



## **GENERATION CONTROLS:**

### **Compliance with Generator Regulatory Technical Requirements**

Kestrel Power Engineering is offering an open enrollment course on Generation Controls at several locations across North America in 2009. Please see our website at [www.kestrelpower.com/training.htm](http://www.kestrelpower.com/training.htm) for dates in your area. The course is designed for engineers and technicians and will cover the theory and practical aspects of testing, modeling and operation of generators, excitation systems, power system stabilizers and turbine governors with a focus on NERC and Regional regulatory compliance standards.

#### **Background**

The various organizations that oversee electricity reliability in North America have been in existence for decades with oversight provided by the North-American Electric Reliability Corporation (NERC). NERC's mission is to ensure that the bulk electric system in North America is reliable, adequate and secure. In 1997, NERC developed a set of Operating and Planning standards for use throughout the North American industry (NERC Planning Standards, Part II System Modeling Data Requirements, approved by Board of Trustees, September 16, 1997). These Planning Standards included rules for the routine verification of generating unit performance and mathematical models.

The US Energy Policy Act of August 2005 contains provisions that made compliance with NERC standards mandatory and enforceable. The technical standards that are the topic of this short training program are the following:

MOD-025 Verification of Generator Gross and Net Reactive Power Capability

MOD-026 Verifications of Models and Data for Generator Excitation  
System Functions

MOD-027 Verification of Generator Unit Frequency Response  
(Governor Controls)

PRC-019 Coordination of Generator Voltage Regulator Controls with  
Unit Capabilities and Protection

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## Course Description

The Generation Controls course is designed to instruct plant engineers and technicians on the core concepts of utility generators and associated control systems with a goal of familiarizing technical utility staff with the requirements of the latest NERC regulations and to help them identify their role in meeting these requirements within their organization. The material is tailored to cover the specific systems, configurations and operating scenarios associated with the attendees. Each requirement will be reviewed using the following approach:

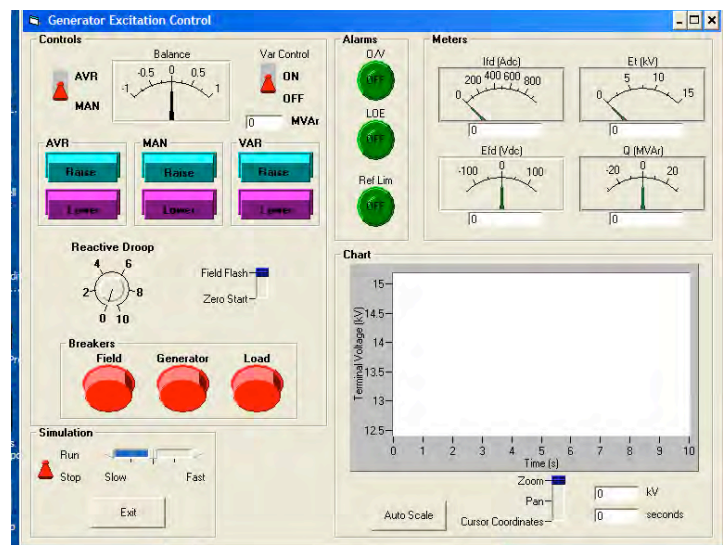
- Review technical background material necessary to understand the topic and provide references for further study

- Review latest version of the applicable standard along with regional interpretations of the requirements

- Discuss methods of meeting technical requirements.

- Perform sample calculations, exercises and simulations illustrating the technical issues and test methods.

The course provides classroom based instruction and utilizes a comprehensive computer based course manual along with a generator controls simulation software package. This software package allows each attendee to perform interactive simulation exercises that are related to various course topics, such as: Generator Reactive Capability, Generator Voltage Control, Auto Voltage Regulator Tuning, Power System Stabilizer Operation and others. The simulations utilize accurate generator and control system models and allow the user to adjust settings, alter system configurations and control operation while viewing the simulated response on graphs and meters. The interactive simulations are an excellent means of better understanding the practical application of the course material.



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## Course Outline

### Module 1: Reactive Power Capability

#### Review of Basic Power System Concepts

- Basic concepts governing synchronously operating power systems
- The power system and control
- Power transfer in ac systems

#### Synchronous Generators

- Energy conversion and the synchronous generator - generator terminal characteristics
- Off-line and on-line operation
- Reactive capability

#### MOD-025 Confirmation of Reactive Capability

- Alternative methods (testing versus operating) voltage versus reactive limitations documentation requirements

### Module 2: Excitation System Performance and Modeling

#### Excitation System Design

- Excitation requirements imposed by the generator and by the power system
- Common designs: bus-fed static, rotating dc systems, rotating ac systems
- Automatic voltage regulation (AVR)
- Reactive current compensation

#### Power System Stability and Stabilizers

- Effect of excitation system on stability
- Oscillatory stability of synchronous machines
- Functional design of common stabilizers

#### MOD-026 Confirmation of Excitation Models and Performance

- Alternative methods manufacturer's data, testing, disturbance recording)
- Test instrumentation and procedures
- Documentation requirements

### Module 3: Coordination of Protection, Limiters with Generator Capability

#### Generator Capability

- Overvoltage and V/Hz capability
- Limited time field winding limits
- Under-excited limitations

#### Excitation Limiters

- Over-excitation limiters
- Under-excitation limiters

#### Generator Protective Relays

- Multi-function digital versus discrete relays
- Fault versus overload relays

#### PRC-019 Confirmation of Excitation Models and Performance

- Excitation limiters and relation to generator and system capability
- Coordinating excitation limiters and protective relays
- Test and documentation requirements

### Module 4: Verification of Generator Unit Frequency Response (Governor Controls)

#### Prime Movers

- Common elements of utility prime movers
- Steam, gas, hydraulic and wind turbines

#### Frequency Control and Governors

- Speed governing of utility generation
- Design of conventional mechanical-hydraulic governors
- Design of electro-hydraulic governors
- Permanent droop and deadband
- Automatic generation control

#### MOD-027 Verification of Unit Frequency Response

- Methods of confirming frequency response (disturbance recording, staged tests)
- Models of turbine governors
- Documentation requirements

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## Course Information

|                     |  |
|---------------------|--|
| Date                | February 3–6, 2009   |
| Time                | T–W–TH<br>8:00–17:00   |
| Location            | Hilton Marco Island<br>Beach Resort & Spa  |
| Includes            | Computer Based Instruction Manual<br>Simulation Software Package<br>Refreshments                   |
| Does Not<br>Include | Travel, Lodging and Meals<br>Laptop Computer<br>Attendees are asked to bring<br>a laptop computer. |

## To Register

|                        |  |
|------------------------|--|
| Contact                | Mike Fogarty   |
| Phone                  | (815) 846–1278   |
| Email                  | mike@kestrelpower.com  |
| Fee                    | \$1595 per person  |
| Cancellation<br>Policy | Kestrel reserves the right<br>to cancel the course and<br>notify attendees 30 days<br>in advance of the<br>scheduled start date.<br><br>Kestrel is not responsible<br>for any non-refundable<br>travel expenses. |

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