PRINCIPLES OF TRANSFORMER MAINTENANCE

Date:
Tuesday & Wednesday,
December 1 & 2, 2009

Time:
9 am–4:30 pm, 8 am–3:30 pm

Location:
Delta-Montrose Electric Assn.
11925 6300 Road, Montrose

Instructor:
S.D. Myers, Inc.

Fee:
$710 16 – 19 students
$575 20 – 24 students
$465 for 25 or more students
Participants will be billed after the course

To Register:
Contact Liz Fiddes at
(303) 455-2700 ext. 103 or
liz@coloradorea.org

Registration Deadline: October 26, 2009

Confirmation:
A minimum of 16 people must be registered for the course to be held. A letter will be faxed to all participants confirming their registration in the course.

READ THIS STRICT CANCELLATION POLICY:
Cancellations received on or before the registration deadline will not be charged.
Cancellations received after the deadline will be charged the full registration fee if attendance drops below 16 participants.
Name changes can be made.

COURSE DESCRIPTION

We are under great pressure to reduce the life-cycle costs of our equipment, especially our transformers. This basic introductory seminar will provide the necessary background education for attendees who are new to the field of transformer maintenance. Introductory concepts are presented to provide both an elementary level of understanding concerning transformers and their maintenance and to provide prerequisite background for later, more advanced seminars.

Course Objectives:

1. Provide a better understanding of how electric power is generated, transmitted, and distributed. Why are transformers necessary? How are they used?

2. Provide a better understanding of how transformers are constructed. What are the materials of construction? How are transformers put together?

3. Provide a better understanding concerning solid insulation and insulating liquid. What do paper and oil do in a transformer? How do paper and oil age in a transformer? How does this aging affect the life expectancy of the transformer? How do insulation aging and other conditions result in failure modes?

4. Provide a better understanding of how we evaluate the condition of the oil and the solid insulation. How is the aging of the oil monitored? How is the operation of the transformer evaluated? How is the aging of the solid insulation monitored and evaluated?

5. Provide a better understanding of how to use these concepts to put together a maintenance program to extend the life of transformers. What maintenance tasks and more extensive testing can be performed? How to decide when to perform these tasks?

Topics to Meet These Objectives:

1. Basic physics of alternating current. V = IR. How electric power is generated. How current is induced by the core and conductors in a transformer. Volts/current/turns relationship. Why different voltages are necessary for generation, transmission, distribution, and use. Basics of electrical distribution, concentrating on role of transformers, mentioning other components and their use.

2. Brief history of transformers and the war of the currents. Development of the core to its current form. Brief introduction to core and winding configurations. Core steel and core losses. Conductor and conductor losses. Insulating materials. Introduction to mechanical forces and insulation mechanical strength. Introduction to standards organizations.

3. Functions of the solid insulation. Cellulose molecule, tensile strength, and degree of polymerization. Breakdown/aging mechanism for solid insulation. Conditions that accelerate this breakdown and aging of solid insulation. Functions of the insulating liquid. Oil molecular structures. Oil aging and oxidation. Conditions that accelerate oil oxidation. Effects of oil oxidation on the aging of the solid insulation. Effects of insulation aging on reliability. Introduction to imminent failure modes – high moisture, dielectric failure, fault conditions such as arcing/sparking and severe hot spot overheating.

4. Oil testing. Why we test. Introduce testing standards. Descriptions, purpose, and AC/QU/UN values for each of these tests, in order: Liquid power factor, oxidation inhibitor, acid number, IFT, color, appearance, and specific gravity, dielectric breakdown strength (D877 and D1816). Discussion of moisture in oil, moisture calculations, what's important. Much reduced discussion of dissolved gas analysis – what gases are formed by which faults, how we arrive at a recommendation, what the recommendations mean. Furans analysis – same idea of a reduced discussion. Furans /DP calculation. Brief mentions of other special testing – dissolved metals, PCBs, particle count, particles analysis, corrosive sulfur.

5. Review AC/QU/UN service recommendations table. Discuss oil reclaiming/hot oil cleaning. Discuss reinhibiting. Discuss MaxLife HOC and reinhibiting maintenance strategies. Moisture reduction. Introduce field electrical testing; particularly as it is used to further diagnose potential maintenance needs suggested by abnormal oil testing results.

NOTE: The registration fee for this course has been reduced thanks to a donation from the Colorado Rural Electric Operations Group and the Colorado Electric Educational Institute.