IWAIS2015 16TH INTERNATIONAL WORKSHOP ON ATMOSPHERIC ICING OF STRUCTURES

Conference Program 2015

Uppsala, 28 June to 3 July

Swedish Energy Agency

Essential support for IWAIS 2015 has been provided by the Swedish Energy Agency

iwais.org

Welcome to IWAIS 2015!

Why do the world's leading experts on atmospheric icing gather in the middle of the summer in Uppsala to talk about wind speeds, ice wettability, icing and ice adhesion?

Because ice on transmission lines, wind turbines, towers, bridges and other structures is a growing problem. Heavy icing can cause flashovers and strike down transmission lines and towers.

Climate change is making matters worse, with more humid weather and an increase in the frequency of wet snow events, which in turn increases the risk of ice accumulating on buildings and other structures.

At the same time more wind turbines, the opening of new logistic sea routes, energy and mineral resources as well as increasing tourism feed the growing activity in cold climate regions and expose more people to the dangers and challenges associated with icing.

The damage caused by severe icing can lead to enormous costs. In early 2008 unusually cold weather coupled with heavy snow and ice paralyzed Southeast China. Infrastructure, especially power and water supply, as well as transportation came to a complete halt in many areas. Direct economic losses were estimated at USD 20 bn, while the total insurance market losses were approximately USD 1.3 bn. The bulk of the insurance loss claims came from the commercial/industrial sector, where power transmission and distribution line operators were particularly affected.

Atmospheric icing can also have a profound effect on wind power production. Ice can accrete on the blades of a wind turbine and change its aerodynamic properties resulting in lower output, increased noise, risk of ice throw and possibly also increased loads.

There's no quick fix for icing, but better forecasts, measurements, equipment and standards might be applied to prevent or decrease the consequences of some of the catastrophic failures we have seen in the past.

So, welcome to the 16th International Workshop on Atmospheric Icing of structures (IWAIS). I'm looking forward to hear about your work.

Göran Ronsten
Program coordinator

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The team behind IWAIS 2015

5 **Uppsala - medieval ruins and a hub for science.**
Lots to do in this city with the oldest centre of higher education in Scandinavia.

6 **Wrecking havoc**
Power outages, broken wires and structural collapses of transmission towers. Heavy icing can cause severe problems along transmission lines.

8 **World class testing in Ludvika**
STRI in Ludvika test the effect ice and snow has on transmission systems. The lab has been involved in projects all over the world.

9 **Smarter technology**
The ABB Corporate Research Center develop technologies for future products and services for ABB's core businesses.

9 Gotland is known for having a top quality transmission system. Now the island take it a step further.

10 **Predicting ice**
Icing rate, melting rate, load and type simultaneously - the new ice sensor prototype MuVi-Graphene has some promising features.

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Why did the manufacturers and developers not wait until they could offer turbines with de-icing systems?

12 **Progam**

Our organizers

Göran Ronsten
Program coordinator

Holds a Master in Aeronautical Science from the Royal Institute of Technology in Stockholm and an MBA from Stockholm School of Economics. He's been engaged in wind energy related research for more than 30 years and is an expert in wind energy in cold climates.

Helena Wickman
Organizer

Helena works as a wind and site analyst at Meventus. She has a MSc in Engineering Physics from Uppsala University and has specialized in ice detection methods for wind energy in cold climates.

Rebecka Klintström
Organizer

Rebecka works at Meventus, holds a MSc in Energy Engineering and has specialized in wind energy in cold and icing climates. She is one of the organizers of IWAIS 2015.

Ulrica Edström
Organizer

Ulrica is a project manager and has led congresses for Resia since 2011. Perhaps you've already met her during the Winterwind 2014 or 2015. Before Resia, she has among other things, project led city development in Sundsvall and Sundsvall music festival.

Jonas Hållén
Journalist

Jonas has a background as journalist and is specialized in renewables. Among other things he has worked as editor of the magazine Swedish Wind Energy and with several conferences. During IWAIS 2015 he's taking care of information and media contacts.

Magnus Nordén
Media and events

With an Economy degree from Uppsala University, Magnus worked as sales manager and media analyst in MTG group for about 10 years. And then 10 years as self-employed and part-owner in some magazines. Assignments for: Swedish Windpower Association, IWAIS and more.

Our exhibitors

NTT Advanced Technology Corporation (NTT-AT) was founded in 1976 as a subsidiary of NTT, the largest telecommunications service provider in Japan. Since then it has grown rapidly, largely due to its close links with NTT Laboratories and its success in the technology transfer business.

Eologix sensor technology gmbh was founded in 2014 and developed a wireless icing detection and temperature measurement system for retrofit application on rotor blades. The measurement data obtained from multiple points on the blade surface can be used to reduce stand-still time as well as to effectively control anti- and de-icing equipment.

Meventus is an international company specializing in wind measurement, wind and site and asset management services with offices in Norway, Denmark and Sweden. We deliver services to customers throughout Central and Northern Europe, with long experience and expertise in cold climate areas and complex terrain.

Explore the oldest university city in Sweden

This year IWAIS is set in Uppsala, one of Sweden's four major cities. Uppsala is rich in history and has been Sweden's temporal and spiritual center of power from far back in time.

Here you can find everything from a 13th century cathedral and 16th-century ruins to cultural festivals and cutting-edge research from its two universities, Uppsala university, (founded in 1477) and the University of Agricultural Science, SLU.

In Uppsala city and the surrounding Uppland countryside, you can spend a few hours or several days experiencing both history and present, nature and city life, science and international peace work. For adults and for families.

Start with a one hour city tour led by experienced guides. It will take you to the most interesting spots and beautiful views of Uppsala, giving you insights into the thousands of years of Uppsala's history.
Time: Wednesday July 1, 6 pm.
Cost: 10 Euro.
Included: One hour tour.

Guided tours in the Cathedral
Experience Norden's largest cathedral. Guided tours in English Monday to Friday at 10 am and 2 pm.
Price: Free!

...and here are some more activities for you and your family:

Old Uppsala Museum

Uppsala is one of the oldest cities in Sweden. Throughout history it has played an important role. The museum tells you about exciting archaeological finds and the history of civilization in Mälardalen. The museum is open every day from 11 am to 5 pm.

Elton John concert

in the Botanical garden in Uppsala. The artist behind hit songs such as "Candle In The Wind" and "Tiny Dancer" comes to Uppsala to play in the Botanical Garden on Wednesday July 1st.
Price: 795 SEK

The Linnaeus Garden

The first botanical garden in Sweden. It was founded in 1655 by Olof Rudbeck the elder. Approximately 1300 species are grown here. The garden is open Tuesday to Sunday from 11 am to 5 pm.
Entrance fee: 60 sek.

Lennakatten

The railway museum in Uppland. Take a trip on the steam train departing from Uppsala railway station. The old train has been taken care of by the museum and is now open to the public. Various trips available. Tickets can be bought on Uppsala Railway station.
Price: 100–180 sek.

Icing destroys transmission lines

Unexpected iceloads are a threat against our power systems. New technology and better weather models might help to predict where the troubles are most likely to erupt.


Bjørn Egil Nygaard

The last two winters the Norwegian transmission system operator Statnett has experienced heavier iceloads than expected on parts of the transmission system.

One of the affected lines was an entirely new 420 kV transmission line crossing an exposed mountain area just north of the Hardanger Fjord in Norway. A ground wire broke due to heavy icing after only three weeks in operation.

Icing has also caused structural collapses of transmission towers.

– The icing challenges the security of supply, says Bjørn Egil Nygaard, advisor at Kjeller Vindtekikk, a Norweigan company that now is working to prevent similar failures in the future.

Iceloads drive the dimensioning of towers and foundations and hence it's vital to Statnett to predict the level of ice.

The most severe problems are in the mountain areas and have been caused by in-cloud icing/rime icing, the same problem that you can find on wind turbines. This

OLE GUSTAV BERG, STATNETT

type of icing typically affects high structures that penetrate clouds.

The measured ice load on the 420 kV transmission line in mountain area north of the Hardanger Fjord was more than double the design load.

– That clearly indicates that the ice loads had been significantly underestimated in the pre-construction phase due to lack of suitable meteorological models, says Bjørn Egil Nygaard.

Is the heavy icing due to climate changes?

– Two years of heavy icing is a too short period to make that kind of conclusion, says Nygaard, but that has of course been discussed.

The design load on the 420 kV transmission line was estimated 2007, by applying the then best available meteorological expertise.

Today, an advanced local-scale meteorological model has been implemented as a tool to improve load estimation of the ice loads. Basically you apply the fastest computer you can find, and then use numerical weather prediction to simulate the local weather and icing conditions over the last decades to map the icing conditions on a local scale.

– With the same system we can do icing forecasts for the next few days and even simulate future icing based on climate change scenarios says Nygaard.

Better forecasts

– With modern meteorological models it will be easier to predict icing and also avoid building transmission lines in certain areas, or at least build them strong enough to cope with icing,

Another solution might be ice detectors. But current devices aren't efficient enough and sometimes doesn't work at all, says Nygaard. He and his colleagues are now working on a prototype that they hope will make proper measurements.

– With better forecasts and measuring we might be able to prevent the kind of failures we have seen the last years, concludes, Bjørn Egil Nygaard. ✱

Weather Research and Forecasting model (WRF)

The model used for simulations is the Weather Research and Forecasting model (WRF), developed by the National Center for Atmospheric Research (NCAR) in USA.
NCAR is federally funded and the WRF modeling system is possible to download free of charge.
It has become an important tool of the trade and it has today grown to have a large worldwide community of users (over 20 000 in over 130 countries), and workshops and tutorials are held each year at NCAR.

29
JUN

World class ice testing

High Voltage Valley in Ludvika has become a center for high voltage testing. STRI is leading the development.


Dr Andreas Dernfalk


Dr Igor Gutman

On the 29th of June stri will host a technical visit for the participants of IWAIS 2015. STRI has been involved in many practical ice and snow investigations all over the world.

The research center in Ludvika is an accredited laboratory specializing in high voltage testing and power system applications. They company has operated for 25 years, and specialize in areas such as HVDC and UHVDC.

The high voltage testing facility can perform tests of equipment rated up to 800 kV UHVDC and 1100 kV UHVAC. They also perform tests with low temperature, ice and snow using STRI's unique climate chamber, which is 18 m in diameter and 24 m in height.

The program for the visit will include the following:

+ Presentation of STRI's experience in ice and snow investigations performed on insulators and conductors, about 1 h (Dr. Igor Gutman)
+ Technical visit of high-voltage laboratory showing facilities for different dielectric and environmental (including ice and snow) tests, about 1 h (Dr. Andreas Dernfalk)

Example of recently performed ice accretion of insulator string under full-scale DC voltage will be shown. ✱

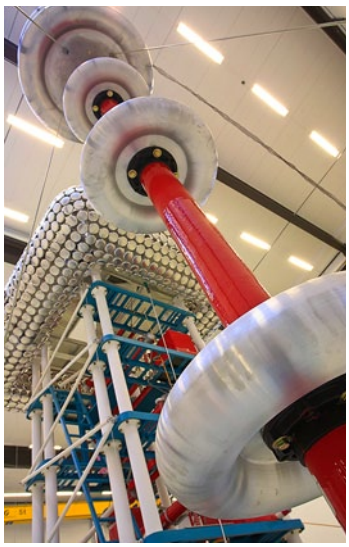
IWAIS 2015 technical visit
Monday June 29.
08:30 Bus from Uppsala
09:45–10:00 "Fika" in Västerås
10:00–12:00 Visit at ABB Corporate Research in Västerås
12:15–13:45 Bus to Ludvika, lunch served in the bus.
14:00–16:00 Visit at STRI
16:00–18:30 Ludvika to Uppsala
More info: www.stri.se

A look into the future

It started with a manufacturer of electrical light and generators. Now ABB has its research center here.

Agenda for the visit of IWAIS the 29 of June is a presentation of ABB Corporate Research in Västerås by Andrew Maxwell and to visit High Voltage Laboratory, Mechanical Laboratory and the newly build High Power Electronic Laboratory "Light House".

The ABB Corporate Research Center in Sweden is located about 100 kilometers west of Stockholm. Together with other R&D centers in the company it develops technologies for future products and services for ABB's core businesses. ✱



03 JUL

Gotland's got the Smartest Grid

Wind energy is the driving force behind the smart transmission system that is being developed on Sweden's largest island.

In the 1950-ies Gotland's electric grid was connected to the Swedish mainland by use of the the first fully commercial static plant for high voltage direct current transmission in the world.

Now, when the national transmission grid operator has agreed to install a second high voltage link, the technology is once again of highest interest. Due to favourable weather condition Gotland has a high and increasing wind power production. The wind power production is, in fact, so high that it already today corresponds to national long term goals for inclusive growth, and so high that the local grid operator, GEAB, has been forced limit the installed wind power capacity.

In order to study and perhaps remedy the side effects of volatile power production, research and development project Smart Grid Gotland was started.

The goal of ther project is to allow an increase of the installed wind power capacity and an increase of the power quality on the island.

During your stay on Gotland you will have the opportunity to visit Ygne, the first fully commercial static plant for HVDC-transmission in the world. ✱

09:30 Introduction – GEAB.
10:00 Smart Grid Gotland – Erik Segergren.
11:00 Smart Customer Gotland – Johan Sjöndin.
12:00 Lunch.
13:00 Site visit, Ygne.
15:00 Future grid solutions for renewable energy on Gotland – Christer Liljegren.
More info: smartgridgotland.com

Promising sensor

It's hard to measure ice. But now a group of researchers in Norway have developed a device that might mean a break-through in measuring ice parameters.

Umair N. Mughal

The new prototype of a atmospheric icing sensor promises to deliver more parameters on ice than current devices. Its set-up is modular so it can be modified for different users and climates.

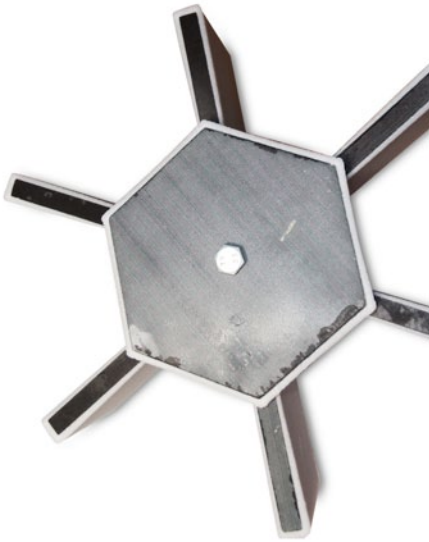
– Presently, there is no ice sensor commercially available that can detect and measure all important icing parameters such as: icing rate, melting rate, load and type simultaneously, says Umair N. Mughal, researcher at Atmospheric Icing ResearchTeam of Narvik University College in Norway.

Now Mr. Mughal and collegue Muhammad S. Virk has designed and developed a new prototype modular hybrid atmospheric icing sensor.

This sensory unit is potentially capable to deliver all of the described icing parameters and has successfully been tested at Cryospheric Environmental Simulator, Japan, in both icing and snow conditions.

MuVi-Graphene , as the device is called, is a modular atmospheric icing sensor, capable to:

+ Measure Icing Load (Using Rotary/Torque Loading)
+ Icing Rate (Using Rotary/ Torque Loading)
+ Detect Icing Event (Using Mutual Charge Transfer Scheme)
+ Determine Ice Type (Using Mutual Charge Transfer Scheme)
+ Measure Melting Rate (Using Mutual Charge Transfer Scheme)



The sensor being modular means that the customers can decide which output parameters he or she wants (detecting ice, identify ice type, measure melting rate or measure icing load and icing rate) by doing minor design changes in the sensor configuration.

– Presently this device is suitable for onshore applications and stationary installations; however it also has adequate potential for offshore applications by introducing minor changes, says Mughal.

The device is an electromechanical rotating hexagon with six multi purpose plates mounted on it. It can be used by mounting on simple pole of designed dimensions. It can also be mounted on stationary structures in cold regions.

Acknowledgement:
The work reported in this article was partially funded by the Research Council of Norway, project no. 195153 and partially by the consortium of the project Cold-Tech- Sustainable Cold Climate Technology. ✱

Wind power in cold climates

Greed are behind many of the problems with wind energy in cold climates.


Göran Ronsten

Why do wind turbine makers sell standard turbines to locations that are so far from standard? And why do developers construct and sell standard plants for use in such locations? I believe we all know the answer to that. Money. Well, greed is rarely as lucrative as suggested by the old joke from the school of economics: "Greed is good!" Not even for the manufacturers and developers.

So why did the manufacturers and developers not wait until the manufacturers could offer de-icing systems? Two reasons are worth mentioning. Prior to the financial crisis in August 2008, it was more profitable for manufacturers to sell standard turbines for standard locations. After the financial and the subprime crises, it has taken the manufacturers years to develop de-icing systems. It will most likely take several more years before the manufacturers are able to offer sufficient de-icing power and functionality guarantees.

Other challenges created by iced wind turbines in cold climates include personal safety, noise, higher grid balancing costs and loads.

Ice throw from blades, nacelles and towers is a hazard for service engineers and members of the general public who find themselves within the risk zone. In this respect, wind turbines are no different from masts, towers and other tall buildings from where ice may drop into the risk zone and reach terminal velocity (i.e. the speed of a falling object if the drag force and the gravitational force are equal).

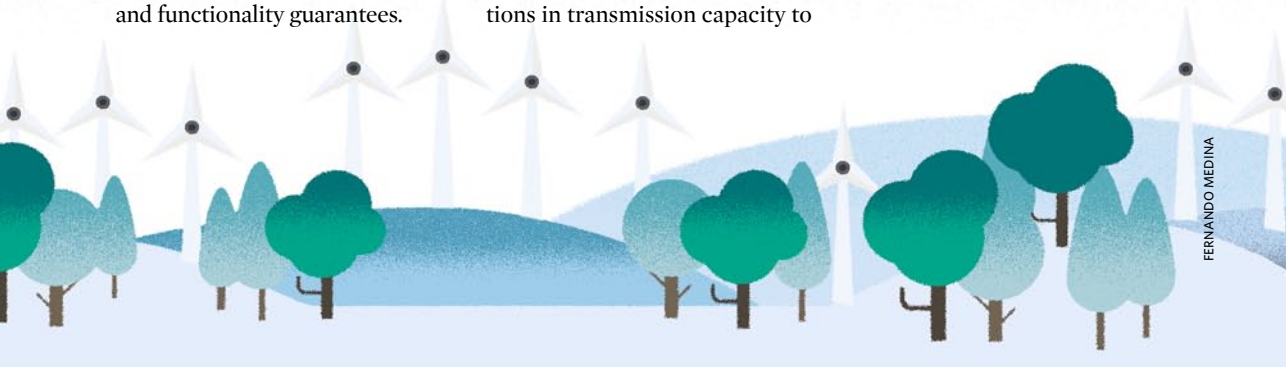
As an increasing number of manufacturers have began to offer de-icing systems, it is likely that the concerns regarding ice throw and high noise levels will abate in the future. However, these concerns may never be fully eliminated.

The compensation paid for electricity production in the two northern bidding areas is lower. This is not only due to the limitations in transmission capacity to more densely populated areas; the compensation is also lower due to the high grid balancing cost caused by icing.

IEC 61400-1, the current standard that governs the design of wind turbines, does not deal with protracted loads on iced wind turbines. An updated version of the standard is currently being reviewed. This is a unique opportunity for Sweden to prevent manufacturers and developers from selling standard turbines to locations that are affected by significant icing.

Smaller manufacturers will most likely try to prevent these more rigorous design requirements. I do hope they will fail, as it is only reasonable that wind turbines designed for use in icing climates must be suited to such conditions. Just like the risk of ice throw and the higher noise levels, grid balancing and load issues may be resolved by improved de-icing systems. ✱

Göran Ronsten
Program coordinator



FERNANDO MEDINA

IWAIS 2015 PROGRAM

72 abstracts, 59 lectures, 13 electronic posters and more than 70 participants. We're now ready to launch IWAIS 2015, a world leading conference on atmospheric icing of structures.

SUNDAY JUNE 28	
18:00–20:00	ICE BREAKER AND REGISTRATION
MONDAY JUNE 29	
08:30–18:30	STUDY VISIT TO LUDVIKA
19:00–20:00	REGISTRATION EXHIBITOR STANDS AND POSTERS TO BE INSTALLED

TUESDAY JUNE 30

TIME	EXHIBITION HALL & OTHER LOCATION	SESSION ROOM 1: GILLESALEN	SESSION ROOM 2: SWEDENBORG
08:00–08:50	Registration		
09:00–10:15		**OPENING SESSION** **CHAIR: KATHLEEN F. JONES**	
		Local organizers	
		Paul Mitten, Chairman of IWAIS	
		Determination of ice deposits thickness on overhead power lines conductors by location method, Renat Minullin, Kazan State Power Engineering University (26)	
		Coatings for protecting overhead power network equipment in winter conditions, Masoud Farzaneh, Université du Québec à Chicoutimi (15)	
10:15–10:45	BREAK		
10:45–12:15		**SESSION 2 CHAIR: MASOUD FARZANEH**	
		Research Condition and Capacity of Xuefeng Mountain Natural Icing Testbase (XMNIT), Jiang Xingliang (61)	
		Meteorological data for assessing climatic loads on overhead lines. Report from Cigre WG B2.28, Svein M. Fikke, Meteorological consultant (36)	
		Back to the basics: Wetting, Icing and Ice adhesion, Lasse Makkonen, VTT Technical Research Centre of Finland (2)	
12:15–13:30	LUNCH		
13:30–15:00		**ANTI- / DE-ICING,COATINGS** **CHAIR: PAUL MITTEN**	**ICING MEASUREMENTS, MODELLING AND FORECASTING** **CHAIR: SVEIN M. FIKKE**
		Optical Fiber Temperature Characteristic of OPGW during DC Ice Melting, Zhigao Meng, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (65)	Analysis of the effect of climate change on the reliability of existing overhead transmission lines, Luc Chouinard, McGill Unviersity (1)
		Passive acoustic signal sensing approach to detection of ice on the rotor blades of wind turbines, Eugen Mamontov, Foundation Chalmers Industrial Technology (Stiftelsen Chalmers Industriteknik), Gothenburg, Sweden (21)	A Research of Icing Forecasting Algorithm Using Genetic Algorithm and Fuzzy Logic, Xin-bo Huang, College of Electronics and Information, Xi'an Polytechnic University, P.R. China (11)

		Study on Icing characteristics of Bundle Conductors under Xuefeng Mountain Natural Icing Testbase, Quanlin Wang, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (67)	Verification of Icing-model in Finland, Karoliina Hämäläinen, Finnish Meteorological Institute (FMI), FI (13)
		On Self-cleaning and Anti-ice Performance of Double-layer-SAMs Coatings with Enhanced Corrosion Resistance on an Al Alloy Substrate, Shahram Farhadi, NSERC/Hydro-Quebec/ UQAC Industrial Chair on Atmospheric Icing of Power Network Equipment (CIGELE) and Canada Research Chair on Atmospheric Icing Engineering of Power Networks (INGIVRE), Université du Québec à Chicoutimi, QC, Canada (55)	
15:00–15:30	**BREAK & POSTER PRESENTATIONS**		
15:30–17:00	• Wet-snow activity research in Italy, Matteo Lacavalla, RSE SpA, IT (6) • Testing six wet snow models by 30 years of observations in Bulgaria, Dimitar Nikolov, National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences (NIMH-BAS), Bulgaria (33) • Effect of alkyl chain length on the hydro/ icephobic properties of SAMs coatings on aluminum alloy 6061 surfaces, Faranak Arianpour, NSERC / Hydro-Quebec / UQAC Industrial Chair on Atmospheric Icing of Power Network Equipment (CIGELE) and Canada Research Chair on Atmospheric Icing Engineering of Power Networks (INGIVRE), www.cigele.ca Université du Québec à Chicoutimi, Chicoutimi, QC, Canada (53) • How the "Steric effects" Affect Ice Repellency, UV stability and Corrosion Resistance of Dissimilar SAMs Coatings on a AA2024 Alloy, Shahram Farhadi, NSERC/ Hydro-Quebec/UQAC Industrial Chair on Atmospheric Icing of Power Network Equipment (CIGELE) and Canada Research Chair on Atmospheric Icing Engineering of Power Networks (INGIVRE), Université du Québec à Chicoutimi, QC, Canada (54)	**ANTI- DE-ICING, COATINGS** **CHAIR: SHIGEO KIMURA**	**ICING MEASUREMENTS, MODELLING AND FORECASTING** **CHAIR: LASSE MAKKONEN**
		Development and Application of Current Transferring Smart Ice Melting method and apparatus for Bundle Conductors Transmissiuon Lines of EHV/UVU, Xingliang Jiang, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (62)	Usage of automated information system for icing control on OHL 110-500 kV, Eugeniy Satsuk, Platov South Russian State Polyechnic University (Novocherkassk Polytechnic Institute), Novocherkassk, Russia (41)
		Hydrophobic and anti-ice properties of homogeneous and heterogeneous nanoparticle coatings on Al 6061 substrates, Faranak Arianpour, NSERC / Hydro-Quebec / UQAC Industrial Chair on Atmospheric Icing of Power Network Equipment (CIGELE) and Canada Research Chair on Atmospheric Icing Engineering of Power Networks (INGIVRE), www.cigele.ca Université du Québec à Chicoutimi, Chicoutimi, QC, Canada (56)	Ice detection methods and measurement of atmospheric icing, Matthew Wadham-Gagnon, Canada (40)
		Influence of Shed Structure on Icing Characteristics of Composite Insulator Based on Natural Icing Testbase, Yang Pan, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (66)	Observations and modeling of sea splash icing, Kathleen Jones, CRREL, USA (3)
		Research on icing behavior and ice adhesion testing of icephobic surfaces, Heli Koivuluoto, Tampere University of Technology, FI (49)	
18:30	**MINGLE & CONFERENCE DINNER, MASOUD FARZANEH AWARD BY UNIVERSITY OF QUÉBEC IN CHICOUTIMI MÅRTEN AJNE ABOUT THE SECRET LIFE OF ICE**		

WEDNESDAY JULY 1

	OUTSIDE SESSION ROOMS	SESSION ROOM 1: GILLESALEN	SESSION ROOM 2: SWEDENBORG
08:30–10:30		**OX2 - DEPLOYMENT OF LARGE SCALE WIND ENERGY IN ICING CLIMATES** **CHAIR: GÖRAN RONSTEN**	
		Lessons learned from "Large scale, cost effective deployment of wind energy in icing climates", Göran Ronsten, OX2 & WindREN (59)	
		Innovations in F-LOWICE real-time forecasts of wind power and icing effects, Erik Gregow, Finnish Meteorological Institute, FI (17)	

		Development of operational forecasting for icing and wind power at cold climate sites, Øyvind Byrkjedal, Kjeller Vindteknikk (46)	
		Vestas de-icing system, Francisco Fernandez, Vestas (71)	
10:30–11:00	**BREAK & POSTER PRESENTATIONS**		
11:00–12:30	• What we learned – Adaption and development of measurement technique and camera supervision for icing conditions, Bengt Norén, In Situ Instrument AB (58) • Wind, Ice and Snow Load Impacts on Infrastructure and the Natural Environment (WISLINE), Harold Mc Innes, The Norwegian Meteorological Institute (32) • Controller for Surface heating, Rolf Westerlund, HoloOptics (57) • Influence Analysis of Transmission Lines Insulator on the Conductor Iceshedding, Xin-bo Huang, College of Electronics and Information, Xi'an Polytechnic University, P.R.China (9)	**OX2 & ICING IN WIND ENERGY** **CHAIR: HELENA WICKMAN**	**ICING ON POWER LINES** **CHAIR: SERGEY CHERESHNYUK**
		Siemens de-icing system, Diego Levati, Siemens (72)	A severe in-cloud icing episode in Iceland 2013-2014 – Weather pattern background, Árni Jón Elíasson, Landsnet, IS (48)
		Experiences from studies of icing and production losses due to icing in OX2's Vindpilot project, Stefan Söderberg, WeatherTech Scandinavia, SE (29)	Wet snow icing - Comparing simulated accretion with observational experience, Árni Jón Elíasson, Landsnet, IS (44)
		Modelling icing conditions for a selection of Swedish wind farms during winter 2014–2015, Heiner Körnich, SMHI, SE (31)	Comparison of measured and simulated icing in 29 test spans during a severe icing episode, Egill Thorsteins, IS (45)
		Probabilistic forecasting of icing and production losses, Jennie Persson Söderman, Uppsala University, SE (28)	Automated Icing Monitoring System on the teritorry of the Czech and Slovak Republic, Jaroslav Šabata, EGÚ Brno, a.s. (70)
12:30–13:30	**LUNCH**		
13:30–15:00		**ICING IN WIND ENERGY** **CHAIR: REBECKA KLINTSTRÖM**	**ICING ON POWER LINES** **CHAIR: JAROSLAV ŠABATA**
		Case study of ice sensor using Computational Fluid Dynamics, measurements and pictures, Marie Cecilie Pedersen, Vattenfall Vindkraft A/S, Denmark (22)	Monitoring and forecasting ice loads on a 420 kV transmission line in extreme climatic conditions, Bjørn Egil Nygaard, Kjeller Vindteknikk, NOR (39)
		Supercooled Water Wettability and Freezing on Hydrophobic Surfaces: The Role of Temperature and Topography, Golrokh Heydari, KTH, Sweden (14)	Neural network approach to characterize atmospheric ice compressive strength, Hicham Farid, CIGELE/UQAC, Canada (23)
		Effect of Surface Roughness of Wind Turbine Blade on its Ice Accretion, Jian Liang, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (64)	Multichannel radar monitoring of ice on power lines, Renat Minullin, Kazan State Power Engineering University (24)
		3-D Numerical Simulation of MWs Wind Turbine Blade's Icing, Qin Hu, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (68)	Collapse of an Arctic Power Line due to strong Wind Gusts during Wet Snow Accumulation, Knut Harstveit, Kjeller Vindteknikk, Norway (34)
15:00–15:30	**BREAK & POSTER PRESENTATIONS**		
15:30–17:00	• Expansion of the ice deposition monitoring network in Germany, Bodo Wichura, German Meteorological Service, Climate and Environment Consultancy Potsdam, Germany (51) • The Numerical Analysis for jump height of multi-two-spans at different intervals of overhead transmission lines, Yong-can Zhu, School of Electro-Mechanical Engineering, Xidian University, Xi'an, P.R. China (12) • Development of snow accretion simulation method for electric wires in consideration of snow melting and shedding, Kazuto Ueno, Central Research Institute of Electric Power Industry, Japan (19)	**ICING ON POWER LINES AND CONDUCTORS/INSULATORS/ FLASHOVER** **CHAIR: BRIAN WAREING**	
		Technology radar monitoring of overhead power lines when detecting ice formations, Renat Minullin, Kazan State Power Engineering University (25)	
		Research on describing the icing level of porcelain and glass insulator based on icing thickness of the equivalent diameter, Zhijin Zhang, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (69)	

	• Effect of icephobic coating on ice protection of ultrasonic anemometer with stack-type transducers, Shigeo Kimura, Kanagawa Institute of Technology (20)	Analysis of radar equipment indications and weight sensors indications during detecting ice deposits on power lines, Renat Minullin, Kazan State Power Engineering University (27)	
		Experimental research on the icing progress of insulators, Yuyao Hu, The State Key Laboratory of Power Transmission Equipment & System Security and New Technology, Chongqing University, Chongqing (63)	
17:30–19:00	IWAIS IAC COMMITTEE MEETING		
18:00–19:30	UPPSALA BY FOOT		
19:30–22:00	IWAIS IAC COMMITTEE DINNER		

THURSDAY JULY 2

		SESSION ROOM 1: GILLESALEN	SESSION ROOM 2: SWEDENBORG
09:00–10:30		**HSE & SENSORS, EQUIPMENT AND MACHINERY** CHAIR: BODO WICHURA	
		Numerical Study of Atmospheric Ice Accretion on Wind Turbines, Muhammad Virk, Atmospheric Icing Research Team, Narvik University College, Norway (7)	
		MuVi Graphene – Hybrid Atmospheric Icing Sensor, Umair Mughal, Atmospheric Icing Research Team, Narvik University College, Norway (8)	
		Methods for evaluating risk caused by ice throw and ice fall from wind turbines and other tall structures, Rolv Erlend Bredesen, Kjeller Vindteknikk, NO (38)	
		Icing forecast in GIS Meteo system, Yury Yusupov, MapMakers Group Ltd. (43)	
10:30–11:00	BREAK & POSTER PRESENTATIONS		
11:00–12:30	• Comparison of three different antiand de-icing techniques based on SCADA-data, Sandra Kolar, Uppsala Universitet/OX2 (52) • Review of icing related failures of wind masts in Bulgaria, Dimitar Nikolov, National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences (NIMH-BAS), Bulgaria (42) • The recognition and detection technology of ice-covered insulatorsunder complex environment, Xin-bo Huang, College of Electronics andInformation, Xi'an Polytechnic University, Xi'an, P.R.China (10)	**CONDUCTORS / INSULATORS / FLASHOVER** CHAIR: XINGLIANG JIANG	**TESTING FACILITIES, ICING ON MASTS, TOWERS AND BUILDINGS** CHAIR: ALAN B. PEABODY
		Anti-icing tests on La Farga CAC copper, Lluis Riera, La Farga, Spain (5)	Icing Measurements at Berlin TV Tower: A case study of a falling ice situation on 23rd December 2012, Bodo Wichura, German Meteorological Service, Climate and Environment Consultancy Potsdam, Germany (50)
		Relation between test span measured ice loads and conductor size, Brian Wareing, United Kingdom (4)	Investigation of Using Icephobic Coatings on a Cable Stayed Bridge, Douglas Nims, University of Toledo, Toledo, USA (37)
		Comparison of ice accumulation on simplex and duplex conductors in parallel overhead transmission lines in Iceland, Pétur Thór Gunnlaugsson, IS (47)	Isotopic Mass Balance Measurements of Spray Ice, Toshihiro Ozeki, Hokkaido University of Education (30)
		Advanced test methods for full-scale ice tests of DC insulators strings intended for ±350 kV, Andreas Dernfalk, STRI (18)	A prediction method of slide snow/ice load applied to roofs, Xuanyi Zhou, State Key Laboratory of Disaster Reduction in Civil Engineering, Tongji University, Shanghai, China (60)
12:30–13:30	LUNCH		
13:30–15:00		**SESSION 16 - CLOSING SESSION** CHAIR: MATTHEW WADHAM GAGNON	
		Ripples on Icicles, Lasse Makkonen, VTT (16)	

		Fault statistics on overhead transmission lines in Russia because of icing, Sergey Chereshnyuk, Research and Development Center at Federal Grid Company of Unified Energy System (R&D Center @ FGCUES), Moscow, Russia (35)	
15:00–15:30	**BREAK**		
15:45–17:45	**TRAVEL TO NYNÄSHAMN**		
18:35–22:00	**BOAT TO GOTLAND**		

FRIDAY JULY 3

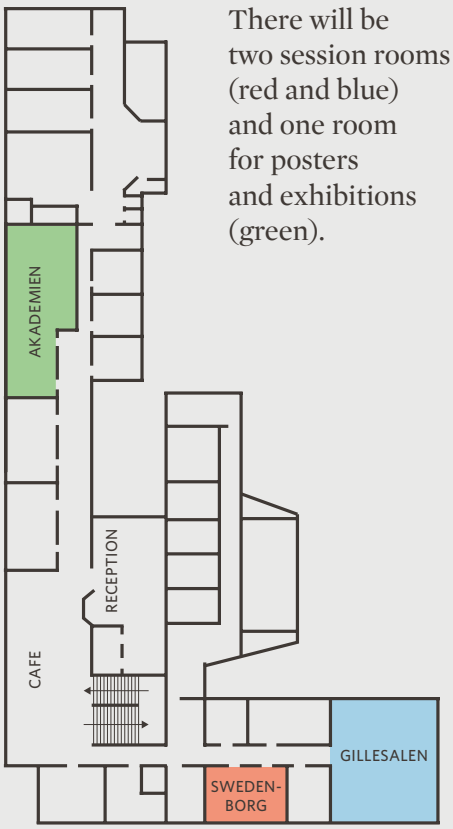
	ACTIVITY	LOCATION
09:00–16:00	SMART GRID GOTLAND	GOTLAND

SATURDAY JULY 4

	ACTIVITY	LOCATION
09:00–17:00	VISIT TO N. GOTLAND	FÅRÖ

SUNDAY JULY 5

	ACTIVITY	LOCATION
09:00–16:00	VISIT TO S. GOTLAND	NÄSUDDEN
18:00	DEPARTURE FOR VISBY HARBOR	VISBY
19:10–22:30	BOAT TO NYNÄSHAMN	VISBY
23:30	ARRIVAL TO C STOCKHOLM	STOCKHOLM



There will be two session rooms (red and blue) and one room for posters and exhibitions (green).