbines when a certain amount of ice has built up on the blades.

### De-icing:

Different de-icing technologies has been evaluated and some have been tested. System performance have been evaluated, under the following factors:  
AEP, Cost Price, O&M, Time-to-market & Maturity level.

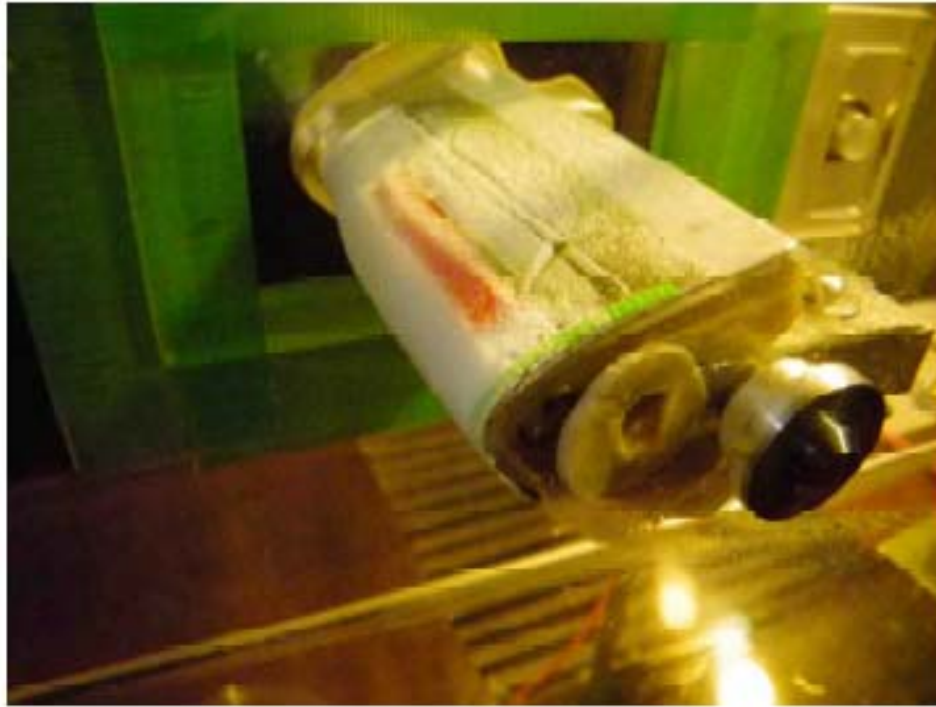
# Vestas de-icing status



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# Lab testing of de-icing technologies



**Passive De-Icing –  
Ice wind tunnel test**



**Active de-Icing system –  
wind tunnel test**

# Field testing of de-icing technologies

2010/2011 – 5 x V90-2MW Mk7

System/ Turbine	#1: Reference turbine	#2: Passive De-icing turbine	#3: Passive De-icing turbine	#4: Active De-icing turbine	#5: Active De-icing turbine - Hybrid
Ice Detection A	X	X	X	X	X
Ice Detection B	X	X	X	X	X
Coating 1		X			
Coating 2			X		X
Heating				X	X



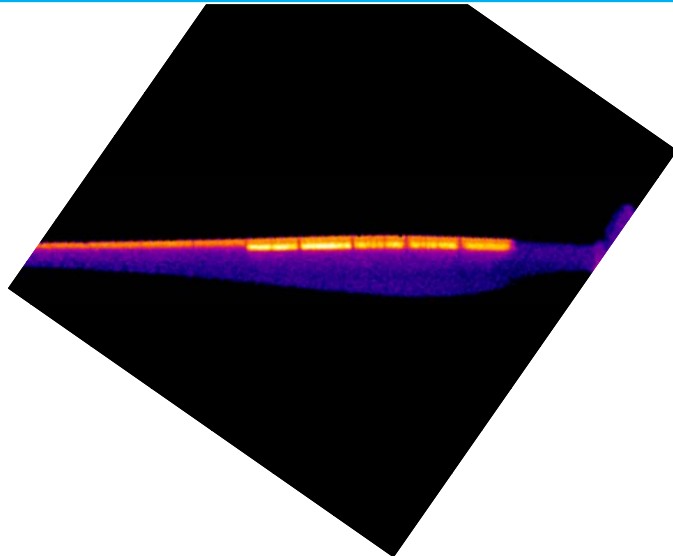
The site was equipped with a comprehensive measurement system collecting information from all turbines/systems incl. met. data, pictures/(video) and controller information.

# Testing Active: Outside hot panels

## Top 5 reasons for not pursuing leading edge heating

- AEP
  - Losses during summer time too large compared to the gain during icing conditions
- O&M cost proved to be too high
- High system costs
  - Component costs and lightning protection
- Lifetime
  - It remains unproven that a reasonable lifetime can be achieved
- Damage from lightning

In terms of *performance* it has to be said that the technology didn't receive a full and fair *trial in severe ice conditions*



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# Testing of ice sensors

- No reliable or convincing evidence for accurate ice mass detection
- Both systems are capable of detecting ice
- Required precision to allow safe stop and start not demonstrated
- No added value in blade mounted ice detectors as switch for de-icing system
- Current performance demonstrates no added value as stand alone ice detection



# Solution Matrix

	Heating panels on leading edge	Integrated heating panels	Hot air solution	Coating/paint
AEP	+	++	++	++
Cost Price	÷ ÷	÷ ÷	+	++
Efficiency	+	+	+	?
O&M/Lifetime cost	÷ ÷	÷ ÷	+	?
Time-To-Market	+	÷	÷	÷ ÷
Maturity level	÷	÷	÷	÷ ÷

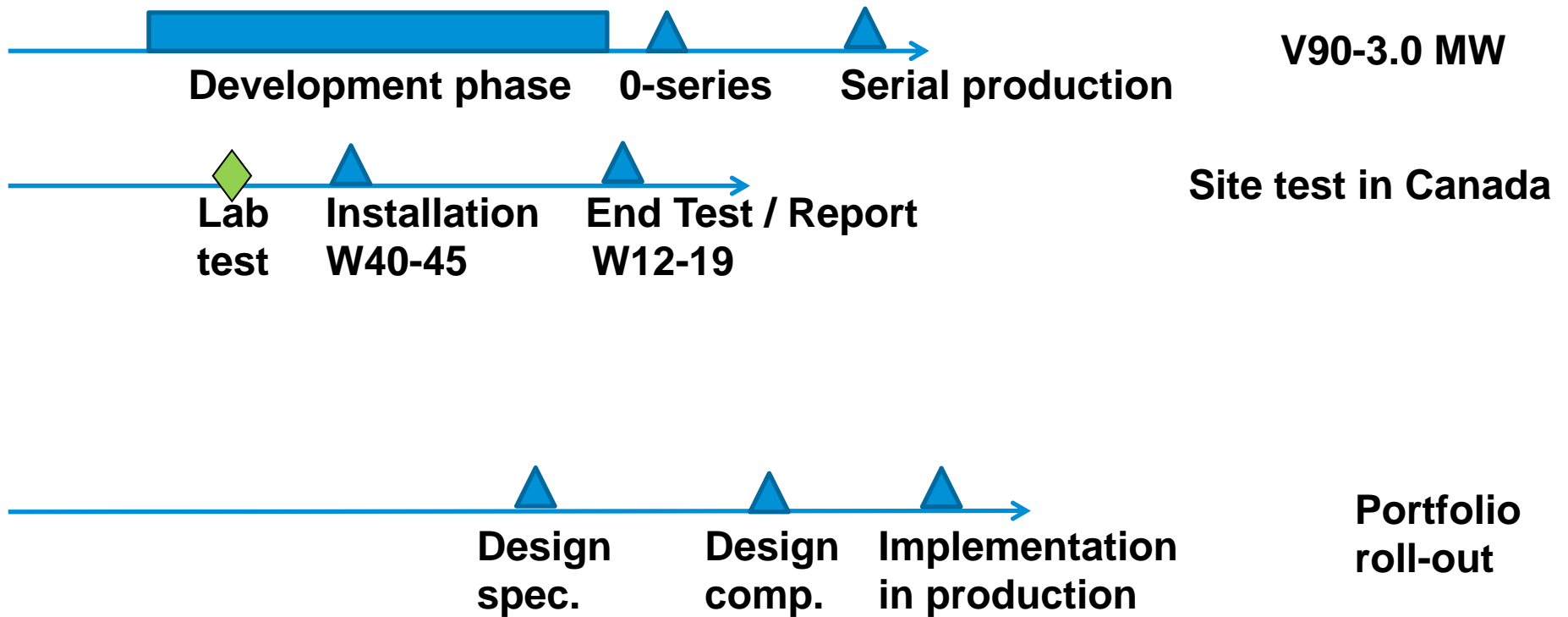
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# Project Plan

Proposed Development Schedule: V90-3.0 / V112-3.0 / V90-2.0 Mk9 / V100 Blade

2011	2012	2012	2012	2012	2013	2013	2013	2013	2014	2014	2014	2014	2015	2015
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2



The Vestas logo is displayed in a white, italicized sans-serif font. It is positioned in the upper left corner of a blue sky background with wispy white clouds. A semi-transparent blue diagonal shape is visible in the top left corner of the image.

**Vestas**<sup>®</sup>

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# Thank you for your attention

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