

# ADVANCED BATTERY STORAGE

**October 23-24, 2019**  
**EUCI Office Building Conference Center**  
**Denver, CO**

**POST-COURSE WORKSHOP**

**Building a Business Case for  
Your Individual Use Case**

**THURSDAY, OCTOBER 24, 2019**



***“Great course to get a broad view of technical aspects of energy storage projects.”***

Senior Engineer, MEPPi

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 EUCI is authorized by IACET to offer 1.1 CEUs for the course and 0.4 CEUs for the workshop.

## OVERVIEW

A radical energy transformation is under way today, one that we will likely fully appreciate only in hindsight. Utility regulators and operators are beginning to rebuild the bulk power system to make it more resilient and better able to accommodate higher penetration levels of variable renewable generation. With more wind and solar coming onto the grid, long duration storage is the holy grail in energy. One of the prime movers in this energy transformation is the rapid advancement battery storage technologies.

There are different application characteristics, which underscore the need for different batteries and battery technologies. Some chemistries or technologies are better suited for short-duration power applications, whereas others are better suited for long-duration energy applications so no one battery is the ideal tool for all applications.

This course will provide an in-depth overview of the various types of long duration batteries. In addition, it will address things to consider such as battery characteristics, projected life, performance and costs. It will look at battery storage applications, utility scale implementations, use cases and system resiliency. The program will address storage design, long duration batteries, use cases, design considerations and the future of battery storage.

## LEARNING OUTCOMES

- Review battery storage and other types of storage
- Identify the various types of long duration batteries, the chemistry and how they work
- Identify the major components in a Battery Energy Storage System (BESS)
- Review the different battery storage applications including frequency regulation
- Discuss various battery storage use cases
- Discuss constraints and systems for utility scale implementations
- Examine AC/DC coupled systems, what they do and advantages/disadvantages
- Identify and mitigate energy storage design
- Discuss the future of energy storage



***“Useful content for those looking to better understand the role batteries might play in a power supply portfolio. Recommend attending before issuing an RFP.”***

Director of Operations, OMPA



***“Worthwhile course for those needing an overview on BESS.”***

National Director of Business Development, BAE Batteries USA

# AGENDA

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WEDNESDAY, OCTOBER 23, 2019

**8:00 – 8:30 am**            **Registration and Continental Breakfast**

**8:30 am – 4:45 pm**        **Course Timing**

**12:00 – 1:00 pm**        **Group Luncheon**

- Storage
  - o Process, non-battery energy storage, batteries
- Long duration batteries
  - o Battery chemistry
  - o Diversity of chemistry – 200 + and counting (periodic table illustration)
    - How it works
    - Potential failure mechanisms
  - o Lithium-ion BESS
    - How they work
    - Family of chemistries – all with different characteristics
  - o Flow batteries
    - Redux
    - Plating
    - Organic and others
  - o Other choices in batteries
    - Advanced lead-based batteries
    - Sodium, fluorine, etc.
  - o Things to know and think about
    - Characteristics to think about
    - Projected life
    - Performance
  - o Safety
    - NEC 700-705 and 855
    - IEEE 1547 and UL 1741
  - o Major components in a BESS
    - A visual walk thru a typical BESS
      - a) Physical batteries (e.g. Li-ion)
      - b) Flow battery
    - Batteries
    - Environmental systems (HVAC, etc.)
    - Inverters
    - Controllers
    - Housings
    - Battery management system
    - Storage management system/Energy management systems
    - Market participation systems
    - Forecasting and analytics
    - Secondary containment
    - Substation
    - Fire suppression
    - Augmentation plan
    - Replacement plan

# AGENDA

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WEDNESDAY, OCTOBER 23, 2019 (CONTINUED)

- Battery storage use cases
  - o Wholesale energy market
  - o Distribution energy market
  - o Utility operations
  - o Renewable locations (e.g. Solar+Storage)
  - o Residential
  - o EV charging
  - o Critical facilities
  - o Other
  
- Building a business case
  - o Typical benefit categories
  - o Regional differences
    - PJM
    - ERCOT
    - CAISO
    - Other regions
  - o Costs
    - Initial capital costs
    - Soft costs of initial placement (e.g. design, permits, etc.)
    - Interconnection
    - Operations
    - Augmentation and replacement
    - Other costs

**4:45 pm**

**Program Adjourns for Day**

**BONUS MATERIAL**

**4:45 – 5:45 pm**

**A Review of all the Types of Storage that Exist** *(optional session)*

# AGENDA

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THURSDAY, OCTOBER 24, 2019

**8:00 – 8:30 am**      **Continental Breakfast**

**8:30 am – 12:00 pm**      **Course Timing**

- Utility scale implementation
  - o Lessons learned
    - Dealing with startups
    - Hidden factors
    - Fire protection
    - Public perception
    - Construction issues
  - o Addressing local constraints and systems
  - o How to avoid impacting end users
- System resiliency
- AC/DC coupled systems
  - o Difference in efficiency
    - Lower losses
    - DC coupled to generation
    - DC coupled to DC loads
  - Issues with arc flash
    - o Components involved
    - o What they do
- Design considerations
  - o Li-Ion and other “square” batteries
  - o Flow batteries
- Implementation
  - o Typical work plan at a high level
  - o Typical timelines
- Operational risks
- Conducting inspections and maintenance
- Assisting with refurbishing and/or decommissioning
  - o Environmental considerations
  - o Recycling
- Integrators
- The future of battery storage
  - o What’s next
  - o Ideal energy user profiles

**12:00 pm**      **Program Adjourns**

## COURSE INSTRUCTORS



**Jason Barmann**

**Staff Electrical Engineer, Burns & McDonnell**

Mr. Barmann is presently assigned to the electrical group of the Energy Division. His responsibilities include utility-scale battery energy storage system (BESS) design, electrical system design, electrical equipment procurement, load flow and short-circuit analysis, protective relay settings and configuration, and preparing electrical schematics for control and protection.



**Doug Houseman**

**Utility Modernization Lead, Burns & McDonnell**

Doug Houseman is a long-time industry veteran who is a member of the Gridwise Architecture Council (GWAC), chair of the IEEE Power & Energy Society (PES) Intelligent Grid and Emerging Technology Coordinating Committee, and a NIST Resiliency Fellow. He has been working on storage issues since 1980, when he was involved with several DOD projects.



**Katlyn Meggers**

**Utility Planning Specialist, Burns & McDonnell**

Katlyn Meggers is a Utility Planning Specialist at Burns & McDonnell, specializing in energy storage technology, power generation benchmarking insights, capital asset planning solutions (CAPS), power plant decommissioning, and due diligence studies. She earned her Bachelor of Science in Chemical Engineering from the University of Kansas.



**Chris Ruckman, P.E.**

**Energy Storage Director, Burns & McDonnell**

Chris Ruckman is the Energy Storage Director for Burns and McDonnell's Energy Division where he oversees the development of solutions to meet growing challenges for the electrical grid. An electrical engineer with more than 24 years of experience, Mr. Ruckman combines a passion for sustainable solutions with his deep technical understanding of the utility industry to develop safe, reliable, and cost-effective energy storage solutions. His experience includes electrical system design and analysis, protective relaying, and detailed design for new and retrofit power generation projects, microgrids, and black start. He is a senior member of the IEEE PES Power System Relaying Committee and currently serves as the Chairman of the Black Start Generator Plant Protection Issues working group. He holds a B.A. in Physics from William Jewell College and a B.S. in Electrical Engineering from The University of Kansas. He is a registered engineer in California, Iowa, Kansas, Kentucky, Minnesota, Nebraska, Ohio, Oklahoma, Texas and Wisconsin.

## POST-COURSE WORKSHOP

# Building a Business Case for Your Individual Use Case

FRIDAY, OCTOBER 25, 2019

**12:30 – 1:00 pm**      **Workshop Registration**

**1:00 – 4:45 pm**      **Workshop Timing**

## OVERVIEW

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This half day workshop will be highly interactive and individualized. You will move groups in the room for several rounds of work. The session will start with a blank template for estimating costs and benefits. In the first rounds of work the benefit categories will be worked in groups based on the use cases and the region, in the next rounds of work the costs will be worked based on the type and sizes of batteries.

## LEARNING OUTCOMES

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- Discuss the challenges associated with building a business case for battery storage
- Discuss choosing the right use case for your specific needs
- Explain the differences between the regional markets
- Explain the different costs associated with building a business case
- Discuss how to build the correct battery size and type for your individual use case

## WORKSHOP AGENDA

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FRIDAY, OCTOBER 25, 2019

- Introduction
  - o Instructor introductions
  - o Passing out the paper template and a quick overview
- Choosing a use case
  - o Overview of the eight most common use cases
  - o Moving to the right use case group
  - o Filling in use case specifics of the template
- Regionalizing your use case
  - o Introduction to the regional markets
  - o Group assignment
  - o Filling in the region specifics of the template
- Costs all systems have
  - o Land costs
  - o Permit costs
- Picking a battery size
  - o Quick overview
  - o Moving to the battery size group
  - o Filing in specifics for your battery size
  - o Interconnection and engineering costs

# WORKSHOP AGENDA

FRIDAY, OCTOBER 25, 2019 (CONTINUED)

- Picking a battery type
  - o Flow or non-flow
  - o Moving to the right group
  - o Filling in the specifics of the battery type
  - o Maintenance costs
- If time – understanding your life cycle costs

## WORKSHOP INSTRUCTORS



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## IACET CREDITS

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EUCI has been accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET). In obtaining this accreditation, EUCI has demonstrated that it complies with the AN-SI/IACET Standard which is recognized internationally as a standard of good practice. As a result of their Authorized Provider status, EUCI is authorized to offer IACET CEUs for its programs that qualify under the AN-SI/IACET Standard.

**EUCI is authorized by IACET to offer 1.1 CEUs for the course and 0.4 CEUs for the workshop.**

## REQUIREMENTS FOR SUCCESSFUL COMPLETION

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Participants must sign in/out each day and be in attendance for the entirety of the course to be eligible for continuing education credit.

## INSTRUCTIONAL METHODS

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Case studies and PowerPoint presentations will be used in this program.

## EVENT LOCATION

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### **EUCI Conference Center**

4601 DTC Blvd., B-100  
Denver, CO 80237

## NEARBY HOTELS

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### **Hyatt Regency Denver Tech Center**

7800 E. Tufts Ave  
Denver, CO 80237  
Phone: 303-779-1234  
0.3 miles away

### **Hilton Garden Inn Denver Tech Center**

7675 E. Union Ave  
Denver, CO 80237  
Phone: 303-770-4200  
0.6 miles away

### **Denver Marriott Tech Center**

4900 S. Syracuse St  
Denver, CO 80237  
Phone: 303-779-1100  
0.7 miles away

### **Hyatt Place Denver Tech Center**

8300 E. Crescent Parkway  
Greenwood Village, CO 80111  
Phone: 888-492-8847  
0.9 miles away

## REGISTER 3, SEND THE 4TH FREE

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Any organization wishing to send multiple attendees to this course may send 1 FREE for every 3 delegates registered. **Please note that all registrations must be made at the same time to qualify.**

# To Register, Click Here, or

## Mail Directly To:

**PMA Conference Management**  
PO Box 2303  
Falls Church VA 22042  
Tel 201 871 0474  
Fax 253 663 7224  
register@pmaconference.com

## EVENT LOCATION

### EUCI Conference Center

4601 DTC Blvd., B-100  
Denver, CO 80237

**See nearby hotels on page 9**

## PLEASE REGISTER

- SPECIAL BUNDLE PRICE: ADVANCED BATTERY STORAGE, SAFETY IN BATTERY STORAGE AND POST-COURSE WORKSHOP**  
OCTOBER 23-25, 2019: US \$2795  
EARLY BIRD on or before OCTOBER 4, 2019: US \$2595
- ADVANCED BATTERY STORAGE AND SAFETY IN BATTERY STORAGE COURSES:** OCTOBER 23-25, 2019: US \$2395  
EARLY BIRD on or before OCTOBER 4, 2019: US \$2195
- ADVANCED BATTERY STORAGE AND POST-COURSE WORKSHOP:**  
OCTOBER 23-24, 2019: US \$1895  
EARLY BIRD on or before OCTOBER 4, 2019: US \$1695
- ADVANCED BATTERY STORAGE COURSE ONLY**  
OCTOBER 23-24, 2019: US \$1495  
EARLY BIRD on or before OCTOBER 4, 2019: US \$1295

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Energize Weekly is EUCI's free weekly newsletter, delivered to your inbox every Wednesday. We provide you with the latest industry news as well as in-depth analysis from our own team of experts. Subscribers also receive free downloadable presentations from our past events

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### CREDIT CARD INFORMATION

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Security Code (last 3 digits on the back of Visa and MC or 4 digits on front of AmEx)

Billing Zip Code/Postal Code

**OR** Enclosed is a check for \$ \_\_\_\_\_ to cover \_\_\_\_\_ registrations.

### Substitutions & Cancellations

Your registration may be transferred to a member of your organization up to 24 hours in advance of the event. Cancellations must be received on or before September 20, 2019 in order to be refunded and will be subject to a US \$195.00 processing fee per registrant. No refunds will be made after this date. Cancellations received after this date will create a credit of the tuition (less processing fee) good toward any other EUCI event. This credit will be good for six months from the cancellation date. In the event of non-attendance, all registration fees will be forfeited. In case of course cancellation, EUCI's liability is limited to refund of the event registration fee only. For more information regarding administrative policies, such as complaints and refunds, please contact our offices. EUCI reserves the right to alter this program without prior notice.