HELLO.

It’s time to make your plans for the highly anticipated 2018 IEEE PES T&D Conference and Exposition. We are excited to bring the biggest and most comprehensive T&D conference in the industry to Denver. Byron Craig and his local organizing team from our host utility Xcel Energy are putting the final touches on the plans for this not to be missed event. The conference theme of “POWER FORWARD” is a fitting description of the efforts being made to ensure this conference represents the hottest trends in the industry. You will see all the groundbreaking new technologies such as automation, data analytics and unmanned aerial vehicles, along with the latest advances to the power equipment such as conductors, breakers, switches and transformers, that have been the building blocks of the amazing machine called the electric grid.

I feel blessed to be part of an industry with such a rich and powerful history that is in the midst of reinventing itself to meet the quickly changing demands of our customers and society. There is no doubt that trends in renewables, storage, resiliency, and smart and interactive applications pose exciting challenges for the utility engineers and leaders of today and tomorrow. Our Technical Program brings the leading experts from industry and academia to explain and discuss these most pressing issues in T&D.

If you can only go to one conference this year — make sure it is this one. Here is the best place to experience under one roof all the transmission, distribution, and distributed energy equipment and ideas combined with a Technical Program that is sure to energize both industry veterans and those just beginning their careers.

I can’t wait to see you in Denver.
IEEE PES OFFICERS

Saifur Rahman  
IEEE PES President

Damir Novosel  
IEEE PES Past President

Frank C. Lambert  
IEEE PES President Elect

Patrick P. Ryan  
IEEE PES Executive Director

Tommy Mayne  
IEEE PES Vice President, Meetings

Carl Segneri  
IEEE PES North America, T&D Director

IEEE PES T&D ORGANIZING COMMITTEE

Byron Craig  
General Chair

Manuel Arrendondo  
Technical Program

Shawn Boon  
Exhibits Chair

Kendra Estes  
Opening Reception

Gilbert Flores  
Attendance Chair

Cherokee Gonzales  
Volunteers

Jeff Grappert  
Technical Tour Chair

Eric Gupta  
Technical Tours

Mike Ibbled  
Industry Relations Chair

Amor Khodaei  
Technical Program Co-Chair

Susan Koval  
PES Education & Meeting Services

Barbara Powell  
Operations Chair

Gary Rehor  
Co-Treasurer

Janet Richards  
Volunteers

Brian Richter  
Colloquium Program Chair

Carri Robinson  
Opening Reception

Josh Ross  
Colloquium Program

Chad Schell  
VIP Chair

Rebecca Schwab  
Volunteers Chair

Gail Sparks-Biegel  
Meeting Rooms Chair & Registration

Diana Watkins  
Opening Reception Chair

Aaron Wilson  
Technical Program

Diana Yee  
Strategic Communications

IEEE PES OFFICERS & COMMITTEE

EVENT SCHEDULE

APRIL/15 SUNDAY

12:00pm – 4:00pm  Registration Open

APRIL/16 MONDAY

7:00am – 5:00pm  Registration Open

7:30am – 5:00pm  Plain Talk (separate registration required)

8:30am – 5:00pm  Tutorials (ticket required)

8:30am – 3:00pm  Technical Tours

6:30pm – 9:30pm  Conference Opening Reception

APRIL/17 TUESDAY

7:00am – 5:00pm  Registration Open

7:30am – 5:00pm  Plain Talk (separate registration required)

8:30am – 9:30am  Opening Session

10:00am – 12:00pm  Technical Panel and Forum Sessions

10:00am – 5:00pm  Exhibits Open

11:30am – 1:00pm  Conference Luncheon

12:15pm – 4:45pm  Technical Tours

1:00pm – 3:00pm  Professional Engineering Practice Ethics

3:00pm – 5:15pm  Technical Panel and Forum Sessions

9:15pm – 9:15pm  Super Session

APRIL/18 WEDNESDAY

7:00am – 5:00pm  Registration Open

7:30am – 5:00pm  Plain Talk (separate registration required)

8:00am – 10:00am  Super Session

8:00am – 10:00am  Technical Panel and Forum Sessions

8:00am – 4:00pm  Technical Tours

8:00am – 5:00pm  Product and Solutions Showcase

10:00am – 6:00pm  Exhibits Open

11:30am – 1:00pm  Student Lunch

1:00pm – 5:15pm  Technical Panel and Forum Sessions

2:30pm – 4:00pm  Student Scavenger Hunt

4:30pm – 6:00pm  Networking Reception

5:00pm – 7:00pm  Poster Session and Reception/Student Poster Contest (exhibitors welcome after 6pm)

APRIL/19 THURSDAY

7:00pm – 12:00pm  Registration Open

8:00am – 10:00am  Super Session

8:00am – 12:15pm  Technical Panel and Forum Sessions

9:15am – 12:00pm  Technical Tours

9:30am – 12:00pm  Product and Solutions Showcase

10:00am – 3:00pm  Exhibits Open

3:00pm – 4:00pm  Closing Reception and Raffle
PLAN YOUR SHOW AND STAY

ACCOMMODATIONS/HOTELS

Register for the conference and book your hotel reservations today! Visit IEEET-D.org to learn more about T&D official hotels, make individual or group reservations, view hotel maps and more.

Providing exclusive rates and reservations for T&D attendees is our official housing vendor, OnPeak. Please be aware that there may be other companies posing as the official housing provider of the conference. These companies may offer hotels that are not part of the official program and overcharge with additional fees or not reserve your room. By booking with OnPeak you are guaranteed the very best service.

Hotel Reservations
Online: IEEET-D.org
Telephone: 800-221-3531
Email: ieee@onpeak.com

Onsite Housing Assistance
OnPeak will be onsite should you need assistance with any of the conference hotels during your stay in Denver.

Hours of Operation:
Tuesday, April 17: 8:00am – 5:00pm
Wednesday, April 18: 8:00am – 6:00pm
Thursday, April 19: 8:00am – 3:00pm

T&D MOBILE CONFERENCE APP

Stay connected with T&D pre-show planning tools and mobile app at IEEET-D.org

SEARCH AND LOCATE
• Exhibitors
• Sessions
• Speakers
• Plus more!

LOG-IN AND STAY ORGANIZED BY ADDING ITEMS TO YOUR AGENDA
• Sessions
• Exhibitors
• Scheduled appointments

DESTINATION DENVER

Make the most of your stay by visiting Denver.org to discover the Mile High city’s many culinary, entertainment, shopping and outdoor recreational experiences.

DOWNLOAD NOW IEEET-D.ORG/MOBILE
OPENING SESSION

Tuesday, April 17: 8:30am – 9:30am

You will not want to miss keynote speaker Gregory Bolino as he kicks off this year’s conference with a special Opening Session presentation – Utility of the Future: Defining a Business Model for Growth.

As customers adopt new innovative technologies, the utility industry will continue to undergo dramatic changes. New models emerging around the world demonstrate the economic and social value of transforming the energy system, enabled by customer-focused technologies and closer integration of distributed energy and alternatives such as storage. An emerging new model can help achieve these goals and provide greater growth and value to the industry. Gain insights on the issues and challenges of this transition which requires both a new regulatory framework and new thinking on how to best approach the grid and investment.

Currently Managing Director, Utilities Strategies North America for Accenture, Gregory has more than 30 years experience helping companies in the utilities, telecommunications, cable and retail sectors transform their businesses to enable growth. He has worked extensively with utilities in North America and Europe and has published numerous perspectives on the changing utility model, including The High Stakes of Low Carbon and Capital Theft: Shaping the Utility Business Model.

CONFERENCE OPENING RECEPTION

Monday, April 16: 6:30pm – 9:30pm

Power Up with friends, customers and new acquaintances for an authentic Colorado experience. Guests will almost feel it snow as the Colorado Convention Center High Ballroom is transformed to showcase the best of Denver! Feel the thrill of virtual kayaking through the rapids, conquer a 2-story high indoor ropes course or hit the slopes with a ski simulator. Then make your way to the “Lodo Beer Garden” for a taste of locally sourced food and craft beer from some of Colorado’s most popular breweries.

EXHIBIT HALL

Tuesday, April 17 – Thursday, April 19

With over 800 exhibitors from across the globe covering more than 240,000 square feet of exhibit space, get ready to immerse yourself in the power industry’s leading and largest exposition. From emerging product and technology solutions to real-world applications to hands-on demonstrations, discover what’s new and what’s next.

CLOSING RECEPTION AND RAFFLE

Thursday, April 19: 3:00pm – 4:00pm

Join the fun while we toast our new Denver friends, thank them for a great event and are greeted with beverages and party snacks by the 2020 Chicago Local Organizing team. Drop your registration badge on the way in for a chance to win one of many great prizes.

CONFERENCE LUNCHEON

Tuesday, April 17: 11:30am – 1:00pm

Thursday marks the opening of the exhibit hall with companies from around the world ready to show you the newest products and services. What better time to see these new products and technologies than during the Conference Luncheon, conveniently served to you in the exhibition aisles.

NETWORKING RECEPTION

Wednesday, April 18: 4:30pm – 6:00pm

Mingle with leading product specialists, experts and industry leaders over hors d’oeuvres and beverages during the exhibit hall Networking Reception. During the conference you will have heard from the best minds covering a wide range of topics that explore and aim to improve our industry. Now explore the exhibit halls, chat with these experts and experience firsthand how some of the new technologies, products and services are being used.

ETHICS SESSION

Tuesday, April 17: 1:00pm – 3:00pm

Be sure to catch motivational speaker Corey Ciocchetti as he discusses inspiring integrity and ethical decision making. An Associate Professor of Business Ethics and Legal Studies at the University of Denver, he currently teaches classes on business law and ethics in a department ranked by the Wall Street Journal and Business Week in the top ten nationwide for producing students with high ethical standards. Corey has spoken to diverse audiences in over 225 cities and 44 states and is author of the book, Inspire Integrity: Chase An Authentic Life.

CONFERENCE HIGHLIGHTS
SUPER SESSIONS
Three dynamic Super Sessions will bring together recognized industry experts to discuss and explore topics of particularly high interest, including energy storage, distributed generation and resiliency of the grid.

PANEL SESSIONS
More than 40 Panel Sessions featuring some of the industry's best minds will provide comprehensive discussions on a diverse range of important trends, issues, and real-world applications and solutions being applied both domestically and globally.

PAPER FORUM SESSIONS
Providing an opportunity to learn more about the best papers presented at the conference, Forum Sessions have been organized with each session featuring papers from a related discipline. Presenters in each themed session will speak on their paper and following all of the presentations, be available for a one-on-one discussion with attendees.

TUTORIALS
This year’s Tutorial line-up will feature in-depth examinations and presentations covering topics important to power and energy professionals. Special paid registration is required and lunch is provided for all ticket holders. Be sure to sign-up now as space fills up quickly.

POSTER SESSION AND RECEPTION
The Poster Session and Reception provides a relaxed environment for registered conference attendees to enjoy hors d’oeuvres and beverages while viewing more than 300 accepted papers in poster format. Here you’ll have the opportunity to interact with the authors and even tour competing papers from the Student Poster Contest.

TECHNICAL TOURS
The Denver Organizing Committee has planned diverse and exciting Technical Tours that give participants the chance to visit more than nine sites such as the NREL Wind Technology Center, Panasonic Technology Facility and SolarTec. Special paid registration is required and space is limited – sign up now to secure your spot.

PRODUCT AND SOLUTIONS SHOWCASE
Brought to you by exhibiting companies, these in-depth sessions are led by industry and product experts and provide an opportunity to learn more about the products and services of interest to you. More sessions will be added leading up to the show so be sure to visit IEEE-T-D.org for updates.

PLAIN TALK
IEEE PES PLAIN TALK courses for the power industry professional will provide a greater understanding of the technical aspects of the electric power industry, even if you do not have an engineering background. Gain insights into the concerns of engineers, the demands of regulators and consumer groups, and the factors and trends that impact the operation of today's electric power systems. These courses are also appropriate for new engineers to the industry or for engineers in other fields who are transitioning to the electric power industry and want to increase your understanding of the electric power system by providing practical knowledge that can be used as you work in or with this important industry.

Registration to the conference is not required. To learn more about these courses and their costs, and to register, please visit: https://www.ieee-pes.org/plain-talk-in-denver-ca-2018.
OFFERING AN EXCITING AND COMPREHENSIVE SCHEDULE OF STUDENT SESSIONS AND ACTIVITIES, THE COLLEGIATE PROGRAM IS DESIGNED TO HELP STUDENTS LEARN MORE ABOUT A CAREER IN THE POWER AND ENERGY INDUSTRY, INCREASE THEIR KNOWLEDGE AND NETWORK WITH LEADING INDUSTRY PROFESSIONALS. FOR A COMPLETE SCHEDULE OF STUDENT ACTIVITIES VISIT IEEE-T-D.ORG.

STUDENT ACTIVITY HIGHLIGHTS:

STUDENT BREAKFAST
Tuesday, April 17 - Thursday, April 19: 7:00am – 8:00am
Graduate and undergraduate students registered for the conference are invited to join the Local Organizing Collegiate Committee for a complimentary breakfast and fun ice breaker exercise (Tuesday and Wednesday) that will help students get to know each other before the day starts.

UTILITY FINANCIALS
Tuesday, April 17: 10:00am – 11:00am
Electric utilities are businesses. How they run their business depends largely on their ownership structure, as well as local and federal regulations. Learn how utilities keep their books with different rate structures and the reasoning behind decisions made.

CONFERENCE LUNCHEON
Tuesday, April 17: 11:30am - 1:00pm
Grab a bite, walk the aisles and experience exhibitors from around the world during the Conference Luncheon held in the exhibit hall.

PES YOUNG PROFESSIONALS PANEL
Tuesday, April 17: 3:15pm – 5:15pm
This panel highlights PES Young Professionals and provides an opportunity for you to hear them share their research and learn more about the projects they have been working on.

STUDENT RECEPTION
Tuesday, April 17: 6:00pm - 9:00pm
Punch Bowl Social / Registered Students Only
Take a break from the conference to enjoy a night out with other students. Experience a unique setting, eat some delicious food and enjoy parlor-style entertainment such as ping pong, pool, 80's era arcade games and bowling at one of Denver’s most popular social spots!

TOUR OF EXHIBIT FLOOR WITH YOUNG PROFESSIONALS
Wednesday, April 18: 8:00am – 9:30am
An exclusive student tour of the T&D exposition floor before it opens Wednesday will be guided by a group of young professionals from various companies with different professional backgrounds. Occupying the entire Colorado Convention Center exhibit floor with over 800 exhibitors, this will be a very unique experience for students interested in the power industry.

“POWERING YOUR CAREER” LIGHTNING TALKS
Wednesday, April 18: 9:30am – 11:00am
Hear from a diverse panel of speakers on a lot of different topics of interest in a short amount of time during this special student session. Speakers from Denver’s top consulting firms will be giving short 10-15 minute presentations on topics such as opportunities in power, landing your first job, trending in the industry and career progression – with the chance for students to ask questions and learn how to become a part of this evolving and exciting industry.

SPEED NETWORKING STUDENT LUNCH
Wednesday, April 18: 11:30am – 1:00pm
Join the Local Organizing Collegiate Committee and young professionals from varying companies across Colorado for an opportunity to interact, learn and develop important industry contacts during this unique networking lunch.

“ROCK YOUR PROFILE” PRESENTED BY LINKEDIN
Wednesday, April 18: 1:00pm – 1:45pm
LinkedIn, the world’s largest professional network, will share insights with students on how to rock their online profile and improve their personal brand for reaching the next level of their professional career.

3D SUBSTATION TOUR
Wednesday, April 18: 2:00pm – 2:30pm
This session will give students an in-depth tour of a high voltage substation without leaving the convention center! Expert guides will lead students around to learn all the parts and pieces that make up a real-world substation seen in the field.

SCAVENGER HUNT
Wednesday, April 18: 2:30pm – 4:00pm
Have those smart phones charged and ready to compete for prizes during the 2018 T&D Collegiate Scavenger Hunt! Using a mobile app based platform with leader boards and social media opportunities, students will compete against other teams in real-time with various challenges on the exhibit floor.

POSTER SESSION AND RECEPTION
Wednesday, April 18: 5:00pm – 7:00pm
Another great student networking opportunity, enjoy light hors d’oeuvres and a tour of the various posters competing in the Student Poster Contest with a chance to talk to the students conducting the research.
TUT-01 
AEOLIAN VIBRATION, GALLOPING AND SUB-SPAN OSCILLATIONS AND CONDUCTOR MOTION MANAGEMENT
8:00am – 12:00pm
Presenter:
Jeff Wang, Engineering & Technology Solutions Inc.

Overhead conductor motion (Aeolian vibration, galloping and sub-span oscillations) has been an operation and maintenance issue for about eight decades, but conductor motion is still causing utilities problems. This tutorial will review Aeolian vibration, galloping and sub-span oscillations, conductor and hardware problems caused by conductor motion, discuss the state-of-the-art conductor motion mitigation technologies and methodologies, and review issues caused by line designs and lessons learned by utilities. This tutorial will also provide recommendations on conductor motion management. Engineers, managers and technicians working in the overhead line design, construction and maintenance areas, utility staff working in operations, system planning or OHL asset management areas, staff from hardware manufacturers and suppliers, consultants and universities will benefit from this half-day tutorial.

TUT-02 
INSTRUMENT TRANSFORMERS AND SENSORS: TECHNOLOGIES, APPLICATIONS AND BEST PRACTICES
8:00am – 12:00pm
Presenter:
Ron Pate, ABB Inc.

Instrument transformers (ITs) are a vital part of the grid infrastructure, allowing accurate measurement of energy flows in the grid, as well as driving protective and control devices which ensure the grid performs reliably. Instrument transformer technology remained relatively the
same for many decades, however in recent years important advances in the underlying components which go into ITs have allowed step change advances in IT performance. Solid state components are also now making their way into ITs and this change is creating a new generation of ITs which have many fundamental differences from traditional IT technology. These differences introduce new possibilities, and new challenges for those responsible for energy measurement and protection. This tutorial will examine IT basics, explain the newer technology making its way into ITs and will cover critical application considerations to ensure participants understand and are able to properly utilize ITs today and in the future.

TUT-03

THIS IS NOT YOUR FATHER’S SURGE PROTECTION: POWER, COMMUNICATION AND DATA
8:00am – 12:00pm
Presenter: Steven Hensley, Sargent & Lundy LLC

Surge protection for utility equipment previously concerned protection of the high voltage power frequency and low voltage supply or auxiliary equipment. With the proliferation of smart devices using data and communication channels, there are additional channels vulnerable to surges. This tutorial will discuss the available application guides for surge protection and present overviews of their content. New work will also be presented for guides that are in development.

C62.22 Guide For The Application Of Metal-Oxide Surge Arresters for Alternating-Current Systems
C62.220 Guide for the Application of Surge Protective Devices for the Smart Grid

TUT-04

IEEE 1547 INTERCONNECTION STANDARD
8:00am – 12:00pm
Presenters:
Babaik Eynati, National Grid
David Narang, NREL
Jens Boerner, EPRI
Leo Comay, Google X
Mark Silva, ComNet
Bob Fox, Sunspec
Charlie Vartanian, NEPPI
Andy Heke, NREL

Due to the increasing amount of Distributed Energy Resources (DER) interconnections with the Electric Power System, the IEEE 1547 standard is going through a major revision to address some of the technical issues associated with this high penetration of DERs, e.g., grid support functionalities. During this tutorial participants will learn about the major changes to the IEEE 1547, e.g., voltage regulation, response to abnormal system conditions (including voltage and frequency ride through), power quality, reliability and interoperability.

TUT-05

APPLICATION OF SYNCHROPHASOR TECHNOLOGY IN DISTRIBUTION SYSTEMS
8:00am – 12:00pm
Presenters:
Yi Lu, Quanta Technology LLC
Julio Romero Agudo, Quanta Technology LLC
Eric Tönnies, Quanta Technology LLC
Farid Kafizan, Quanta Technology LLC

Penetration of Distributed Energy Resources (DER) in distribution systems and the introduction of microgrid deployment are fundamentally changing the way distribution systems are planned, operated, protected and managed. Synchrophasor measurement technology, now widely adopted in transmission systems, can be applied to address challenges brought about by these changes in distribution systems. This tutorial will explain the synchrophasor technology and discuss the unique challenges and technical requirements and issues related to the utilization of real-time measurement and its benefits in network assessment, power system quality, islanding and interoperability.

TUT-06

USING STANDARD COMMUNICATION PROTOCOLS FOR THE GRID OF TODAY AND MANAGING DER IN THE FUTURE
8:00am – 5:00pm
Presenters:
Andrew West, SUBNET Solutions Inc.
Joe Stevens, Triangle MicroWorks Inc.
James Mather, QualiPhy Inc.

A variety of standard communication protocols are used today in the grid for a variety of purposes. The landscape of standard protocols is quickly evolving to meet the needs of Distributed Energy Resources (DER) integration, including demand response, in an interoperable way. This tutorial will provide background on which protocols are used for what applications – both traditionally and for DER, give a high level overview of how the leading standard protocols function and explain how some protocols complement each other or overlap in functionality for certain applications. Both highly adopted and emerging protocols will be covered including IEC 61850, DNP3 (IEEE 1811), IEEE 2030.5 and OpenADR, MESA, SunSpec and standards for data modeling and protocol mapping will be addressed as it relates to DER integration using standard protocols. Security features of standard protocols will also be covered. The challenges of DER communications will be covered in some depth and include use cases, communications requirements and evaluation of each protocol against the requirements.
Due to changing utility infrastructure with regards to conventional
generation retirement and increased levels of renewables, dynamic shunt
compensation solutions (e.g. SVC, STATCOM, synchronous condensers)
are becoming even more vital for transmission system operation and
reliability. Historically AC transmission shunt compensation is primarily
used to maximize transmission capacity. New system stability is a primary
concern during major disturbances. As utility requirements become even
more complex the optimal solution may be a combination of available and future
technology. This tutorial will present planning and specifying approaches,
technology principles with sample installations, a comparative evaluation of
performance, and an analysis of future trends expected to influence
the technology development and its place in the market. The technology
includes mechanically switched shunts, synchronous condensers, static
var compensators (SVC), static synchronous compensators (STATCOM) and
hybrid configurations.

**TUT-09 CYBERSECURITY OF THE ELECTRIC POWER TRANSMISSION AND DISTRIBUTION SYSTEM**

**8:00am – 5:00pm**

**Presenters:**
- Marty V.E.S. Yalla, Beckwith Electric Co. Inc.
- Steve A. Kunsman, ABB Inc.
- Nathan Wallace, Amperical
- J. Matt Cole, Sargent and Lundy
- Richard Corrigan, SDG&E

Cyber-attack on an Electric Power T&D communications system can have
damaging impact and cause widespread power outages as evident from the December
2015 cyber-attack on a Ukrainian Electric Power Distribution System. Securing Electric Power Systems from cyber-attacks is of national importance and in North America NERC is spearheading the effort in developing and enforcing Critical Infrastructure Protection (CIP) Standards for Bulk Electric Systems (BES). Local and state regulating agencies are also looking at cybersecurity of the Electric Power Distribution System. Substation protection, automation and control systems along with distribution field devices have changed significantly in the past decade. These systems have become more interconnected and provide end users with much more information to allow for higher reliability and greater levels of control. Interoperability between different vendor products and systems has been achieved using open standards.

This change in technology has not only brought huge benefits from an operational point of view, it also permits to address cyber security issues similar to other traditional enterprise systems which have been facing the same industry challenges for years. This tutorial will discuss cybersecurity basics including passwords and access management, authentication, encryption, network security monitoring, techniques in cyber alarming, logging and auditing. This tutorial will also cover NERC CIP requirements applicable to T&D systems along with a brief overview of IEEE and IEC standards. Cybersecurity implementation examples of substations, protection, automation and controls systems including devices inside, as well as outside the substations will also be discussed. Utilization of Cybersecurity and NERC CIP compliance will be included.

**TUT-10 GIL- IEEE STD C37.122.4™-2016 IEEE GUIDE FOR APPLICATION AND USER GUIDE FOR GAS-INSULATED TRANSMISSION LINES, RATED 72.5 KV AND ABOVE**

**1:00pm – 5:00pm**

**Presenters:**
- Hermann Koch, Siemens AG
- Patrick Fitzgerald, A2Z Inc.

This tutorial will give information about the IEEE Guide for application and use of gas-insulated transmission lines for voltage of 72.5 kV and above. The content of the tutorial covers the following topics: guidance for the planning, permitting, design, equipment specification, installation, commissioning, operation and maintenance of gas-insulated transmission lines. Only technical aspects will be addressed in this guide; commercial and legal issues associated with gas-insulated transmission lines are not considered. This guide applies to AC transmission lines rated for maximum operating voltage of 72.5 kV and higher. The purpose of the tutorial is to provide technical assistance for the selection, application and project management of GIL for transmission project, including decommissioning and retirement. Results from the current signatures are examined and compared to contractual or commercial questions related to GIL projects. The document includes tables, flowcharts and other aids that may be of use in a typical GIL project.

**TUT-11 SHUNT REACTOR SWITCHING: THEORY AND PRACTICE**

**1:00pm – 5:00pm**

**Presenter:**
- David Peel, OF Peeks & Associates Ltd.

Circuit breakers generally have no difficulty in interrupting shunt reactor currents and in fact may force the current to a premature zero due to the phenomenon of current chopping. Shunt reactor switching is however a unique and onerous duty for circuit breakers involving a complex interaction between the characteristics of the circuit breaker type, gas or vacuum, and by way of its current chopping capability, arc voltage and arcing time, and the circuit as represented by its effective inductions and capacitances and reactor grounding arrangement. This tutorial explains the interaction in detail and the derivation of a generalized circuit breaker_TRV equation which can be used for any shunt reactor application. Five reactor application cases will be considered and attendees should bring a calculator for this part of the course.

**TUT-12 TAP CHANGER (OLTC) FIELD TESTING TESTING**

**1:00pm – 5:00pm**

**Presenter:**
- Raka Levi, Mforsun

OLTC field testing has a couple of new tools for the condition assessment of this moving transformer component. Dynamic testing can now provide information on the operational characteristics of the OLTC, as well as problems with components. The techniques for these tests are presented. This tutorial will cover the background and characteristics of Digital Switchgear and contrast it with conventional switchgear. Two key component technologies, current and voltage sensors and IEC 61850 based protection and control, will be covered in detail. The practical experiences gained from the early projects in the field will also be presented.

**TUT-13 AN INTRODUCTION TO DIGITAL SWITCHGEAR**

**1:00pm – 5:00pm**

**Presenters:**
- Hari Karandikar, ABB Inc.
- Ron Patel, ABB Inc.
- Edgar Flores, ABB Inc.

Medium voltage (MV) switchgear is a key element of the electrical energy distribution system. The Digital Switchgear concept, at the MV distribution level, presents many operational advantages and is inherently safe. It is based on the combination of technologies such as current and voltage sensors and IEC 61850 incorporated into modern numerical IEDs. When these technologies are combined in an optimal way, the advantages of Digital Switchgear include increased safety, space, weight and energy savings, flexibility towards changing load flows, the ability to more easily handle last minute load changes, quicker delivery times and the possibility of late customization. This tutorial will cover the background and characteristics of Digital Switchgear and contrast it with conventional switchgear. Two key component technologies, current and voltage sensors and IEC 61850 based protection and control, will be covered in detail. The practical experiences gained from the early projects in the field will also be presented.

**TUT-14 INTEGRATED MODELING AND SIMULATION OF TRANSMISSION, DISTRIBUTION AND COMMUNICATION SYSTEMS**

**1:00pm – 5:00pm**

**Presenters:**
- Zheng-Hung Huang, Pacific Northwest National Laboratory
- Shrangi Abhaynagar, Argonne National Laboratory
- Trevor Hardy, Pacific Northwest National Laboratory
- Liang Min, Lawrence Livermore National Laboratory
- Jason Fuller, Pacific Northwest National Laboratory
- Bryan Palmintier, National Renewable Energy Laboratory
- Phil Top, Lawrence Livermore National Laboratory
- Arjan Bose, Washington State University
The power grids across the world are evolving on a path different than traditional generation and transmission expansion. Driven by economic and environmental factors, consumer engagement and participation fundamentally move the grid onto a path that all parts of the grid become active. The power system exhibits significant interactions between the transmission and distribution system with greater dependency on a variety of communication media. This leads to a revolution in how the power system should be planned and operated. Such revolution requires modeling and simulation capabilities to understand the interdependency of transmission, distribution and communication (TDC) systems and build confidence in deploying systems that will meet, or improve upon, current reliability, security, efficiency and cost-effective benchmarks. This half-day tutorial will provide participants a solid understanding of TDC interactions, the need for TDC integrated modeling and possible solution methods with demonstrative examples. The cross-domain nature of this topic calls for technical leadership by the IEEE PES to bring diverse sets of experts together to further advance such integrated modeling capabilities.

POWER SYSTEM BASICS: UNDERSTANDING HOW THE BULK ELECTRIC POWER SYSTEM WORKS
8:00am – 5:00pm
This course will provide a fundamental foundation in electric power systems, from basic formulas to the planning, operations and equipment involved in generating, transmitting and distributing electric power. Basic electrical terminology will be explained in simple to understand language with regard to design, construction, operation and maintenance of power plants, substations, and transmission and distribution lines. Anyone who is involved in some way with the electric utility industry will benefit from attending this course.

Each day begins at 7:30am with continental breakfast and registration. These courses are eligible for CEU/PDH credit. Plain Talk registrants will also be provided with a complimentary exhibit floor pass for Thursday, April 19.

Registration and Costs:
Registration to the conference is not required. To learn more about these courses and their costs, and to register, please visit: https://www.ieee-pes.org/plain-talk-in-denver-co-2018.

TECHNICAL TOURS

TT-01 SOLARTAC
8:30am – 11:30am
Cost: $30
Capacity: 20

TT-02 SOLARTAC
12:00pm – 3:00pm
Cost: $30
Capacity: 20
Two tour times available.
Located minutes from Denver International Airport, Solar Technology Acceleration Center (SolarTAC) is recognized globally as the largest private outdoor test facility for solar technologies in the United States. SolarTAC was developed to provide a real-world testing environment that would take emerging technologies to the next level. With access to the electric grid, this 74-acre facility has hosted photovoltaic, concentrating photovoltaic and concentrating thermal technologies, as well as battery storage and other grid management systems. Come tour some of the exciting projects being tested, including a residential solar and storage application, and visit GridNXT – the brand new 1.5MW microgrid technologies test facility that offers a variety of solar, wind, diesel, as well as AC/DC generation sources plus a large utility scale battery and inverter, programmable load banks and single and three phase distribution connections and system communications that enable companies to integrate and test their individual components with the microgrid.

Closed toe shoes must be worn. Weather permitting; refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-03 XCEL ENERGY'S LOOKOUT CONTROL CENTER
12:15pm – 3:00pm
Cost: $30
Capacity: 21
Located in scenic Golden, Colorado, the Xcel Energy Lookout Center facility provides 24/7 real time monitoring of over 4,300 miles of high voltage transmission, 365 days of the year. With a service area in excess of 8,200 square miles, the Lookout Center dispatch crew provides real time contingency analysis and supplementary control of over 5,000 megawatts of Xcel owned generation and 220 substations. Within the Xcel Energy PS&O footprint, Xcel operates over 250 megawatts of Solar and 3,500 megawatts of wind generation capacity, demonstrating Xcel Energy’s commitment towards renewable energy sources. The Control Center features an 80’ wide by 20’ high state of the art dynamic map board that contains over 4,500 LED status indicators. The Lookout Center also has a dedicated training simulator facility for operator training and testing.

Government IDs are required to gain access. Non-US citizens may participate with passport.

CONFERENCE OPENING RECEPTION
6:30pm – 9:30pm
Kayak through rapids, conquer a high ropes course or hit the slopes during a virtual event experience you will not soon forget! Then power up with friends, customers and new acquaintances while enjoying locally grown food and some of Colorado’s best craft beers.
OPENING SESSION

UTILITY OF THE FUTURE: DEFINING A BUSINESS MODEL FOR GROWTH
8:30am – 9:30am

Keynote Speaker:
Gregory Bolino, Managing Director, Utilities Strategies North America, Accenture

During this special session, keynote speaker Gregory Bolino will set the stage for the underlying Technical Program theme, The Future is Now. As customers adopt new innovative technologies, the utility industry will continue to undergo dramatic changes. New models emerging around the world demonstrate the economic and social value of transforming the energy system, enabled by customer-focused technologies and closer integration of distributed energy and alternatives such as storage. An emerging new model can help achieve these goals and provide greater growth and value to the industry. Gregory will address the issues and challenges of a transition that requires both a new regulatory framework and new thinking on how to approach the grid and investment.
SS1 REALITY CHECK ON ENERGY STORAGE
3:15pm – 5:15pm
Chair: Damir Novosek, President, Quanta Technology
Panelists:
- DAVID GEIER, Senior Vice President of Electric Operations, SD&G
- VIBHU KAUSHIK, Director of Grid Technology and Modernization, SCE
- SHYF BAHRAMVAR, Director of Electric System Planning and Smart Grid & Innovation, ConEd
- ERIC SEDDING, VP Asset Management, Engineering and Maintenance, Amren Transmission
- RAMON LEON CANDELA, ISA, Colombia
Energy storage promises the ability to mitigate renewable DER variability and improve T&D utilization and economics. “Shared applications” – multiple use of the same energy storage device, is important to realizing the best economic potential from this technology. Regulatory and market paradigms are essential for supporting the rapid adoption of these technologies and the most effective uses by allowing “stacked and market paradigms are essential for supporting the rapid adoption of these technologies and the most effective uses by allowing “stacked

PS1 TECHNOLOGIES TO ENHANCE GRID RESILIENCY, RELIABILITY AND SUSTAINABILITY: NEEDS, TRENDS AND EMERGING SOLUTIONS
10:00am – 12:00pm
Chair: Dengbo Zhao, Argonne
Panelists:
- D. ZHAO, Argonne
- J. AGGERO, Quanta Technology
- S. MELIDOPULOS, Georgia Institute of Technology
- C. HERBST, Eaton Corporation
- A. PAASO, ComEd
The power system encounters significant challenges for its resilient, stable and reliable operation given the recently incorporated renewable and dynamic sources and loads. These challenges not only exist in the operational control of the power systems but also the planning and market aspects. Specifically, the requirements of a resilient, reliable and sustainable power system will include the capability to survive disasters, ability to afford fluctuations from dynamic sources and loads, and the intelligence to operate and control with flexibility to system scales and changing topologies. Autonomous operation, for example, is a key way to achieve the enhancement of such features. This panel will present and discuss the needs, trends and insights into existing and future technologies to drive the strengthening of power grid resilience, reliability and sustainability, considering both operating and planning phases for transmission and distribution grids.

PS2 PROVISION OF GRID SERVICES FROM DR RESOURCES
10:00am – 12:00pm
Chair: Farrukh Rahimi, Open Access Technology International Inc. (DATI)
Panelists:
- B. YAPACHI, DATI Inc.
- N. LUI, North Carolina State University
- J. LANH, PNNL
- J. LAUNDEGAN, Enveris
The electric power utility landscape is changing due to a combination of factors including increasing levels of renewable and distributed energy resources, new technologies and increasingly savvy consumers. With the proliferation of renewable generations the fundamental operating principle of power systems is changing from “load following” to “generation following”. Current power grid operation predominantly relies on conventional generation resources to supply balancing services under normal and contingency situations. Increased variability of renewable generation resources results in the need for higher levels of balancing requirements and other grid services. Demand-side assets can participate in provision of balancing energy and other grid services. This panel will cover the challenges existing utility operational and business models emerging for new grid services at bulk power and distribution levels, cost-effective provision of these services from Demand Response resources, and lessons learned in the UK demo and actual field implementation projects carried out in recent years.

PS3 SMART CITIES: A COLLABORATION BETWEEN GOVERNMENT, COMMUNITIES, UTILITIES AND BUSINESS
10:00am – 12:00pm
Chair: William Abbot, ACCOM
Panelists:
- A. PAASO, ComEd
- E. SILVERMAN, City and County of Denver
- J. MAZUREK, Accenture
- C. HOYLE, Duke Energy
The macro themes that shape cities around the world are changing. To address challenges from changing climate to increasing congestion, cities are searching for ways to become more efficient, more connected and more responsive to constituent needs. With all of the attention being given to smart cities and IoT, how can we increase meaningful collaboration amongst relevant stakeholders to accelerate the deployment of smart city services that bring real value to people?”

PS4 ARE ELECTRIC UTILITIES READY FOR THE ERA OF BIG DATA?
10:00am – 12:00pm
Chair: Nanpeng Yu, University of California, Riverside
Panelists:
- N. YU, University of California, Riverside
- M. MASSONY, C3 IoT
- D. DORE, Electric Power Research Institute
- P. ZHAIQ, Oncor
- K. CHEN, Electric Power Group
The electric utility industry is being swamped by petabytes of data coming from various sources such as smart meters, phasor measurement units, SCADA systems, equipment monitors, geographical information systems and customer management. The primary and secondary value embedded in the complex and heterogeneous data sets from power distribution systems is immense. However, strategies for unlocking the potential of big data in power systems are at an early stage of development. This panel will bring together big data analytics experts from the industry and academia to discuss recent developments of big data applications and value proposition of these applications in power systems.

PS5 OVERHEAD TRANSMISSION LINE UPRATING AND UPGRADEING
10:00am – 12:00pm
Chair: Jose Daconti, Siemens
Panelists:
- J. DACONTI, Siemens PTI
- D. LYNCH, Power Line Systems Inc.
- J. MCCALL, Lindsey Manufacturing Co.
- O. LYNCH, Power Line Systems Inc.
The macro themes that shape cities around the world are changing. To address challenges from changing climate to increasing congestion, cities are searching for ways to become more efficient, more connected and more responsive to constituent needs. With all of the attention being given to smart cities and IoT, how can we increase meaningful collaboration amongst relevant stakeholders to accelerate the deployment of smart city services that bring real value to people?”
This panel will address overhead line upgrading and improving feasibility and the major feasibility aspects to be taken into account before deciding to go ahead with an upgrading or upgrading project. Lecture #1 (“Computer Aided Overhead Line Upgrading”) will present state-of-the-art computational resources available to the process of overhead line upgrading. Lecture #2 (“Overhead Line Upgrading via Real Time Thermal Rate Monitoring”) will demonstrate proven techniques and hardware for the thermal upgrading of overhead lines. Lecture #3 (“Outage-Free Overhead Line Recomductoring”) will introduce live line techniques for the recomductoring of overhead lines. Lecture #4 (“Advanced Materials for Overhead Line Recomductoring”) will focus on the engineering aspects associated with the application of new conductor materials for increasing the power transfer capability of overhead lines. An active participation of the audience will be encouraged after each lecture and final concluding remarks will be issued by the panelists.

**Panelists:**
- John McDaniel, National Grid
- T. THOMAS, NRECA
- A. HOFMANN, American Public Power Association
- V. WERNER, We Energies
- Panelists: John McDaniel, National Grid
- Chair:
- 10:00am – 12:00pm

**TO REVIEW THEIR OUTAGE DATA**

**TECHNIQUES USED BY UTILITIES**

**TO REVIEW THEIR OUTAGE DATA**

10:00am – 12:00pm

Chair:

John McDaniel, National Grid

Panelists:
- T. HENDERSON, 1W Energies
- A. HOFMANN, American Public Power Association
- T. THOMAS, NRECA
- H. CARNELL, PacifiCorp

Focus on reliable power delivery has intensified over the last two decades. More and more customers expect that their power will be on all the time. Events on the distribution system account for the vast majority of all outage events (depending on which measure used it is calculated at over 95% of all interruption events; on some systems, the distribution system is the source of close to 99% of all events). In order to analyze interruption data preparatory to coping with any necessary improvements, the interruption event records need to be accurate. This panel will look at different utilities practices and techniques of reviewing their interruption events to ensure the accuracy of the interruption data. Besides investor owned utilities, cooperative power providers, rural electric providers and municipal providers will be represented.

**PS7 ADVANCEING UTILITY MAINTENANCE AND CONSTRUCTION WITH AUGMENTED AND VIRTUAL REALITY**

10:00am – 12:00pm

Chair:

Zachary Wassenberg, Burns & McDonnell

Panelists:
- A. VUKOJEVIC, Duke Energy
- M. TINKLEPAUGH, Electric Power Research Institute
- D. ENNS, Manitoba Hydro International
- A. WASHBURN, Burns & McDonnell

This panel of industry and technology experts will discuss their experiences with augmented reality (AR) and virtual reality (VR) while exploring the benefits of these technologies for utility maintenance and construction. The discussion will range from cutting edge research of AR and VR to firsthand accounts of the benefits of AR and VR. The panel will discuss how useful 3D scanning and design directly relate to AR and VR and the combined benefits of the technologies.

**PS8 ECONOMIC AND RELIABILITY BENEFITS OF POWER FLOW CONTROL TECHNOLOGIES: HARDWARE AND SOFTWARE**

10:00am – 12:00pm

Chair:

Alberto Del Risco, EPRI

Panelists:
- E. ELA, EPRI
- J. NISSEL, Smart Wires
- P. RIHIZ, NewGrid
- B. LI, MGSO

Power systems across the world experience transmission congestion that can lead to significant costs. In the United States, billions of dollars a year are incurred due to transmission congestion. Numerous power flow control technologies – both hardware solutions and software solutions, can be used to reduce transmission network congestion and potentially save hundreds of millions, if not billions of dollars, as well as improve power system reliability and reducing the necessity of any additional transmission capability built. This panel will focus on the ways in which manufacturers, software vendors and system operators are evaluating ways to incorporate these technologies into the bulk power system and the potential benefits that they can provide.

**PS9 POWER QUALITY AND EMC ISSUES ASSOCIATED WITH FUTURE ELECTRICITY NETWORKS**

1:00pm – 2:00pm

Chair:

Francis Zaveda, IREQ

Panelists:
- M. MAHINDER, IREQ
- R. DAS, IntaPower LLC
- S. KONNIBERG, Luleå University of Technology
- T. LAUCHNER, TVA

The increasing complexity of the electric power network and its management, growing demand and service quality expectations such as greater grid reliability, efficiency and security, as well as environmental and energy sustainability concerns have triggered the next major step in the evolution of the electric power system towards a flexible power system or “Smart Grid.” To achieve this result requires the implementation of new technologies in power systems, including renewable energy sources (RES), distributed generation (DG) and the latest information and communication technologies. Power quality is an important aspect of the power system which cannot be neglected and adequate power quality guarantees the necessary compatibility between consumer equipment and the grid. This panel will include five presentations which conclude the activities of the CIRED/CRED Working Group C4.24 on these topics.
Integration of Distributed Energy Resources (DER), such as Electric Vehicles (EVs), Battery Energy Storage System (BESS) and renewable generations, etc. into the power grid poses many technological challenges on communication, control, optimization, data analytics and power electronics. Advanced algorithms that improve the cost-effectiveness and reliability of the DER integrations have been proposed, however, there exist clear gaps among the academia, utilities and vendors. Handling the interconnection of DERs and uncertainties of consumer behaviors remain a challenging task. This panel will discuss the most recent DER integration technologies and projects in the perspectives of academia, utilities and vendors with an objective to present new findings and lessons learned that bridge the gaps in DER integration projects. Particularly, panelists will discuss the data analytics, solar PV adoption forecast, distributed DER management strategies, service infrastructure, and real-world DER integration projects atameda County, UCAL campus and City of Santa Monica.

Panelists:
- Bin Wang, Lawrence Berkeley National Laboratory
- Chair:
- CHALLENGES
- RESOURCES: TECHNOLOGIES, EFFECTIVE INTEGRATION
- PS12
- FUTURE RELIABLE AND COST-EFFECTIVE INTEGRATION OF DISTRIBUTED ENERGY RESOURCES: TECHNOLOGIES, PILOT PROJECTS AND CHALLENGES
- 1:00pm – 3:00pm
- Chair: Lin Wang, Lawrence Berkeley National Laboratory
- Panelists:
  - D. Black, Lawrence Berkeley National Laboratory
  - R. Gahd, University of California, Los Angeles
  - S. Karam, Southern California Edison
  - N. Yu, University of California, Riverside
  - Y. Wang, Siemens Corporate Technology

Would you like to have the possibility to be able to exchange a transformer within a few days? Keeping the light on at all times calls for fast reaction in (un)planned outages, as well as enhanced physical strengthening, operational safety and (predictive) maintenance. What is needed is a comprehensive, yet modular concept to face the challenges of today’s power sector – along the entire value chain, from power generation and transmission to distribution level. During this panel you will learn different options for preventing failures, protecting your assets and reacting fast in critical situations.

Panelists:
- K. Schneider, Siemens
- C. Kiat (CK) Ng, Hydro One Networks Inc.
- M. McGrath, Hydro Ottawa
- Chair:
- 1:00pm – 5:15pm
- MAKING ENTIRE ENERGY VALUE CHAIN)
- NETWORK STABILITY (ALONG THE TRANSFORMATION PATH)
- FURTHER OPTIONS TO MAXIMIZE WITHIN A FEW DAYS AND KEEPING GRIDS RESILIENT:
- VALUE ENGINEERING: OPTIMIZING SOLUTIONS WHILE BALANCING FUNCTION AND COST
- 1:00pm – 3:00pm
- Chair: Oscar Santos, Southern California Edison
- Panelists:
  - H. Sharpina, IEEE
  - O. Santos, Southern California Edison
  - N. Bargas, Southern California Edison
  - R. Berzescu, Sargent & Lundy
  - K. Goldstein, MEPP

This panel will outline and share the Southern California Edison’s (SCE) Value Engineering (VE) efforts focused on improving the value of goods or products and services to customers by either improving function or reducing cost through value-engineering principles. A VE work group was established to review SCE’s standards, specifications and planning guidelines. The VE tenets were to meet identified regulatory obligations, develop technology and service requirements, provide mechanism for suppliers to present design alternatives and innovation, unbundle requirements to allow suppliers to provide cost saving options, assess reliability and risk vs cost based trade-off, align SCE design with common industry practice where practical and to increase the competitive pool.

**PS14**
**KEEPING GRIDS RESILIENT: TRANSFORMER EXCHANGE WITHIN A FEW DAYS AND FURTHER OPTIONS TO MAXIMIZE NETWORK STABILITY (ALONG THE ENTIRE ENERGY VALUE CHAIN)**

Panelists:
- K. Cheung, Siemens
- P. Mueller, Pfisterer
- T. Prevost, Medelmus
- G. Luuberes Rincón, Siemens AG Germany
- Chair: Ewald Schneider, Siemens
- 1:00pm – 5:15pm

**PS15**
**ENHANCING ASSET MANAGEMENT INTELLIGENCE: BEST PRACTICES IN DATA-DRIVEN DECISION MAKING**

Panelists:
- R. Ofal, METICO
- M. McGrath, Hydro Ottawa
- C. NAT (DC/AC) Hydro One Networks Inc.
- A. Moskalevsky, GE (Int’l)
- Chair: Robert Stal, METICO
- 1:00pm – 3:00pm

**PS16**
**VALUE ENGINEERING: OPTIMIZING SOLUTIONS WHILE BALANCING FUNCTION AND COST**

Panelists:
- N. Bargas, Southern California Edison
- Chair: Oscar Santos, Southern California Edison
- Panelists:
  - H. Sharpina, IEEE
  - O. Santos, Southern California Edison
  - N. Bargas, Southern California Edison
  - R. Berzescu, Sargent & Lundy
  - K. Goldstein, MEPP

This panel will outline and share the Southern California Edison’s (SCE) Value Engineering (VE) efforts focused on improving the value of goods or products and services to customers by either improving function or reducing cost through value-engineering principles. A VE work group was established to review SCE’s standards, specifications and planning guidelines. The VE tenets were to meet identified regulatory obligations, develop technology and service requirements, provide mechanism for suppliers to present design alternatives and innovation, unbundle requirements to allow suppliers to provide cost saving options, assess reliability and risk vs cost based trade-off, align SCE design with common industry practice where practical and to increase the competitive pool.
of suppliers. This panel will share SCE’s experience with others in the industry to help them understand what VE is and how it can be applied to various project execution models.

**PS17 SUPERCONDUCTING SYSTEMS: EFFECTIVE SOLUTIONS FOR THE MODERNIZATION OF POWER GRIDS**  
3:15pm – 5:15pm  
Chair: Dietmar Steinbach, Nexans Deutschland GmbH

Panelists:  
F. Frenzazis, ComEd  
M. Stemmele, Nexans  
R. Ryu, LS Cable & System Ltd.  
M. Ross, AMSC  
S. Chen, Seattle City Light

Significant progress has been achieved in the development of power applications for high temperature superconducting (HTS) technologies, in particular power cables and fault current limiters. Several pilot projects for both applications have been energized, with several installations in constant operation for years. The technologies are now regularly evaluated as solutions alternatives for many power system projects and challenges. In particular, the application of medium voltage HTS systems as replacement for conventional high voltage cable systems is often attractive, both technically and commercially. HTS cables provide increased power density with negligible thermal impact on the environment, resulting in solutions that are more compact than conventional cables, require smaller rights of way, simpler installation and ultimately reduced substation footprints.

This panel highlights PES Young Professionals and provides an opportunity for them to share research or projects that they have been working on.

**PAPER FORUM SESSIONS**

**FORUM 1 POWER SYSTEM ECONOMICS**  
10:00am – 12:00pm  
Chair: Sahar Hendabadi, ComEd

Papers and Authors:  
18TD0008: Pre-Commercial Demonstration of a Direct Non-Rervative State Estimator  
X. Jiang, Quanta Technology LLC  
B. Atirovic, Quanta Technology LLC  
M. Lelic, Quanta Technology LLC  
V. Garapure, Quanta Technology LLC  
Y. Hu, Quanta Technology LLC  
B. Fabbaros, New York Power Authority  
G. Stefopoulos, New York Power Authority

18TD0009: Regional Assessment of Virtual Battery Potential from Building Loads  
D. Wu, Pacific Northwest National Laboratory  
H. Hao, Pacific Northwest National Laboratory  
T. Fu, Pacific Northwest National Laboratory  
R. Kals, Pacific Northwest National Laboratory

18TD0110: Residential DC House Cost Benefit Analysis  
L. Sun, North Carolina State University  
D. Limhamn, North Carolina State University  
M. Baran, North Carolina State University

18TD0135: Substation Risk Analysis - A Hidden Failure Model  
J. Delport, Virginia Tech  
C. Centeno, Virginia Tech  
J. Thorp, Virginia Tech

18TD0187: Plug-in Electric Vehicle Planning toward DOPP Constrained by Electricity Grid Limitation  
A. Hakehi, Laval University  
J. Kamin, Hydro-Quebec/IREQ

18TD0282: Reliability Price Mechanism of Distribution Network with Distributed Generation  
Y. Zheng, Guangxi Key Laboratory of Power System Optimization and Energy Technology (Guangxi University)  
B. Chen, Guangxi Key Laboratory of Power System Optimization and Energy Technology (Guangxi University)

18TD0289: Privacy-Preserving Economic Dispatch in Competitive Electricity Market  
L. Wu, Clarkson University  
J. L. Clarkson University

18TD0292: Distribution Locational Marginal Price for Grid-Connected Microgrids in Real-time Balancing Market  
Y. Gu, University of Tennessee, Knoxville  
F. Li, University of Tennessee, Knoxville  
H. Yuan, Peak Reliability  
W. Wei, Southern California Edison

18TD0399: Cost Optimal Control of Microgrids Having Solar Power and Energy Storage  
N. Gupta, FAMU- FSU College of Engineering  
G. Francois, FAMU- FSU College of Engineering  
J. Gospa, FAMU- FSU College of Engineering  
A. Newburg, FAMU- FSU College of Engineering  
E. Collins, FAMU- FSU College of Engineering  
O. Farugue, FAMU- FSU College of Engineering  
R. Meeker, NRU Energy Inc.  
M. Harper, Florida State University

18TD0424: A Hierarchical ADMH Based Framework for EV Charging Scheduling  
A. Alim, California Independent System Operator  
G. Gopinathan, California Independent System Operator  
S. Shrestha, California Independent System Operator  
Z. Zhao, California Independent System Operator  
J. Wu, California Independent System Operator  
R. Xiong, California Independent System Operator

18TD0024: Real-Time Contingency Analysis with RAS Modeling at CAISO  
G. Gopinathan, California Independent System Operator  
A. Alim, California Independent System Operator

**FORUM 2 POWER SYSTEM OPERATION AND PLANNING**  
1:00pm – 3:00pm  
Chair: Ibrahim Krad, NREL

Papers and Authors:  
18TD0054: Topological Adjustment of Distribution Grids Based on Grid Feasibility Indicators for Improved Planning and Operation  
D. Wolter, University of Wuppertal  
M. Szware, University of Wuppertal  
C. Schwarz, Siemens AG  
I. Mladenovic, Siemens AG

18TD0180: Virtual Bus Angle for Phase Angle Monitoring and its Implementation in the Western Interconnection  
H. Yuan, Peak Reliability

28
H. ZHANG, Peak Reliability
Y. LIU, Peak Reliability

18TD0211: Impact of Simplified Convection Model in Overhead Lines Thermal Rating Calculation Methods
S. ABDUL RAHMAN, University of Manchester
K. KOPISKAD, University of Manchester

18TD0308: A Security Distance Based Design Method for Active Distribution Systems Integrating Multiple Distributed Generations
J. LIU, Shanghai Jiao Tong University
H. CHENG, Shanghai Jiao Tong University
Q. XI, State Grid Zhejiang Electric Power Corporation Economic Research Institute
Z. LIAN, State Grid Zhejiang Electric Power Corporation Economic Research Institute
P. ZENG, China Electric Power Research Institute
L. YAO, China Electric Power Research Institute

18TD0309: Marginal Hosting Capacity Calculation for Electric Vehicle Integration in Active Distribution Networks
M. ALTURKI, University of Denver
A. KHODAEI, University of Denver

18TD0238: Decentralized Multi-Area Look-Ahead Dispatch for Cross-Regional Renewable Accommodation
X. LIU, Tsinghua University
G. O. Tsinghua University
H. ZHONG, Tsinghua University
Y. WANG, Tsinghua University
Z. LIOO, State Grid Corporation of China
J. WANG, North Carolina State University
L. LIU, North Carolina State University

18TD0381: Real-Time Bi-Directional Electric Vehicle Charging Control with Distribution Grid Implementation
Y. XIONG, University of California at Los Angeles
C. CHU, University of California, Los Angeles
R. GADH, University of California at Los Angeles

18TD0387: Coordinating Central Devices and Smart Inverter Functionalities in the Presence of Variable Weather Conditions
D. MONTENGRO, EPRI
M. BELL, EPRI

18TD0404: Operation of Distribution Networks with Volatile Supply and Controllable Data Center Demand
A. VARADHAN, Southern Methodist University
M. HODAMIR, Southern Methodist University

R. HODAMIR, University of Utah

K. OKONOMIOU, University of Utah
M. FARVANIA, University of Utah

18TD0420: A Simplified Parallel Power System Restoration for Large-Scale Transmission Grids
S. ABDAS, University of Houston
M. BARAKI, Louisiana State University
G. LIM, University of Houston

Q. GUO, Tsinghua University
H. SUN, Tsinghua University
J. WANG, Southern Methodist University
X. XI, Tsinghua-Berkeley Shenzhen Institute

18TD0029: Reliability Data and Assessment for HVDC Bipolar Links
A. CAMARRIO, Universidad de los Andes
M. RIUS, Universidad de los Andes

18TD0041: A Case Study of Breaker Failure During Simultaneous Single-Line-to-Ground Faults on a Parallel Circuit
K. HOLLAND, Southwestern Power Administration

18TD0089: Open-Source Suite for Advanced Synchrophasor Analysis
P. ETINGOV, Pacific Northwest National Laboratory
J. FORMER, Pacific Northwest National Laboratory
J. FOLLUM, Pacific Northwest National Laboratory
L. LI, Pacific Northwest National Laboratory
H. WANG, Pacific Northwest National Laboratory
Y. ZHANG, Pacific Northwest National Laboratory
Y. WANG, Pacific Northwest National Laboratory
J. YU, Pacific Northwest National Laboratory
D. KOSTEREV, Bonneville Power Administration
S. WANG, Bonneville Power Administration
G. MATTHEWS, Bonneville Power Administration

18TD0237: Alternative Database Designs for the Distribution Common Information Model
T. MCDERMOTT, Pacific Northwest National Laboratory
J. YU, Pacific Northwest National Laboratory
G. TUFFNER, Pacific Northwest National Laboratory
R. DIAO, Pacific Northwest National Laboratory
H. WANG, Pacific Northwest National Laboratory
Y. WANG, Pacific Northwest National Laboratory
G. TUFFNER, Pacific Northwest National Laboratory

18TD0243: Cascading Trees and Power System Resiliency
E. BERNABEI, PAW Interconnection
R. WALSH, Dominion
Y. CHEN, PEC Interconnection

18TD0256: Estimate the Lost Phasor Measurement Unit Data Using Alternating Direction Multipliers Method
M. LIU, North Carolina State University
D. SHI, GE/ North America
Z. LJU, GE/ North America
W. ZHU, GE/ North America
W. ZHANG, GE/ North America
Y. XIAO, University of Wisconsin, Milwaukee
DISTRIBUTION SYSTEM: DELIVERING POWER TO THE CUSTOMER
8:00am – 5:00pm

This course will provide an overview of the issues associated with planning, engineering, design, operation and automation of electrical distribution systems. Types of distribution systems and network circuits, as well as engineering issues related to distribution systems will be explored, as well as new concepts in the design, challenges and operation of the smart grid. The course is intended for those who are not familiar with the delivery of electricity to the end user.

Each day begins at 7:30am with continental breakfast and registration. These courses are eligible for CEU/PDH credit. Plain Talk registrants will also be provided with a complimentary exhibit floor pass for Thursday, April 19.

Registration and Costs: Registration to the conference is not required. To learn more about these courses and their costs, and to register, please visit: https://www.ieee-pes.org/plain-talk-in-denver-co-2018.

NREL - NATIONAL RENEWABLE ENERGY LABORATORY TOUR
12:15pm – 3:45pm
Cost: $35
Capacity: 18

The National Renewable Energy Laboratory (NREL) is focused on creative answers to today’s energy challenges. From breakthroughs in fundamental science to new clean technologies to integrated energy systems that power our lives, NREL researchers are transforming the way the nation and the world use energy.

XCEL ENERGY’S TRADING FLOOR
12:30pm – 2:30pm
Cost: $20
Capacity: 15

Visit Xcel Energy’s downtown Denver location for an overview of electric operations on the Xcel Energy trade floor. Topics of discussion will include daily electric planning and real time operations, with a focus on how the integration of renewable energy has impacted these processes. Participants will be introduced to some of the tools and displays used by trade floor personnel with the opportunity to ask questions.

All participants will need to show a valid government issued photo ID to receive a visitor pass.

CONFERENCE LUNCHEON
11:30am – 1:00pm

Explore the newest products, services and emerging technologies while enjoying a conference lunch served to you in the exhibitor aisles.

Plaintalk Tour

TT-04 NREL - NATIONAL RENEWABLE ENERGY LABORATORY TOUR
ESIF - ENERGY SYSTEMS INTEGRATION FACILITY
12:15pm – 3:45pm
Cost: $35
Capacity: 18

TT-05 XCEL ENERGY’S TRADING FLOOR
12:30pm – 2:30pm
Cost: $20
Capacity: 15

ETHICS SESSION

PROFESSIONAL ENGINEERING PRACTICE ETHICS
1:00pm – 3:00pm
Presenter: Corey Ciocchetti, Associate Professor of Business Ethics and Legal Studies, University of Denver

During this highly anticipated session motivational speaker Corey Ciocchetti will discuss inspiring integrity and ethical decision making. An Associate Professor of Business Ethics and Legal Studies at the University of Denver, he currently teaches classes on business law and ethics in a department ranked by the Wall Street Journal and Business Week in the top ten-nationally for producing students with high ethical standards. Corey has spoken to diverse audiences in over 225 cities and 44 states and is author of the book, Inspire Integrity: Chase An Authentic Life.
Distributed generation offers not only the possibility of increased efficiency and improved reliability in the electricity sector, but potentially changes the traditional practice in planning and operational paradigms of the grid. Regulators and legislators across the world are promoting policies that can increase the penetration of these resources onto the grid, requiring system operators to develop the planning tools and physical infrastructure needed to meet this challenge. This session will address the various attributes of distributed generation, how electric utilities, regulators and stakeholders can enable higher distributed generation penetration and how they need to respond to it, as well as provide operational, regulatory and market viewpoints. This session will bring to bear panel expertise in business, policy and technical issues to discuss ongoing efforts and best practices in building the infrastructure to allow for higher levels of penetration and new opportunities for more robust integration of distributed generation, while maximizing the value of distributed generation to the grid.
Modern electric utilities are facing enormous challenges for economic and reliable operation of power systems, such as imbalance distribution of power transmission. Due to the limitation of transmission lines with heavy loading, the power supply capability is difficult to be fully utilized. The contradiction between the growing power load and the decreasing land resource has become increasingly serious in urban areas. As the 3rd generation of flexible alternative transmission system (FACTS), the unified power flow controller (UPFC) has advantages of compact structure, small occupation, fast and flexible adjustment of power flow, as well as improving system stability and transmission capacity. The development of the high-power and fully controlled power electronic device brings great opportunity for UPFC technology and marketing. This panel will introduce and discuss the state-of-the-art UPFC technologies, practical project applications and standard proposals for promoting the development of UPFC technology and industry around the world.

In future power systems different agents will take responsibility for different parts of the system. Since any decision made by one agent affects decisions made by other agents, the agents need to collaborate with each other for reliable operation of the whole grid. Having a central management entity that gathers all information may not be viable as agents are not willing to share their information with other parties. Meanwhile, formulating a centralized optimization leads to a complex model that is difficult to solve. Hence, the existing centralized energy management functions may no longer be appropriate for management of such a multi-agent distributed system. This panel will discuss challenges and potentials of distributed optimization and multi-agent systems for management of power systems, including challenges and applications of distributed computing algorithms for power transmission, distribution, and control; deployment of synchrophasor technology for 3736

PS21
INDUSTRY COLLABORATION AND STANDARDS ORGANIZATIONS SUPPORTING THE GRID OF THE FUTURE
1:00 pm – 3:00 pm
Chair: David Roop, Dominion Energy
Panelists:
- D. NOVOSEL, Quanta Technology
- M. J. MCDONALD, GE Grid Solutions
- D. CURTIS, NERC
- T. GALLOWAY, North American Transmission Forum

The future electric grid requires collaboration from many different industry organizations. No one organization has the capability to cover the technology, standards, policy, business models, cyber security, etc. needed. Additionally, the landscape of Smart Grid, or the grid of the future, is “turbine-to-turbo”. This is a daunting landscape that includes generation, transmission, distribution and the customer. This panel will emphasize how different industry organizations can successfully collaborate to provide the industry a consensus for grid modernization for the future. Discussion topics will include roles and responsibilities of each organization, a process for collaboration, case studies of successful collaboration, and the goals and deliverables for this effort.

PS22
SYNCHROPHASOR TECHNOLOGY IN DISTRIBUTION SYSTEMS
1:00 pm – 3:00 pm
Chair: Farnoosh Rahmatian, NuGrid Power Corp., BC
Panelists:
- F. RAHMATIAN, NuGrid Power Corp., BC
- S. HENDARABADI, ComEd
- A. MOOSAHER, Power Standards Lab
- Y. LUI, University of Tennessee, Knoxville
- A. VON MEIER, California Institute for Energy and Environment
- D. GABEL, ComEd

Deployment of synchrophasor technology has seen significant growth in the electric power transmission systems in the recent years. The use of synchrophasor technology in distribution systems, however, is in its very early stages. The business case for deployment of synchrophasor systems with high accuracy and large volume of data for distribution applications is more challenging than that for transmission applications. This panel will look into recent developments in synchrophasor technology for distribution applications, discuss several applications of interest including topology detection, grid model, post-mortem analysis, fault location, failing conductor protection, detecting cyberattacks and microgrid controls, and address recent deployment efforts and challenges, including PMU placement strategy, integration with and support of other applications that do not necessarily need, but can benefit from, synchrophasor measurements, as well as other infrastructure support challenges.

PS23
DISTRIBUTED COMPUTING AND MULTI-AGENT SYSTEMS APPLICATIONS IN SMART GRID
1:00 pm – 3:00 pm
Chair: Amin Kargarim, Louisiana State University
Panelists:
- S. WEIDEREID, Pacific Northwest National Laboratory
- Z. WANG, Iowa State University
- M. BARATI, Louisiana State University
- L. KRISTOV, California Independent System Operator
- S. HENDABADI, ComEd

This panel will present the latest tools developed or under development by national labs and research institutes funded by the DOE Sunlamp Program and will include topics such as an overview of the DOE Sunlamp Program, a tool suite for improving grid performance and reliability of combined transmission–distribution with high solar penetration; enabling high-penetration of distributed PV through the optimization of sub-transmission voltage regulation; rapid GQT simulations for high-resolution comprehensive assessment of distributed PV; opportunistic hybrid communications systems for distributed PV coordination; and visualization and analytics of distribution systems with deep penetration of distributed energy resources (WADER).

PS24
NEW OPERATION AND PLANNING TOOLS/MODELS FOR HIGH PV PENETRATION GRIDS
1:00 pm – 3:00 pm
Chair: Gushui Yuan, US DOE
Panelists:
- S. JUKCOVE, SLAC
- N. SAMAAN, Pacific Northwest National Laboratory
- S. ABHYANKAR, ANL
- B. BRODERICK, Sandia National Laboratory
- B. HODGE, NREL

In future power systems different agents will take responsibility for different parts of the system. Since any decision made by one agent affects decisions made by other agents, the agents need to collaborate with each other for reliable operation of the whole grid. Having a central management entity that gathers all information may not be viable as agents are not willing to share their information with other parties. Meanwhile, formulating a centralized optimization leads to a complex model that is difficult to solve. Hence, the existing centralized energy management functions may no longer be appropriate for management of such a multi-agent distributed system. This panel will discuss challenges and potentials of distributed optimization and multi-agent systems for management of power systems, including challenges and applications of distributed computing algorithms for power transmission, distribution, and control; deployment of synchrophasor technology for 3736
This panel has been organized jointly by IEEE PES CFWG, NERC, North American Synchrophasor Initiative (NASPI) and US electric utilities and ISOs. Maintaining reliable and resilient operation of the bulk power system are fundamental aspects of grid operation and focus on ensuring the system can withstand sudden disturbances or unanticipated failures of system elements such that instability, uncontrolled separation or cascading failures will not occur. Synchronized measurement techniques such as synchrophasor data from PMUs unlock the capability for improved real-time monitoring and control room solutions, as well as improved analysis of power system behavior in the planning horizon. Analyses of historical blackouts show that system operators could have mitigated and lessened the extent of outages had they had access to real-time data and software tools to identify an impending crisis. This panel will cover industry experience, perspectives and lessons learned with the use of PMUs from three US Interconnections – WECC, Eastern Interconnection and ERCOT.

**PS27**

**POWER SYSTEM RELIABILITY WITH HIGH PENETRATION RENEWABLE RESOURCES: CHALLENGES AND OPPORTUNITIES**

*1:00pm – 5:15pm*

**Chair:**

Jay Liu, P.M. Interconnection
Ryan Quint, NERC

**Panelists:**

M. PARC, Idaho Power
R. QUINT, NERC
W. HARM, P.M Interconnection
K. NOBIT, TVA
D. NARANG, NREL
R. SUBRAMANIAM, IEEE SA

This panel will raise awareness of reliability issues which are foreseen or have been identified with renewable energy resource integrations. During this panel experts from industry and regulatory agencies will review the current activities of reliability standard development, share operational experiences on complying reliability standards and discuss ongoing research on challenges with high penetration inverter based energy resources.
Under funding from DOE’s SHINES program, Austin Energy is creating a DER management platform that maintains grid reliability while also enabling energy loads to be delivered at the lowest possible costs when there are high penetration levels of distributed PV generation. Austin Energy, Doosan GridTech and their partners will design and install more than 3 megawatts of distributed storage, smart solar inverters, a DER control platform, and other technologies utilizing customer and utility locations and multiple aggregation models. The goal is to demonstrate a DER solution adaptable to any region and market structure that offers a credible pathway to a system-leveled cost of energy (LCOE) for solar when augmented by storage and other DER management options. This panel will provide insights on what it takes to deliver on this advanced DER platform and how utilities facing similar scenarios like Austin Energy will benefit from the outcomes of this project.

**PS32**

**INTERNATIONAL REVIEW OF ENERGY STORAGE: REGULATIONS, APPLICATIONS, SUCCESS STORIES AND NEXT STEPS**

1:35pm - 5:15pm
Chair: David Elizondo, Quanta

Panelists:
- S. KOLLURI, Entergy Services Inc.
- LUIS CARDELA, Interconexión Eléctrica S.A.
- G. VILLA, CENIQUE Mx.
- P. VALENCUELA VÁSEQUE, Coordinador Eléctrico Nacional, Chile
- P. ELIZONDO, Quanta Technology

Currently, electric power systems are experiencing increasing trends for solar and wind generation penetration, which are intermittent sources by nature. For electric power systems that have aggressive goals for these intermittent generation, energy storage will play a key role in order to maintain acceptable limits key operational variables such as frequency and voltage. Also the electric power systems are experiencing increasing grid congestion and difficulties to build new transmission infrastructure to reliably serve the load. This panel will focus on key electric power system problems that can be solved by energy storage. The presentation will include the regulatory aspect of energy storage and will emphasize the importance of recognizing that energy storage is a multi-purpose, multi-service asset and revenue streams should be recognized by type of service which may cross generation, transmission or distribution. The panel will share international perspectives of energy storage, success stories and future vision.

**PS33**

**COLLABORATING TO ADVANCE DISTRIBUTED ENERGY RESOURCES**

1:35pm - 5:15pm
Chair: Sharon Allan, SEPA

Panelists:
- R. SMITH, Entergy
- S. MICHNAUS, Energy Policy ConsEd
- T. MAKAYSU, SCE
- M. BROWNING, ConsEd

Hear from four different utility executives on what they are doing with regard to planning and operating distributed energy resources onto their grids. This panel will bring perspective from policy, operations, and strategic viewpoints. Distributed Energy Resources impact how a utility performs their operations from planning to operations and to customer engagement. These innovative utilities will share information regarding their programs with a focus on distribution. This information includes how the organization aligns, how communications have been key with lessons learned, how collaboration won the industry was sought and how the utility is charting their course. Each executive will also represent the regional view of the activity and policy climate.

**FORUM 4**

**TRANSFORMERS AND SUBSTATIONS**
8:00am - 10:00am
Chair: Saina Tanei Ninalowo, ComEd

Papers and Authors:
18TD0003: A New Approach to Anti-Islanding: Design, Installation and In-Service Experience
B. BENZ, RENZ CONSULTING LLC
N. SADAN, GRIDEDGE NETWORKS Inc.

18TD0005: A New Approach to Anti-Islanding: Deployment Examples
N. SADAN, GridEdge Networks Inc.
B. BENZ, RENZ CONSULTING LLC

18TD0011: A Sine Filter-Based Phasor Estimation Algorithm Using an AR Model to Eliminate the Influence of a DC Offset
W. KIM, Myongji University
S. KANG, Myongji University

18TD0008: Online Sequential Extreme Learning Machine for Partial Discharge Pattern Recognition of Transformer
Q. ZHANG, Shanghai Jiaotong University

WID 41
18TD0046: Communicative Scheduling of Integrated Microgrids
A. ALBAREJ, University of Denver
A. KOHADDE, University of Denver

18TD0033: Fault Current Mitigation Using 550kV Air Core Reactors
S. DALAL, Salt River Project
R. KRUTH, Salt River Project
A. GAJIN, Coil Innovation

18TD0032: Voltage Regulation at Grid Edge: Tuning of PV Smart Inverter Control
H. PADULLAPARTH, University of Texas at Austin
N. GANTA, University of Texas at Austin
S. SANTITOSI, University of Texas at Austin

18TD0042: Online Monitoring Data Cleaning of Transformer Considering Time Series Correlation
J. LIN, Shanghai Jiaotong University
G. SHENG, School of Electrical Information and Electrical Engineering
Y. YAN, Shanghai Jiaotong University
Q. ZHANG, Shanghai Jiaotong University
X. JIANG, Shanghai Jiaotong University

18TD0046: Impact of Neutral Current on Cable Overloading
W. FENG, UTK

18TD0047: Applicability of Temperature Set-Point Regulation on Commercial Air Conditioners in Power Systems with Various Load Characteristics
F. LIU, East China Branch, State Grid Corporation of China
G. GUAN, Ranning Electricity Supply Company, JSEP
J. XIN, Dept. of EE, Shanghai Jiaotong University

J. DEPORT, Virginia Tech
V. CENTENO, Virginia Tech
J. THORP, Virginia Tech

18TD0053: Capacitor Voltage Balancing Algorithm Using Voltage Fluctuation Threshold for Modular Multilevel Converters
Y. XU, Zhejiang University

H. XIAO, Zhejiang University
Z. ZHU, Zhejiang University
Y. LIU, State Grid Zhejiang Electric Power Company
L. LI, State Grid Zhejiang Electric Power Company
P. QIU, State Grid Zhejiang Electric Power Company

18TD0055: Deferral of Grid Reinforcement by Using Dual Flexibility Options Enabled by a Grid-Connected Heat Pump
S. KLEINHOFT, Technical University of Denmark
S. YAO, Technical University of Denmark
R. CALPE DOMENS, Technical University of Denmark
H. GAI, Technical University of Denmark
N. BINDEN, Technical University of Denmark

18TD0057: Event Zone Identification in Electric Utility Systems Using Statistical Machine Learning
M. MOUSAYI, ABB Inc.
J. STOPP, ABB Inc.
K. SAKIMEN, ABB Inc.

18TD0040: Coordinated Control Technology of Uninterrupted Supply Operation for Medium Voltage Multi-Terminal AC/DC Interconnection System and its Test Platform
W. ZENG, Institute of Electrical Engineering, Chinese Academy of Sciences
W. PEI, Institute of Electrical Engineering, Chinese Academy of Sciences

18TD0079: Optimizing Next-Generation HVAC System Using Synchronized Data
K. GUDDA RAVIKUMAR, Schweitzer Engineering Laboratories Inc.
A. UPIETTI, Schweitzer Engineering Laboratories Inc.
A. DRAZIN, Washington State University

18TD0080: Augmentation of Power Quality of Grid-Connected Wind Generator By Fuzzy Logic Controlled TSC
S. GHOSH, University of Memphis
M. ALL, University of Memphis

18TD0082: A Comprehensive Optimization of Load Transfer Strategy for Distribution Network with Flexible Interconnect Device
Y. YANG, Institute of Electrical Engineering, Chinese Academy of Sciences
W. PEI, Institute of Electrical Engineering, Chinese Academy of Sciences
P. TIEJUN, China Electric Power Research Institute
S. FAN, China Electric Power Research Institute
R. HUANG, State Grid Beijing Electric Power Company

Papers and Authors:

POSTER SESSION AND RECEPTION
Including Student Poster Contest
5:00pm – 7:00pm

The Poster Session and Reception provides a relaxed environment for registered conference attendees to enjoy refreshments while viewing more than 300 accepted papers in poster format. Here you have the opportunity to speak with the authors and even tour competing papers from the Student Poster Contest.

18TD0091: BOLD: New Line Design Meets New Impedance Measurement Method
R. GOTTWALD, American Electric Power
W. Warpke, OMI Electronics Corporation

18TD0092: Physical and Electrical Effects of Applying Dynamic Line Rating to Nearby Facilities
B. BHATTARAI, Idaho National Laboratory
R. SCHAEER, Power Engineers
C. DE JONG, Eindhoven University of Technology
D. KELLY, Idaho National Laboratory

H. CHOU, Dominion Energy

18TD0099: Design of a Flexible AC/DC-link
A. BURSTIEN, Eindhoven University of Technology
C. O. JONG, DNV GL

18TD0090: Power-up: A Model for Increasing Power Engineering Career Readiness at Minority-Serving Institutions
A. ZHANG, Texas A&M University-Kingsville
M. GREEN, Texas A&M University-Kingsville
S. PARK, Texas A&M University-Kingsville
M. LARIFETTA, Texas A&M University-Kingsville

18TD0100: Impact of Geomagnetically Induced Current on Distributed Generators
A. ABUSISEIN, University of Alaska Anchorage

18TD0101: Smart Fault Indicators for Advanced Outage Management of Distribution Systems
Y. XIAO, GE
Y. CHENG, Schneider Electric Lab

18TD0102: Residual Magnetic Flux of Three-Phase Three-Leg Transformer for Controllable OCLC
Y. HIRATA, Tokyo Denki University
M. HIRABE, Tokyo Denki University
A. TANAKA, Tokyo Denki University
T. KAKUMA, Tokyo Denki University
T. KOSHIZAKI, Tokyo Denki University

The poster session and reception provide a relaxed environment for registered conference attendees to enjoy refreshments while viewing more than 300 accepted papers in poster format. Here you have the opportunity to speak with the authors and even tour competing papers from the student poster contest.
18TD0110: A Simulation Study of Dynamic Wireless Power Transfer for EV Charging Versus Regenerative Braking in a Caribbean Island
C. MAHARR, University of the West Indies
S. BAHADOORSINGH, University of the West Indies
C. POWELL, Trinidad and Tobago Electricity Commission
G. MAHADEV, Electric Vehicle Company of Trinidad and Tobago
C. SHARMA, University of the West Indies

18TD0111: Demand Response Application for the Reduction of System Heat Rate in a Small Isolated Power System with Significant Short Term Demand Variation
J. COTHRUST, Trinidad and Tobago Electricity Commission
S. BAHADOORSINGH, University of the West Indies
C. SHARMA, University of the West Indies

18TD0127: Silicone Polymer Insulators in Distribution Cutout Applications
M. FETEL, Eaton

18TD0129: PMU-Assisted Bad Data Detection in Power Systems
J. MAI, National University of Arkansas
J. AKINGENEYE, University of Arkansas
J. WU, University of Arkansas

18TD0139: Clustering Methods and Validation of Representative Applications
I. NDIAYE, GE Global Research

18TD0148: Patterns in Failure Rate of LV Distribution Components
B. MATHER, National Renewable Energy Laboratory

18TD0150: Clustering Methods and Validation of Representative Distribution Feeders
A. JAIN, Virginia Polytechnic Institute and State University
B. MATHER, National Renewable Energy Laboratory

18TD0146: Patterns in Failure Rate of LV Distribution Components
M. KLERX, Eindhoven University of Technology

18TD0152: Hardware-in-the-Loop Test Bed and Test Methodology
W. WHITTINGTON, Mississippi State University
J. KLUSS, Mississippi State University

18TD0154: Hardware-in-the-Loop Test Bed and Test Methodology for Microgrid Controller Evaluation
K. PROHASKA, NREL
A. PRATT, NREL
D. KRISHNAMURTHY, NREL
A. MAUTA, Electric Power Research Institute

18TD0160: Hardware Implementation of R-GOOSE for Wide-Area Protection and Coordination
J. YELLSKULSA, Michigan Technological University
N. SHARMA, Michigan Technological University
M. SUNDARARAMAN, Michigan Technological University
P. PAHWA, Michigan Technological University
B. NORDK, Michigan Technological University

18TD0161: Optimization of Multiple Electricity Markets Participation Using Evolutionary PSO
R. FISCH, Polytechnic of Porto
P. PINTO, University of Salamanca
Z. VALE, Polytechnic of Porto
J. CORCHADO, University of Salamanca

18TD0162: A Utility’s Response to Major Storm Events
C. MINOGOSIN, Accenture
C. EYES, United Illuminating
P. CHAKRABORTY, Accenture
D. DODD, United Illuminating
B. BUCO, Accenture
M. BIRON, United Illuminating

18TD0163: Recent Advances of FACTS Devices for Power Quality Compensation in Railway Traction Power Supply
K. LAD, University of Macau
M. KONG, University of Macau
S. SANTISO, University of Texas at Austin

18TD0165: Grid Optimization of Shared Energy Storage Among Wind Farms Based on Wind Forecasting
K. ZOU, University of Buffalo
S. CHOWDHURY, University of Buffalo
M. SUN, University of Texas at Dallas
J. ZHANG, University of Texas at Dallas

18TD0166: Impact of Distributed Solar PV Systems Operation on Residential Feeders Performance
I. NOVAK, GE Global Research
E. AUNED, GE Global Research
C. BIRING, National Grid
J. NICKERSON, National Grid
M. FALLS, National Grid

18TD0175: Technique for Safety Design Improvement of Grounding System by Compression Ratio Methods in Metropolitan Electricity Authority’s System
A. PAYHONKHOR, Metropolitan Electricity Authority Thailand
S. SIRIUSBHANARUL, King Mongkut’s University of Technology Bangkok
B. ANGUK, Provincial Electricity Authority

18TD0179: Substation Secondary Asset Health Monitoring Based on Synchrophasor Technology
H. CHEN, Electric Power Group
L. ZHANG, Electric Power Group
J. CHYNNOTHI, Electric Power Group
N. NIYOM, Electric Power Group
G. WANG, American Electric Power

18TD0180: Frequency Support from Wind Farms Utilizing MTDC Grids
Y. GONG, American Electric Power
N. NAYAK, Electric Power Group
H. CHEN, Electric Power Group
J. CHYNOWETH, Electric Power Group
A. HARRELL, Electric Power Group

18TD0181: Frequency Support from Wind Farms Utilizing MTDC Grids
Y. GONG, American Electric Power
N. NAYAK, Electric Power Group
H. CHEN, Electric Power Group
J. CHYNOWETH, Electric Power Group
A. HARRELL, Electric Power Group

18TD0185: HVDC Grid Optimization of Shared Energy Storage Among Wind Farms Based on Wind Forecasting
K. ZOU, University of Buffalo
S. CHOWDHURY, University of Buffalo
M. SUN, University of Texas at Dallas
J. ZHANG, University of Texas at Dallas

18TD0192: Effect of Mutual Coupling on Ground Relay Operation
M. MAHARR, University of the West Indies
M. ETZADY-AMOL, University of Nevada, Reno

18TD0193: Data Fusion and Machine Learning Integration for Transformer Loss of Life Estimation
M. MAHARR, University of the West Indies
A. HODGCH, University of Denver

18TD0200: GPU-Based Batch LV-Factorization Solver for Convex Analysis of Massive Power Flows
Transaction Number: PES-00164-2016
D. ZHU, Northeast University China
B. D. Missouri University of Science and Technology
L. CHEN, NVIDIA

18TD0205: High Current Vacuum Interrupters: The Future of Generator Switching up to 450 MVA
H. URBANEK, Siemens AG
K. YENNA, Siemens AG
R. MAHOO, Siemens AG
L. FELIPINON, Power Projects Leviens

18TD0206: Detection of Series Arcs Using Load Side Voltage Drop for Protection of Low Voltage DC Systems
Transaction Number: TSG.2017.270438
A. SHERKCHAR, Delphi University of Technology
L. RAMIREZ-VELAZCO, Delft University of Technology
S. BANDYOPADHYAY, Delft University of Technology
L. MAUCH, Delphi University of Technology
F. BAUER, Delphi University of Technology

18TD0207: Comparison of University Departments Regarding Their Area and Load Profile of an Existing Campus
L. MACKAY, Delft University of Technology
S. BANDYOPADHYAY, Delft University of Technology
L. RAMIREZ-ELIZONDO, Delft University of Technology
A. SHEKHAR, Delft University of Technology

18TD0196: Comparison of the Volume and Surface Approaches to Compute Temperature and Electric Field Along the Stress-Grading on Stator Bars (Roebel Type)
H. YE, Chinese Academy of Sciences
L. KONG, Chinese Academy of Sciences
H. YE, Chinese Academy of Sciences

18TD0186: Comparison of the Volume and Surface Approaches to Compute Temperature and Electric Field Along the Stress-Grading on Stator Bars (Roebel Type)
H. YE, Chinese Academy of Sciences
L. KONG, Chinese Academy of Sciences
H. YE, Chinese Academy of Sciences

18TD0168: Dynamic Reconfiguration and Fault Isolation for a Self-Healing Distribution System
A. ARIF, Iowa State University
S. MA, Iowa State University
Z. WANG, Iowa State University

18TD0169: Failure Investigation on Field Aged Porcelain Suspension Insulators
J. KUSS, Missouri State University
D. WALLACE, Mississippi State University
W. WHITTINGTON, Mississippi State University
M. STAFFORD, NREL Electric
These courses and their costs, and to register, please visit: Registration to the conference is not required. To learn more about Registration and Costs:

April 19.

These courses are eligible for CEU/PDH credit. Plain Talk registrants will Each day begins at 7:30am with continental breakfast and registration.

understanding of the electric grid and how it functions in the electric

This course will provide a knowledge of how electric power is transferred from generation sources to distribution systems via the interconnected

Plain Talk

for Extreme Events

ETC-08

Protection Maloperation and Intermittent Resources on Cascading Failures for Extreme Events

B. VYKARANAM, Pacific Northwest National Laboratory

M. WILLEN, Pacific Northwest National Laboratory

S. SAMAAN, Pacific Northwest National Laboratory

K. KE, Pacific Northwest National Laboratory

V. NARAYANOV, Pacific Northwest National Laboratory

J. DASGE, Pacific Northwest National Laboratory

R. DIAO, Pacific Northwest National Laboratory

This is an energized substation. Xcel Energy requires and will provide hard

hats, fire resistant (FR) jumpsuits, safety glasses and safety vests while

on site. Each guest must have a valid government issued photo ID; driver’s license is acceptable. All participants must be a minimum age of 18 years old in order to attend. No children under the age of 18 or pets are allowed on Xcel Energy property. Appropriate dress including

Pants (no skirts or shorts) and comfortable closed toe walking shoes are

required. Sandals, flip flops, open toe shoes or sling back shoes are not permitted. Firearms or explosives, dangerous weapons or materials are prohibited on Xcel Energy property at all times. Weather permitting, refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

5:00am – 5:45am

Cost: $35

Capacity: 18

The National Renewable Energy Laboratory (NREL) focuses on creative answers to today’s energy challenges. From breakthroughs in fundamental science to new clean technologies to integrated energy systems that power our lives, NREL researchers are transforming the way the nation and the world use energy.

8:00am – 12:00pm

Cost: $35

Capacity: 25

Visit Xcel Energy’s outdoor training facility and learn how UAV technology can be used to inspect energy infrastructure in the training yard. Each participant must have a valid government-issued photo ID; driver’s license is acceptable. If you are a non-U.S. citizen (Canadian, permanent resident alien or resident aliens are included in this category), you will need to contact Xcel Energy representative Jeff Garquet at 303-571-7820 as soon as possible. If Jeff is unavailable contact Eric Gupta at 303-571-3550 or Eileen Lockhart at 303-716-2058. All participants must be the minimum age of 18 years old in order to attend. No children under the age of 18 or pets are allowed on Xcel Energy property. Appropriate dress including pants (no skirts or shorts) and comfortable closed toe walking shoes are required. Sandals, flip flops, open toe shoes or sling back shoes are not permitted. Firearm or explosives, dangerous weapons or materials are prohibited on Xcel Energy property at all times.

Weather permitting, refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-06

NREL - NATIONAL RENEWABLE ENERGY LABORATORY TOUR

ESIF - ENERGY SYSTEMS INTEGRATION FACILITY

8:00am – 11:45am

Cost: $35

Capacity: 18

For the past 23 years, NREL has pioneered wind turbine components, systems and modeling methods that have driven the industry’s acceleration over the past 40 years. The addition of NREL’s Wind Technology Center (NWTC) at the National Renewable Energy Laboratory (NREL) is the nation’s premier wind energy, water power and grid integration research facility. Join us for a tour of NREL’s wind research facilities where NWTC has pioneered wind turbine components, systems and modeling methods that have driven the industry’s acceleration over the past 40 years. The tour includes an exciting view of the field research validation sites of several prototype wind turbines, various dynamosimeters and structural research facilities for blade testing/bending, composite materials and blade molding.

TT-09

NREL WIND TECHNOLOGY CENTER: SIEMENS WIND TURBINE CLIMB

Cost: $25

Capacity: 12

Tour Xcel Energy’s new under-construction gas insulated substation (GIS) project and speak with project engineers about the challenges faced while upgrading one of their oldest Denver substations to meet current and future needs.

Closed toe shoes appropriate for a substation environment must be worn (athletic type shoes and loafers without large heels are acceptable). Full personal protective equipment (PPE) supplied by Xcel Energy is required as this is an energized substation. Xcel Energy requires and will provide hard hats, fire resistant (FR) jump suits, safety glasses and safety vests while on site. Each guest must have a valid government issued photo ID; driver’s license is acceptable. All participants must be a minimum age of 18 years old in order to attend. No children under the age of 18 or pets are allowed on Xcel Energy property. Firearm or explosives, dangerous weapons or materials are prohibited on Xcel Energy property at all times.

Weather permitting, refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-08

CAPITOL HILL GIS

8:30am – 11:30am

Capacity: 50

This course will provide a knowledge of how electric power is transferred from generation sources to distribution systems via the interconnected

Basic physical laws governing the grid will be introduced, as well as the regulatory agencies involved in its governance. The great blackouts, their root causes and lessons learned will all be presented. This course will increase the understanding of the electric grid and how it functions in the electric power system. Each day begins at 7:30am with continental breakfast and registration.

TRANSMISSION SYSTEM: THE INTERCONNECTED BULK ELECTRIC SYSTEM

8:00am – 5:00pm

This course will provide a knowledge of how electric power is transferred from generation sources to distribution systems via the interconnected electric bulk power system known as “the grid.” Basic physical laws governing the grid will be introduced, as well as the regulatory agencies involved in its governance. The great blackouts, their root causes and lessons learned will all be presented. This course will increase the understanding of the electric grid and how it functions in the electric power system. Each day begins at 7:30am with continental breakfast and registration.

Registration and Costs:

Registration is the conference is not required. To learn more about these courses and their costs, and to register, please visit: https://www.ene-pcs.org/plain-talk-in-denver-co-2018.
• The onsite speed limit is 25 miles per hour (mph), except where otherwise posted.
• Using portable electronic devices of any kind—including mobile phones, Blackberries and PDA/MP3 players, while operating a motor vehicle or bicycle is prohibited while on NREL’s South Table Mountain campus and National Wind Technology Center.

Weather permitting; refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-10 PANASONIC TECHNOLOGY FACILITY
12:15pm – 4:30pm
Cost: $30
Capacity: 25
Tour Panasonic and Xcel Energy’s new microgrid including battery storage, solar parking structure and Panasonic’s nation-wide photovoltaic (PV) control center. Attendees will have the opportunity to view the internals of the onsite Xcel Energy battery and microgrid system, followed by a tour of the Panasonic Network Operations Center, where they can view the performance of the onsite system and compare it to other North American installations.

Weather permitting; refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-11 DRONE INSPECTION DEMONSTRATION
12:15pm – 4:00pm
Cost: $35
Capacity: 15
Visit Xcel Energy’s outdoor training facility and learn how UAV technology can be used to inspect energy infrastructure in the training yard.

Each participant must have a valid government issued photo ID; driver’s license is acceptable. If you are a non-U.S. citizen (Canadian, permanent resident alien or resident aliens are included in this category), you will need to contact Xcel Energy representative Jeff Gragert at 303-571-7820 as soon as possible. (If Jeff is unavailable contact Eric Gupta at 303-571-3550 or Eileen Lockhart at 303-716-2058.) All participants must be the minimum age of 18 years old in order to attend. No children under the age of 18 or pets are allowed on Xcel Energy property. Appropriate dress including pants (no skirts or shorts) and comfortable closed toe walking shoes are required. Sandals, flip-flops, open toe shoes or sling back shoes are not permitted. Firearms or explosives, dangerous weapons or materials are prohibited on Xcel Energy property at all times.

Weather permitting; refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

TT-12 CAPITOL HILL GIS
12:30pm – 3:45pm
Cost: $25
Capacity: 15
Tour Xcel Energy’s new under construction gas insulated substation (GIS) project and speak with project engineers about the challenges faced while upgrading one of their oldest Denver substations to meet current and future needs.

Closed toe shoes appropriate for a substation environment must be worn (athletic type shoes and loafers without large heels are acceptable). Full personal protective equipment (PPE) supplied by Xcel Energy is required as this is an energized substation. Xcel Energy requires and will provide hard hats, fire resistant (FR) jumpsuits, safety glasses and safety vests while on site. Each guest must have a valid government issued photo ID; driver’s license is acceptable. All participants must be a minimum age of 18 years old in order to attend. No children under the age of 18 or pets are allowed on Xcel Energy property. Firearms or explosives, dangerous weapons or materials are prohibited on Xcel Energy property at all times.

Weather permitting; refunds will be given only if the tour is cancelled due to poor weather conditions and will be posted after the conference.

PRODUCT AND SOLUTIONS SHOWCASE
POWERING TOMORROW’S LIGHTS/SENSORS OFF FREE POWER
8:00am – 9:00am
Hosted by P&R Technologies
Speaker: George Osgood, President, P&R Technologies
Powering tomorrow’s lights, sensors and cameras off live power lines.

EASING NERC CIP COMPLIANCE WITH AUTOMATED ASSET INVENTORY FOR SUBSTATIONS
9:30am – 10:30am
Hosted by SecurityMatters
Historically, asset inventory for substation assets has been a manually intensive process. This showcase will outline how assets owners can automate asset inventory (identification of device part number, firmware version, vendor, model, serial number) in a passive way for all their substation assets thus eliminating site visits and manual processes.

56
PROTECTING MODERN POWER SYSTEMS
9:30am – 10:30am
Hosted by Schweitzer Engineering Laboratories Inc.
Speaker:
Dr. Bogdan Kasztenny, R&D Director of Technology, Schweitzer Engineering Laboratories Inc.

LINE RELIABILITY AND ANIMAL MITIGATION PRODUCTS
9:30am – 10:30am
Hosted by Preformed Line Products
Speakers:
Mark Burns, Market Manager, Preformed Line Products
Robin Bartlett, Product Support Specialist, Preformed Line Products

A BREAKTHROUGH: 3M NOVEC INSULATING GASES
11:00am – 12:00pm
Hosted by 3M Electrical Markets Division
Speaker:
Joseph Frisk, Business Development Manager, 3M

NOVEL GUY ANCHORING SYSTEM FOR SANDY SOIL/WATER
11:00am – 12:00pm
Hosted by Tower Solutions Inc.
Speakers:
Ciro Pasini, President, Tower Solutions Inc.
Sarah Ramji, Project Engineer, Tower Solutions Inc.

REMOTE MONITORING TRANSFORMERS
1:00pm – 2:00pm
Hosted by Springner Controls
Speaker:
Fabrizio Giavenni, COO, Tec System

UTILITY RISK ASSESSMENT OF T&D SYSTEMS
9:30am – 10:30am
Hosted by HDR
Speakers:
Ben McKinsey, Utility Risk Assessment Practice Lead Group, HDR
Mall Wijie, Utility Risk Assessment Practice Lead Group, HDR

FIBERGLASS SOLUTIONS FOR TRANSMISSION STRUCTURES
11:00am – 12:00pm
Hosted by PUPI Crossarms (GEOTEK)
Speaker:
Michael Schenaorf, Vice President of Engineering, PUPI Crossarms (GEOTEK)

FLOWING LINES? AN INTEGRATED APPROACH TO A NEW AND DIFFERENT APPROACH TO TRANSMISSION DESIGN
11:00am – 12:00pm
Hosted by General Cable
Speaker:
Joseph Coffey, Director Transmission, General Cable

PROJECTING ULTIMATE LIFECYCLE PERFORMANCE
1:00pm – 2:00pm
Hosted by Efacec
Speakers:
Jose Manuel Carvalho, Marketing & Sales Director, Efacec
Carlos Carvalho, Technology Director, Efacec

ADVANCED CONDUCTOR TECHNOLOGIES
1:00pm – 2:00pm
Hosted by General Cable
Speaker:
Joseph Coffey, Director Transmission, General Cable

Transmission utilities face intense pressure to do more with less and advanced conductor designs can allow utilities to meet these challenges. Whether it is opening an existing corridor, competing for a new project or building a line through a sensitive area, today’s projects face an ever increasing list of constraints. This presentation will review several common scenarios and alternative design approaches by comparing attributes of available conductor technologies that are a best fit for different types of projects. In this session, ACSR, ACCS, ACCS TWP and ACCC® will be considered and the speaker will share how EPR® Technology can add to any of these designs for lowering cost, decreasing risk and expanding capabilities.
MAPPING THE HEALTH OF THE POWER GRID INSULATORS IN SUBSTATIONS AND TRANSMISSION OVERHEAD LINES

1:00pm – 2:00pm
Hosted by Positron, Inc.

Speakers:
Charles Jean, Chief Engineer, Positron, Inc.
Reg Weiser, CEO, Positron, Inc.

A new electric field device that quickly assesses the health of insulators in energized power substations, including bushings on voltage and current transformers, circuit breakers, coupling capacitors, cable terminations, posts, etc. will be introduced during this session. A mapping procedure that displays the health of insulators in the transmission lines of power utilities, geo-located by a tower that provides an instantaneous overview of the condition of their assets will also be unveiled. The solution will enable utilities to prevent power outages, damages, fires, unscheduled emergencies and damage to reputation.

CO-SIMULATION OF TRANSMISSION AND DISTRIBUTION SYSTEMS

2:30pm – 3:30pm
Hosted by DlgSILENT Americas LLC

Speaker:
Matt McGrail, Senior Engineer, DIgSILENT Americas LLC

TOOLS FOR ELECTRIC MOTOR MAINTENANCE PROGRAMS

2:30pm – 3:30pm
Hosted by EDE Electric Motor Testing

Speakers:
George Frey, Applications Engineer/Owner, EDE Electric Motor Testing
Jack Hamilton, President, MDS Inc.

From monitoring equipment and tools to test instrumentation and calibration standards, maintenance professionals can be overwhelmed with information on what technology best suits many electric motor maintenance situations. EDE can help demystify electrical testing programs and offer support and training for increasing your understanding and knowledge of interpreting results from maintenance activities. This showcase will provide answers to questions on testing solutions and tools, along with ongoing training capabilities that suit the needs of increased capability and knowledge base, and keep your electric maintenance program running smoothly.

FIREFLY BIRD DIVERTER PROOF OF FUNCTION THROUGH MULTISPECTRAL VIDEO RECORDING

2:30pm – 3:30pm
Hosted by P&R Technologies

Speakers:
George Osgood, President, P&R Technologies
Dr. Klausw Schmitt, Scientific Advisor, Hammarprodukter

Proof of function of the Firefly Bird Diverter will be presented and discussed based on multiple multispectral video record. Birds show altered behavior and flight patterns which provide proof of function even under adverse weather conditions, protecting birds and avoiding power interruptions. Additionally, the scientific background of bird vision and multispectral video recording will be explained in an easy to understand fashion.

IMPROVING GRID RELIABILITY WITH QUALITY COMPONENTS

2:30pm – 3:30pm
Hosted by SPX Transformer Solutions

Speaker:
Art Martin, Senior Product Engineer, SPX Transformer Solutions

Optimal grid performance depends on every transformer part operating at peak performance levels. Systems are negatively impacted when individual components, such as heaters and breathers, fail to operate properly or at compromised levels. In some cases, these items can actually create adverse conditions in control cabinets, tap changers and transformers. Often, transformer health products are the lowest cost components of the transformer but have a significant impact on performance.

TRANSMISSION SYSTEM RELIABILITY THROUGH SMART SWITCHING

2:30pm – 3:30pm
Hosted by Southern States LLC

Speakers:
Buddy Reneau, National Sales Manager, Services, Southern States LLC
Steven Fan, Southern States LLC

ENHANCING PRODUCTIVITY AND ACCURACY IN TRANSFORMER CORE CUTTING AND ASSEMBLY

2:30pm – 3:30pm
Hosted by L.A.E. Lughese Attrezzature per l’Elettromeccanica S.r.l.

Speaker:

Innovative solutions to enhance productivity and accuracy during transformer core cutting and assembly process.

OVERCOMING ELECTRICAL INFRASTRUCTURE CHALLENGES OF POWERING A MIDDLE EASTERN CITY

4:00pm – 5:00pm
Hosted by HDR

Speakers:
Sean Everett, Project Manager, HDR
Walid Obeidalla, Sr. Program Manager, HDR

Building a city from scratch in the Middle East is a huge undertaking, and getting power and other utilities to the site are a critical first step in order to return funds to investors and continue development. However, developing an entire city from the sand up without a systematic plan and with a “say-yes-to-anything” approach can lead to a poorly performing electrical grid, increased costs, missed deadlines and other frustrations. This showcase will discuss several challenges and lessons learned through our experience in helping develop the King Abdullah Economic City in Saudi Arabia.

NETWORKING RECEPTION

4:30pm – 6:00pm

Mingle with leading product specialists and industry experts during the exhibit hall Networking Reception. Explore the exhibit hall and enjoy hors d’oeuvres and beverages as you experience firsthand how some of the industry’s newest technology and solutions are being applied in the real world.
The rise in the frequency and magnitude of major weather events, as well as the increasing salience of threats such as cyber and physical attacks against the grid, make it necessary to think not only about the reliability, but the resilience of the grid and its ability to withstand and recover from intense shocks to the infrastructure. Regulators and policymakers across the world are pushing for new structures that can properly value and promote the redundancy and resilience capabilities the grid needs using technologies like microgrids and distributed energy resources and wide-area situational awareness. This session will address best practices and technologies that have been implemented to improve resilience, regulatory structures that best promote those efforts, and how companies can respond to changing realities. This panel of leaders from business, technical and regulatory fields will discuss their diverse experiences with new regulations to encourage resilience and how best to design the resilient grids of the future.
**PS34 SMART CITIES: BUILDINGS, TRANSPORTATION AND ENERGY PROGRAM INTEGRATION WITH IOT**

**8:00am – 10:00am**

Chair:
Shawn Chandler, IEEE IoT
Rendall Farley, Avista Utilities

Panellists:
S. CHANDLER, IEEE IoT
R. FARLEY, Avista Utilities
J. GARTNER, Navigant Consulting
G. KARAVANIS, Durst Energy

As energy systems are getting more complex, grid quality and control in the high-voltage grid becomes of utter importance for transmission grid operators. Two products can assist to increase grid stability and efficiency: (Variable) Shunt Reactors and Phase Shifters. Shunt reactors solve local overvoltage problems and compensate the Ferranti Effect. Variable shunt reactors with a regulation range up to 80% allow grid operators to act in an extremely flexible way as they can be adjusted according to the current load situation and thus always compensate adequately. Phase shifters are used for load flow control enforcing load flow and avoiding more expensive grid extensions. On the other hand they also can block load flow to protect a grid therefore increasing stability and reliability of a network. During this panel you will learn how both products work, how they can be helpful for your grid, and who needs them technically and can profit economically.

**PS35 IMPROVING GRID STABILITY WITH VARIABLE SHUNT REACTORS AND PHASE SHIFTERS**

**8:00am – 10:00am**

Chair:
James McIver, Siemens

Panellists:
G. LINORTNER, Siemens AG Austria
M. LAMBE, Dominion
D. DURBAK, Siemens USA

As energy systems are getting more complex, grid quality and control in the high-voltage grid becomes of utter importance for transmission grid operators. Two products can assist to increase grid stability and efficiency: (Variable) Shunt Reactors and Phase Shifters. Shunt reactors solve local overvoltage problems and compensate the Ferranti Effect. Variable shunt reactors with a regulation range up to 80% allow grid operators to act in an extremely flexible way as they can be adjusted according to the current load situation and thus always compensate adequately. Phase shifters are used for load flow control enforcing load flow and avoiding more expensive grid extensions. On the other hand they also can block load flow to protect a grid therefore increasing stability and reliability of a network. During this panel you will learn how both products work, how they can be helpful for your grid, and who needs them technically and can profit economically.

**PS36 BUILDING A MORE RESILIENT DISTRIBUTION SYSTEM AGAINST EXTREME EVENTS**

**10:15am – 12:15pm**

Chair:
Wei Sun, University of Central Florida

Panellists:
Z. WANG, Iowa State University
C. CHEN, Argonne National Laboratory
K. ANDERSON, National Renewable Energy Laboratory

Critical power infrastructure has to operate against extreme events, such as long-term climate change, natural hazards and disasters and cyber intrusion. Fast recovery and successfully adapting to extreme events are critical to build a resilient power grid. Recent advances on smart grid technologies, especially in the distribution domain, bring both opportunities and challenges for system operators to enhance system reliability and resilience. This panel will present recent developments in advanced computational models and analytical methods in distribution system restoration, as well as industry practice and training procedure. It will also discuss challenges from extreme events (hurricanes, geomagnetic disturbance, cyber attacks) and opportunities from new technologies (renewable energy, PMU, microgrids, DER, electric vehicles). The diversified panelists are from both academia and industry, including universities, national labs, ISO and utilities, and will provide a comprehensive review of the state-of-the-art and discuss future directions to power grid resilience.

**PS37 PLANNING, DEPLOYMENT AND OPERATION OF ENERGY STORAGE PROJECTS**

**10:15am – 12:15pm**

Chair:
Nanpeng Yu, University of California, Riverside

Panellists:
J. ARAIZA, Southern California Edison
N. YU, University of California, Riverside
F. FOK, LG Chem
R. LIN, NEC
H. ZAREIPOUR, University of Calgary

As renewable energy penetration levels increase, the energy storage systems gain traction. The first quarter of 2017 was the biggest in history for the U.S. energy storage market. During this panel practitioners from industry and researchers from academia will come together to discuss the barriers, challenges and best practices of energy storage integration, and the path forward. The practical considerations for energy storage deployments and implementation will be discussed by industry experts. The economics, planning and degradation aspects of energy storage systems will be discussed by researchers from academia.

**PS38 BUILDING A MORE RESILIENT DISTRIBUTION SYSTEM AGAINST EXTREME EVENTS**

**10:15am – 12:15pm**

Chair:
Wei Sun, University of Central Florida

Panellists:
Z. WANG, Iowa State University
C. CHEN, Argonne National Laboratory
K. ANDERSON, National Renewable Energy Laboratory

Critical power infrastructure has to operate against extreme events, such as long-term climate change, natural hazards and disasters and cyber intrusion. Fast recovery and successfully adapting to extreme events are critical to build a resilient power grid. Recent advances on smart grid technologies, especially in the distribution domain, bring both opportunities and challenges for system operators to enhance system reliability and resilience. This panel will present recent developments in advanced computational models and analytical methods in distribution system restoration, as well as industry practice and training procedure. It will also discuss challenges from extreme events (hurricanes, geomagnetic disturbance, cyber attacks) and opportunities from new technologies (renewable energy, PMU, microgrids, DER, electric vehicles). The diversified panelists are from both academia and industry, including universities, national labs, ISO and utilities, and will provide a comprehensive review of the state-of-the-art and discuss future directions to power grid resilience.

**PS39 RELIABILITY CONSIDERATIONS OF HIGH-PenetRATION DER ON THE BULK POWER SYSTEM**

**10:15am – 12:15pm**

Chair:
Jason McDowell, GE Energy Consulting

Panellists:
N. SEGAL, NERC
E. VITAL, EPRI
C. LOUTRA, CALISO
M. AMOLES, Utility Variable generation
N. KANG, Argonne National Laboratory

High penetration of distributed energy resources (DER) in distribution systems not only introduces two-way power flows but also impacts system responses to various disturbances potentially threatening the reliability of the Bulk Power System (BPS). Treating distribution systems as lumped loads is no longer sufficient to represent the impact of DER in the planning and operation of the BPS. At the same time, the advanced control capabilities of DER offer potential opportunities for improving BPS’s reliability when applied in a well thought-out manner. This panel will discuss the impact of high penetration DER on the BPS from various aspects, including BPS planning and operation, wholesale market participation by DER, BPS voltage, frequency and dynamic stability. The DER modeling and interconnection standards, monitoring and control of DER will also be discussed, as well as details from the efforts of NERC’s various working groups with respect to DER.

**PS38 RELIABILITY CONSIDERATIONS OF HIGH-PenetRATION DER ON THE BULK POWER SYSTEM**

**10:15am – 12:15pm**

Chair:
Pat Evin, ABB Inc.

Panellists:
C. STEIGMEIER, ABB Inc.
G. BECKER, Power Engineers
J. KAPPENMAN, Phoenix Electric

Compact High Voltage Gas Insulated Substations (GIS) coupled with underground transmission can effectively and economically build energy bunks as opposed to large traditional Air Insulated Substations (AIS) requiring fortress-like protection (exterior and interior 8-20’ walls with interlocking gating, curved roadways, anti-drone capability, extensive high intensity lighting and camera systems, forward looking radar, mantraps, annual first responder training and security guards). This panel will present resilient solutions: hiding substations and switchyards underground or in a building; digital solutions enabling predictive asset health and performance; a program to significantly reduce the risk and rapidly repair/replace/transform; and new solar farms and EMP mitigation solutions providing simpler and lower cost approaches to hardening against these threats.
As network conditions continue to shift within transmission systems, additional flexibility and controllability are significant drivers for application solutions. FACTS technologies are well suited to meet these challenges now and in the foreseeable future. This panel will cover the network challenges and provided solution and operational experience of recent transmission FACTS installations.

**PS41**
**EVALUATION OF ADVANCED DISTRIBUTION SYSTEM APPLICATIONS USING DMS CENTRIC APPROACHES**
10:15am – 12:15pm
Chair: Murali Baggu, National Renewable Energy Laboratory

Panelists:
- K. SCHNEIDER, Pacific Northwest National Laboratory
- D. SULLIVAN, Merpi
- M. CAMERON, Xcel Energy

The proliferation of distributed photovoltaic (PV) systems is creating network challenges and provided solution and operational experience of additional flexibility and controllability are significant drivers for application solutions. FACTS technologies are well suited to meet these challenges now and in the foreseeable future. This panel will cover the network challenges and provided solution and operational experience of recent transmission FACTS installations.

**PS42**
**FUTURE TSO-DSO INTERACTION AND COORDINATION**
10:15am – 12:15pm
Chair: Jim Reilly, Reilly Associates

Panelists:
- J. BOEMER, Electric Power Research Institute (EPRI)
- T. MUIR, PNNL
- T. TAYLOR, Brunel University London
- S. WENDE-VON BERG, Fraunhofer ISE
- A. GHASSEMIAN, U.S. Department of Energy

Power systems are evolving to incorporate material and significant levels of distributed energy resources (DER) with impact on the bulk power system. This paradigm shift in power system operation is leading to new roles, responsibilities and opportunities at both the distribution and transmission level. This panel will discuss the different approaches of the autonomous control of grid edge devices that interact with the centralized control layer. Panelists will present the different approaches of the autonomous control of grid edge devices that interact with the centralized control layer.

_PAPER FORUM SESSIONS_

**FORUM 7**
**POWER SYSTEM INSTRUMENTATION, MEASUREMENTS AND DYNAMIC PERFORMANCE**
8:00am – 10:00am
Chair: Masoud Barati, Louisiana State University

**PAPERS AND AUTHORS:**

18TD0050: Coordinated Timing of Controller Parameters in AC/DC Grids for Power Oscillation Damping
- M. MAJESTIC, Otto-von-Guericke University Magdeburg
- T. WERLING, Siemens Corp.
- F. FINDEISEN, Otto-von-Guericke University Magdeburg

18TD0063: A Novel Time-Frequency Analysis for Power System Waveforms Based on “Pseudo-Wavelets”
- C. GOAN, Texas A&M University
- M. KEZUNOVIC, Texas A&M University

18TD0090: Stability Criterion for Interfacing a Transient Stability Model to a Dynamic Phasor Model
- H. KONRAK, University of Manitoba, Canada
- A. ARZHANOV, University of Manitoba, Canada
- C. KAHN, TransGrid Solutions

18TD0165: Dynamic State Estimation of Full Power Plant Model from Terminal Phasor Measurements
- A. PAL, McGill University
- K. KAMMA, Hydro-Québec (Research institute of Hydro-Québec)
- G. JOOS, McGill University

18TD0204: The Effect of Different Representations of Power Transducers on the Power Factor Control in Distributed Generators Under Unbalanced Conditions
- A. PAVIC, Itaipu Technological Park - FPTI/BR
- R. OTTO, Itaipu Technological Park Foundation - FPTI/BR
- J. PESENTE, Itaipu Binacional
- R. REGINATTO, State University of Western Paraná - UNIOESTE
- J. DOS SANTOS, Itaipu Technological Park Foundation - FPTI/BR
- R. RAMOS, São Carlos School of Engineering - University of São Paulo - ESCE/USP

18TD0332: Critical PMU Measurement Identification Based on Analytic Hierarchy Process
- R. MA, Syracuse University
- S. STEENHOF, Syracuse University

18TD0357: U. S. Eastern Interconnection (EI) Model Reductions Using a Measurement-Based Approach
- X. ZHANG, Oak Ridge National Laboratory
- Y. YU, University of Tennessee
- Y. LIU, University of Tennessee
- W. DU, University of Tennessee

18TD0284: The Effect of Different Representations of Power Transducers on the Power Factor Control in Distributed Generators Under Unbalanced Conditions
- M. KEZUNOVIC, Texas A&M University
- C. QIAN, Texas A&M University
- A. MESANOVIC, Otto-von-Guericke University Magdeburg
- R. FINDEISEN, Otto-von-Guericke University Magdeburg
**PRODUCT AND SOLUTIONS SHOWCASE**

**UAS INSPECTIONS FOR EVALUATING UTILITY ASSETS**
9:30am – 10:30am
Hosted by Preformed Line Products
Speaker: John Markiewicz, Global Market Manager, Preformed Line Products

This session will address safer and more efficient methods for inspecting and analyzing utility transmission and distribution power lines.

**UNDERGROUND GRID MONITORING SYSTEM**
9:30am – 10:30am
Hosted by 3M Electrical Markets Division

Speakers:
- Aditya Ranade, Technology Manager - Grid Modernization, 3M Electrical Markets Division
- Kate Sherrwood, Sr. Director - Grid Modernization, 3M Electrical Markets Division

3M combines accurate sensing of electrical parameters and low power local analytics to synthesize actionable critical event information such as fault detection, fault location, waveform capture and power quality. 3M’s unique communication hardware enables efficient transmission of signals from underground environments, while maintaining the integrity of the assets.

**QUIET POWER TRANSFORMERS FOR URBAN AREAS**
9:30am – 10:30am
Hosted by Virginia Transformer Corporation
Speaker: Rakesh Rathi, VP Engineering, Virginia Transformer

**ON-SITE TESTING AND EVALUATION OF ELECTRICAL EQUIPMENT OF WINDFARMS AND IN DISTRIBUTION GRIDS**
11:00am – 12:00pm
Hosted by Reinhausen Manufacturing Inc.

Speakers:
- Dr. Alexander Winter, Regional Sales Director Americas, HIGHVOLT Germany
- Dr. Uwe Kaltenborn, Director Business Development, HIGHVOLT

Medium voltage equipment will receive more attention as renewable energy resources are implemented in the power grid. Therefore the operators of windfarms, as well as of distribution grids move from event triggered repair and maintenance to time and even condition based maintenance. To evaluate the condition of the equipment like transformers, cables, switchgears and generators, a suitable test system is needed. We have accepted the challenge and have developed a highly compact test system including induced voltage source and measurement system even for partial discharges. The test system is so compact that it can be used at the nacelle of a windmill. A live presentation of this test system will be presented, along with some application cases and test results during this showcase.

**MAXIMIZING SERVICE LIFE OF STATIONARY BATTERY SYSTEMS THROUGH TRUE BATTERY MANAGEMENT**
11:00am – 12:00pm
Hosted by Storage Battery Systems
Speaker: Wayne Eaton, Technical Sales Engineer, Storage Battery Systems

While NERC compliance and IEEE recommended practices drive current battery maintenance activities, the applications of a true Battery Management approach – which will be presented during this showcase, can extend the service life, capacity and reliability of your battery system.

**TRAVELING WAVE BASED RELAYS – CLOSED-LOOP TESTING**
11:00am – 12:00pm
Hosted by RTDS Technologies Inc.
Speaker: Paul Forsyth, VP - Marketing and Sales, RTDS Technologies Inc.

For many years, developers have investigated the possible use of traveling wave data for protective relaying applications. Now the first commercial devices using traveling wave based algorithms have been released. These new devices use sampling in the range of 1 MHz to very accurately measure the timing of reflections caused by faults. This creates a challenge for closed-loop testing of these relays with a real time simulator. In order to test the traveling wave based relay algorithms the simulator must operate with a timestep in the microsecond range, whereas previously protective relays were tested using timesteps in the 50 microsecond range. NovaCor, the recently released next generation RTDS Simulator, has the processing power to provide a flexible, high fidelity modeling capability well-suited for testing traveling wave based relays. The raw processing power of NovaCor helps to facilitate simulation timesteps in the microsecond range. Just as important though, innovative programming has created an environment which is very flexible and completely expandable i.e. the network representation can be expanded to suit the testing requirements. The challenges faced, as well as the solution delivered by the NovaCor platform will be presented during this showcase.

**CLOSING RECEPTION AND RAFFLE**
3:00pm – 4:00pm
Join us for a special toast thanking our new Denver friends for a great event, while welcoming the 2020 Chicago Local Organizing show team! Enjoy hosted beverages and snacks, along with a chance to win some great prizes.
EXHIBITOR LIST

T&D provides an unprecedented opportunity to discover the latest products and solutions from more than 800 exhibitors, all under one roof. As of February 7, 2018, the following participating companies have been confirmed. This list grows daily so be sure to visit IEEE-T&D.org for new exhibitor announcements.