BECKWITH ELECTRIC CO.INC.

PROTECTION & CONTROL SEMINAR

July 30–August 2, 2018

Sandpearl Resort, Clearwater Beach, FL




Power Plant Protection | Distribution Protection & Control

The Protection & Control Seminar is divided into two program tracks to help you find the educational programs of most interest and value for you.

Power Plant Protection Track

Day 1
- Generator Protection (Based on IEEE C37.102)
- Fault Fundamentals

Day 2
- Generator Protection Calculations & Settings
- Generation Protection Hands-on Testing Lab Breakout Session

Day 3
- Transformer Protection (Based on IEEE C37.91)
- Transformer Protection Calculations & Settings
- Transformer Protection Hands-on Testing Lab Breakout Session

Day 4
- Motor Bus Transfer (MBT)
- Automatic Synchronizing

Distribution Protection & Control Track

Day 1
- Distribution Feeder Protection (Based on IEEE C37.230)
- Distribution Feeder Protection & Control

Day 2
- Feeder Protection Calculations & Settings
- DER/DG Operation, Protection & Control
- Distribution Protection Hands-on Testing Lab Breakout Session

Day 3
- Transformer Protection (Based on IEEE C37.91)
- Transformer Protection Calculations & Settings

Day 4
- Distribution System Optimization: VVO/CVR

Hands-on Testing Lab Breakout Sessions: Review and practice skills required to work with Beckwith Electric Relays at Testing Lab Breakout Sessions for protection, distribution feeder protection, and transformer protection.

Hospitality & Demo Expo: Beckwith Electric and Special Guests will host a Hospitality & Demo Expo for a time of networking and information sharing including food and drinks. Meet with the experts and visit interactive product demonstrations.

Factory Tour & Product Demo at Beckwith Headquarters: Visit the Beckwith Electric factory for a behind-the-scenes look at our advanced manufacturing and services capabilities at work. Discover how we turn raw material into cutting-edge technology. Experience the Beckwith Electric commitment to quality, equipment reliability, testing procedures, new product development, and customer service. Talk to Beckwith Electric technical and product support staff and learn first-hand about our technology through live product demonstrations.

Earn 2.6 CEUs or 26 PDHs

Visit the seminar website for detailed course information, instructor bios, and schedule.

www.protectionseminar.com

Power Plant Protection Track | Monday

Generator Protection

Generators are subject to internal faults, external faults and abnormal operating conditions impressed by the turbine and excitation system issues, as well as power system events the generator has no control over but must cope with. False (nuisance) trips are costly as the generators output is lost. Inability to trip due to lack of sensitivity, lack of certain protections or deficiencies in protection application may cause severe damage to generators, resulting in prolonged outage and revenue loss, plus increased system instability risk. Achieving the ideal balance of secure and dependable protection involves use of an array of elements that protect the generator for all operating modes: off-line, start up, synchronizing, various levels of power output and when challenged by system faults and anomalies. Based on IEEE C37.102.

- Generator construction and operation
- Grounding and connections
- IEEE standards for generator protection
- Generator and power system interaction
- Generator protection element overview
    - Internal faults (in the generator zone)
    - Abnormal operating conditions
    - External faults
- Protection Application Exploration
    - Stator Ground Fault (27TN, 59N, 59D, 64S, 67N, 87GD)
        - Exploration of stator ground fault injection sensitivity and security
    - Rotor Ground Fault/Brush Lift Off (64F, 64S)
    - Stator Phase Fault (87G)
    - Turn-to-Turn Fault
    - Phase Unbalance/Open Conductor (46)
    - Overexcitation (24)
    - Abnormal Voltage (59)
    - Field Loss (40)
    - Loss of Synchronism (78)
    - Abnormal Frequency (81-U, 81A)
    - Inadvertent Energizing (50/27)
    - Blown VT Fuses (60FL)
    - Breaker Failure/Pole Flashover (50BF)
    - Loss of Prime Mover (32)
- Tripping considerations and sequential tripping
- Discuss tactics to improve reliability (security & dependability)
- Generator protection upgrade considerations
    - Lessons learned from NE Blackout (2003)
    - Redundancy concepts
- Explore Setting, Commissioning and Event Investigation Tools

Fault Fundamentals

- Fault Types
- Short-Circuit Calculations
- Calculations and Settings

Power Plant Protection Track | Tuesday

Generator Protection Calculations & Settings

Building on the base knowledge covered in Generator Protection Fundamentals, calculations for protective elements are developed. Depending on the element, these calculations use nameplate data, system data or a combination of the two. Margin considerations are explored and impacts on element reliability are discussed, as well as element interdependencies with protection and control in the generator zone, local power plant and system.

Power Plant Protection Track | Wednesday

Transformer Protection

Transformers are subject to internal faults, the effects of external faults and abnormal operating conditions impressed by the power system events the transformer no control over but must cope with. False (nuisance) trips are costly as the transformer and load are disconnected. Inability to trip due to lack of sensitivity, lack of certain protections or deficiencies in protection application may cause severe damage to transformers, negatively impact power quality and upset stability. Achieving the ideal balance of secure and dependable protection involves use of an array of elements that protect the transformer from prolonged internal faults, excessive through faults, when challenged by power system faults and anomalies. Based on IEEE C37.91.

- Why transformers fail & the cost of failures
- IEEE C37.91, Guide for Power Transformer Protection
- Common transformer, bus and breaker connections
- Explore non-electrical protections
    - Buccholtz (63)
    - Sudden pressure (63) - Sudden pressure relay supervision schemes
    - Thermal (49)
- Explore electrical protections
    - GIC events
    - Overcurrent based (50, 51, 50N, 51N, 46)
    - Through fault protection (TFM)
    - Overexcitation (24)
        - Generating plant and T&D system causes
    - Differential: high set (87HS), restrained (87T) and ground (87GD)
    - CT performance issues (saturation, remenance, X/R ratio)
        - Transformer protection challenges (phase shift, ratio difference, inrush, grounding)
        - Percentage differential characteristics
        - Restraints for inrush and Overexcitation
            - Adaptive restraint for security
- Realization of settings
- Tools to view relay operation
    - Commission examples

Transformer Protection Calculations & Settings - Differential Elements

Building on the base knowledge covered in Transformer Protection Fundamentals, calculations for protective elements are developed. Depending on the element, these calculations use nameplate data, system data or a combination of the two. Margin considerations are explored and impacts on element reliability are discussed, as well as element interdependencies with protection and control in the transformer zone, whether in generation, transmission or distribution.

Power Plant Protection Track | Thursday

Motor Bus Transfer (MBT)

Motor Bus Transfer is the process of rapidly transferring sources to a motor bus for planned source switching and unplanned source failure. The rapid transfer allows the process to continue without interruption. To avoid damage to the motors, specialized equipment and methods are employed to cope with the dynamics of motor deceleration, and voltage and phase angle change between the new source and the motor bus. Improper reconnection of the motor bus can cause cumulative or immediate damage to the motors, and result in a process crash.

- Why Transfer Motor Load Sources
- Basic Application Configurations
- Motor Bus Transfer Classification- Methods & Modes
    - Closed Transition Method- Hot Parallel Transfer
    - Open Transition Method- Fast, In-Phase, Residual w/Case Study
    - Open Transition Modes- Simultaneous, Sequential
- Transfer Initiate and Lockouts
- Load Shed During Transfer
- Conditions Across Normally Open Startup or Bus Tie Breaker – Before/During Transfer
    - Effects of a Fault
    - Out-of-Step (OOS) Generator Trip
    - System Separation between Transmission or Distribution Incoming Supply Sources
    - Supply Source Transformer Winding Phase Shift
    - Transient Effects upon Disconnect of Motor Loads
    - Motor, Load, and Inertia Characteristic Effects on MBT
- Resultant pu V/Hz Limits - ANSI Standard C50.41-2012
- Bus Transfer Spin Down Testing, Acceptance Testing, Setting Considerations
- Spin Down Analysis & Settings Calculations – Case Study
- Sequential vs. Simultaneous Transfer, The Need for Speed – Case Study
- Fast Transfer Sync Check Relay Performance Requirements
- Residual Voltage Transfer Relay Performance Requirements
- MBT Expanded Test Protocol - Performance Verification Test Results & Observations
- A New Motor Bus Transfer Torque Ratio Criterion
- Live Motor Bus Transfer Field Results
- A Motor Torque Ratio Metric for Assessing Motor Bus Transfer
- Observations & Conclusions

Automatic Synchronizing

Synchronizing is the process of taking two electrical systems and connecting them. This can be affected on a generator to a bus, or a tie between two bulk power systems. Proper synchronizing involves minimizing the phase angle, slip frequency and voltage difference between the two systems. Prior to synchronizing, the systems may have a static phase angle or rotating phase angle. The application of sync check and automatic synchronizing elements is explored and calculations developed. Synchronizing schemes are illustrated that improve security. Specialized control algorithms to properly adjust generator speed and voltage for proper synchronization are defined and graphically illustrated.

- Effects of Synchronizing Errors
- Synchronizing System Components and Elements
- Classical Synchronizing Scheme
- Manually-Supervised Automatic Synchronizing
- Fail-Safe Analysis and Schemes to Improve Security
- Testing Provisions
- Backup Path Philosophy
- System Restoration Scenario (Tie Line Syncing)
- Matching a Generator to the System Prior to Synchronizing
    - Conventional Method & Pulse-Width-Modulated Proportional Method
- Field Test Results

Distribution Protection & Control Track | Monday

Distribution Feeder Protection

- Distribution System Reliability
- Standards and Practices
- Protection Philosophies
- Causes of Faults
- Fault Types
- Distribution System Construction and Configurations
- Impedances Used in Fault Current Analysis
- Based on IEEE C37.230

Distribution Feeder Protection & Control

Distribution protection is a complex scenario with many elements: relayed feeder breakers, recloser controlled feeder breakers, line reclosers, sectionalizing switches, sectionalizers and fuses. The application and location of the protective and sectionalizing infrastructure predicates the application and coordination of protection. Compounding the complexity is the application of DMS/DA and presence of DER/DG. The session covers the distribution topology and protective infrastructure, and application of settable of relays and recloser controls.

Distribution Protection & Control Track | Tuesday

Feeder Protection Calculations & Settings

DER/DG Operation, Protection & Control

This technical session provides a background into DER operation and associated protection and control considerations for conventional and inverter-based power sources. We will review types of DER/DG and the modes in which they can operate in parallel with the distribution system. Key aspects of IEEE 1547 and a sample DER interconnection screening process are highlighted. Details of on-site standby power system conversion to operate in parallel with the distribution system are shown. Protection methodology at the point-of-common coupling (PCC) and point-of-interconnection (PI) is explored for all types of DER. A treatment of distribution system protection and control considerations and applications with DER is discussed, including addressing the impact of IEEE 1547A.

- Define Distributed Electrical Resource (DER)
- Explore Types of DERs
- Why DER?
- Utility and Facility Drivers for DER
- Mission Critical Power and Conversion to DER
- Rates and DER Operational Sequences
- Industry Concerns
- IEEE 1547: Industry DER Guide
- Sample Utility DER Interconnection Guide
- Interconnection Protection: “The Five Food Groups”
- Anti-islanding
- Powerflow
- Fault detection
- Abnormal operating conditions
- Reconnection
- Interconnection Transformer Impacts
- Generator Types and Impacts
- Synchronous
- Induction
- Asynchronous (Inverter Based)
- Example Protection Applications
- Distribution Protection Coordination Issues
- Directionalization
- Reclosing coordination
- Smart Grid / Microgrid and DER
- Impact of IEEE 1547A
- Fault ride-through
- Reactive support and voltage control
- System Control with DER
- LTC, Regulator and Capacitor Control Issues

Distribution Protection & Control Track | Wednesday

Transformer Protection

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Distribution Protection & Control Track | Thursday

Distribution System Optimization: VVO/CVR

- Volt-var control (VVC), Volt-var optimization (VVO), Conservation Voltage Reduction (CVR)
- Allowable voltage ranges
- Equipment and devices used in Volt-var control LTC, voltage regulator and capacitor controls
- Volt-var Control Technologies and tradeoffs
- Cost-Benefit Analysis of VVO
- Verification, Assessment and Monitoring Requirements for CVR

Sandpearl Resort

500 Mandalay Avenue
Clearwater Beach, FL 33767

The Protection & Control Seminar will be held at the Sandpearl Resort in Clearwater Beach, Florida. Surrounded by the powder white sand and crystal blue waters of Clearwater Beach, the AAA Four-Diamond Sandpearl Resort blends the natural beauty of Florida's Gulf Coast with premium comforts and warm, personalized service. From the coastal-inspired décor in our guest rooms and suites to Clearwater Beach's only Four-Diamond restaurant (Caretta on the Gulf), you'll find signature amenities around every corner and relaxation reflected in every detail.

The sparkling Gulf of Mexico waters, the sugar-white sands and awe-inspiring views share space with delightful resort amenities and warm, welcoming staff. Reflecting an elegant island style, the atmosphere embodies a "British Colonial meets Tommy Bahama" feel...elegant, yet always comfortable. Open and airy guestrooms, a lagoon-style beachfront pool, fine and casual dining options, a full-service spa, exclusive children's activity programs, and the attractions, restaurants and shops of nearby Pier 60 and downtown Clearwater are just a few of the many highlights that await!

www.sandpearl.com

WHAT IS IT?

This intensive four-day seminar will provide the background you need to understand the complex subjects of generator, transformer, feeder and distributed electrical resource protection, as well as motor bus transfer and synchronizing. The seminar is divided into two program tracks, Power Plant Protection and Distribution Protection & Control, to help you find the educational programs of most interest and value for you.

WHO SHOULD ATTEND?

The Protection & Control Seminar is designed for engineers and technicians at utilities, consultancies, integrators, packagers, and OEMs, as well as others who design, engineer and develop settings for protective relay and automation control systems. Relay technicians, and those responsible for testing and commissioning Beckwith protective relay systems are also encouraged to attend our Testing Lab Breakout Sessions.

WHERE IS IT?

The Protection & Control Seminar, daily breakfast and lunch, and Tuesday night hospitality, will be held in Clearwater Beach, Florida at the Sandpearl Resort. The resort overlooks the picturesque Gulf of Mexico and sits on 700 feet of white sandy beachfront.

ACCOMMODATIONS

Sandpearl Resort
500 Mandalay Avenue, Clearwater Beach, FL 33767

Participants must make their own hotel room reservations by Tuesday, July 3, 2018 at 5 p.m. ET. Special Room Rate: $175.00 for single or double rooms. Hotel room rates are subject to applicable state and local taxes.

For easy hotel reservations call 877-726-3111 or 727-674-4111 and mention code "Beckwith Electric."

TRANSPORTATION

Sandpearl Resort is convenient to the services of Tampa International Airport (TPA) and St. Petersburg-Clearwater International Airport (PIE). Ground transportation from all airports to Sandpearl is available via limousine, shuttle van, bus charter, taxi, sedan service and car rental. Executive car-and-driver service is available at the resort as well, with limousines, sedans and vans on-call. Recommended transportation is available through Super Shuttle (800-258-3826). Hotel parking is available on a per car, per night charge: Valet-$25.00

REGISTRATION INFO

$1,350 per person by Friday, June 29, 2018.
12% group discount for 2+ attendees from the same company. Includes all course materials, breakfast and lunch, morning and afternoon breaks, and Tuesday night hospitality. Substitute attendees are welcome at no additional charge with prior notice.

REGISTER

Online at www.protectionseminar.com
Or call Beckwith Electric at (727) 544-2326 and ask for the Seminar Administrator.