Hands-On

Substation Maintenance and Testing

Course Description

This Hands-On course will cover the maintenance and testing requirements for common substation devices, including power transformers, oil, air and vacuum circuit breakers, switchgear, ground grid systems, batteries, chargers and insulating liquids. This course focuses on what to do, when to do it and how to interpret the results from testing and maintenance.

Substation maintenance is a key part of any plant's maintenance program. Failures in key components such as racking mechanisms, meters, relays and busses are the most common cause of unplanned outages. Transmission, distribution and switching substations generally have switching, protection and control equipment and one or more transformers. Having skilled substation maintenance technicians is essential to equipment reliability.

This course focuses on maintenance and testing of switchgear, circuit breakers, batteries and protective relays, and more...

Students Will Learn

- **Substation Types, Applications, Components and Safety Procedures**
- **Medium-Voltage Circuit Breaker Maintenance and Testing Methods**
- **Perform Insulation Resistance, Contact Resistance on Air, Oil and Vacuum Breakers, and Tank Loss Index On Oil Circuit Breaker and Vacuum Bottle Integrity Tests on Vacuum Breaker**
- **Switchgear Arrangement, Torque Requirements, Insulation Systems and Maintenance Intervals**
- **Perform Switchgear Inspection and Maintenance In Lab**
- **Battery Types, Applications, Systems and Components**
- **Perform Battery Maintenance and Testing In Lab**
- **Substation Types, Applications, Components and Safety**
- **Procedures**
- **Air and Disconnect Switch Fundamentals, Maintenance and**
- **Testing Methods**
- **Perform Air Disconnect Maintenance and Testing In Lab**
- **Ground Testing Fundamentals, Maintenance and Testing**
- **Methods**
- **Perform Ground Resistance Testing in Lab**
- **Transformer Fundamentals, Maintenance and Testing Methods**

- **Perform Insulation Resistance, Transformer Turns Ratio (TTR),**
- **Power/Dissipation Factor, Core Excitation, Winding Resistance**
- **and A Wide Range of Insulating Liquid Tests in Lab**
- **And More...**

Target Audience

Designed for apprentices, technicians and engineers that are responsible for the maintenance and testing of industrial and utility substations.

Prerequisites

Requires working knowledge of AC/DC theory. Students must wear safety toe shoes. Field experience beneficial but not required.

Course Outline

Module I. Introduction

a. Student introductions
b. Pre-Test
c. Safety

Module II. The Substation As A System

d. Application
e. Common problems
f. Ratings

Module III. Circuit Breaker Maintenance

g. Maintenance frequencies
h. Inspection
i. Testing
j. Interpreting test results
k. Devices covered
- Air circuit breakers
- Vacuum circuit breakers
- Oil circuit breakers

Module IV. Insulating Liquids

o. Sampling
- Routine tests

- Dissolved-Gas Analysis (DGA)

r. Testing
- Color
- Dielectric breakdown voltage
- Interfacial tension
- Neutralization number
- Moisture
- Visual

y. Dissolved-Gas Analysis (DGA)
`. Interpreting test results

Module V. Transformers

a. Types
b. Inspection
c. Testing
- Insulation resistance
- Winding resistance
- Power factor tests
- Coree excitation curren
- Turns ratio (TTR)
- Gas blanket tests

Module VI. Lightning Arrestors

j. Types
k. Inspection
l. Maintenance
m. Testing

Module VII. Protective Relays

n. Application
o. Instrument transformers
p. Inspection
q. Testing
r. Calibration
- Devices covered
- Voltage
- Transformer differential

Module VIII. Ground Grid Systems

v. Purpose
w. Grounding theory
x. Types of test equipment
y. Inpsection
`. Testing

Module IX. Batteries and Chargers

a. Types of station batteries
b. Battery systems
c. Maintenance
d. Inspection
e. Testing

Delivery Method

Instructor-Led with numerous Hands-On labs and exercises.

Equipment Requirements

(This apply's to our hands-on courses only)

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

Course Length

4 Days