

Existerande och framtida lösningar

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Vintervind 2008



Teknologiasta liiketoimintaa

History

- VTT and Kemijoki Oy developed ice prevention system for wind turbines since 1991.
 - Pyhätunturi, Finland, 2,5 kW stand alone turbine 1991, 220 kW grid connected test turbine 1993, VTT and Kemijoki research projects
 - Lammasoivi, Finland, 2x450 kW greid connected 1996, 600 kW grid connected 1998, Kemijoki and VTT, demonstration
 - Olostunturi, Finland, 5x600 kW grid connected, 1998-99, Kemijoki Arctic Technology Oy (KAT)
 - Suorva, Sweden, 600 kW, grid connected 1998 (KAT)
 - Rodåvålen, Sweden, 600 kW, grid connected 1998 (KAT)
 - Björneborg, Finland, 4x1 MW, 1999 (KAT)
 - Kotka, Finland, 2x1 MW, 1999 (KAT)
- KAT and Kemijoki not anymore in wind business
 - Technology follow-up, concept development, VTT
 - O&M services VAPO Oy
 - Heating system applications Carbonel Oy

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Technology Heating elements

- The selected technology is based on carbon fibre heating elements that are integrated into a blade structure.
- The first experiments were made using heating foils with conductive elements in Al or Cu inside thin epoxy films.
 - Tend to break due to blade bending even if the shape of the metal mesh was designed to withstand the bending.
- Up to now the carbon fibre elements have been laminated onto the surface of a blade after which the surface is finished with thin layer of the primary blade material and final surface finishing. Resulting blade with anti-icing is visually similar to a standard blade.

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Technology rights

- The heating system development in co-operation between Kemijoki Oy and VTT. Kemijoki Arctic Technology Oy, full subsidiary of Kemijoki Oy,
- VTT and Kemijoki entered a license agreement in 1997. This agreement has expired.
- Kemijoki Oy and Bonus Energy A/S had exclusive agreement on the use of the heating system of Kemijoki Oy. This agreement has also expired.
- Kemijoki Oy has a patent on a manufacturing process of the blade heating system. The process can be used also in other applications.
- Carbonel Oy, a company owned by 5 private persons, got the rights to use the patent in other applications. Carbonel Oy has developed prototype applications of composite heating systems to metal industry, car industry and aviation. Carbonel Oy has also developed the manufacturing process of the heating element further.

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Manufacturing process

- Prefabricated carbon fibre elements
 - delivered to blade factory for installation
 - include connections between heating elements and conductors
 - sensor wiring is done in connection to blade manufacturing process.
- The first series heated blades using carbon fibre
 - Lamination of the elements was done to the surface of unfinished blades.
 - After integration of carbon elements and lamination of protection layer for mechanical wear and tear the blades were coated normally.

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Development needs

- Series production of the anti-icing system requires
 - further development of the control of ice prevention system
 - integration of heating element installation to the blade manufacturing process.
- Heated blades for a 2-3 MW size turbine require
 - new dimensioning of the heating elements to improve the performance of the ice prevention system.
 - An integration of control system to the turbines control system at some level would allow better optimization of heating energy.
 - Higher level of integration of manufacturing process would improve the quality of work and reduce the amount of handwork.

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Wind energy in cold climate esp. icing environment

- Need: ice-free solutions for 1-3 MW variable speed turbines with modern control capabilities
- Steps
 - Evaluation of wind resources and evaluation and verification of icing risks (work carried out partly within IEA Task 19)
 - Performance of wind turbines in icing conditions, verification of models
 - Technology and product development for ice free blades
 - Demonstration in sites with different conditions

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