



**UVIG FORECASTING WORKSHOP AND TUTORIAL -
APPLYING METEOROLOGY IN
POWER SYSTEM PLANNING AND OPERATIONS**

June 20-22, 2017

Renaissance Atlanta Midtown Hotel
Atlanta, GA

Tutorial

Tuesday, June 20, 2017

7:00 a.m. – 8:00 a.m.

Registration & Breakfast

Location: Lobby

8:00 a.m. – 12:00 p.m.

Tutorial on Integration of Uncertainty Forecasts into Power System Operations

Location: High Ballroom A

Tutorial Background

This half-day tutorial on the topic of integrating uncertainty forecasts will assist in unlocking the value of the forecasts through the understanding and use of the uncertainty information which they contain. The tutorial includes participants from the IEA Wind Task 36 "Wind Energy Forecasting" project. It will examine the challenges arising with increasing shares of VG (wind and solar energy) and the corresponding tools for VG plant operators, system operators, utilities and traders for using uncertainty forecasts in their operations. This tutorial is intended to help understand what information is required for specific tasks and how it can be used in daily operations. The cost of the tutorial is in addition to the workshop registration fee and the tutorial registration fee includes lunch.

Part 1 will cover the background on the methods for extracting uncertainty information from forecasts and what it means. Part 2 will address applications of the methods to real situations, values that may result, and approaches that may have added value or usability. The focus of the tutorial is on the understanding of the practical use of uncertainty information.

Chair - Part 1: Sue Haupt, NCAR: *Background, Methods and Meaning of Uncertainty Forecasts*

The focus here is on the applied use of the uncertainty information rather than on the detailed methods of producing forecasts for probabilistic tools. We will emphasize the “what you need to know, what it means, and how to use it” aspect.

8:00 a.m. – 9:45 a.m.

- How are uncertainty forecasts produced and what information do they really contain? What is the range of probabilistic forecast information that is currently being provided by forecasters (from simplest to most comprehensive)?

Sue Haupt, NCAR: *Overview of Techniques and Issues Associated with Probabilistic Forecasting*

Matt Wandishin, NOAA: *Extracting Uncertainty Information from Probabilistic Forecasts*

Eric Gritmit, Vaisala: *Providing Uncertainty Information to End Users in the Electric Sector*

- What market design and operation tools are currently available or being developed to enable forecast users to more effectively use probabilistic forecast information? For ISOs? For utilities? For traders? How can we bridge the gap between what is available and what we need with respect to data, tools and applications?

Erik Ela, EPRI

Open Discussion

9:45 a.m. – 10:00 a.m.

Break

Location: Lobby

Chair - Part 2: Bob Zavadil, Enernex: *Applications and Value of Uncertainty Forecasts*

What are the needs that can be exposed by the application of uncertainty information? How can the power sector better use the information available or what information could it better use?

10:00 a.m. – 10:30 a.m.

- How is uncertainty forecast information currently being used in the operational environment? What do the users feel are the significant barriers to making more effective use of probabilistic forecast information? What do they feel would help overcome those barriers?

Corinna Möhrten, WEPROG

10:30 a.m. – 12:00 p.m.

- Short presentations (10 minutes) and discussion of examples of applications of uncertainty forecasts. What decisions could be informed by uncertainty information; what are the time frames for such decisions; how would such uncertainty information be used (e.g., fed into an automated system, considered by a human, both, or other). Panelists will pick a single specific challenge they are facing that is a result of uncertainty and describe how they are addressing it now with an uncertainty forecast. What happens when you get it wrong? How could it be done better?

Nick Steffan, ERCOT: *Recent ERCOT Developments in Applications of Uncertainty Forecasts to System Operations*

John Zack, AWS/Truepower: *Applications of Uncertainty Forecasts to Extreme Net Load Prediction at HECO*

Bruce Tsuchida, Brattle: *Applications of Uncertainty Forecasts to Extreme Net Load Ramps*

Frank Puyleart, BPA: *Use of Uncertainty Forecasts in Decision Making in System Operations*

- Open Discussion and Adjourn

12:00 p.m. – 1:00 p.m.

Lunch for Tutorial and Workshop Participants

Location: Lobby

Forecasting Workshop

Tuesday, June 20, 2017

1:00 p.m. – 5:30 p.m.

UVIG Forecasting Workshop – Applying Meteorology in Power System Planning and Operations

Location: High Ballroom A

Workshop Purpose

This workshop is intended for utility, wind and solar industry personnel associated with producing and using variable generation (VG) plant output forecasts for power system operation. The workshop purposes are to:

- Explore the practical aspects of the use of VG forecasting models to the scheduling and operation of power systems
- Develop a better understanding of the value of VG forecasting in the day-ahead, hour-ahead and real-time periods
- Explore the value of multiple forecasts and new approaches to distributed PV forecasting
- Develop a better understanding of VG forecasting developments on the horizon
- Continue an ongoing dialog between the VG forecasting research, development, applications and user communities

1:00 p.m. – 1:45 p.m.

Welcome and Opening Session

Introduction

Mark Ahlstrom, NextEra Energy Resources/WindLogics

Welcome and Keynote Remarks

Mark Lauby, Sr. VP, NERC – *The Future Role of Weather, Climate and Forecasting in Power System Planning and Operation with the Changing Generation Mix*

Meeting Overview

Charlie Smith, UVIG

1:45 p.m. – 3:30 p.m.

Session 1: Meteorology, Climate and the Electric Sector

Session Chair: **Justin Sharp**, Sharply Focused

This session will focus on where existing meteorological knowledge and climate science can be used by the electric sector, and particularly on the linkages between wind, solar, hydro, and load and the pressing research priorities for improving future energy sector outcomes. The session will consist of an overview panel looking at the big picture, followed by a second panel looking at applications, and a concluding panel discussion with the participants.

1:45 p.m. – 2:30 p.m.

- What is the nexus between meteorology and climate science, and power system planning and operations?

Melinda Marquis, NOAA, American Meteorology Society (AMS) Viewpoint (10 min)

Sue Haupt, NCAR, World Energy and Meteorology Council (WEMC) Viewpoint (10 min)

Dave Souder, PJM, Large Independent System Operator (ISO) Viewpoint (15 min)

2:30 p.m. – 3:45 p.m.

- What examples have you seen of where existing meteorological knowledge and climate science can be used by the electric sector? What feedback have you received from users? Where is there opportunity for improved coordination and information flow between meteorology and climate science, and power system planning and operation? (10 minutes each)

Chris Clack, Vibrant Clean Energy, *Meteorology and Power System Planning for a Large Share of Variable Generation*

Tim McJunkin, INL, *Forecast Applications to Dynamic Line Rating*

Corinna Möhrten, WEPROG, *Meteorological Data Collection: Results from Eirgrid's Met Mast and Alternatives Study*

Nick Keener, Duke Energy, *Opportunities for Improved Coordination between Meteorology and Operations*

Panel Discussion

3:45 p.m. – 4:00 p.m.

Break

Location: Lobby

4:00 p.m. – 5:30 p.m.

Session 2: Where is the Value in Improved Forecasts?

Session Chair: **Melinda Marquis**, NOAA

This session will explore the reliability, economic and market drivers for improved forecasts, and the reality of the incentives and disincentives for developing improved forecasts. It will consist of a series of 20 minute presentations with Q&A as time permits.

David Maggio, ERCOT, *Impacts of Near-Term Forecasts on ISO and Market Participant Decisions*

Yok Potts, MISO, *Reliability Value of Improved Forecasts*

Eric Gritmit, Vaisala, *Value of More Accurate Power Forecasting in Global Electricity Markets*

Carlo Brancucci, NREL, *The Value of Wind and Solar Power Forecasting Improvements*

6:00 p.m. – 7:30 p.m.

Reception

Location: Lobby

Wednesday, June 21, 2017

7:00 a.m. – 8:00 a.m.

Breakfast

Location: Lobby

8:00 a.m. – 10:00 a.m.

Session 3: Global VG Forecasting, Market Implementation and Operation, and R&D Experience with a Focus on Uncertainty

Session Chair: **Bob Zavadil**, Enernex

There is a growing body of international experience with the use of VG forecasts in system and market operations. We had an initial glimpse of how uncertainty forecast information is being used in the tutorial session, and some additional insight from Sessions 1 and 2. This session will provide an update on current forecasting system implementation and operation, and R&D experience, with additional thoughts on the use of uncertainty information. The format will be a series of ten-minute presentations, followed by a panel discussion.

Malte Siefert, Fraunhofer/EWIS, *German VG Forecasting and Market Operation Experience*

John Zack for Dora Nakafuji, HECO, *Hawaiian Experience with the Integration of Uncertainty Forecasts into the EMS*

Nick Steffan, ERCOT, *ERCOT Experience with the Integration of Uncertainty Forecasts into the EMS and MMS*

Stephanie Dubost, EDF, *French Experience with Wind and Solar Power Forecasting Tools*

Jacques Duchesne, AESO, *VG Forecasting and Market Operation Experience from Alberta*

John Zack, AWS Truepower, *Improved Wind and Solar Ramp Forecasting in Tehachapi*

Panel Discussion

10:00 a.m. – 10:15 a.m.

Break

Location: Lobby

10:15 a.m. – 12:00 p.m.

Session 4: Forecasting Benchmarking, Trials and Evaluations

Panel Chair: **Aidan Tuohy**, EPRI

Benchmarking and evaluating forecast performance is important for a number of reasons: selecting new forecasting vendors as part of a trial, understanding forecast performance, determining how forecasts can be used and assessing performance improvements over time. Experience from trials and other valuation activities show that the design of the evaluations can be important for the value of the results. A series of presentations exploring these issues, including international cooperation through IEA Wind Task 36, will be followed by a panel discussion.

Corinna Möhrten, WEPROG, *IEA Wind Task 36 Status and Progress*

Tiffany Maupin, Vaisala, *Wind and Solar Forecasting Trials Experience: Do's and Don't's, Part 1: Introduction to the IEA Wind Task 36 Guideline for Forecasting Trials*

John Zack, AWS/TrueWind, *Wind and Solar Forecasting Trials Experience: Do's and Don't's, Part 2: Introduction to the IEA Wind Task 36 Guideline for Evaluation of Forecasting Approaches and Selection*

Craig Collier, DNV/GL, *Why Do Forecast Trials Often Fail to Answer the Questions for which End-users Need Answers: A Forecaster's Point of View*

Will Hobbs, Southern Company, *A Third Party Approach to Solar Forecast Benchmarking and Evaluations*

Panel Discussion

12:00 p.m. – 1:15 p.m.

Lunch

Location: Lobby

1:15 p.m. – 3:00 p.m.

Session 5: Distributed PV Forecasting and Market Integration: Where are We Going?

Panel Chair: **Tassos Golnas**, DOE

Among the differences compared to central station PV plants, distributed PV forecasting systems exhibit the following characteristics:

- Often don't have a complete inventory or information about the physical characteristics of the generation assets
- Often don't have much ground-based solar irradiance data in proximity to the generation assets
- Frequently don't have much or any near-real-time generation data or in many cases even historical generation data and must infer generation from solar irradiance data or load data

- The impact of distributed solar is often intertwined with true load variations (which can also depend on solar irradiance variations)

Because of the lack of visibility of most distributed PV, the behavior of the load can often be masked. This session will explore some of the consequences of that behavior. Presenters will have 10 min each to address three series of questions, followed by a panel discussion with the attendees. Following are the questions to be addressed:

- What have been the recent experiences by ISOs/utilities doing distributed solar forecasting? Can detailed forecasts be used to help operate the distribution system? Are we moving towards a combined DG/load forecast in the future?

Bill Henson, ISO-NE

John Zack for Dora Nakafuji, HECO

- How have forecasters addressed the distributed solar forecasting issues noted above? What methods have been used? How have the limited data issues been addressed? What needs to be done to further improve forecasts?

Tom Hoff, Clean Power Research / **Frank Monforte**, ITRON

Anne Lenz, energy and meteo

- The gap between the transmission and distribution systems is closing rapidly. Renewable generation is disrupting the status quo from both ends of the power system. FERC recently issued a NOPR on Storage and DER Aggregation. What are the benefits and drawbacks of bundling the treatment of generation, DR, and storage as in the NOPR? How might the outlook for reliable forecasts at the distribution level be impacted by participation of DER aggregators in the wholesale markets? What are the implications of forecasting multiple dispersed areas vs a single larger area? Are there added complications due to the need for nodal injection points? DLMPs?

Erik Ela, EPRI

Mark Ahlstrom, NextEra Energy Resources

Panel Discussion

3:00 p.m. – 3:15 p.m.

Break

Location: Lobby

3:15 p.m. – 5:00 p.m.

Session 6: What's New Under the Sun?

Session Chair: **Mike Knowland**, ISO New England

This session will give a preview of the planning that has been done for the August 21, 2017 total solar eclipse visible from a path across the continental US. It will consist of a series of 15 min presentations with discussion as time permits.

Jim Blatchford, Clean Power Research Consultant, *Meteorology Considerations for the US Total Solar Eclipse on Aug. 21, 2017*

John Zack, AWSTruepower, *Meteorology Considerations for the US Total Solar Eclipse on Aug. 21, 2017*

Rebecca Webb, CAISO, *Expected Operating Impact of the US Total Solar Eclipse on Aug. 21, 2017 in CAISO*

Nick Keener, Duke Energy, *Expected Operating Impact of the US Total Solar Eclipse on Aug. 21, 2017*

Nicole Segal, NERC, *Expected Operating Impact of the US Total Solar Eclipse on Aug. 21, 2017*

Thursday, June 22, 2017

7:00 a.m. – 8:00 a.m.

Breakfast

Location: Lobby

8:00 a.m. – 9:45 a.m.

Session 7: Renewable Energy, Energy Trading, Market Evolution and the Role of Forecasting

Session Chair: **Rob Gramlich**, Consultant, Grid Strategies LLC

There is an implicit linkage between growing shares of zero marginal cost renewable energy and the operation of electricity markets. Depressed energy prices in the markets are leading to a growing inability of generators of all types (and fossil and nuclear generators in particular) to recover their fixed costs due to fewer operating hours. At the same time, energy traders are looking for (and finding) many profitable trading opportunities, and traders generally tend to prefer a higher level of price volatility in the markets. How are traders using forecasts within the markets? Do forecasts have greater value for energy traders than for ISOs? The use of forecasting tools for energy trading in the current electricity markets is an active topic which will be explored in this session through a series of 15-20 min presentations followed by a panel discussion.

Corinna Möhrten, WEPROG, *Use of Probabilistic Forecasting Tools in Energy Trading*

Jeff Lerner, Vaisala, *FTRs and Virtual Energy Trading*

Johnny Wang, NextEra Energy Resources, *Energy Trading Opportunities in Volatile Energy Markets*

Laurent Huet, Reuniwatt, *Intra-day and Day-ahead Forecasting for Energy Traders on European Markets*

Panel Discussion

9:45 a.m. – 10:15 a.m.

Break

Location: Lobby

10:15 a.m. – 12:15 p.m.

Session 8: Changing Markets – Reliability, Economics and Forecasting in a Wind, Solar and Storage Future

Session Chair: **Mark Ahlstrom**, NextEra Energy Resources, WindLogics

Wind and solar resources are now permanent fixtures on the energy landscape, and energy storage is looking more promising as the installed price projections continue to decline. Forecasting will play an increasingly important role as the penetration of these resources continues to increase. As markets evolve to go beyond “just energy” into valuing other reliability and operating services, how will this change the types of forecasts that have value and the way that forecasts are used? The rapid growth of distributed resources, and the multiple operating strategies and revenue streams available from the different modes of operation of storage assets, will only make the operating decisions more complex and important. This session will explore the questions below.

Each speaker will have 10-15 minutes to answer one of the questions below or present a point of view, followed by a panel discussion among the panelists and the participants.

- Will declining energy prices and growing appreciation for “reliability services” result in increased value for other reliability, flexibility, and ancillary services? What role will co-optimization of such services play?
- What will today’s markets need to do to adapt? Will markets allow most resources, including storage, solar and wind, to offer such services?
- How will the role of forecasting change in such a system, and particularly in one that is increasingly dominated by wind, solar and storage?
- How will the value of uncertainty forecasts change in such a world? For what timeframes and of what types?
- How will such changes, including uncertainty information from forecasts, be handled in the EMS and MMS software for the day-ahead market and the real-time market?

Rob Gramlich, Consultant, Grid Strategies LLC, *Future Market Design Trends*

Dave Maggio, ERCOT, *Evolution of Market Thinking in ERCOT*

Anne Lenz, energy and meteo, *Forecasting and Trading with Virtual Power Plants*

Michael Goggin, AWEA, *What Does a Level Playing Field Look Like?*

Panel Discussion

12:15 p.m. – 12:45 p.m.

Closing Session – Open Mic

Moderator: **Charlie Smith**, UVIG

- Evaluation Criteria for Forecast Products and Services
- Critical Needs for Research, Data, Validation, etc.
- What Remains to be Done?
- What Did We Miss This Time?
- Research Priorities
- What Do You Want to Hear about Next Time?