

FALL TECHNICAL WORKSHOP DENVER, CO

October 1 - 3, 2018

1 Monday

7:00 AM - 8:00 AM

8:00 AM - 12:00 PM

Our 2018 ESIG Fall Technical Workshop will be held at the Embassy Suites Downtown Denver in Denver, Colorado.

This three-day event will include a half-day tutorial, ESIG Working Group Meetings, and our technical workshop.



Registration & Breakfast

Location: **Crestone Foyer**

Tutorial

Location: **Crystal B/C**

Inertia Ain't All It's Cracked Up to Be

Chairs: **Derek Stenlik** and **Matt Richwine**, *GE*

There is a lot of buzz in the industry over inertia today. What is it, why do we need it, how much do we need, and what happens as it starts to decline with the replacement of coal and nuclear plants with wind, solar and storage? These are all very good questions which will be explored in this tutorial at the fall meeting. We might also call the tutorial **Everything You wanted to Know About Inertia, but Were Afraid to Ask**.

We will start with the fundamentals of system frequency response, followed by the roles of inertial response, fast frequency response and governor response in avoiding under-frequency load shedding. We will cover how it is done now, how it will change as we reach ever higher levels of instantaneous penetration, and what things might look like in a completely converter-fed power system, and what market mechanisms are in place already and taking shape to procure related services.

We will have some industry all-stars chairing and participating in the tutorial. There are a lot of misconceptions about inertia floating around the industry, and we hope to dispel them during the course of the tutorial. Please plan to join us for what looks to be a very timely and informative industry event!

Tutorial Outline with approximate times

- 8:00 - 8:15** Introduction and Industry Trends in Low Inertia Operations
- 8:15 - 8:45** Common Definitions, What's What
 - High-level trends
 - Synchronous inertia, synthetic inertia, FFR, PFR, SFR, UFLS, DR
 - Technology aspects
- 8:45 - 9:15** Island Grid Perspective, **Matt Richwine**, *GE*
- 9:15 - 10:00** Large System Perspective, **Nick Miller**, *HickoryLedge, LLC*.
- 10:00 - 10:30** Coffee Break
- 10:30 - 11:00** Market Design, **Derek Stenlik**, *GE*
- 11:00 - 11:40** System Operator Experience, **Sandip Sharma**, *ERCOT*
- 11:40 - 12:00** Open Discussion & Questions

10:00 AM - 10:30 AM

Break

Location: **Crystal Foyer**

12:00 PM - 1:00 PM

Lunch

Location: **Atrium**

1:00 PM - 5:15 PM

Working Group Meetings (*ESIG Members + Invited Guests Only*)

1:00 PM - 3:00 PM

Reliability Working Group

Location: **Crestone A**

Co-Chairs: **Sebastian Achilles** and **Jason MacDowell**, *GE*

- Presentation of scoping paper on 100% Renewables by Sebastian Achilles of GE, followed by a discussion of 100% Renewables, implications for system reliability, and how the Reliability WG can contribute to this effort.
- An update on the work of the Model Validation TF led by Bob Zavadil, Enernex.
- A panel discussion on reliability aspects of operating a very high instantaneous penetration converter fed system, with several panelists discussing different aspects of the problem. The end goal will be to identify specific key topics for development of fact sheets, a technical workshop panel session, or other near-term deliverables by the WG.

1:00 PM - 3:00 PM

System Operation and Market Design Working Group

Chair: **Aidan Tuohy**, *EPRI*

Location: **Crystal B/C**

- **Discussion of recent efforts on very high penetration renewables, and potential future work in the area**

Here, we will first describe a recent initiative, led by a number of us involved with ESIG, on very high renewable penetration. I'll introduce the overall effort and plans, and then focus on discussions related to the WG scope. In particular, this will include discussion on market design, operational practices and forecasting for very high penetration. High penetration here could include by annual energy or instantaneous, and could be for an entire synchronous system or part of such a system. The idea is to discuss what issues may be raised by such situations.

- **Discussion on recent experiences in system and market operations related to renewables, storage and energy systems integration**

Here, we plan to have introductory comments (3-5 minutes) by a number of speakers from the working group, and then plan on open discussion on a number of recent issues:

- Recent experiences with high wind or solar penetrations - ramping and low minimum generation, periods with low inertia, large forecast misses, and use of advanced wind/solar controls to provide system services.
- Experiences with integration of battery energy storage - recent developments including FERC Order 841 and deployment of energy storage systems.
- Market updates - new reserve products and changing requirements due to renewables, storage and demand response.
- Operations and markets related to energy systems integration - including increased emphasis on the demand side, interaction of gas and electric networks in operations and updates on transport and heat sectors.

3:00 PM - 3:15 PM

Break

3:15 PM - 5:15 PM

Distributed Energy Resources (DER) Working Group

Chair: **Debbie Lew**, *GE*

Location: **Crestone A**

- Presentation of scoping paper on 100% Renewables by Debbie Lew, GE, followed by a discussion of 100% Renewables, implications for DER, and how DERWG can contribute to this effort.
- State-of-the-art in methods and experiences in high penetrations of DERs

An Evolution to High DER Penetrations

Lisa Giang, *HECO*

DERMS/ADMS Experiences in Advanced DER Management

Santosh Veda, *NREL*

Managing Protection with High Inverter-Based Resource Penetrations

TBD

3:15 PM - 5:15 PM

System Planning Working Group

Chair: **Aaron Bloom**, *NREL*

Location: **Crystal B/C**

- Presentation of scoping paper on 100% Renewables by Aaron Bloom, NREL, followed by a discussion of 100% Renewables, implications for system planning, and how the System Planning WG can contribute to this effort.
- A panel discussion on the challenges of planning for wide scale adoption of distributed PV in RTO markets and a discussion of how California municipalities like LADWP are planning for 100% renewable energy in light of local and now state directives. Panelists will include Paritosh Das from NREL and James Barner from LADWP. The end goal will be to identify specific key topics for development of fact sheets, a technical workshop panel session, or other near-term deliverables by the WG.

3:15 PM - 5:15 PM

Research and Education Working Group

Chair: **Mark O'Malley**, *NREL*

Location: **Crestone B**

- Presentation of scoping paper on 100% Renewables by Mark O'Malley of NREL, followed by a discussion of 100% Renewables, implications for research and education, and how the Research and Education WG can contribute to this effort.
- A group discussion on the development of the ESI Roadmap. This is a major activity of the work group, and will continue over the next year. The end goal will be to develop a robust roadmap and research plan to guide future efforts of industry and academia.

6:00 PM - 8:30 PM

ESIG Board of Directors Meeting/Dinner

Location: **Cripple Creek 1**

2 Tuesday

7:00 AM - 8:00 AM

Registration & Breakfast

Location: **Crestone Foyer**

8:00 AM - 9:00 AM

Welcome and Overview Session

Location: **Crystal B/C**

Introduction

Mark Ahlstrom, *NextEra Energy Resources*

Welcome and Opening Remarks

Alice Jackson, *President, Xcel Energy PSCO*

Meeting Overview

Charlie Smith, *ESIG*

9:00 AM - 12:00 PM

Session 1: Managing a High Penetration Renewable Power System

Chair: **Goran Strbac**, *Imperial College, London*

Location: **Crystal B/C**

Stability Considerations at 100% Instantaneous Penetration

Helge Urdal, *Urdal Power Solutions Ltd.*

Comparison of Fast Frequency Response with Synchronous Machine Response during System Disturbances

Matt Richwine, *GE*

ERS from Wind, Solar, Storage and Conventional Plant

Jason MacDowell, *GE*

Towards 100% Renewable Energy

Terji Nielsen, *Electric Power Company SEV, Faroe Islands*

Hydropower in the 21st Century

Alejandro Moreno, *DOE*

Market Considerations for a High Penetration Renewables Scenario

Audun Botterud, *ANL*

10:15 AM - 10:45 AM

Break

Location: **Crystal Foyer**

12:00 PM - 1:15 PM

Lunch

Location: **Atrium**

1:15 PM - 5:15 PM

Workshop Parallel Sessions

1:15 PM - 3:00 PM

Session 2A – Market Design and System Operations for Storage, Flexibility, and Beyond: View from the Front Lines

Chair: **Sonia Aggarwal**, *Energy Innovation*

Location: **Crestone A**

A View from California

Jill Powers, *CAISO*

A Flexible Market Participation Model for the Future

Mark Ahlstrom, *NextEra Energy Resources*

A Personal View

Paul Sotkiewicz, *Consultant*

A National Perspective

Rob Gramlich, *Grid Strategies*

1:15 PM - 3:00 PM

Session 2B - Energy Storage Developments

Chair: **Rashid Abdul**, *WEG Transformers*

Location: **Crystal B/C**

Future Opportunity for PV-Storage Peakers in CAISO

Paul Denholm, *NREL*

Developments in Solar-plus-Storage

Mahesh Morjaria, *First Solar*

Ancillary Services from Ternary Pumped Storage Hydropower

Dave Corbus, *NREL*

Energy Storage and Forecasting

Tristan Doherty, *IHI Energy Storage*

1:15 PM - 3:00 PM

Session 2C – Resilience, Price Formation and Market Design

Chair: **Bethany Frew**, *NREL*

Location: **Crestone B**

Wholesale Energy Price Formation – What Does It All Really Mean?

Erik Ela, *EPRI*

Reliability and Resilience

Michael Milligan, *Consultant*

Reliability and Resilience During the Bomb Cyclone

John Simonelli, *ISO-NE*

Reliability, Resilience and Transmission

Michael Goggin, *Grid Strategies*

3:00 PM - 3:30 PM

Break

Location: **Crystal Foyer**

3:30 PM - 5:15 PM

Session 3A – Panel Discussion on DOE *Beyond LCOE*

Chair: **Mark O'Malley**, *NREL*

Location: **Crestone A**

A Personal Perspective on *Beyond LCOE*

Michael Milligan, *Consultant*

A European Perspective on *Beyond LCOE*

Goran Strbac, *Imperial College, London*

A Solar Industry Perspective on *Beyond LCOE*

Mahesh Morjaria, *First Solar*

3:30 PM - 5:15 PM

Session 3B - Electric Transportation and ESI

Chair: **Obadiah Bartholomy**, *SMUD*

Location: **Crystal B/C**

Electrification Futures Study Scenario Analysis

Caitlin Murphy, *NREL*

Electrifying Transportation – Where Are We Today?

John Halliwell, *EPRI*

National Plug-in Electric Vehicle Infrastructure Analysis

Eric Wood, *NREL*

3:30 PM - 5:15 PM

Session 3C - Planning for Future Energy Systems

Chair: **Bruce Rew**, *SPP*

Location: **Crestone B**

Offshore Wind: A U.S. Northeast Study

Jessica Lau, *NREL*

DER and CAISO's Flexibility Needs

Jill Powers, *CAISO*

Integrated Gas and Electric Planning

Antje Orths, *Energinet*

Offshore Wind Reliability Considerations

John Simonelli, *ISO-NE*

6:30 PM - 8:00 PM

Reception

Location: **Atrium**

3 Wednesday

7:00 AM - 8:00 AM

Registration & Breakfast

Location: **Crestone Foyer**

8:00 AM - 9:45 AM

Workshop Parallel Sessions

8:00 AM - 9:45 AM

Session 4A – Innovative Methods to Improve Flexibility

Chair: **Russ Philbrick**, *Polaris Optimization*

Location: **Crystal B/C**

Pool Pumps for Peak Shaving and Valley Filling
Bob Moye, *U of Florida*

Enhanced Hot Water Heater Control
Ken Schuyler, *PJM*

Power to Gas
Ken Dragoon, *Renewable Hydro Alliance*

Smart Thermostats
Sam Shrank, *Tendril*

8:00 AM - 9:45 AM

Session 4B - Distribution System Developments

Chair: **Debbie Lew**, *GE*

Location: **Crestone A**

BES to DER: Reliability Perspectives and Direction
Ryan Quint, *NERC*

Control of Distributed PV on Distribution Feeders
Andrew Riegler, *Schneider Electric*

IEEE Standard 1547 Implementation and Use Considerations
Babak Enayati, *National Grid*

Distribution System Protection with High PV Penetrations
Normann Fischer, *SEL*

9:45 AM - 10:15 AM

Break

Location: **Crestone Foyer**

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10:15 AM - 12:25 PM

Session 5 – Long Term ESI Planning Considerations

Chair: **William D’haeseleer**, *KU Leuven*

Location: **Crystal B/C**

Evolution of the Utility Business Model

Bryan Hannegan, *Holy Cross Energy*

Integrated Grid Planning (IGP) Process

Lisa Giang, *HECO*

Capacity Value of Solar, Storage, Solar plus Storage, and
Demand Response

Derek Stenclik, *GE*

Modern Power Systems Driving Change in Software, Planning,
Design and Operations

Ken Donohoo, *Electric Power Engineers*

Capacity Adequacy in ERCOT’s Energy-Only Market: What Did
this Summer Teach Us

Sandip Sharma, *ERCOT*

ESIG Working Group 100% Renewable Theme Report-out

Debbie Lew, *GE, DER Working Group Chair*

12:25 PM - 12:30 PM

Closing Remarks

Charlie Smith, *ESIG*