Vestas Cold Climate Solutions and next steps

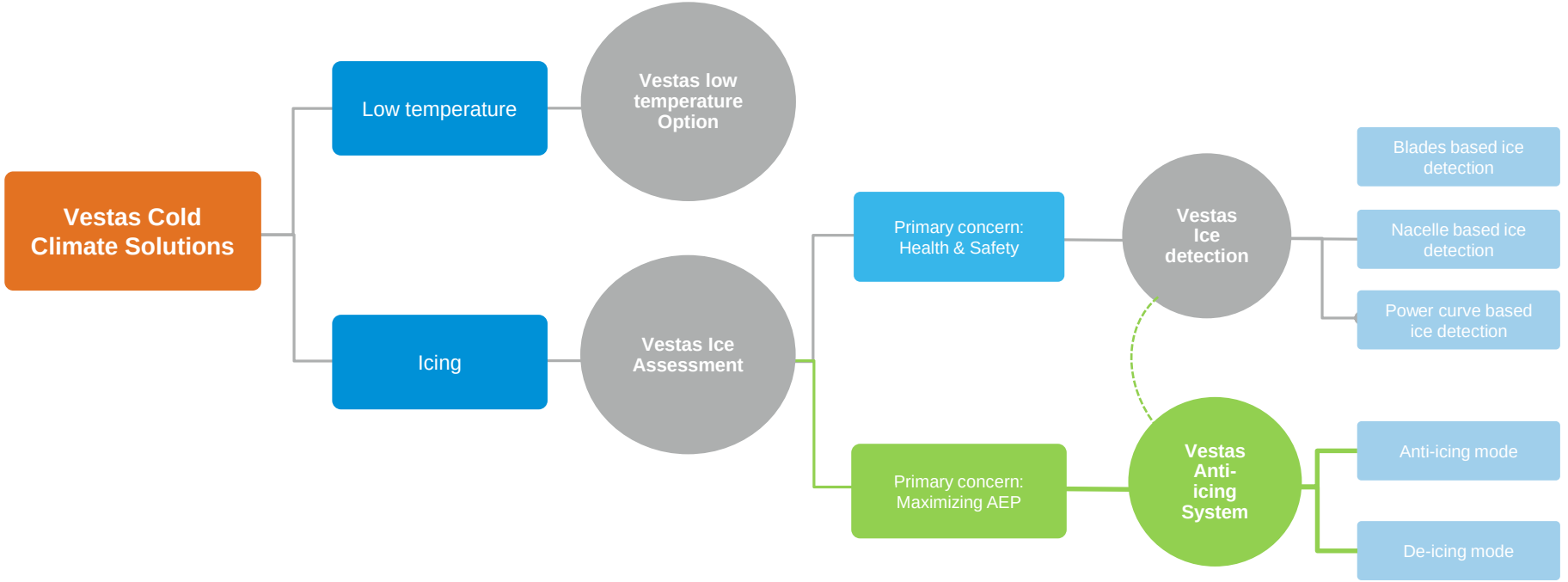
Brian Daugbjerg Nielsen, Product Management

Winterwind 2019

PUBLIC


Vestas
Wind. It means the world to us.™
VESTAS COLD CLIMATE OFFERINGS
FEATURING MODULAR ANTI-ICING ON ENVENTUS
Power Solutions, Product Management

VESTAS ANTI-ICING SYSTEM



Introducing

Vestas Anti-icing System™

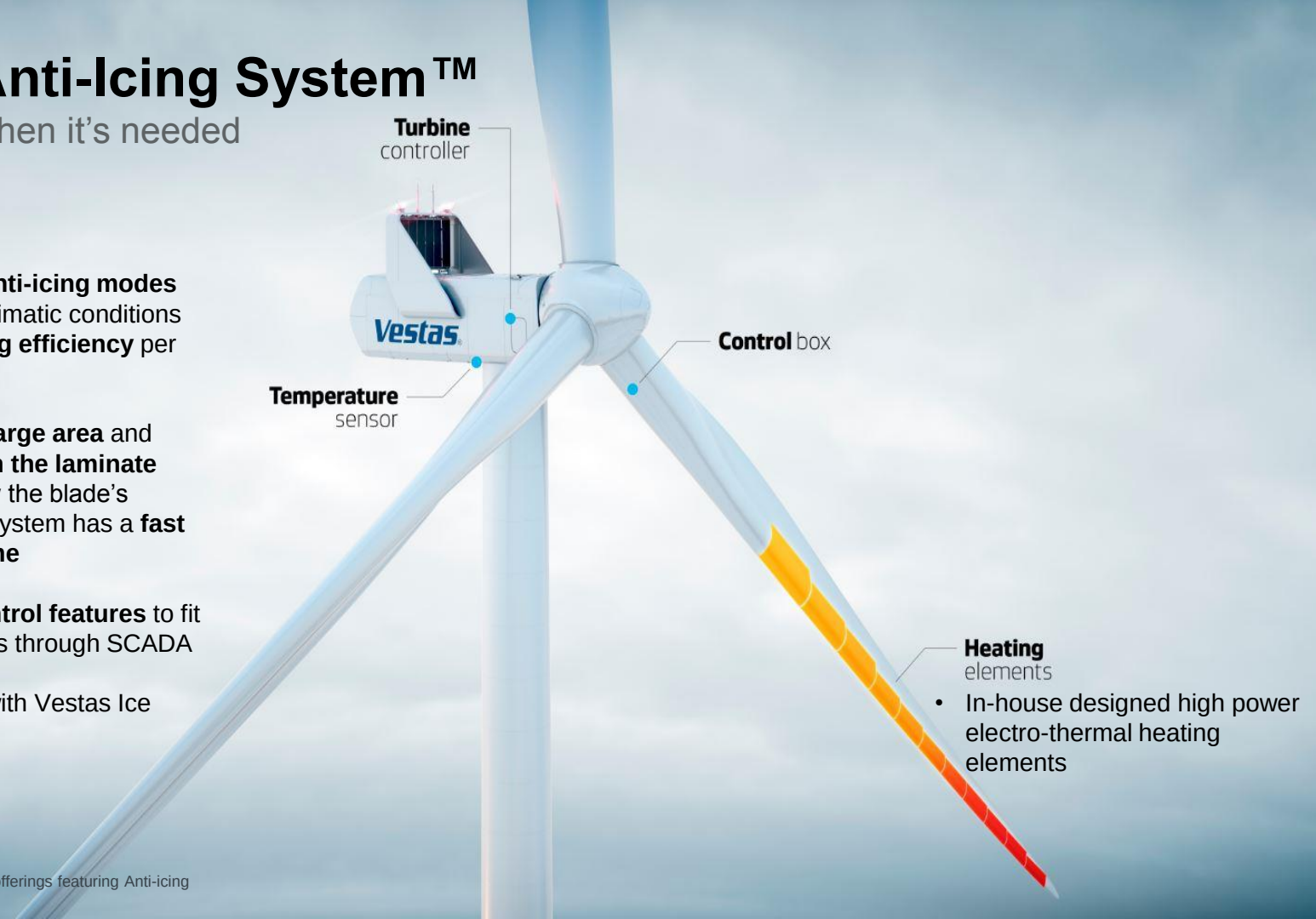
Efficiently removes ice built-up on blades during operation to maximise energy production.

Available for:	Delivery
• **V136-4.2 MW™**	**2019**
• **V150-4.2 MW™**	**2019**
• **V150-5.6 MW™**	**2020**
• **V162-5.6 MW™**	**2021**

Vestas Anti-Icing System™

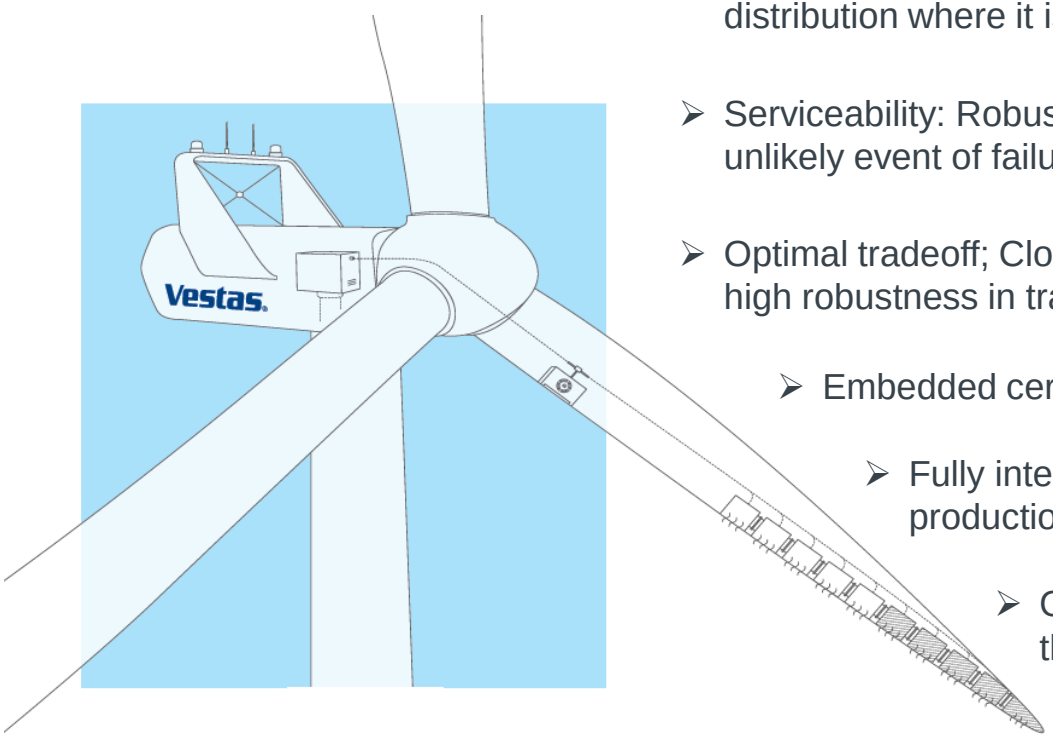
Where and when it's needed

- **Automatic anti-icing modes** adaptive to climatic conditions for **optimising efficiency** per icing event
- **Covering a large area** and **embedded in the laminate** directly below the blade's surface, the system has a **fast response time**
- **Optional control features** to fit site conditions through SCADA
- Compatible with Vestas Ice Detection™



- In-house designed high power electro-thermal heating elements

WHERE AND WHEN IT'S NEEDED



- Individual powering of heating elements to secure equal power distribution where it is needed
- Serviceability: Robust system to secure operation even in unlikely event of failure mode of the elements
- Optimal tradeoff; Close to surface for rapid heating response but high robustness in transport/handling
  - Embedded certified level 1 lightning protection
    - Fully integrated into the turbine from design and production
      - Optional control features to fit site conditions through SCADA

Vestas Anti-Ice System™ Availability

One module, applicable to multiple turbine variants

Designed to encompass a **wide range of turbine configurations** the **Vestas Anti-ice system™** designs **apply advanced modularity** to meet customisation and market demands more efficiently.

By design – blade surface heating coverage highly adaptable:

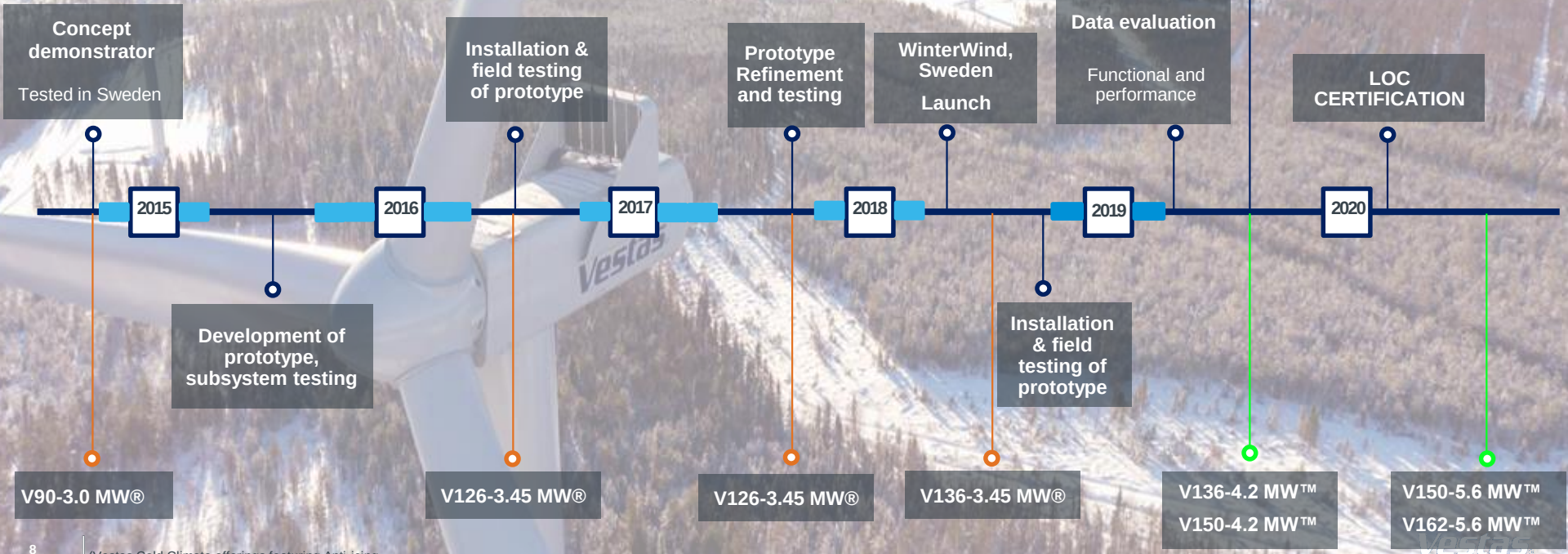
- Common component and circuit design/sizing
- Modular hardware integration
- Common software architectures – modular configuration
- Common ice detection system

Illustrative

V136-4.2 MW™ **V150-4.2 MW™** **V150-5.6 MW™** **V162-5.6 MW™**

VESTAS ANTI-ICING SYSTEM ™

5 years of product development to secure high reliability & performance



No stranger to cold climates

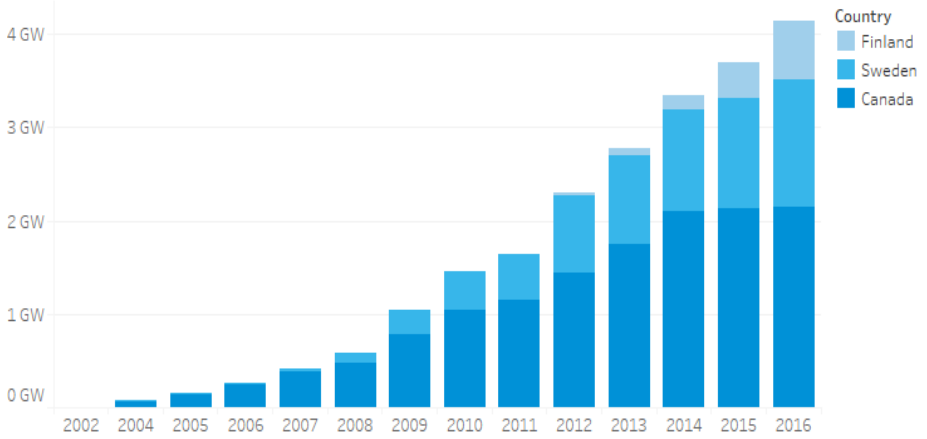
Strong track record and rapid growing

- **+ 17GW** installed with Vestas Low temperature option
- **+ 3GW** with Vestas Ice detection™
- **+ 1GW** with Vestas De-Icing™
- **+ 0.8GW** with Vestas Anti-Icing™ (firm order intake)

- Vestas Cold Climate Solutions are continuously producing valuable data
- Systematically incorporating into Cold Climate solutions

+4 GW
installed in ice prone areas*

16 years
Of experience in cold climates



*Above IEA ice class II

VERIFICATION & CERTIFICATION

VESTAS ANTI-ICING SYSTEM

Vestas

Vestas Anti-Icing System – In Operation

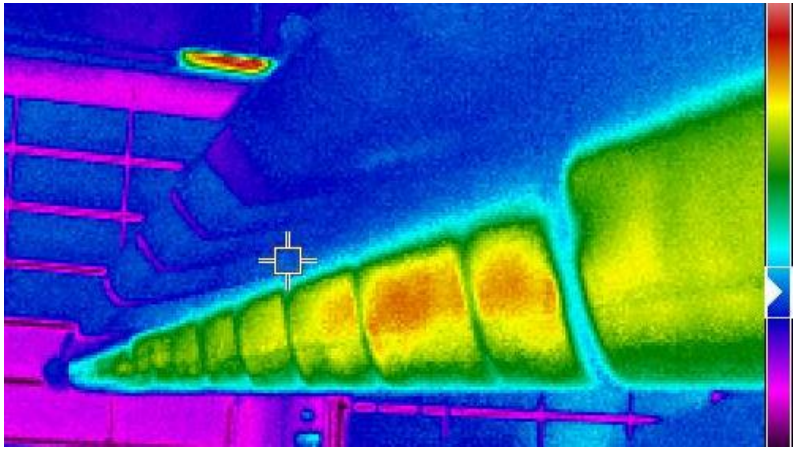
Demonstration of operation, reliability and optimal operational strategies:

- 2 V136-3.6MW Anti-icing WTGs are installed in Sweden for field testing ‘19
- The WTGs are fitted with additional instrumentation for the purposes of monitoring the VAS and environmental conditions
  - x5 independent meteorological measurement devices
  - x2 blade heating based measurement systems
  - x1 load based blade mounted ice detection sensor system
  - x2 blade imaging systems installed
- In-house designed camera mounting system to permit observation of each blade at multiple angles and orientations fitted with IR capability and thermal imaging

Vestas Anti-Icing System – Designed for Robustness

Blade Quality Assessments:

- Through the build phase interval checks are performed to assure quality
- The final build quality is systematically checked in the factory prior to transit using a purpose built test box

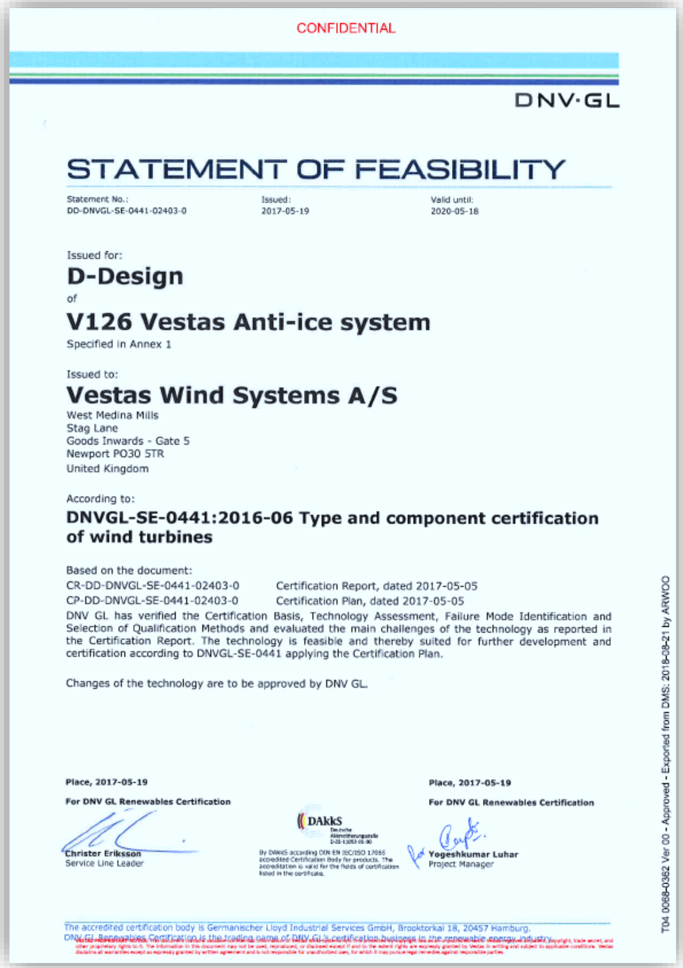


CERTIFICATION STRATEGY

- Anti-ice System will be verified by issue of a LETTER OF COMPLIANCE to the baseline turbine Type Certificates

- Production Anti-ice System DVPR common with concept demonstrator verifications

- Collaboration upfront with DNV-GL in order to generate a qualification plan for certification
  - D - certificate for V126 demonstrator - 0068-0362
  - Certification plan for VAS - 0068-0363 - **aligns with existing system DFMEA**


CONFIDENTIAL

DNV·GL

STATEMENT OF FEASIBILITY

Statement No.:	Issued:	Valid until:
DD-DNVGL-SE-0441-02403-0	2017-05-19	2020-05-18

Issued for:

D-Design

of

V126 Vestas Anti-ice system

Specified in Annex 1

Issued to:

Vestas Wind Systems A/S

West Medina Mills
Stag Lane
Goods Inwards - Gate 5
Newport PO30 5TR
United Kingdom

According to:

DNVGL-SE-0441:2016-06 Type and component certification of wind turbines

Based on the document:

CR-DD-DNVGL-SE-0441-02403-0	Certification Report, dated 2017-05-05
CP-DD-DNVGL-SE-0441-02403-0	Certification Plan, dated 2017-05-05

DNV GL has verified the Certification Basis, Technology Assessment, Failure Mode Identification and Selection of Qualification Methods and evaluated the main challenges of the technology as reported in the Certification Report. The technology is feasible and thereby suited for further development and certification according to DNVGL-SE-0441 applying the Certification Plan.

Changes of the technology are to be approved by DNV GL.

Place, 2017-05-19

For DNV GL Renewables Certification

Christer Eriksson
Service Line Leader

DAkkS Deutsche Akkreditierungsstelle D-ZE-11053-01-00

By DAkkS according DIN EN ISO/IEC 17065 accredited Certification Body for products. The accreditation is valid for the fields of certification listed in the certificate.

Place, 2017-05-19

For DNV GL Renewables Certification

Yogeshkumar Luhar
Project Manager

The accredited certification body is Germanischer Lloyd Industrial Services GmbH, Brooktorkai 18, 20457 Hamburg.
DNV GL Renewables Certification is the trading name of DNV GL's certification business in the renewable energy industry.

T04 0068-0362 Ver 00 - Approved - Exported from DMS: 2018-08-21 by ARWOO

Vestas

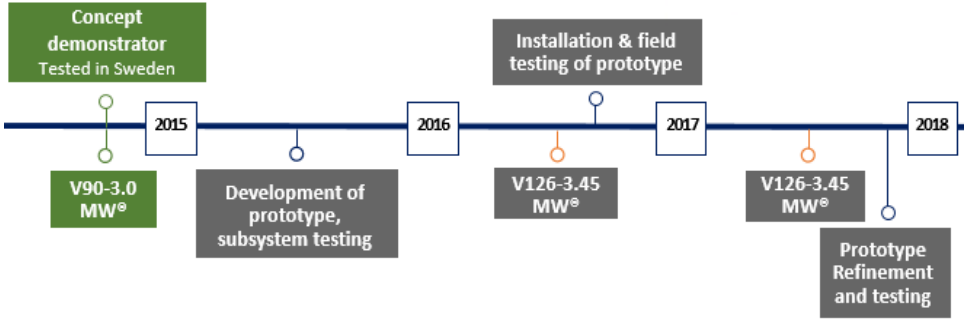
CONCEPT DEMONSTRATOR FIELD PERFORMANCE

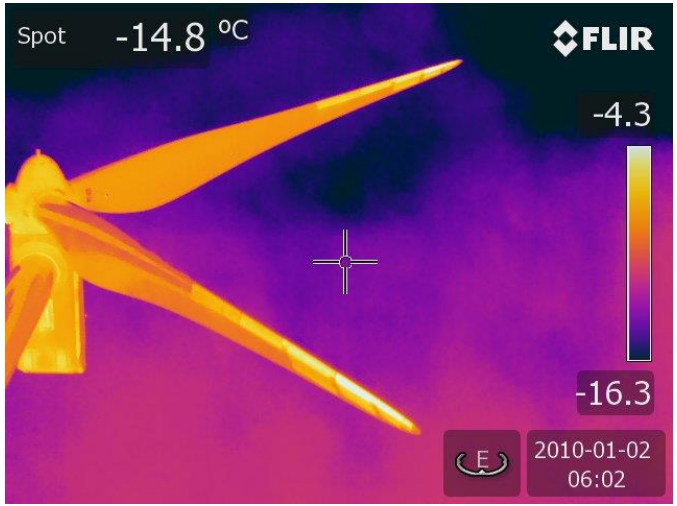
VESTAS ANTI-ICING SYSTEM

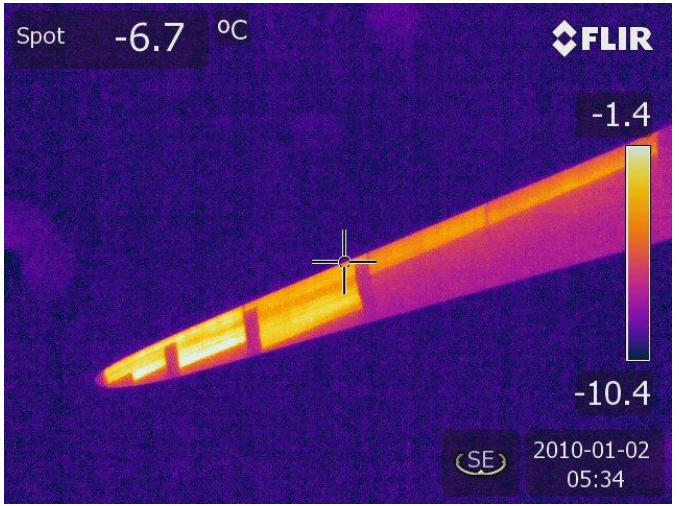
Vestas®

V90 ANTI-ICE TURBINE CONCEPT DEMONSTRATOR TEST

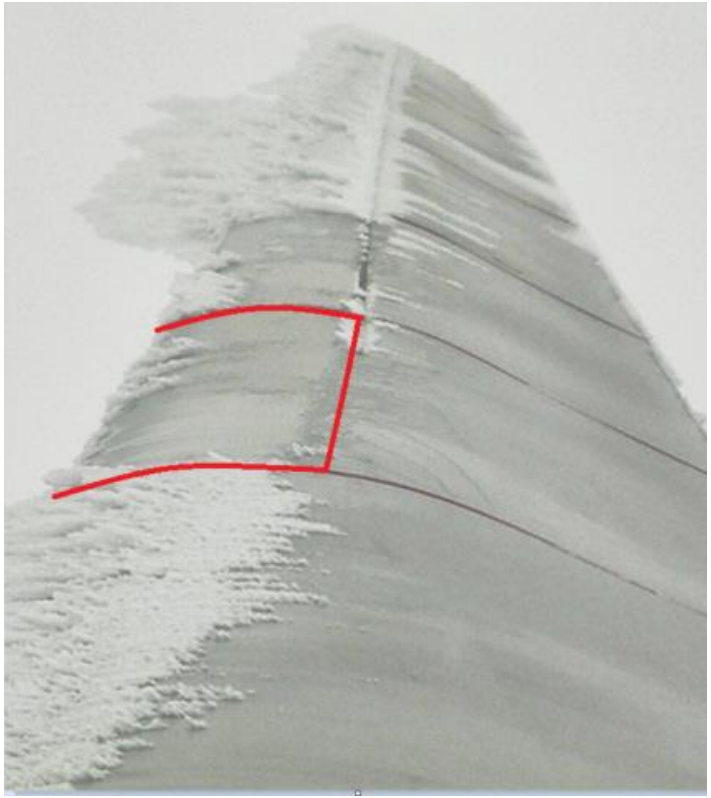
- Tested all panels and sensors successfully
- Activated multiple panels sequentially at ≈6% power, windspeed at 20m/s and -4°C
- Tip panels (A, B and C) showed positive temperatures when turbine was in stop and idle.



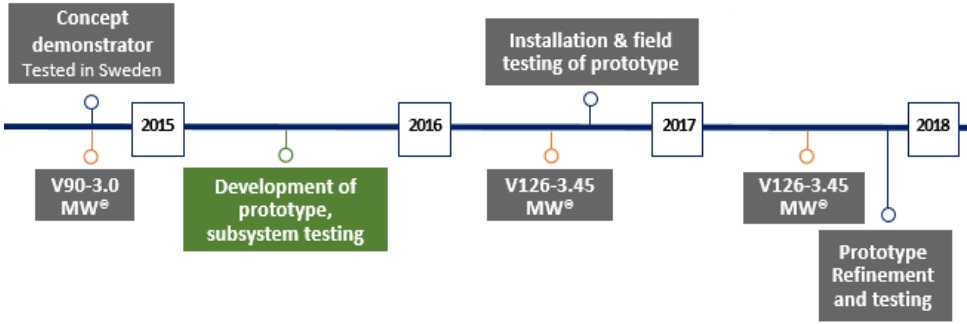




ICED V90 ANTI-ICED BLADE



Panel H Activated



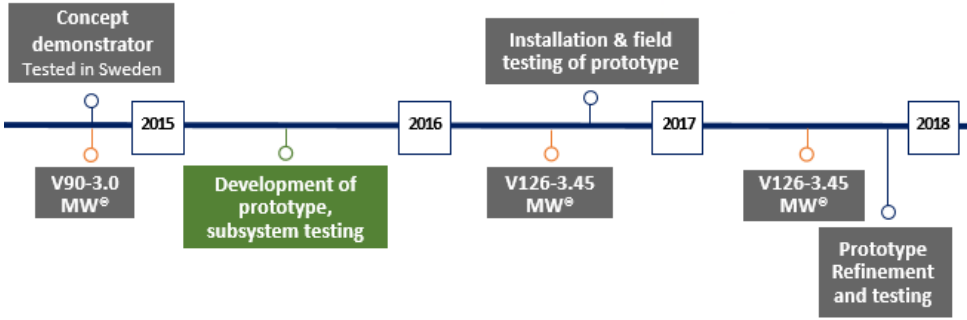
Sweden

- Glötesvålen 7th March 2016
- Ambient temperature -6°C at nacelle height. Wind speed 7m/s

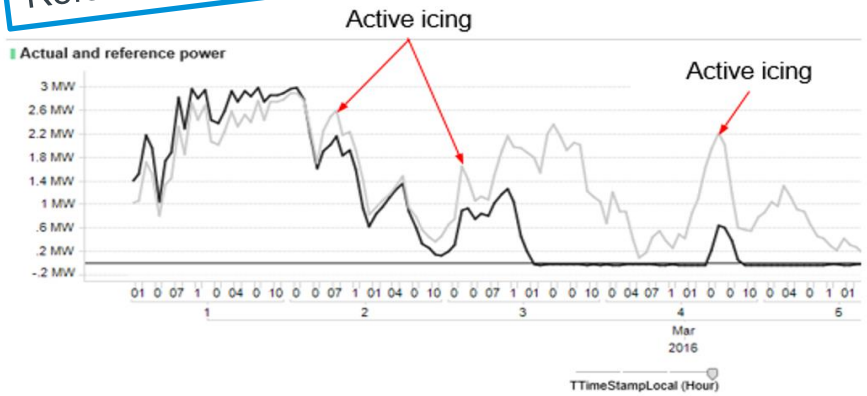
- Panel H De-iced to Show Ice Shape

V90 CONCEPT TURBINE TESTING

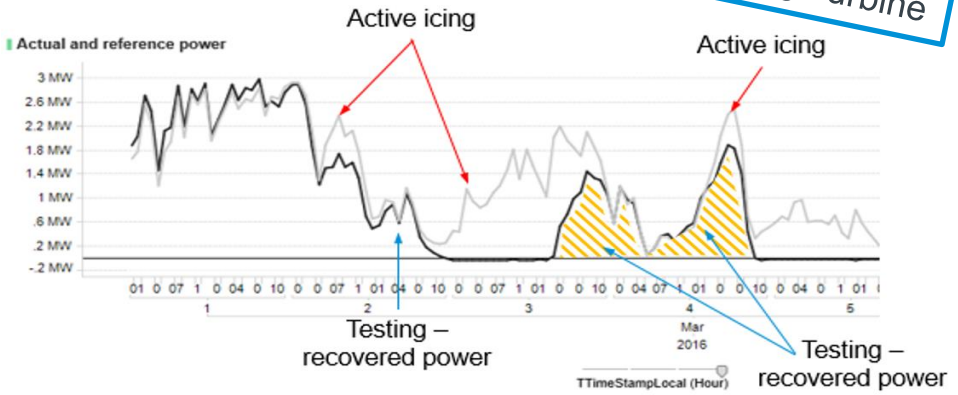
Example icing event



Reference Turbine



Anti-icing Turbine



Vestas Anti-icing System ™

Where and when it matters

- Available on V136-4.2MW, V150-4.2MW, V150-5.6MW & V162-5.6MW
- Anti-icing mode: maximum power 230-280kW from WTG's own energy production – in rotation
- De-icing mode: Nominal power 75-90kW from grid – in standstill (idle) 30 Minutes
- Environmental conditions for heating system activation:
  - -25°C
  - 22.5 m/s
- **90% retention of power production** in common icing conditions*

*Depending on siting and climatic conditions, most common in Ice class 1-3