

## Electrical Metering Program Outline

### // Unit 1 – Basic Mathematics & Electricity

- Electrical System Components
- The Distribution System
- Basic Math
- Electrical Circuits
- Trigonometry & Vectors

### // Unit 2 – Fundamentals of Alternating Current

- Alternating Current and Circuits Containing Resistance
- Inductance in Alternating Current Circuits and Resistance and Impedance in Series Circuits
- Capacitors are not only fun, they're Important Too!
- Series Circuits: Resistance, Inductive Reactance, and Capacitive Reactance
- AC Parallel Circuits and Series-Parallel Circuits
- AC Instruments and Meters
- AC Instruments and Meters
- Alternating Current Generators
- Transformers
- Transformer Connections and Special Applications

### // Unit 3 – Electric Metering

- Introduction to Substation Metering
- Working Safely in the substation Environment
- Electronics, Logic and Microprocessors
- Review of Power Circuit Calculations
- Data Acquisition and Power System Controls
- Instruments and Instrument Transformers
- Substation Switchboard Meters
- Demand Metering
- Meter Installations and Applications
- Meter Testing and Maintenance

## // Course Outline – TVPPA Metering Lab A

TVPPA's Meter Lab A covers a variety of concepts pertinent to the meter field. Some of the content included in the A lab includes:

- Basic electrical theory
- Metering math and practical uses
- Understanding metering equipment including CTs, PTs, Test switches, meters and more
- Safety in meter work
- Meter site inspections
- Vector Diagrams
- Revenue protection
- Troubleshooting skills
- Misc. metering related topics

Meter Lab A starts with the basic concepts of electricity. The basic concepts of electricity are essential in understanding our electrical system and how to meter it. The loads we can expect on the systems and what characteristics we can expect those loads to exhibit.

Meter Lab A is also heavily weighted in meter math and understanding formulas. Math is a perishable skill and meter math is no different.

Safety in metering is a focal point of lab A and discussed at length. The equipment used to meter customer loads takes center stage early in the week as we start breaking the group down into smaller teams to collectively work through various metering situations.

While investigating metering equipment, we do a deep dive into the equipment that provides the measurements. These include current transformers, potential transformers, and the meters themselves. During these investigations, we look at how they work, comparison measuring methods, troubleshooting, and common industry mistakes. Test switches are also an item of focus due to their complexity and maintenance /inspection needs.

As we tie up the equipment portion of the lab, we start to introduce vector diagram. Vector diagrams as found on test equipment and in meter software can play a pivotal role in diagnosing and catching problems.

Meter site inspections and testing procedures are also an important part of the lab. During this portion, we introduce a few of the more commonly used meter forms and tie them back to our discussion on vector diagrams. Meter software and test equipment are often valuable tools in diagnosing metering issues in the field.

As we close our week together the groups will pull from the skills they have learned to trouble shoot and diagnose various metering issues. TVPPA's meter Lab A is not a sit and listen lab. Various hands-on activities, worksheets, and group activities break up the week's lecture portions and help to re-enforce the presentation topics.

Required/Suggested PPE include: low voltage gloves, clear safety glasses and a digital multimeter if possible.

## // Course Outline – TVPPA Metering Lab B

TVPPA's Meter Lab B starts with a short review of the basic concepts of electricity. Those concepts play an essential role in understanding our electrical system and how to meter it. We also do a quick refresher of common math used in metering.

In the Meter Lab B, some of the math focuses on CT sizing and an introduction to vector addition. All of the math is covered with handouts and worksheets to aid in understanding and retention.

High-bill investigations and techniques are covered as needed, depending on the participants. Other items covered in the B lab include load estimation, common electrical equipment, usage costs, etc.

Meter Lab B is designed to quickly cover many of the concepts introduced in Lab A and transition into more complex metering situations. Ample time will be spent exploring meter forms and uses.

During this portion of the Lab, we will also discuss common mistakes of metering and demonstrate some of them during one of several hands-on activities. We will demonstrate and discuss meter installation safety and voltage checks to promote safe work practices in metering. Advanced meter testing and troubleshooting is a large part of Meter Lab B.

During the testing and troubleshooting portion of this lab we will look at some of the more confusing vector diagrams. Meter site inspections and procedures are also an important part of the lab as they go hand in hand with testing and safety.

TVPPA's meter lab B is not a sit-and-listen-to lab. Various hands-on activities, worksheets, and group activities break up the week's lecture portions and help to reinforce the presentation topics.

We recommend attendance of Meter Lab A prior to attending this Lab to maximize the learning potential of the program. The topics covered in depth in Lab A are the building blocks Lab B stands on.

Required/Suggested PPE include: low voltage gloves, clear safety glasses and a digital multimeter if possible.