FOSSIL CONSULTING SERVICES, INC
6325 WOODSIDE COURT, SUITE 350, COLUMBIA, MD 21046
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NERC-APPROVED! REACTIVE POWER & VOLTAGE CONTROL (FCS_123_RPV_103)

Fossil Consulting Services, Inc. is proud to offer the NERC-Certified Approved Reactive Power & Voltage Control Training Course. Course participants will receive top-notch training by credentialed instructors with 20+ years of experience in power plant and power system operations and training.

It's a fact: Operators with inadequate training can hurt your bottom line and lead to possible violations of control area agreements. NERC standards emphasize the importance of monitoring, controlling, and maintaining within limits in real time all voltage levels, reactive power flows, and reactive resources. This helps to ensure reliable operation of the interconnection.

This 2-day course is designed to improve the knowledge of Plant Operators and Power System Operators about the balance of reactive power (MVAR) sources and loads and the impact of this MVAR balance on maintaining system voltage. A complete understanding is necessary in order to understand the system's daily MVAR load curve and to anticipate the need to put voltage control equipment into and out of service in order to ensure target voltages are always maintained.

This course ensures that the participants understand and can fulfill the requirements of NERC Standard VAR-001-1, Voltage and Reactive Control, as well as Appendix 1, Interpretation of Requirement 4 of VAR-001-1. A quiz is administered at the conclusion of the course to verify that trainees learned the material in the course

This course ensures that trained operators will be able to respond appropriately, and with proper anticipation, to daily changes in the MVAR balance and be able to react correctly in placing additional MVAR sources in service, or removing excess MVAR sources. For Power Plant Operators, this is mostly limited to adjusting the excitation of the generators. For Power System Operators, this includes generator dispatching, as well as capacitors, reactors, synchronous condensers, transformer tap changers, etc.

After completion of this course, trainees will understand the purpose, configuration, limitations, and operational characteristics of the various reactive power devices at their disposal and for which they are responsible. More training, more knowledge, less chance of costly mistakes -- now that's something worth investing in!

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THE FCS DIFFERENCE

What makes our programs superior to other training programs on the market? FCS experts will visit YOUR facility and examine YOUR plant documentation to customize a SITE-SPECIFIC course that fits YOUR needs. We go one step further than generic training courses; course participants will not only learn conceptual knowledge, they will learn the specifics of how to put those concepts into practice at YOUR facility.

Already have a training program in place? Great! We can improve your existing program to ensure that trainees learn the materials faster and better. FCS-produced, plant-specific courses are more effective than generic courses and provide a greater Return On Investment (ROI) than generic materials alone.

WHAT OUT CLIENTS SAY ABOUT US:

"The staff provided by FCS were professional trainers and engineers, whose technical experience and training capabilities resulted in a maximum amount of technology transfer to (our) plant operators."

- Plant-specific custom training for an overseas Power Plant

"Thanks to FCS' effective training, our employee knew exactly what to do during our emergency situation, and his quick actions prevented forced outage!"

- Plant-specific simulator training for a major Mid-West U.S. plant

NERC APPROVAL

This Reactive Power & Voltage Control Training Course (FCS_123_RPV_103) is recognized by the North American Electric Reliability Corporation as an approved learning activity for which NERC CE Hours can be awarded, and that the provider adheres to NERC CE Program Criteria.

This course fulfills a total of 16.0 CE hours, 1.5 hours of Standards, and 1.0 hour of Simulation.

Contact Scott Hommel, at (410) 312-6240 or shommel@fossilconsulting.com for information regarding technical content and pricing

COURSE OBJECTIVES:

- List and describe NERC standards relating to voltage and reactive control.
- Define megavolt-ampere reactive power.
- Define inductance and capacitance and state the relationship of inductance and capacitance to reactive power sources and loads.
- List the types of reactive sources and loads on the power system and describe how reactive power sources support voltage and how reactive loads lower voltage.
- State the relationship between MVAR flow and voltage and determine low voltage areas from MVAR flows.
- Explain how the MVAR load curve changes throughout the day and describe a typical daily MVAR load curve.
- Show how MVAR sources (system capacitance, generators, capacitors, and reactors) are adjusted through the day to match MVAR load.
- List common causes of voltage deviations and describe the effects that voltage deviations have on the power system.
- Define a voltage limit and describe the high and low voltage limits for 500kV, 230kV, and 115kV transmission facilities.
- Describe the effects on system voltages of switching reactors and capacitors.
- Describe the capabilities and limitations of generating units with respect to controlling reactive power and voltages.
- Describe the effects on system voltages of changing transformer tap positions.
- Describe how switching high voltage transmission lines is used to control reactive power and voltages.
- Briefly explain how inductive and capacitive elements on the power system effect both reactive power flow and voltage.
- State and explain the elements of the MVAR flow equation and explain what is meant by "reactive (MVAR) flow downhill on voltage."
- Given voltages on adjacent buses, determine the MVAR flows.
- Describe a typical daily MVAR load curve.
- Describe control actions for low and high voltage situations.

COURSE OUTLINE:

- NERC Standards Addressing Reactive Power and Voltage Control
  - Standard VAR-001-1 – Voltage and Reactive Control
  - Appendix 1 – Interpretation of Requirement 4
- Basic Reactive Power Concepts
  - Reactive Power
    - Overview of Reactive Power
    - Power Relationships
    - Power Triangle
    - Reactive power
  - Inductance and Capacitance Overview
    - Capacitance
    - Inductance
    - Capacitance vs. Inductance
    - Inductance and Capacitance as Elements of Reactive Power
    - Resistance, Inductance, and Capacitance on a Three-Phase Line
    - Surge Impedance Loading

- Reactive Power Flow
  - Components of a Transmission Line
    - Effects of Current Flowing Through a Transmission Line
    - Reactive Losses/Gains on Transmission Lines
    - Reactive and Real Power Capacity
  - Reactive Sources and Loads
    - MVAR Sources
    - MVAR Loads
    - Reactive Power and Voltage
  - Reactive Power Flow and Voltage
    - Overview
    - Reactive Power Courses and Loads
    - Determining MVAR Flow
    - Reactive Power Flow Limitations
    - Reactive Power Flow Equation
    - Using the Reactive Power Flow Equation
- Voltage Control
  - Causes of Low Voltage
  - Causes of High Voltage
    - Long Term High Voltages
    - Short Term High Voltages
  - Effects of Voltage Deviations
    - Effects of Voltage Deviations on Transformers
    - Effects of Voltage Deviations on Transmission Lines
    - Effects of Voltage Deviations on System Stability Margins
    - Effects of Voltage Deviations on Customer Load
  - Voltage Limits
    - Definition of Voltage Limits
    - Purpose of Voltage Limits
  - Use of Voltage Control Equipment
    - Capacitors
    - Reactors
    - Role of Generators in Reactive Power Control
    - Generator Capability Limits
    - Coordination of Generators to Avoid VAR Circulation
    - Cost Associated with VAR Generation
    - Transformer Tap Changing
    - Voltage Regulators
    - Switching High Voltage Transmission Lines
    - Synchronous Condensers
- Daily MVAR Load Balancing
  - MVAR Load Curve
    - MVAR Load Curve Characteristics
  - Matching MVAR Sources to MVAR Load
    - Meeting the MVAR Demand
    - Goals of a MVAR Management Program
    - System Voltage Control Throughout a Day
    - Anticipating High Load – Low Voltage Problems
    - Control Actions for Low Voltage Problems
    - Anticipating Low Load – High Voltage Problems
    - Control Actions for High Voltage Problems