PROGRAM
REGULATOR, OCR AND CAPACITOR SCHOOL
AMEC Training Center, Jefferson City, Missouri
April 28-30, 2025

PRESENTED BY:
Fletcher-Reinhardt Company
Fletcher-Reinhardt Service Company
Kevin Reinhardt, Brian Hunter, and Alyx Hedgpeth

Monday, April 28, 2025

12:30 P.M. **REGISTRATION**

1:00 P.M. **WELCOME - AMEC Staff**

CAPACITORS

1:15 P.M. **CAPACITORS**

Inductive Load Using Motor Working & Magnetizing Current

- Shunt Capacitors
- Demo Board for Capacitors and Load Changes
- Chart effect of different load combinations

Safe Operation of Power Capacitors

- Testing of Power Capacitors - **REFUSING IS NOT A SAFE TEST**
- Fuse Sizing
- Discharge before handling or testing
- Load Break Device to De-Energize
  - Arc Snuffers
  - Load Buster Tool
  - Oil Switches
- Proper Inspection

2:45 P.M. **REFRESHMENT BREAK**

Discuss Fixed and Switched Banks

- Minimum and Maximum Loading on Circuit or Sub
- Interruption of Capacitor Current

Controlling Methods

- Time
- Voltage
- Temperature
- Current
- KVAR / Power-Factor

Microprocessor-based controls

4:15 P.M. **CAPACITOR TEST**

4:30 P.M. **ADJOURN**

Tuesday, April 29, 2025

VOLTAGE REGULATORS

8:00 A.M. **VOLTAGE REGULATORS**

Regulator Basics

- What is a Regulator?
- Transformer Demonstration
- Lift lugs
- By-pass Arrester (internal and external)
- Oil sight glass
- Serial Number Plates
- A/C Siemens free-breathing design

Discuss Need For Voltage Regulation And Load Reduction

- Varying Voltage due to Source
- Voltage Regulation due to Loading
- Conductor Impedance (Induction and Resistance)
- Power Factor Load
- Reduce Conductor Impedance
- Shorter Circuits (More Substations)
- Larger Conductors
- Control Load Power Factor
- Determined By MFG and Loading

Basic Transformer theory

- Polarity
- Boost and Buck

Regulator Transformer Basics

- Regulator Windings
- Tap Changer
- Reversing Switch
- Reactor Transformer (voltage divider)
- Motor Capacitor
- Straight and Inverted Designs (important in new controls)

Control Basics

- Auto/Manual Switch
- Raise/Lower Switch
- Neutral Light
- Voltage Bandwidth
- Position Indicator and limit switches
- Motor Capacitor (internal and external)
- Load-Bonus/Add-Amp (increase regulator rating)
- Time Delay / Time Coordination between regulators.
- Reverse Feed
- Current Circuit
- Voltage Circuits (both load and source side)

9:30 A.M. **REFRESHMENT BREAK**

Methods of Finding Neutral Position

- Control Indication
- Position Indicator
- Hastings Device
- General Discussions

Installing and Removing Regulators from Service

- Testing Prior To Installation
  - External Power Connections with 120 VAC
  - Grounding
  - Fuse Protection
  - Voltage Level
  - Bandwidth
  - Time Delay
  - Oil Level
- **Switching into Circuit**
  - Neutral Position Check
  - Blocking Automatic Operation
  - Switching Procedure
  - Recording Information
- **Switching out of Circuit**
  - Neutral Position Check
  - Blocking Automatic Operation
  - Switching Procedure
  - Recording Information

Field Inspection of Regulators in Service

- Visual Inspection
- Manual Operation
- Automatic Operation
- Recording Information

12:00 P.M. **GROUP LUNCH**

Control Settings

- Manufacturers covered
  - GE controls
  - Siemens / A/C IJ-2, MJ-3A, MJ-XL
  - Cooper CL series controls
- Settings
  - Voltage
  - Bandwidth
  - Time Delay
  - Resistance and Reactance
  - Effect of Power Capacitors on Regulators
  - Reverse Power Flow
  - Voltage Limit

Control Change-out

- McGraw Edison/Cooper
- Siemens / Allis-Chalmers

3:00 P.M. **REGULATOR TEST**

RECLOSERS

3:30 P.M. **RECLOSERS**

Discussion on Overcurrent Detection and Protection

- Maintenance
- Type of Faults
- Permanent
- Temporary
- Automatic Reclosing
- Recloser / Fuse Coordination

4:30 P.M. **ADJOURN**

Wednesday, April 30, 2025

8:00 A.M. **RECLOSERS – CONTINUED**

Fault Detection and Protection

- Permanent Faults
- Fuses
- Temporary Faults
- Reclosing

Oil Circuit Reclosers (OCRs)

- Type Of Interruption
  - Oil
  - Vacuum
  - SF-6
- Timing
- Hydraulic
- Electronic
- Digital
- Sequencing

Coordination

- Recloser / Fuse
- Recloser / Recloser
- Sequence Coordination

Three-Phase Reclosers

- Hydraulic
- Electronic
- Ground Protection
- Triple-Single

Three-Phase Recloser Controls

- Features
- Settings
- Comparison Of Cooper Controls
  - Form 3A
  - Form 4C
  - Form 4D (3-Phase Only)
  - Form 5 (3-Phase And Triple-Single)
  - Form 6 (3-Phase And Triple-Single)
  - SPEAR (Single Phase)
  - Form 7 (Triple Single NXT)

11:45 A.M. **RECLOSERS TEST**

12:00 P.M. **ADJOURN**