



Winterwind

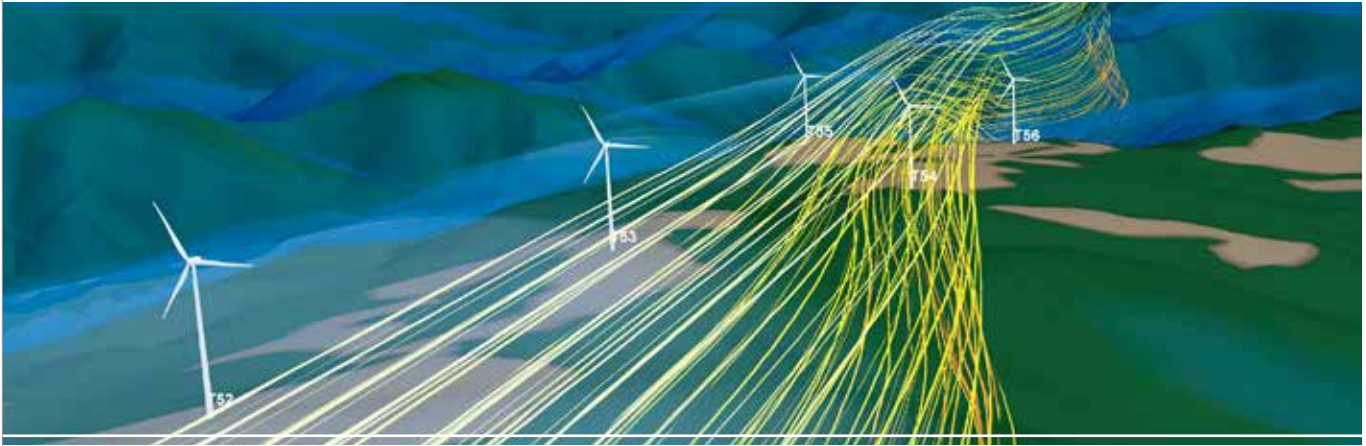
INTERNATIONAL WIND ENERGY CONFERENCE



Conference program 2017

WHERE THEORY MEETS PRACTICE

- * NECESSITY IS THE MOTHER OF INVENTION
- * FOCUS ON INTERNATIONAL STANDARD
- * ARE THE INTERNATIONAL STANDARDS BEING ADAPTED FOR COLD CLIMATES?



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En route to the new world

RENEWABLE ENERGY IS CHEAPER to produce than oil! This piece of news is more important than any climate change negotiations in the world. The price trend for renewable energy depends on the production cost; the more you produce, the lower the unit price. Renewable energy competes with fossil fuel, the cost of which is linked to supply – the cost of natural resources increase the more you use. So we have two intersecting curves, as we have seen in recent years.

Renewable energy has finally become financially competitive – in the future, it may become *cheap energy*. It's no longer the tree huggers who want us to invest in saving the world. Sophisticated institutional investors are currently making major investments in renewables, and they don't change their return criteria just because renewable energy is "nice". When politicians disagree, developments are driven by the business community.

Wind power in cold climates has enormous potential. There are no excuses for not meeting the energy and climate goals – the goals have already been adopted. The next ten years will be about global cooperation between people, all over the world.

It's not only the world around us that's of interest; we are looking at a particularly exciting year for the Swedish Windpower Association. We kick off the year with the Winterwind conference, which has a highly exciting programme this year with many interesting topics and important speakers.

In June, we have the 16th World Wind Energy Conference, WWEC2017. This annual conference has been arranged by the World Wind Energy Association (WWEA) since 2002, in cooperation with a national organisation. In 2017, will be held in cooperation with the Swedish Windpower Association. It's the first time the conference is held in Sweden, and five years since it was last held in Europe. At the Swedish Windpower Association, we are convinced that the conference will create business synergies and contribute to the exchange of knowledge.

Welcome! ❄️

JEANETTE LINDBLAD

Chairwoman, Swedish Windpower Association

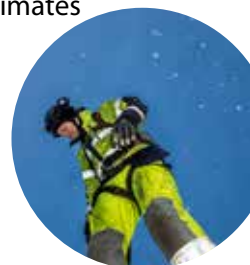
ULLA HEDMAN ANDRÉN

Director of Operations, Swedish Windpower Association
Project Manager Winterwind







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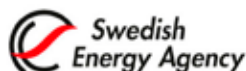
Let's Connect!

-  **LinkedIn**, is where you stay in touch with colleagues, clients and friends between conferences.
-  **Facebook**, here you'll find photos from the conference, discussions and trivia.
-  **winterwind.se**, at our website you can download the presentations and sign up for the Winterwind newsletter.
-  **Instagram & Twitter**, keep yourself updated @WinterwindEvent

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Swedish Windpower Association celebrate 10 years as organizer 2018

Swedish Windpower Association celebrates 10-year as organizer of Winterwind International Wind Energy Conference 2018 and we are planning for something extra. Project Manager Ulla Hedman Andrén will tell you more about the plans during the final session.

World Wind Energy Conference



WWEC an annual conference held since 2002 and by organized by World Wind Energy Association (WWEA) in cooperation with a national member organization that in 2017 is Swedish Windpower Association.

The Conference will bring together the foremost experts, peers and practitioners in the business from the whole world. The conference theme 2017 is "Popular and Participatory Wind Power" on how to contribute to the development of wind power with a mix of players that are committed to energy conversion. More info at wwec2017.com
Questions? Contact Ulla Hedman Andrén, Swedish Windpower Association or Stefan Gsänger WWEA.

Extended session with the wind turbine manufactures

As requested the manufactures have now given more space in the program!

Session 5-7 • Tuesday 7 februari at 15.30 h- 17.00 h (17.30)

Dongfang Electric Corporation • Wei Chu – Introduction for Dongfang low-temperature.

Enercon energy converter GmbH • Katarina Roloff – Reliable energy production during the winter months.

Siemens Wind Power • Lennart Frølund – Improving performance and reliability in cold climate.

Nordex Energy GmbH • Konrad Sachse – Anti-Icing System on N131 wind turbines – development and validation.

Vestas Wind System A/S • Brian Daugbjerg Nielsen – R&D within cold climate.

Experienced moderator in the final session



Willy Silberstein has a long history as a journalist. He has worked both as a foreign correspondent and as a reporter for several of the largest daily newspapers in Sweden. When Willy leads debates and hearings, it is a fast-paced tempo and he does not give up before he received answers to their questions.

Look out for this man!



Talk to Magnus and get information about exhibition stands and sponsor packages for WWEC2017 and Winterwind 2018. He is also the guy to discuss advertisement with in the largest trade magazine on Wind power in Sweden; Tidningen Svensk Vindkraft.

Job Corner

Take the opportunity to present in writing your company and the job opportunities that you offer, during Winterwind! You will reach both senior professionals who are seeking for new challenges and students. The Job Corner is located in connection to Swedish Windpower Association's stand.
NOTE: Job ads must specify where/how to apply or a contact person incl. contact information, as we do not handle any documents at the booth.

We support GIVEWATTS

We do not share any gifts to our presenters. Instead, we donate money to those who need it better, this year the money goes to Givewatts.

Givewatts is a non-profit organisation bringing clean and safe energy to people in developing nations. They distribute renewable energy solutions to school children and their families that live in areas without access to electricity.

Solar energy lights replaces dirty kerosene and wood, allows children to read their homework and doctors to operate after dark and much more

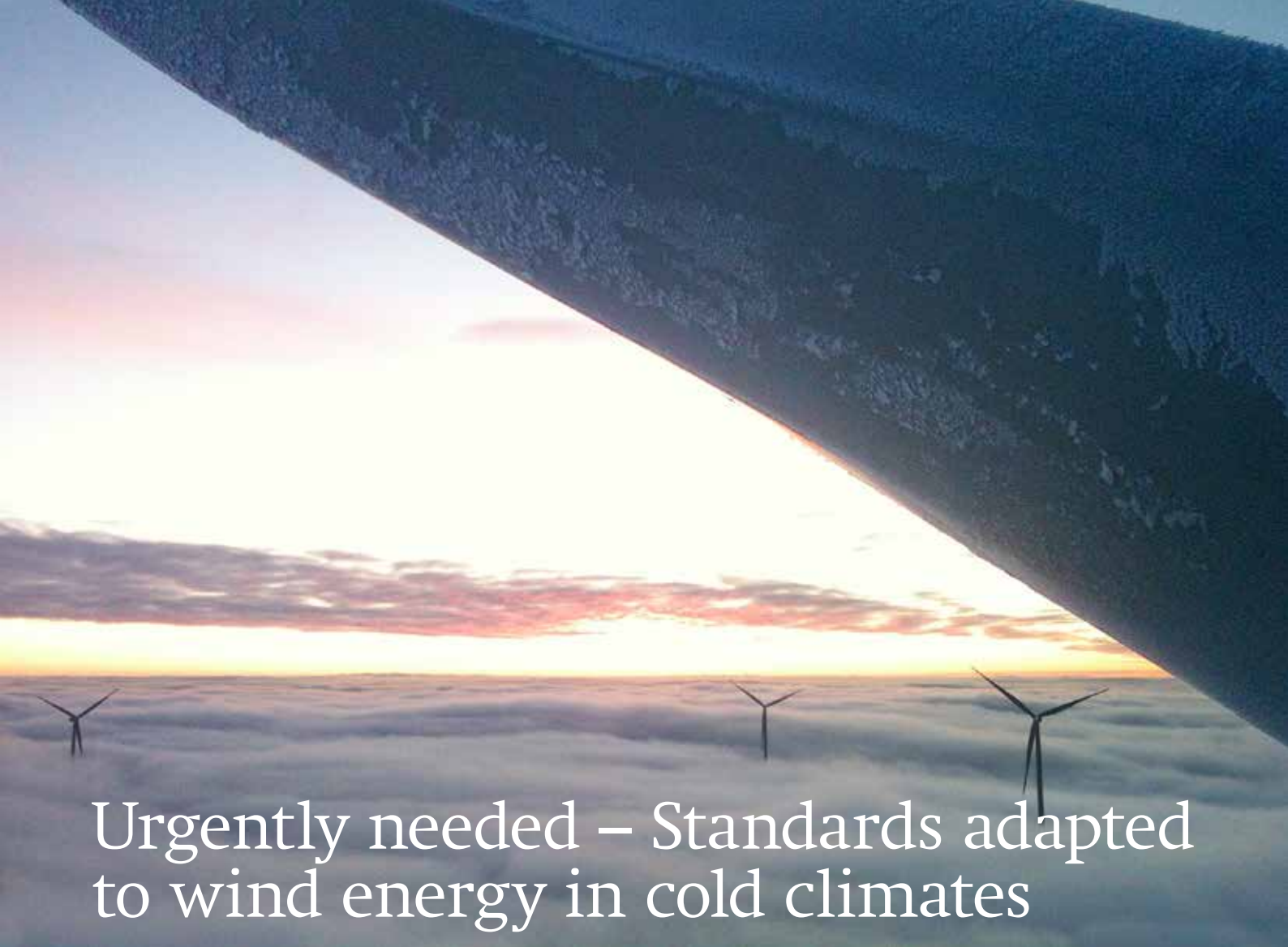
Krutov & Co – The partyband from Skellefteå

Krutov the band for the conference dinner. With hundreds of gigs in the back, from small parties to festivals for thousands of people, Krutov know by experience what it takes to set the speed of a party.



ANNONS





Urgently needed – Standards adapted to wind energy in cold climates

THE ENERGY PRODUCTION potential in low temperatures and icing conditions is vast. Utilizing wind power in such conditions is, however, challenging for all parties involved including developers, wind turbine manufacturers, component suppliers, service staff, utilities, owners of grids and wind turbines as well as for neighbours.

Winterwind has previously (2008–2016) addressed the lack of de-icing systems, the dangers of ice throw and the need for performance warranties. Solutions are now, as the cold climates markets have matured, readily available but are they any good?

Efficient standards can prevent the wheel from being invented over and over again, make sure common mistakes, which in this field can be quite expensive, aren't repeated and, in

the end, lower the risks and thereby reducing the cost of project financing. Assuming there are people interested in developing the standards, there are two main challenges: Opposition from wind turbine manufacturers and financing of the development of standards.

THE BENEFITS OF EFFICIENT standards are hard to challenge from both a societal and a commercial point of view. Still, we've seen wind turbine manufacturers preventing cold climate requirements entering such a fundamental standard as "Design requirements for wind turbines", IEC 61400-1, ed. 4. Financing of standardization work is normally viewed as a commercial activity.

Manufacturers, be it in for example the fields of medicine, concrete or telecommunication, strive to adapt the developing standards to their own pat-

ents. In countries without wind turbine manufacturers this commercial driving force is largely absent. Consequently, it seems odd that countries such as Sweden support the development of large wind farms in cold climates but lack financing to participate in the creation of IEC 61400-1 5, ed. 1, "Energy yield assessment" where cold climates require special attention for numerous reasons.

Some other titles for which standards adapted to cold climates need to be developed are: Assessing and mitigating the risk of ice throw, Classification of sites, sensors, subcomponents & wind turbines and How to deal with noise from iced up wind turbines. ❄️

TEXT & PHOTO **GÖRAN RONSTEN**
Program coordinator Winterwind 2008–2017
On behalf of the Swedish Windpower Association

Necessity is the mother

Uljabuouda, a pioneering project outside Arjeplog in Northern Sweden, has faced most problems that may potentially arise in cold climates. Skellefteå Kraft is currently working on a new de-icing system that is to be installed on the existing turbines.

TEXT JONAS HÅLLÉN • PHOTO JANN LIPKA

WHEN CIVIL ENGINEER Jonas Sundström left the operational centre to take charge of the ten wind turbines on the mountain Uljabuouda, he was thrown straight into the deep end – Dynawind, the Swedish supplier, had become insolvent and had requested a restructuring.

“My first task was to go with a colleague to Oulu in Finland for negotiations with Winwind, the turbine manufacturer, about the availability of spare parts and other contractual matters,” says Jonas Sundström. “We knew that the climate would be harsh on the mountain, but we hadn’t realised that we would also need to fight the manufacturers, sellers and lawyers.”

In the last six years, Skellefteå Kraft AB and its wholly-owned service Com-

pany, Energiservice, have learned a lot about the technical solutions required for wind power in winter climates.

“We have made use these lessons in our other windfarms. Without the work we carried out in Uljabuouda, wind power in cold climates would not be where it is today,” says Jonas Sundström.

The most important lesson is that de-icing is a must, but it doesn’t solve every problem.

“There isn’t a system in the world at present that can withstand freezing rain and a temperature of -10°C ,” says Jonas Sundström:

THE AREA AROUND Uljabuouda has large lakes with strong currents. Because of the currents, the lakes remain unfrozen for a large part of the year, emitting water vapour that condensates into small droplets and ice crystals that form moist clouds.

Due to the wind farm’s location on a mountain top, at an altitude of almost 700 metres (with the nacelle a further 80 metres up), the turbines spend much of the year in the clouds.

“We see the most ice formation in temperatures ranging from $+2$ to -8°C . Which we have for extensive periods every year.

In the current market, two systems are used for preventing and/or removing ice from the rotor blades:

Hot air from the turbine is fanned through channels in the blades. There are several methods for this: Vestas’ de-icing system can’t be used while the turbine is in operation, while Enercon’s

system can. However, hot air is not as effective as using an electrically heated front edge.

Carbon fibre weave is embedded in the front edges and sides of the blades, a few millimetres under the surface. The de-icing process is activated when a sensor on the nacelle indicates that there is a risk of icing.

“In a place like Uljabuouda, with such extreme ice formation, only one system works: carbon fibre mats,” states Jonas Sundström.

But these have other disadvantages:

In Uljabuouda, Skellefteå Kraft has experienced problems with broken connections between the copper cables and the carbon fibre mats in the blades. Also, falling ice and lightning have damaged the carbon fibre mats.

“Damage from an impact on the front edge may cause the heating mat to generate heat unevenly, giving rise to hotspots. Too much heat in one place can damage the underlying epoxy composite, so we can’t use the de-icing system if we have a potentially harmful hotspot,” explains Jonas Sundström.

The problems experienced with the connections, cables and carbon fibre mats came as an unpleasant surprise for the company. Winwind, one of the few manufacturers that offered de-icing systems in 2006, had promised that the system would be virtually maintenance-free.

“When the carbon fibre mats were damaged, we attempted to repair them, but we caused the hotspot to grow, aggravating the problems,” explains Jonas Sundström.

ANOTHER PROBLEM that we ran into was that relays and sensors broke down, making it difficult to measure temperature, humidity and ice formation. This is a common problem for wind turbines in cold climates and is due to the fact that the measuring equipment typically con-

Uljabuouda in Arjeplog is the first major farm built above the treeline in the Northern Sweden mountain region. Obtaining permits for the wind farm was a drawn-out process, and it took a full eight years before all permits were in place.



of invention



Hardened by ice. Jonas Sundström and his colleagues have been forced to devise many solutions of their own to get to grips with ice formation on rotor blades.

sists of standard components that can't withstand such extreme conditions.

"The lack of spare parts has been highly frustrating, both for the company and for the engineers. The reason for the shortage is that the Swedish supplier and the Finnish manufacturer were in financial difficulties and eventually went bankrupt. For this reason, even minor defects have caused longer standstills than expected."

But necessity is the mother of invention, and Skellefteå Kraft and Energiservice has replaced the lubrication system with a proprietary design (where the oil keeps a constant temperature of at least 30°C), the Condition Monitoring Systems ("CMS") from Sensodec with SKF Windcon and added a particle counter, making it easier to monitor the condition of the powertrain.

The energy company also did something that was generally held to be impossible: they replaced the gearbox in the winter. Defying the cold, the winds and the steep access road, the company managed to haul two major cranes up the mountain.

"We used two large tractors, one that pulled and one that pushed, to drag the crane and trailer up the mountain, with chains and all," says Jons Sundström.

"To replace the gearbox, we had to lower the rotor using two cranes. While lifting, two tracked vehicles held the rotor in place with right ropes, preventing the wind from grabbing the rotor blades and throwing them straight at the tower."

Another achievement by Skellefteå Kraft and its contractors involve replacing some bearings in situ in the nacelle, between the two planets in the gearbox, which the manufacturer claimed would be impossible.

THE EXPERIENCES from carrying out its own maintenance came in particularly handy when Skellefteå Kraft and Chinese Dongfang Electric jointly developed a de-icing system that combined front edge heating with hot air (IPS-HAS). It is different from the Vestas system, as the new system can be used while the turbine is operation, and it uses a combination of carbon fibre mats and hot air.

The energy company has also experimented with running the de-icing systems on different power settings.

"We ran four turbines on low power and six turbines on high power. We arrived at the conclusion that high power results in very small improvements, while causing much more wear and tear on the connections. It is therefore not worth using high power during normal ice conditions."

The next step for Skellefteå Kraft is finding measuring equipment capable of withstanding the harsh conditions in the Arctic.

"We are also cooperating with a number of local contractors, trying to design a new type of de-icing system that can be fitted to existing turbines. We are right at the beginning of this project, but we believe we have collected enough knowledge and experience to build something better than the systems we have today. In five years' time, I believe we will have made some headway on drastically reducing the icing of blades and turbines," says Jonas Sundström. ❄️



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Focus on international standard

The wind power community must be proactive, and take security measures before a severe accident, due to ice throw, occurs.

Understanding of the physics of ice and a working standard are needed.

ONE OF THOSE who work with such a new, international standard is Rolv Erlend Bredeesen, a scholar of computational mathematics and meteorology. He is the Norwegian member of a project about security and ice throw, for IEA's Wind task number 19 on wind power in cold climate. To him, security is one of the most important issues for the future of wind power.

– If something happens today, and the authorities have to step in, the reputation of the industry will be damaged. That would be the worst, and to the wind power community most costly, scenario. Hence, to take care of the future of wind power, we must take the security initiatives ourselves.

Today, the most standard-alike is the so-called Seifert formula. It is primarily a screening tool of risk, and should not be considered to be more than that, Bredeesen stresses.

– This current formula is wrongly seen as a standard. But it really doesn't say anything about the probabilities of dangerous ice throw. We need much more descriptive methods.

An international, overall standard should also be based on a better understanding of ice physics, such as the process of ice accretion on turbine blades, shedding, and ice crushing to fully describe the hazard.

– It is a very difficult material to describe. We still know too little about it.

Even if the security challenges may be his first choice of work, mapping and forecasting of icing are also crucial parts of the making of the new standard.

The IEA task group is now focusing on having a new standard by the end of 2018. Today, one big challenge is to gather all knowledge and applied methods (which are not standards but might, wrongly, be called so) that occur all over the world. Therefore, the participants of Winterwind are given the opportunity not only to take part of the latest research finds and current knowledge but also to themselves contribute with experiences from different applied methods.

THE SUM OF ALL experience and different applications will form the basis of the new to-be-standard and guidelines.

Today, Rolv Erlend and his co-workers use a ballistic trajectory method, calculating from an impact kinetic energy limit of 40 joules and above. With ice debris energies above 40 joules, the risk of severe harm to human beings is increasing rapidly, and safety zones should therefore be customized with this in mind.

Bredeesen is sure of that the new international standard will be fixed in due time. Next step thereafter is to

improve all kinds of techniques. Heating of blades may be a good method for increasing the power production but not necessarily the best, or sufficient, method for improving the safety.

– It just shifts the location of the highest risk, when ice falls right down from the turbine, says Rolv Erlend, who also wants to see other kinds of solutions.

Weather forecasting, mapping of ice risks and smooth ways of communicating risk might be just as important as de-icing techniques to improve safety.

– Addressing the risk is important. Both to passers-by, service personnel and to the wind power industry itself. If one accident occurs, the whole industry will suffer. It is important for the industry to avoid accidents. ❄️

TEXT ANNA HAGNELL



Rolv Erlend Bredeesen, Vindteknikk

Are the international standards being adapted for cold climates?

“Standards for wind turbines are extremely important instruments for limiting the risk of doing business within wind power,” says Ville Lehtomäki of VTT Technical Research Centre of Finland Ltd.

When drawing up new standards or revising the existing the standards, it’s important to incorporate all aspects, including operations in cold climates.

Is the industry in Sweden taking responsibility for this?

TEXT **JAN LOTHIGIUS** • BACKGROUND PHOTO **JANN LIPKA** • PORTRAIT PHOTO **JYRI LAITINEN**

STANDARDISATION DOESN’T mean that everything must be designed the same way, but it sets a standard for how design requirements should be worded. This makes wind power standards indispensable in wind turbine procurements. Standards are also important tools for wind turbine manufacturers. Moreover, standards make it easier to follow up whether requirements have been met. If necessary, independent appraisers can be engaged to determine whether requirements have been met.

The work on the standards for wind turbines was initiated by the International Electrotechnical Commission in the 1990s, and the first standards for the design of wind turbines, IEC 61400-1, were published in 2005.

Since then, a great number of standards have been published in the series, and new standards are still being developed. It’s important that each standard developed has global reach.

“You should be able to use the same standards in Texas, Africa and Finland,” says Lene Hellstern. She is a member of the IEC’s Working Group 15, which has been tasked with the development of new standards for the assessment of site specific wind conditions for wind power

stations (IEC 61400-15). These new standards are due in 2018.

“The group is definitely taking a serious approach to the special conditions in the Nordic region, where we have a cold climate as well as forests and mountains,” says Lene Hellstern. She works at E.on in Malmö, but she is a member of the IEC group in her own right.

Lene Hellstern’s participation is funded by E.on, but the funding of the work on the standards has been an issue.

Ville Lehtomäki of VTT Technical Research Centre of Finland Ltd is also a member of Working Group 15.

“We managed to secure funding for our participation in the standardisation work by incorporating our work as an element of various development projects,” Ville Lehtomäki explains.

Until a few years ago, the Swedish Energy Agency funded Sweden’s participation in the IEC standardisation work through its Vindforsk programme.

This is no longer the case.

“As we see it, we are looking at an established market with established suppliers, and it’s up to the companies themselves to drive the standardisation work,” explains Pierre-Jean Rigole, who works at the department of innovation

and research at the Swedish Energy Agency.

TK88 IS THE NAME OF THE GROUP within SEK, Svensk Elstandard – the Swedish national committee of the IEC – that oversees wind power standardisation. “But the level of activity in the group is low,” explains Henrik Lagerström, who is responsible for the administration. The group has not had a chairman since Bengt Göransson resigned from the position several years ago.

“Swedish commitment to wind power standardisation has experienced an uphill struggle in recent years,” says Bengt Göransson of Pöyry.

Anders Björk of OX2, a Swedish company engaged in the exploitation of wind power, confirms that the standards are highly important to the company’s operation. Naturally, it’s very important to ensure that Nordic conditions for wind power are taken into account, but it would be difficult for a single company to justify the cost of participating in the standardisation work.

Ice formation, de-icing and ice throw are major issues in cold climates, but these have only been partially referred to in the standards.

However, an IEA working group,



STANDARDS FOR WIND TURBINES

IEC 61400 is the international standards for wind turbines. It has been divided into different chapters, for example the design of onshore and offshore wind turbines, chapters measuring power production and noise and chapters on how to design the communications for the monitoring and control of wind turbines.

A selection of chapters:

- IEC 61400-1 Design requirements for wind turbines
- IEC 61400-2 Design requirements for small wind turbines
- IEC 61400-3 Design requirements for offshore wind turbines
- IEC 61400-11 Acoustic noise measurement techniques
- IEC 61400-15 Assessment of site-specific conditions for wind power (planned for 2018)
- IEC 61400-2[5] Communications for monitoring and control of wind power plants (with six sub-chapters)


IEC is short for the International Electrotechnical Commission. The IEC has been approved by the World Trade Organisation as a standardisation body.

Wind Task 19, currently focuses on these issues. T19 publishes reviews of technical methods as well as Recommended Practices, which can be regarded as a suggestion for the future development of IEC standards.

DANIEL GUSTAFSSON is a project manager at Vattenfall's development department with a past in Task 19.

“Many manufacturers have worked on different solutions to reduce production losses caused by icing. As this technology is still under development, it's too early to standardise the de-icing methods, but it might be a good idea to draw up requirements to prevent production losses and control ice throw from the turbines,” Daniel Gustafsson states.

Ice throw affects both the safety and accessibility of the turbines. If there is a risk of significant ice throw, you must either to shut down the affected turbine or have some other way of ensuring the safety of those who find themselves nearby. ❄️



Ville Lehtomäki is employed by the VTT Technical Research Centre of Finland Ltd.

MONDAY 6 FEBRUARY

OUTSIDE SESSION ROOMS

09:15	Departure from Stadshotellet
09:35–13:00	Pick up at the airport
13:00–17:00	Field trip
17:00–19:00	Arrival back to Stadshotellet
18:00–20:00	Registration Poster set up



FESTVÅNINGEN

- IEA Task 19 workshop – Ice throw,** Rolv Erlend Bredesen, Kjeller Vindteknikk, Norway (52)
- IEA Task 19 workshop on Ice throw,** Dag Haaheim, Statkraft, Norway (53)

TUESDAY 7 FEBRUARY

08:00–10:00	Registration
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10:00–11:30 SESSION 1 • VERANDAN

Inauguration and keynote 1

Chairs: Jeanette Lindblad and Göran Ronsten

- **Global status and future outlook of renewable energy with a focus on wind,** Christine Lins, REN21, France (11)
- **High-resolution simulations of freezing drizzle and freezing rain events and comparisons to observations,** Gregory Thompson, National Center for Atmospheric Research, USA (22)
- **IEA Task 19 – Long-term visions for cold climate,** Ville Lehtomäki, VTT, Finland (23)

11:30–13:00 LUNCH

12:30–12:55 POSTER PRESENTATIONS

- **A review of MERRA-2 data in Scandinavia,** Gemma Daron, DNV GL, United Kingdom (43)
- **Internet of Things gives cost effective monitoring solutions,** Patrik Jonsson, Combitech, Sweden (21)
- **Changing the oil in a cold climate – OBV 4406,** Larissa Lärneklev, Energiservice Skellefteå, Sweden (55)

ANNONS

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13:00–14:30 **SESSION 2–4**

VERANDAN

Forecasting, cloud physics, aerodynamics

Chairs: Nadine Rehfeld & Gregory Thompson

- **Numerical simulation of ice accretion on an airfoil**, Matilda Ronnfors, Lund University, Sweden (15)
- **ICE CONTROL – Measurements and probabilistic forecasting of icing events in Austria and Germany**, Lukas Strauss, University of Vienna, Austria (20)
- **A novel approach for combining measurements and models for icing predictions**, Emilie C. Iversen, Kjeller Vindteknikk, Norway (37)

FESTVÅNINGEN

HSE

(Health, Safety and Environment)

Chairs: Hannele Holttinen & Dag Haaheim

- **Experimental investigation of risk from ice throw and ice shed**, Markus Drapalik, University of Natural Resources and Life Sciences Vienna, Austria (3)
- **ICETHROWER – mapping and tool for risk analysis**, Jenny Lunden, Pöyry Sweden (13)
- **IEA Task 19 – IceRisk: Review of current knowledge and the way forward in risk assessments associated with ice throw from wind turbine blades**, Rolv Erlend Bredesen, Kjeller Vindteknikk, Norway (28)

BOVIKEN

Operational experience

Chairs: Kristina Conrady & Ville Lehtomäki

- **New recommended practises for low temperature and icing climate conditions**, Kai Freudenreich, DNVGL Renewables Certification, Germany (12)
- **IEA Task 19 – Low temperature compliance testing of wind turbine applications**, Pieter Jan Jordaens, SIRRIS / OWI-Lab, Belgium (10)
- **Modeling the dynamic behavior of wind farm power generation**, Beanán O'Loughlin, AWS Truepower, USA (41)
- **Estimating icing losses at proposed wind farms**, Till Beckford, DNV GL, United Kingdom (27)

14:30–15:30 **BREAK**

15:00–15:25 **POSTER PRESENTATIONS**

- **WlceAtlas public website**, Simo Rissanen, VTT, Finland (35)
- **Comparison of icing measurements from nacelle-mounted and blade-mounted ice sensors with icing simulations on a wind turbine blade**, Tatu Muukkonen, Labkotec, Finland (38)
- **Hotspot resistant blade heat system**, Greger Nilsson, Blade Solutions, Sweden (25)

15:30–17:00 (17:30) **SESSION 5–7**

Wind turbine manufacturers

Chairs: Christine Lins & Sven-Erik Thor

- **Introduction for Dongfang low-temperature wind turbine**, Ke Chen, Dongfang Electric Corporation, China (1)
- **ENERCON – reliable energy production during the winter months**, Katharina Roloff, Enercon, Germany (45)
- **Siemens – Improving performance and reliability in cold climate**, Lennart Frølund, Siemens Wind Power, Denmark (7)
- **Nordex Anti-Icing System on N131 wind turbines – development and validation**, Konrad Sachse, Nordex Energy, Germany (48)
- **Vestas R&D within cold climate**, Brian Daugbjerg Nielsen, Vestas Wind Systems, Denmark (51)

De-/anti-icing including ice detection & control

Chairs: Carla Ribeiro & Emilie C. Iversen

- **Measuring in cloud water droplets – the real cause of icing**, Timo Arstila, University of Oulu, Finland (18)
- **Standardizing ice detector tests in icing wind tunnel**, Tuomas Jokela, VTT, Finland (17)
- **So where exactly is the ice – how many sensors does a turbine need?**, Michael Moser, eologix sensor technology, Austria (42)
- **IEA Task 19 – Evaluation of ice detection systems for wind turbines – first experiences from field test**, Saskia Bourgeois, Meteotest, Switzerland (8)

Pre-construction site assessment

Chairs: Jenny Longworth & Kai Freudenreich

- **Probabilistic long term correction of production losses due to icing**, Magnus Baltscheffsky, WeatherTech Scandinavia, Sweden (29)
- **IEA Task 19 – Blind icing map validation**, René Cattin, Meteotest, Switzerland (9)
- **IEA Task 19 – IceLoss – 10 years of experiences with calculation of production losses caused by icing**, Øyvind Byrkjedal, Kjeller Vindteknikk, Norway (32)

17:30– **MINGLE AND POSTER PRESENTATIONS IN EXHIBITION HALL**

19:00– **DINNER AND ENTERTAINMENT**

WEDNESDAY 8 FEBRUARY

08:30–10:00 **SESSION 8 • VERANDAN**



Keynote 2

Chairs: Saskia Bourgeois & Göran Dalén

- **Wind Energy in Cold climates – one of many niche markets requiring technical adaptations**, Jos Beurskens, SET Analysis, The Netherlands (56)
- **Grid challenges to wind deployment**, Hannele Holttinen, VTT, Finland (14)
- **Wind power in cold climate in the global energy landscape**, Stefan Gsänger, World Wind Energy Association WWEA, Germany (47)

10:00–10:30 **BREAK – POSTER PRESENTATIONS**

- **How to extend the life time of wind turbine gearboxes**, Stefan Bill, REWITEC, Germany (31)
- **Features of design of high-penetration wind-diesel power plants for villages in the Arctic regions of Russia**, Elistratov Viktor, Peter the Great St.Petersburg Polytechnic University, Russia (44)
- **Application of a SCADA data monitoring methodology**, Bojan Alavanja, Nordex Acciona Windpower, Sweden (50)

10:30–12:00 **SESSION 9–11**

VERANDAN

Market, research, offshore

Chairs: René Cattin & Øyvind Byrkjedal

- **IEA Task 19 - Cold climate wind power market study 2016–2020**, Timo Karlsson, VTT, Finland (24)
- **Site specific simulations of sea ice and wave loads on offshore wind turbine support structures**, Simo Rissanen, VTT, Finland (33)
- **Overview of challenges associated with offshore wind farms in cold climates**, Pieter Jan Jordaens, Sirris / OWI-Lab, Belgium (34)
- **New Swedish Energy Agency research programme within wind energy**, Pierre-Jean Rigole, Swedish Energy Agency, Sweden (49)

FESTVÅNINGEN

De-/anti-icing including ice detection & control

Chairs: Katharina Roloff & Rolv Erlend Bredesen

- **Identification of ice build-up and corresponding control optimisation**, Oscar Hugues-Salas, DNV GL, United Kingdom (19)
- **A novel meteorological conditions monitoring system for icing detection purposes on wind turbines: operational experience in Canada**, André Bégin-Drolet, Université Laval, Canada (6)
- **Recent ice wind tunnel test results and correlations with surface characteristics**, Nadine Rehfeld, Fraunhofer IFAM, Germany (4)

BOVIKEN

Environmental Impact Assessment (EIA)

Chairs: Jenny Lunden & Fredrik Lindahl

- **Experience with de-icing systems, noise and vibrations evoked by ice accretion**, Daniel Brenner, Weidmüller Monitoring Systems (WMS), Dresden, Germany (39)
- **Impact of snow on sound propagating from wind turbines**, Kristina Conrady, Uppsala University, Sweden (16)
- **Acoustic monitoring for ice detection and wind park maintenance**, Timo Mämmelä, APL Systems, Finland (40)

12:00–13:15 **LUNCH**

12:45–13:10 **POSTER PRESENTATIONS**

- **Detection of atmospheric icing conditions via cloud information**, Juha Paldanius, Vaisala Oyj, Finland (54)
- **Uncertainty quantification for wind power forecasts in cold climates**, Jennie P. Söderman, Uppsala University, Sweden (26)

13:15–15:00 **SESSION 12 • VERANDAN****GRAND FINALE – The way forward**Chairs: **Willy Silberstein**

- **Stefan Gsänger**, Secretary General of World Wind Energy Association (WWEA), member of the steering group of the IRENA Coalition for Action and adviser to governments and international organisations.
- **Tomas Kåberger**, Professor at Chalmers Univ of Technology, Göteborg and Executive Board Chairman of Renewable Energy Institute, Tokyo
- **Christine Lins**, Executive Secretary of REN21, the Renewable Energy Policy Network for the 21st Century. Secretary-General of European Renewable Energy Council (2001–2011)
- **Ville Lehtomäki**, VTT Technical Research Centre of Finland. Operating Agent of International Energy Agency (IEA) Wind Task 19 “Wind Energy in Cold Climates” and coordinator of cold climate sub-committee in the revision of IEC 61400-1 ed3->ed4 “Design requirements for wind turbines” standard.

14:15–14:35 **Summary of Conference**

- **Hannele Holttinen**, VTT
- **Gregory Thompson**, UCAR

14:35–14:45 **WWEC2017 presentation and final words**

- **Ulla Hedman Andrén**, Director of Operations Swedish Windpower Association, Project Manager Winterwind International Wind Energy Conference. Member of WWEC2017 organizing committee.

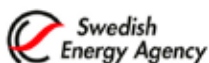
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The Swedish Energy Agency works for a sustainable energy system, combining ecological sustainability, competitiveness and security of supply.

The Agency finances research for new and renewable energy technologies, smart grids, and vehicles and transport fuels of the future. The Agency supports commercialization and growth of energy related cleantech.



DNV GL in the Energy Industry In DNV GL we unite the strengths of DNV, KEMA, Garrad Hassan and GL Renewables Certification. DNV GL's 2,500 energy experts support customers around the globe in delivering a safe, reliable, efficient, and sustainable energy supply. We deliver world-renowned testing, certification and advisory services to the energy value chain including renewables and energy efficiency. Our expertise spans onshore and offshore wind power, solar, conventional generation, transmission and distribution, smart grids, and sustainable energy use, as well as energy markets and regulations. Our testing, certification and advisory services are delivered independent from each other. Learn more at www.dnvgl.com/energy



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 now. Currently, the product catalogue includes turbines ranging from 800 kW to 7,500 kW. ENERCON has already installed more than 26,500 turbines worldwide with a total rated power of more than 43.5 gigawatts. ENERCON Sweden em-

ployes 326 people, and the offices are based in Malmö (Sales/PM and Service) and Landskrona (steel tower production factory).



GE Renewable Energy is one of the world's leading wind turbine suppliers, with over 30,000 turbines across the globe. Our portfolio includes a suite of onshore and offshore turbines, flexible support services ranging from development assistance to operations and maintenance, and cutting edge technology to upgrade fleets. With continuous investment in product development, our fleet of onshore wind turbines, with rated capacities from 1.7-3.8 MW, continues to involve to increase efficiency, reliability and availability with each evolution. Our customizable wind services offerings range from monitoring fleets and planned or unplanned maintenance, to fully operating and maintaining farms. GE is pushing the wind industry into the future.



Energyservice are an independent service provider of strategic and operational maintenance in wind, water, power grids and industries. We takes care of your strategic and operationa maintenance so you can concentrate on your core business. We have extensive experience in preventive maintenance and work across the entire process, from optimization to operational services and emergency preparedness. At new installations and renovations, we can offer project management, design and drawing services. We can also take care of the entire project.

With more than one hundred employees we have a broad expertise and our service portfolio includes a number of special service including thermography, vibration analysis, machine analysis, alignment and balancing, industrial climbing and high voltage maintenance. Our clients range from major power utilities to smaller industrial companies..



STV is manufacturing tracked vehicle for heavier loads that is perfectly suitable for service and maintenance at the wind mill park. These types of tracked vehicles are extremely suitable in sensitive environments, and can be used on both bare ground, marshes, swamps and as over snow vehicles. With the most modern engines they also meet the environmental requirements of our customers. Maintenance work in winter climate may be associated with the risk of falling ice. Our Ice Armor™ has met great interest from our customers. With it installed, staff can travel safely at the wind mill park. The vehicles can be equipped with platforms, cranes, fuel tanks and work shop modules to make your service and maintenance easy. STV has delivered tracked vehicles all over the world to work in the most demanding conditions.



Nordex and Acciona Windpower have joined their businesses, creating one of the leading companies in the wind power industry. The group offers reliable and high efficient multi-megawatt wind turbines for nearly all geographical regions. Also part of the company group's offer are solution-driven innovations, a dense service network, preventive maintenance, an anti-icing system with warranted performance, and end-to-end modernization. Nordex/Acciona Windpower has installed more than 22 GW worldwide and has offices in more than 25 countries around the world. The Swedish subsidiary is located in Uppsala.



eologix sensor technology gmbh was founded in 2014 and developed a wireless and easily retrofittable smart sensor system for icing detection and temperature measurement on the surface of wind turbine rotor blades. The measurement data can be used to reduce downtime as well as to control anti- and de-icing equipment. The system configuration ranges from blade based ice detection for a SAFETY shutdown (simple ice detection and ice prevention) to a RESTART solution for automated operation – both configurations are DNV-GL certified. More than 40 systems with over 600 sensors have been installed on turbines all over Europe and also overseas.



Gill Instruments is a world leader in the design and manufacture of meteorological solutions based on their highly successful ultrasonic anemometer range. Gill has over

25 years' experience in producing sensors for wind speed and direction using their 2D and 3D platforms, with more complex weather monitoring systems based around the MaxiMet and MetPak platforms. Gill products are renowned for their rugged design and excellent long-term reliability in a wide range of harsh and inhospitable environments where ultrasonic technology is deployed in order to take advantage of enhanced accuracy, reduced maintenance and calibration on the basis of no moving parts.



Peikko is a family-owned company founded in 1965. Peikko supplies a large selection of concrete connections and composite beams for building industry. Peikko's innovative solutions make your construction process faster, safer, and more effective. Peikko Group Corporation is a leading global supplier of concrete connections and composite structures. Peikko has sales offices in over 30 countries in Asia, Europe, North America, and the Middle East with manufacturing operations in 9 countries. Choosing a Peikko solution helps to secure the profitability of wind power project. It can be complex soil or rocky area anyway Peikko have the correct solution. Industrialized process from design even in a day and integrated production is securing the fastest and the most reliable on shore wind turbine foundation solution. Peikko has created a holistic solution consisting of design, manufacturing and installation of both gravity and rock foundations. A solid concept, Peikko has experience with all major turbine manufacturers. With deliveries to more than 1000 foundations.



VTT Technical Research Centre of Finland Ltd. is the leading research and technology company in the Nordic countries. We develop new smart technologies, profitable solutions and innovative services. Wind power is an important part of VTT's R&D in energy and we have over 25 years of cold climate experience. Our activities cover the whole value chain from resource assessment, system integration, wind turbine technology to wind power production and O&M. We serve the needs of our customers through direct contract research and development, but also through active national and international R&D collaboration with universities, research centres and industries.



Wicetec is a company established 2014 to sell the proven Finnish wind turbine blade ice prevention system. Wicetec wraps the tech-

nology and Finnish cold climate experience of 25 years to an effective package to deliver "winter ride-through" feature for your wind farm. The turbines will be in operation without icing losses. More than 700MW of wind power is currently operating equipped with the technology. www.wicetec.com



WPS – Your local partner for wind turbine service. WPS is one of the leading independent service provider for wind energy in northern Sweden. We are a sub contractor with a strong local perspective. Our technicians live near the large wind farms in northern Sweden, making us quick to respond and flexible for our clients demand. WPS performs:

- service, installation and maintenance of all brands of wind turbines.
 - service, installation and commission on service lifts.
 - logistics, site facility management and various rough work .
 - We have drivers license for terrain vehicles.
- All our techs are GWO- certified.



Blade Solutions inspect and repair wind turbine blades. The company uses rope access as primary access method. Specific knowledge of blade heat system repairs and cold climate solutions. Frequently using advanced composite methods such as vacuum infusion and UV-curing systems. The company is based in Piteå, located in northern Sweden.



Bladefence is a specialist for wind turbine blade condition analysis, repairs and maintenance. The company utilises advanced skylift equipment and UV-curing blade repair method in its operations. In combination, these enable operations in harsh weather conditions, cutting-edge efficiency and minimise turbine downtime. The company was certified by Germanischer Lloyd for blade repairs in 2012 as the first company in the Nordic countries.



CRESTO AB We focus on the user that experience heights as a risk as well as exciting and wants to be associated to a person facing a challenge. Cresto has insight in the industrial climber's workday. We develop and manu-

facture innovative solutions, products and services driven by insight about our customers need. Cresto is GWO certified and offer courses in 5 of their modules.

CLEANER GROWTH

Cleaner Growth is a unique long-term investment in northern Sweden that supports business development of companies in the cleantech area. The ambition is to position the North Sweden internationally as an attractive place to establish and grow, but also strengthen the development of innovative and sustainable growth and the collaboration between academia, municipality and industry within cleantech.



Connected Wind Services welcomes you to a truly connected world where you get everything you need from one professional, experienced and service-minded Independent Service Provider.

Our highly skilled service technicians provide you with unrivalled knowledge and dedication. For more than 25 years, we have focused on getting the best possible yield for the full lifetime of your assets:

- 1st ISP in Europe, established 1987
- Strong local presence deeply rooted in the European wind industry
- 1800+ wind turbines in service

As Europe's first Independent Service Provider, we apply best practices gained from decades of work with operators and owners at a wide array of locations – from the single standing turbine to the largest wind farms.

CUE DEE

CUE DEE was founded 1978 and since 2001 we have been supplying masts to the wind energy sector. Cue Dee has been a market leader in the Nordic countries for many years and developed a complete range of masts and accessories quality designed to be the best choice for the wind industry.

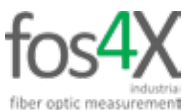


On the safe side.

DEKRA is working for increased safety in a variety of industries through independent inspection, testing and certification. DEKRA is Europe's leading expert organization with 37 000 employees in 58 countries. With our long experience from the wind energy industry, we can support the customer to reach high safety both during construction of a new plant and in operation of existing plants.



Deutsche Windtechnik offers a complete maintenance of wind turbines, ranging from basic service agreements to individually tailored maintenance contracts. The company operates both onshore and offshore. We have 2,800 wind turbines throughout Europe, which have permanent maintenance contracts. We focus on Vestas/NEG Micon, Siemens/AN Bonus, Nordex, Senvion and Fuhrlander turbines.



fos4X's fos4IceDetection system measures the vibrations at the tip of the rotor blade which leads to a very reliable detection of smallest amounts of ice on the rotor blade. It operates even after a shutdown of the wind turbine and at very low wind speeds – hence an automatic restart is feasible.



FT Technologies are the leading manufacturer of ultrasonic wind sensors for turbine control. At Winterwind we are introducing our new FT7 Series wind sensors with improved accuracy. Featuring our patented Acoustic Resonance technology our small, tough wind sensors are easily heated, help to improve output and reduce costly turbine down-time.



FUCHS is a global lubricant provider. Our lubricants business covers everything from research and development to production and sales. We offer a complete range of products and services for all types of industries.



In Situ Instrument AB develops and delivers turnkey systems for environmental measurements in soil, water and air. We provide customized total solutions. Everything from system design and installation to support, service and data collection. In Situ Instrument AB offers its customers maximum accessibility to reliable data!



Klüber Lubrication. As a global leader in speciality lubricants, Klüber Lubrication offers a comprehensive line of lubricants designed to meet the extreme demands of the wind energy industry.

Our product portfolio includes high-performance gear oils and greases for all bearings. The solutions we offer for your applications add to your revenue and success.

Klüber Lubrication is part of the Freudenberg Group. www.klueber.com



NEAS is an independent energy trading and management company specializing in renewable power generation. NEAS covering physical and financial responsibility and offers balancing responsibility, trading, electricity certificates, LECs etc. We've now become one of the leading players in northern Europe with a portfolio of more than 3700 MW production capacity.



Nibe Element Wind Solutions, are supplying heating solutions for turbines erected in cold climates. It means, heating of all critical applications in the nacelle to make it possible to start up, after a stand still situation. We make de-icing systems as well as heating blankets for blade repair.



Rise is a strong, independent research institute, we offer a wide range of cutting-edge competency as well as research and innovation services. We focus on establishing value for and with our customers and partners, by developing value-creating future solutions within a range of technology areas. Our numerous test and demonstration facilities are important drivers for innovations to become real.



The Rope Access Group provides contract services in wind power industry with the help of industrial climbing / rope access and offers a wide range of training courses, whether you are a wind technician, subcontractor or rescue personnel. We have offices in Solna (Stockholm), Gothenburg, Malmö, Östersund and Piteå.

SIEMENS

Siemens is one of the world's leading suppliers of offshore and onshore wind power solutions, including services throughout the entire life cycle of the wind turbines. Our wind turbines around the globe help to provide the world with clean, renewable energy. Siemens has long experience of working with turbines in cold climate areas. Welcome to our booth where we will tell you more about our solutions.



Uppsala University Campus Gotland provides capacity building and research communication in the Swedish National Wind Utilization Network, and offer a large selection of multi-disciplinary wind power courses and a Master programme in Wind Power Project Management.



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.



Vindforsk is a technical research programme run by the Energy Agency in cooperation with the Swedish industry. The project's aim is to increase knowledge and strengthen the Swedish wind power industry's knowledge base.

WeatherTech

WeatherTech Scandinavia AB offers qualified consultancy services such as customized wind and weather related reports, icing studies and weather forecast services for the power industry and actors on the energy market. We have broad meteorological competence from university and wind industry including many years of experience from modelling atmospheric processes.



ICEMET is a commercialization project in the University of Oulu, Finland, funded by Tekes (the Finnish Funding Agency for Innovation) and University of Oulu. The project develops a novel measurement technique to determine the liquid water content (LWC) of the freezing cloud, which causes the icing of wind turbine blades.



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- Snabba, kostnadseffektiva och säkra



Gravitationsfundament



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With more than one hundred employees we have a broad expertise and our service portfolio includes a number of special services including thermography, vibration analysis, machine analysis, alignment and balancing, industrial climbing and high voltage maintenance. Our clients range from major power utilities to smaller industrial companies.

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