Skellefteå, April 19th-21st 2022

Winterwind

INTERNATIONAL WIND ENERGY CONFERENCE

Improved ice detection
New guidelines and AI solutions

Data modeling
Assessing energy exchange and icing losses

From racing cars to de-icing
Swedish inventor finds new solutions

Scan the QR code to watch a video presentation about the Swedish Windpower Association on YouTube.

Winterwind is an international must-go for everyone working with issues related to wind energy in cold climates. Every year, the world's wind energy professionals meet at Winterwind in Sweden to discuss the challenges and solutions of generating wind power in cold climates.

Organizer

Swedish Windpower Association

Main Sponsor

Skellefteå Kraft

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Svensk Vindkraft – För en framtid i medvind

Vindkraftsnyheter.se

Nordisk Energi

Vinden. En 100 % förnybar

Skellefteå Krafts mål är att bidra till att Sveriges energisystem blir 100 % förnybart. Då behöver vi hitta på massor med olika projekt som ger oss de insikter, lösningar och idéer som behövs i omställningen.

Där har energi från förnybara källor en viktig roll att spela.
Vindkraften, till exempel. 100 % förnybar kraft!
Besök oss i monter nummer 7 eller läs mer på skekraft.se.

kraft.

WELCOME

to Winterwind conference 2022

THE NEED FOR more renewable electricity production has become even more obvious to all of us. We see a fast progress for technology development and investments for wind energy production in harsh climates.

The international Winterwind conference has after 14 years evolved into a shared experience arena where industry and science meet to improve utilization of wind energy in cold climates. #Winterwind2022 challenges the industry to put main focus on validation, and we have a record number of exhibitors.

The conference takes place in Skellefteå, and this is where to be when it comes to the new industrialization with massive investments in electrification, hydrogen production, battery production, fossil-free steel and more.

We hope all of you will have a great experience; take the opportunity to get new contacts, new knowledge and new business opportunities!

Let the show begin!

Jakob Economou
Coordinator, Winterwind 2022

Jeanette Lindeblad
Chairwoman of the Board, Swedish Windpower Association

Swedish Windpower Association

Swedish Wind Power was founded in 1986 and is an industry organisation for wind energy producers, with approximately 800 members, ranging from smaller wind power owners to large-scale energy companies. With more than 35 years experience we are an established referral body and stakeholder in the Swedish wind energy sector, working to promote efficient development and economic conditions for wind power in Sweden.

One of the areas that define Swedish Wind Power is the exchange of knowledge, both as a referral body and provider of courses, seminars, and conferences. The seminars and conferences work as meeting points for the wind industry in Sweden. Being a member of Swedish Wind Power has several advantages and we are continuously working to develop new membership benefits to find attractive solutions that provide real and practical value to our members.

Every year we arrange international conferences like Winterwind and RE-Scandinavia. We offer a wide range of attractive benefits!

More about members benefits and the association at: **www.svenskvindkraft.com**

Scan the QR code for enlarged version of the membership benefits table shown above.

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Think beyond convention today

You might expect an energy company to only do energy. But to live fossil free tomorrow, we need to think beyond convention today. At Vattenfall, that's the mindset that drives everything we do. It's why we're collaborating with partners from beyond the energy sector to decarbonise entire industries and help make fossil free living a reality.

Meet us at stands 12 and 15

VATTENFALL

Weidmüller

Rotor blade condition monitoring

Get the most out of your system

BLADEcontrol® – more transparency for maximum return

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- Optimisation of service operations
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- On- and offshore

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WIND SWEDEN

MEET OUR SPONSORS & EXHIBITORS

In the exhibition you'll meet interesting companies and organizations offering services and products specific to your business within renewables. These are the sponsors and exhibitors for the 2022 conference.

Please visit their websites and social media channels.

Main Sponsor

Skellefteå Kraft

Skellefteå Kraft is one of Sweden's largest energy producers, generating wind-power, water-power, heating and bio-energy. Our goal is a Sweden running on 100 % renewable energy. That is why we only sell 100 % renewable energy and put as much as we can into investments and research.

It's going to be alright.

IMAGE: Jonas Hasselstam, Vasa Vind.

GigaWatt Sponsors

W3 ENERGY
ACTIVE ASSET MANAGEMENT

W3 Energy is the independent Asset Manager specialized in cold climate wind farms in the Nordic region. W3 Energy offers proactive coordination and optimisation within four business areas: Technical Management of Windfarms, Financial Management of SPVs, IT Management and Electrical Management.

Based on the experiences from managing Europe's by far largest wind farm, every part of the process is optimized. This has acknowledged W3 Energy as the reliable game-changer in Active Asset Management, that both technically and financially empowers the green conversion.

We are an independent Active Asset Manager with only one loyalty - the customer.

KJELLER
VINDTEKNIKK
Part of Norconsult

Kjeller Vindteknikk is one of the leading consultancies within meteorological wind and ice modelling in the Nordics. We provide services such as wind measurements, energy yield assessments, icing loss estimations, post production reviews and icing forecasting for all stages of wind farm development.

Kjeller has carried out icing loss assessments for over 150 wind farms, been involved in third party performance assessment of de- and anti-icing systems and have supported in warranty discussion connected to anti and de-icing systems.

Kjeller Vindteknikk has more than 20 years of experience, supporting more than 500 clients within wind energy in cold and icing climates.

wpd windmanager

As one of the leading companies in the commercial and technical operation of wind farms and solar projects, wpd windmanager manages a total capacity of over 6,000 MW worldwide and currently employs over 500 people. With its offices in Oulu and Piteå, wpd windmanager possesses many years of experience in the Scandinavian market and handles wind farms with a capacity of over 370 MW for various investors. The German company operates worldwide and has offices in various other European countries, in South America and in Asia. More information at: www.windmanager.net

VATTENFALL

For more than 100 years Vattenfall have electrified industries, supplied energy to people's homes and modernised our way of living through innovation and cooperation across Europe.

Today, wind power is a central pillar of our strategy. Our portfolio comprises around 1,200 wind turbines in operation with a total installed capacity of 4.2 GW in five countries. With more than 2 GW of capacity under construction, we have the ambition to build more.

To live fossil free tomorrow, we need to think beyond convention today. At Vattenfall, that's the mindset that drives everything we do.

Learn more at vattenfall.com

MegaWatt Sponsors

ENERCON products are known for their innovative technology, outstanding reliability and excellent returns on investment, worldwide. With their tried and tested drive system, constant technological sophistication and high quality standards, the company has been setting benchmarks in the wind energy industry for more than 30 years. Currently, the product catalogue includes turbines ranging from 800 kW to 5.560 kW. ENERCON has already installed more than 31.000 turbines worldwide with a total rated power of 56 gigawatts.

Phoenix Contact offers you innovative automation and connection technology for the equipment of your wind turbine or wind farm. Many products have been specially developed for the wind industry and impress with their exceptional robustness and clever functions. A user-friendly operation and a seamless interaction are a matter of course. At Winterwind 2021 we present you our „Blade Intelligence" . It is a modular rotor blade monitoring system that combines the ice detection, lightning measurement, structural health monitoring and load monitoring functions in one system.

As part of the Weidmüller Group, Weidmüller Monitoring Systems GmbH is a powerful partner for wind turbine manufacturers and operators. Since 2004, the Dresden-based company has been using its core competence in the field of multi-dimensional natural oscillation measurement on fiberglass and carbon components. This long-standing know-how is used worldwide in over 29 countries for condition monitoring and ice detection of rotor blades on wind turbines.

With more than 4,000 monitoring systems in use, we can draw on 14,000 machine years of monitoring experience to provide you with the optimum solution for your turbines.

Wicetec is the world-leading wind turbine blade heating technology provider. Our solution prevents ice formation on blade surfaces. This enables continuous turbine operation throughout the winter. Our patented technology is available for new turbines and retrofits with field proven lifetime of 20 years. Wicetec staff are highly skilled professionals with firm experience of wind power in cold climate.

Vasa Vind develops, constructs, owns, and operates large scale wind power in Sweden. The portfolio includes 490 MW of operational assets with an additional 90 MW under management, all in northern Sweden. Furthermore, Vasa Vind has a substantial development pipeline, including one of Sweden's largest development projects in cold climate. Vasa Vind has a long-term sustainability perspective in all its activities, with particular focus on sustaining local communities and the health and safety of all who work at or visit site. Vasa Vind works closely with suppliers and industry experts to continuously promote further development in these areas.

Personally engaged advisor in wind power and renewable energy and an experienced partner for your project. Wind Sweden are specialized in various parts within renewable energy with specialist expertise in on- and offshore wind power in the Nordics. The company consists of twelve senior consultants.

Read more on: wind-sweden.com

KiloWatt Sponsors

AQSystem
Remote sensing technique

Wind measurement in harsh winter climates is challenging and selecting wind measurement instruments is important for your project. Vattenfall has shared 13 years of data for performance evaluation of the AQ510CW system. Average system uptime has been 98 % and data availability at 100 meters 97 %. Robust technology, no moving parts and sophisticated snow melting solutions makes the AQ510CW perfect for cold climate wind measurements. Jan-Åke from Vattenfall service Nordic comments:

"The main issue with the new generation is that failures are so rare that this prevents the engineers from getting experienced".

NORDEX acciona Windpower

Nordex Group The development, manufacture, project management and servicing of wind turbines in the onshore segment has been the core competence and passion of the Nordex Group and its more than 8,500 employees worldwide for more than 35 years. As one of the world's largest wind turbine manufacturers, the Nordex Group offers high-yield, cost- efficient wind turbines in the 3 to 6MW+ class that enable long term and economical power generation from wind energy in all geographical and climatic conditions. A broad range of options and solutions, including cold climate packages and Anti-Icing solutions, ensure that our turbines fit perfectly to individual specifics.

Exhibitors

FuGen

FuGen is a privately held company founded by a group of seasoned renewable energy entrepreneurs. Our team has more than 100 years combined experience in the energy industry, bringing in-house expertise in development, financing, construction, operation, and optimization of renewable energy assets.

VINDFORSK

Vindforsk is a technical research programme run by Energiforsk the Swedish Energy Research Centre and financed by the Swedish industry. The aim is to hoard and share knowledge to strengthen the knowledge base of the Swedish wind power industry and the energy sector.

UPPSALA UNIVERSITET

Uppsala University Campus Gotland governs the online course Vindkraftskurs.se, and offers a large selection of multi-disciplinary wind power courses and a Master programme in Wind Power Project Management at University level. Vindkraftskurs provides knowledge on conditions, legislation and research findings for wind power development.

VINDVAL

Vindval collects and provides scientific knowledge of wind power's impacts on humans and nature. The program is a cooperation between the Energy Agency and the Swedish EPA.

Exhibitors

Connected Wind Services is an independent, global independent service partner (ISP) in the renewable energy market. Our history and heritage go way back 35 years, our experience has been proven repeatedly over time. Dedicated to advancing the transition to sustainable energy, we challenge the current service solutions and explore new, innovative ways to reduce complexity and optimize the operation of wind turbines by combining our vast knowledge and experience with progressive thinking, this applies in Service Project, O & M, Up Tower, Technical Management, and full service concepts. For detailed info, contact us at info.se@connectedwind.com

DNV is an independent assurance and risk management provider, operating in more than 100 countries. Through its experience and expertise DNV advances safety and sustainable performance, sets industry standards, and inspires and invents solutions. For the energy sector, we provide assurance to the entire energy value chain through our advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, we help industries and governments to transition faster to a deeply decarbonized energy system.

Since its founding in 1930, TKF has developed from a cable manufacturer to a technologically leading supplier of connectivity solutions.

With a complete portfolio of cables, systems and services, we offer customers worldwide solutions for creating safe and reliable energy and data connections. TKF is a member of the TKH Group.

Linnovation is a Swedish innovation company that is specialized in developing heating solutions for usage in cold climate. One of the products is the anti/deicing system for wind turbine blades which has been developed in co-operation with Skellefteå Kraft AB and with financial support from The Swedish Energy Agency.

Skylark is a digital operational control software platform to enable owners and operators of wind farms to track and manage workers more safely and effectively.

Site-based personnel use our mobile app with built-in safety features to complete inductions, check on and off site, receive work orders, mitigate risk, and achieve compliance.

www.skylarkcontrol.com

Modvion develops the next generation of wind turbine towers in laminated wood, nature's carbon fibre. Using wood enables radical emission reductions through replacing emission-intensive materials, such as steel and concrete. Modvion's patented modular tower concept, enables reduced manufacturing costs, and enhances transport efficiency when installing high towers.

Exhibitors

Clobotics Wind Services combines decades of experience, state of the art technologies and senior in house blade specialists. Both onshore and offshore blade repairs are documented by Clobotics Raven, which enables automated data acquisition, reporting and online access. We set new standards for wind turbine blade repair quality and documentation.

eologix sensor technology produces flexible, retrofittable smart sensor solutions for overarching rotor blade monitoring. eologix market proven sensor systems installed on more than 500 turbines are designed for ice detection, temperature measurement and pitch angle monitoring on rotor blades, minimizing downtimes and offering best performance.

EVVA is a family owned business and has always stayed true to its fundamental values, innovation and quality. From its establishment in 1919, the first lock in 1937 and modernisation measures in the 1970s, EVVA is now one of Europe's leading security companies in mechanical and digital locks.

www.evva.com

SENTEA develops the most cost effective fiber optic sensing solutions for wind turbines, including ice detection, blade load sensing, and drivetrain condition monitoring. Monitor all critical parts of your wind turbine with fiber optic sensors, which are intrinsically resistant to corrosion, extreme temperatures, lightning strikes, and electromagnetic interferences.

Wölfel Wind Systemsis focused on Structural Health Monitoring of the complete wind turbine. We deliver reliable data analysis (Structural Intelligence) for lifetime assessments, increase of energy yield as well as ice and damage detection for rotor blades. Additionally we manufacture systems for reduction of vibrations and structure borne noise.

www.woelfel.de

Wind turbine blades have an acoustic signature. We record changes in this signature to continuously monitor the state of your wind turbine blades and use advanced acoustic analysis to detect change. Ping has developed ice detection algorithms using sound and is launching this new service at Winterwind 2022. For more information please contact:

info@ping.services

Exhibitors

FT Technologies' ultrasonic wind sensors are designed specifically for wind turbine control and are used by the world's leading turbine manufacturers both on and offshore. Fitted with thermostatically controlled heating system, FT sensors are ideal for cold climates and help to improve AEP and reduce LcoE.

EMD International A/S is a software and knowledge centre supplying companies and institutions worldwide with software, consultancy services, training and know how within the fields of project design, planning, documentation and operation of environmentally friendly energy projects.

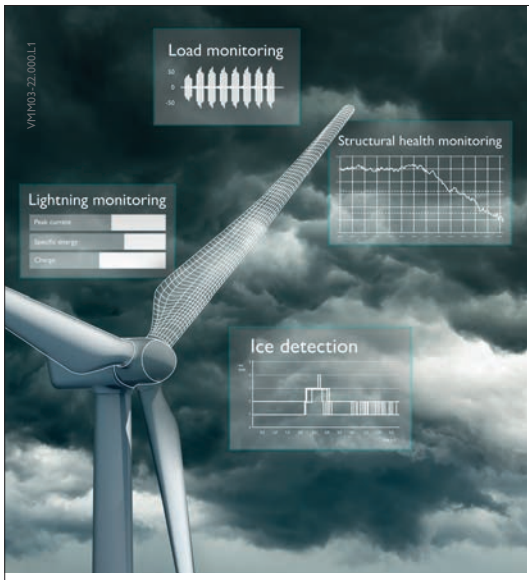
INKOM; Industrikomponenter AB, represents ORGA NL in Sweden. Since 1967, INKOM has provided Nordic industry with components in energy, process, manufacturing, trains and defense electronics. ORGA NL and INKOM works together to help companies and organizations that have flight obstacles so that safety is always in accordance with current regulations. Contact us at:

www.inkom.se

Megger has been a leader in electrical test and measurement globally for 130 years. From power generation to the power outlets in your home, Megger products cover almost every application within the Electrical Supply Industry. Our products are categorised into seven core application segments: cable test and diagnostics, protection relays and systems, circuit breakers, transformer test and diagnostics, low voltage installations, general electrical testing, and motor and generator testing

Deutsche Windtechnik AB, provides complete maintenance, ranging from basic service agreement to individually tailored full service agreements for nearly 300 wind turbines manufactured by Vestas, Enercon, Siemens, Gamesa, Nordex in Sweden The Deutsche Windtechnik group has over 6000 turbines totally in Europe, USA and Asia. The company operates both onshore and offshore.

Labkotec ice detection systems detect icing conditions on the blades of a windturbine. With Labkotec Ice Detection, you can reduce risks caused by ice formation and optimise wind turbine operations. Labkotec Ice Warning detects icing weather conditions and provides ice alarms to prevent accidents in the vicinity.



Solutions for wind power

Maximum availability for efficient energy production

Harsh environmental conditions and long lifecycles – wind turbines place highest demands on electrical engineering. Phoenix Contact is your reliable partner for innovative solutions from the wind turbine up to the wind farm.

For additional information, visit **phoenixcontact.com**

PHOENIX CONTACT
INSPIRING INNOVATIONS

ENERCON. TRAILBLAZER FOR THE ENERGY TRANSITION.

Ambitious climate protection and an accelerated energy transition are the dictates of our time. Apart from the will to change, innovative onshore wind solutions are indispensable in order to stop the ongoing destruction of the basis of our existence. As a committed trailblazer for the energy transition ENERCON offers innovative products and services to support the construction of climate-protecting regenerative energy systems all over the world. ENERCON technology is reliable, has stood the test of millions of operating hours and guarantees sustainable security of supply and system stability.

www.enercon.de

ENERCON
ENERGY FOR THE WORLD

Winterwind
INTERNATIONAL WIND ENERGY CONFERENCE

Tuesday April 19th

09:25-18:00

Field Trip to Markbygden

Full day activity!

09.25	The bus will be outside Skellefteå Airport
~ 09.40	The bus leaves the Airport
09.55	Pick up at The Wood Hotel, Skellefteå (1.5 tim)
11.30	Welcome to Markbygden Wind Farm (information and safety briefing)
13.00	Lunch. Prepared outside on a mourikka and meeting with Sami
~ 14.00	Bus leaves for Skellefteå
~ 15.30	Short visit at the showroom in Skellefteå (information on Northvolt battery factory)
~ 16:00	Back at the Wood Hotel

Check the website for the latest updates: www.winterwind.se

Wednesday April 20th

09:00 - 10:00

Ice detection (1)

Chairs: Helena Wänlund & Mark Zagar

Accelerated Integration of Joint Ice Load and Damage Detection, Timo Klaas, Wölfel Wind Systems, DE (14)

Autonomous calibration and optimization of blade based ice detection systems, Daniel Brenner, Weidmüller Monitoring Systems GmbH, GER (27)

Load Monitoring: The way to operate WTG under Ice Conditions?, Nils Lesmann, Deutschland (28)

Production losses (2)

Chairs: Jenny Longworth & Sven-Erik Thor

Validation of icing loss forecasts with SCADA data, Mona Kurppa, Kjeller Vindteknikk part of Norconsult, FI (4)

Improvement of ILM calculation by pre-processing of the acquired data, Wakana Igarashi, Kanagawa Institute of Technology, JP (13)

A smart algorithm for wind turbine controlling under icing conditions, Franziska Gerber, Meteotest AG (36)

10:30 - 12:00

Opening session (3)

Moderators: Jeanette Lindeblad & Göran Ronsten

Swedish Windpower Association, Jeanette Lindeblad, Swedish Windpower Association, SE (40)

Renewable energy as a growth factor, Stefan Forsgren, Skellefteå Kraft AB, SE (42)

Wind and Electricity Storage from an European perspective, Johan Söderbom, InnoEnergy, SE (41)

Northvolt - Enabling the Future of Energy, Wilhelm Löwenhielm, Northvolt, SE (39)

12:00 - 13:30

Exhibition: Lunch break

13:00 - 13:30

Poster session

Moderator: Nils Lesmann

A novel model for glaze ice accretion, Robert Szasz, Lund University, SE (26)

Cold climate validation testing using a large climate chamber, cold-start-up test bench and large size ice spray array, Bram Cloet, Sirris, BE (18)

13:30 - 14:30

Ice detection (4)

Chairs: Sigrid Carstairs & Timo Klaas

Enhancing power production without safety concessions in cold climates – early ice prediction by sensor fusion of surface and high-precision wind data, Michael Moser, eologix sensor technology, AT (22)

A thermal based ice detection sensor - from academic research to a commercial product, André Bégin- Drolet, Université Laval and Instrumentation Icetek, CA (20)

Marinvent Airfoil Performance Monitor integration to a wind turbine, Dominic Bolduc, Nergica, CA (29)

Production losses (5)

Chairs: Mona Kurppa & Per Olofsson

Validation of Ice-Affected Plant Energy Assessment at a Large OEM, Anne Lund Christophersen, Vestas, DK (16)

Nordex advanced Anti-Icing System for N163 wind turbines, Konrad Sachse, Nordex Energy SE & Co. KG (1)

Aerodynamics of iced blades: a 2D investigation, Hamid Sarlak, DTU, DK (32)

14:30 - 15:00

Break, Poster session two

Moderator: Christer Andersson

Wind measurment that works in cold climate, Emil Dahl, AQ system AB, SE (45)

Drone Based Direct Wind Resource Measurement & Performance Monitoring, Rasmus B. Lajevardi, First Airborne Ltd, IL (46)

15:00 - 16:00

Ice throw forecast (6)

Chairs: Marie Cecilie Pedersen & Gilles Boesch

Introducing IceRiskForecast 2.0: Managing icing related risks at wind farms with nowcasts and ensemble forecasts, Sigbjørn Grini, Kjeller Vindteknikk part of Norconsult, NO (11)

windThrow 1.0: the aerodynamics ice-throw toolbox, now with a graphical interface, Hamid Sarlak, DTU, DK (31)

Calibration icing forecasts using real-time SCADA data, Kristian Ingvaldsen, Kjeller Vindteknikk part of Norconsult, NO (8)

Third party solutions (7)

A joint panel with Raphael Janssen (EDF), Daniela Roeper (Borealis), Petteri Antikainen (Wicetec) and André Bégin-Drolet (ULaval)

Third-party solutions for ice mitigation, Dominic Bolduc, Nergica, CA (34)

16:00

Exhibition break

19:00

Dinner

Thursday April 21st

08:30 - 09:30 Key Notes (8)

Moderators: Anne Lund Christophersen & Lars Jacobsson

Enhancing icing datasets: Lessons learned from the U.S. ice storm, Luke Cunningham, Clir Renewables, CA (5)

Business Intelligence Analyst, Simon Grenholm, W3 Energy, SE (24)

Using drones for an ice piece collection campaign, Anne Mette Nodeland, Kjeller Vindteknikk part of Norconsult, NO (6)

10:00 - 11:00 Validation and offshore (9)

Chairs: Daniela Roeper & André Bégin-Drolet

Addressing the challenges of accurately characterising the impact of cold climate atmospheric conditions for ever larger offshore turbines through a review of operational data, Marie-Anne Cowan, Wood Thilsted, UK (30)

Storage of electricity in molecules, Finn Daugaard Madsen, Siemens Gamesa (37)

Validation study of modelled icing using met mast data and SCADA data, Marie Cecilie Pedersen, EMD International A/S, DK (15)

Ice throw (10)

Chairs: Liselotte Aldén & Anne-Mette Nodeland

Comparison and validation of ice throw models, Markus Drapalik, University of Natural Resources and Life Sciences, Vienna (BOKU), AT (9)

Perceptions of impact-based warning information for ice-throw risk: A Norwegian survey, Rolv Erlend Bredesen, Kjeller Vindteknikk part of Norconsult, NO (for Norwegian Meteorological Institute, NO) (7)

Edition 2 of the IEA Wind TCP Task 19 International Recommendations for Ice Fall and Ice Throw Risk Assessment – What's new?, Claas Rittinghaus, Energiewerkstatt Verein, AT (21)

11:00 - 11:30 Break, Poster session three

Moderator: Linnéa Karlsson

Long-term high-efficient Graphene-based anti-/de-icing coating, Jun Chen, Lulea University of Technology, SE (44)

ArcticDEM – Next generation elevation model for wind farms in cold climate? Morten Lybech Thøgersen, EMD International A/S, DK (17)

Preliminary Investigation into Shear-Web Behaviors under Thermal Loads from IPS, Dylan Baxter, Borealis Wind Inc., CA (47)

11:30 - 12:30

Ice protection systems and repair (11)

Chairs: Marie-Anne Cowan & Konrad Sachse

Preventing wind turbines from catching colds, Patrice Roberge, Canada (2)

Blade repair in artic climate, Greger Nilsson, Blade Solutions, SE (43)

Linnovation concept for wind turbines in cold climate – experiences from field operation fall 2021- winter 2022, Lars Tarberg, Linnovation AB, Sweden (19)

Validation (12)

Chairs: Franziska Gerber & Finn Daugaard Madsen

Validation of modelled instrumental icing with mast measurements, Ville Lehtomäki, Kjeller Vindteknikk part of Norconsult, FI (3)

Bridging the Gap – Validation of Pre-construction Wind Farm Modelling Against Operational Data, Enrico Sindici, Natural Power, UK (10)

A note on ice detection of wind turbine blades by a rotating-cylinder-type ice sensor, Reina Muto, Kanagawa Institute of Technology, JP (12)

12:30 - 13:30

Exhibition: Lunch break

13:00 - 13:30

Poster session four

Moderator: Andreas Wickman

An open source ice model running in WRF, Jana Fischereit, DTU Wind and Energy Systems, DK (48)

Lifetime extension of main bearings, scientific calculation and practical implementation, Stefan Bill, Rewitec GmbH, DE (35)

13:30 - 15:00

Closing session (13)

Moderators: Cecilia Dalman Eek & Lars Ydreskog

Challenges with Powering the Electrification of the Industry, Daniel Gustafsson, Vattenfall, SE (38)

The IEA Wind TCP Task 19: 19 years of cold climate wind research., Timo Karlsson, VTT Technical Research Centre of Finland Ltd, FI (23)

Ice Detection Guidelines for Wind Energy Applications by IEA Wind TCP Task19, Charles Godreau, Nergica, CA (33)

Went from racing cars to de-icing

RPB's racing cars, built in Burträsk, competed internationally.

Where others see problems, Kjell Lindskog sees challenges. Over the years, his innovations have included a trackable security case and a modular system for de-icing rotor blades on wind turbines.

TEXT: Peter Wiklund

AT THE END of the 1960s, the village of Burträsk outside Skellefteå became world famous among racing enthusiasts. It was here that Kjell Lindskog and a colleague had started manufacturing top-class racing cars, with cars from their team winning two European championships. Up until the early 1970s, they produced around 250 cars that are now considered classics.

Over the next few decades, Kjell Lindskog focused his talents as an inventor on completely different and very varied fields. He is responsible for, among other things, a trackable security case, which will also destroy the money inside if someone tries to tamper with the case. This type of case is now used in 22 countries, and has clearly contributed to the dramatic de-cline in cash transport robberies.

Kjell Lindskog.

Kjell Lindskog, who will be celebrating his 80th birthday this summer, has now turned his attention to the wind power industry.

"They told me that no one had found a satisfactory solution for de-icing the rotor blade. That was all I needed to spark my interest", laughs Kjell Lindskog.

He saw that a conference was about to be held on wind power in cold climates – you guessed it, Winterwind – and signed up straight away. The year was 2014 and by chance, he sat next to Sven-Erik Thor, then head of research at Vattenfall wind power, at the conference's dinner, and was quickly able to convince him that the same type of copper mesh used in his security cases was the solution for managing the problem of ice on wind turbines.

THE SWEDISH ENERGY Agency was similarly attracted by his plans and gave financial support to his newly formed company, which back then was called Lind-

skog Innovation. After a few years of development, a solution was ready to be tested. A de-icing system and one with a standard solution.

"Without a doubt, our system worked much better than the standard version", Lindskog reports.

Their concept is based on applying copper mesh with 'epoxy-preg' – the same type of material as used in rotor blades – in panels on the rotor blades. The mesh is used to control the temperature so that the panels can cure into place properly.

The mesh enables the initial detection of ice formation – essentially the same technology that allows the security cases to register tampering attempts. The same mesh is then used to heat away the ice.

Applying the copper mesh in modules – 22 panels per blade – makes it possible to ensure that every part of the rotor blade gets the correct amount of heat. Obviously, the need for this varies greatly between the exterior and interior parts.

ENERGY COMPANY SKELLEFTEÅ KRAFT was interested in the solution from the beginning and was involved in the field trials. This year, they and Lindskog's company – which has changed its name from Lindskog Innovation to Linnovation – will test the system even more rigorously than before and productify the solution, with financial assistance from Vinnova.

"I know all too well what it's like when you come up with something completely new – convincing the market that it's worthwhile is a difficult mountain to climb. At least Skellefteå Kraft has realised the potential, and understands that this solution will enable them to produce more and reduce the damage to the turbines", says Lindskog.

Cold Climate Experts

We are one of the leading companies in wind measurements, modelling and analysis in the Nordics, with over 20 years of experience delivering results to more than 450 customers.

Among other services, we perform:

- Wind Measurements
- Icing Loss Analysis
- Risk for Ice Throw
- Ice Risk Forecasting
- Due Diligence
- Energy Assessment

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KJELLER VINDTEKNIKK
Part of Norconsult

Vasa Vind holds extensive experience from wind power in cold climate

Vasa Vind contributes to the green transition through the development of new renewable energy. We are one of the largest independent power producers on the market and an experienced operator of wind power in cold climate with nearly 600 MW in operations in northern Sweden.
Our 400 MW Hällberget development project in Norrbotten will add further to this in an expanding region with a growing demand for fossil-free electricity.

Read more on
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VASA VIND

Guidelines and Artificial Intelligence can aid ice detection

Artificial intelligence (AI) can provide a better understanding of icing. New guidelines will make it easier for wind turbine owners to choose the right ice detection method for specific applications. And a comprehensive study is underway to map the performance of ice detection systems.

TEXT: Eva Ekholm

LukeCunningham.

Charles Godreau.

IN FEBRUARY 2021, an ice storm paralyzed wind farms in the southern parts of USA. Luke Cunningham, data analyst at Clir, says that because the ice storms in Texas were an unprecedented event, the turbines were not built to withstand such weather and they were not equipped to deal with icing conditions.

"Without proper systems to detect icing, the turbines reported that they were available but they did not generate power. This resulted in inaccurate loss calculations", says Cunningham.

He says this experience shows that climate change is creating unfavourable weather patterns all over the world, which means renewable energy providers need to be prepared for anything.

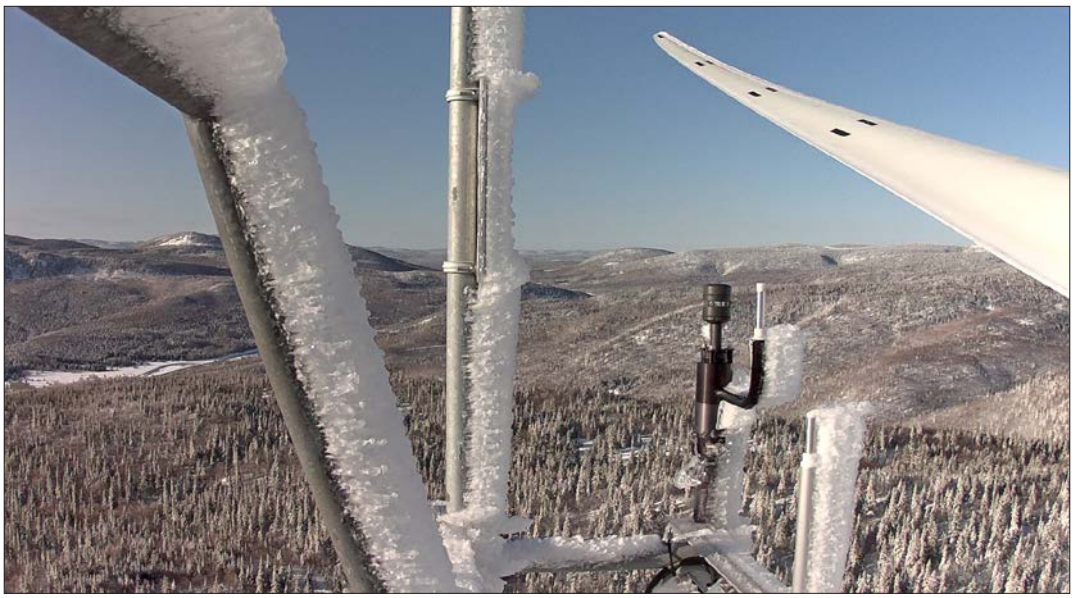
"During the ice storms, the status codes provided by the OEM were not detailed enough to accurately describe the power that was lost. More detailed data during unexpected and undesirable weather conditions can help owners understand how availability is affected and how they can better prepare for such conditions."

LUKE CUNNINGHAM SAYS that improved and high-quality data on icing is important because it can provide better insight into the performance of wind turbines. Improved icing data can also help provide visibility into potential risks of icing, allowing operators to implement de-icing strategies to reduce risk and turbine loading. This, in turn, can increase the life of turbine components.

"It can also help validate de-icing systems and cold climate packages offered by OEMs", says Cunningham.

Clir has developed a platform that gives owners a deeper understanding of how adverse weather conditions, such as icing, affect turbine performance and energy production.

"Icing events can be misunderstood if you rely solely on status codes provided by OEMs. AI can provide a deeper context and understanding of when icing events



begin, how long they last and what energy is lost as a result of these events", Cunningham concludes.

BUT IT'S NOT always easy to navigate the wide range of ice detection methods and compare the various options on market.

"A vibrating wire detecting meteorological icing on a wind turbine nacelle is quite different from a rotor icing detector measuring eigenfrequencies inside a wind turbine blade. A wind turbine operator or OEM must choose the ice detection method that is best suited to the requirements and constraints of the intended application", says Charles Godreau, Nergica's Research and Innovation Project Manager and Canada's representative on IEA Wind TCP Task 19.

In developing guidelines to support the selection of ice detection methods, the IEA Wind TCP Task 19 has focused on the most important applications: de-icing system activation, ice throw risk reduction and measurement of wind turbine performance in icing conditions.

THE GUIDELINES REPORT was submitted to the IEA Wind Executive Committee in October 2021 and is awaiting approval at the time of writing. It is expected to be approved in early 2022 and will be available free of charge through the Task 19 website [iea-wind.org/task19].

Charles Godreau notes that the report will be useful regardless of prior knowledge.

"Owners who regularly deal with icing can target ice detection for different applications, and get a checklist of what requirements an ice detection method should meet for that specific application. The guidelines can also be helpful in understanding how ice detection methods are validated in the lab and in the field, so owners can ask potential providers of ice detection technology what they can expect in terms of performance."

Currently, Nergica is working on a project where the performance of 70 percent of commercially available ice detection methods have been tested over three years.

"The project is currently in its final year and we aim to publish the results in a scientific paper. To my knowledge, it will be the first public study on the long term performance of ice detection methods for wind energy in icing conditions", says Godreau.

Luke Cunningham and Charles Godreau will talk about their projects at Winterwind 2022.

New method validates accuracy of modelling data

Better models to assess factors such as energy exchange and icing losses. That's the goal of a time series analysis that takes stochastic factors into account, and links them to actual data from more than 100 wind farms.

TEXT: Eva Ekholm

THE COMPLEXITY OF wind power generation means that the assessments made in the pre-construction studies often differ from those based on measured operational data once the site is in operation. Some of the contributing factors can be detected by making time series-based comparisons of modelling done before and after construction and commissioning.

Natural Power has conducted a validation study, based on real production data from operational sites in different regions and climates.

Enrico Sindici, an Energy Analyst at the British consultant Natural Power, explains that the validation includes the accuracy of, among other things, spatial modelling, wake losses (the reduction of wind speeds at downwind turbines due to wakes caused by upwind turbines), availability and other secondary losses such as icing.

"The key tool is a timeseries-based pre-construction model which can be compared against the time-series of actual production data for the site. By having simultaneous time series of model and operational data, it is possible to compare how accurately different components of the pre-construction model reflect the performance of the actual wind farm. This also includes the assessment of icing", says Enrico Sindici.

Enrico Sindici talks about the validation study at Winterwind 2022.

BY ISOLATING ICING events in the operational data, from those due to turbine stoppage or performance degradation, a more direct comparison between modelled and measured availability losses can be made.

"In our time series model, availability losses are treated stochastically; as affected by chance. This stochastic availability model was optimised using a database of more than 100 operational wind farms. Since the model takes random downtime into account, it corresponds more accurately to the production fluctuations of a real wind farm, than a model where capacity losses are applied as a static factor."

Sindici argues that the time series approach is valuable before construction, in a variety of assessments where the fluctuations of production over time are relevant to the economics of the project.

"This includes, for example, the risk of production shortfalls under PPA agreements and the estimation of losses due to grid export capacity limits. Another aspect is yield assessments in hybrid projects involving wind generation combined with battery or hydrogen energy storage, or solar energy generation. In addition, a more accurate description of the time dependence of secondary losses, such as icing, can help to improve the design of seasonal and hour-of-day budget targets."

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