



Presenter

Michael L. Terbrueggen,
CEO, O-T-S

Mike Terbrueggen was born in Grosse Pointe, Michigan in 1954. He graduated from De La Salle High School in 1972. Upon graduation in 1972 he entered the U.S. Army and was stationed in Colorado Springs, Colorado. He was in the 4th Infantry with the 4th Combat Engineers. He has two daughters, one son, two grandsons, and two granddaughters and lives in Longmont, Colorado where, in his spare time, enjoys golfing and hiking.

Mike's undergraduate degree is from Michigan and is in Electronics Engineering. His graduate degree is from University of Colorado and is in Power Engineering.

Mike formed Operations-Training-Solutions in 1994, is the CEO and Principal Engineer, and designs, develops, and delivers advanced training seminars, develops training programs and materials, and provides consulting services for power operations and engineering personnel.

2017 System Fundamentals

Power System Protection for System Operators is a class that describes and illustrates the fundamentals of power system protection and examines the types of protection used to protect transmission, generation, transformer, substation buses, and describes those protection systems used to maintain stability, voltage and frequency.

33 Operating Topics, 22 Standards, 33 EOP



This course is designed by

Mike to provide Operations

**Personnel with an understanding
of power system protection.**

2017 Power System Protection for Operations Personnel

Otter Tail Power Company
is proud to host the

**Power System Protection
for Operations Personnel
February 13 - 16, 2017
Bigwood Event Center
Fergus Falls, Minnesota**



Primary Business Address
215 South Cascade Street
Fergus Falls, MN 56537

Phone: 218-739-8264
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E-mail: tsmith@otpc.com



Course Schedule:

Monday, February 13

- 0800-1700 Power System Protection (Mike T.)
 - Overview of the NERC PRC family of reliability standards
 - Review of the IEEE relay definition
 - What are the goals of protective relaying?
 - Review of relay types
 - Overview of the zones of protection
- Overview of the following:
 - Vectors and phasors
 - Per-unit systems
 - Transformer polarity
 - Symmetrical components
 - Polarizing quantity
- Description of five functional types of relaying:
 - Protective
 - Regulating
 - Reclosing/Synchronism
 - Monitoring
 - Auxiliary

Tuesday, February 14

- 0800-1700 Power System Protection (Mike T.)
- Overview of the following:
 - Instrument transformers
 - Differential relays
 - Over-current and distance relays
 - Back-up protection
 - Electro-mechanical
 - Microprocessor relays
 - Different types of generator protection
 - Direct connected generators
 - Unit connected generators
 - Introduction to power system grounding concept

Wednesday, February 15

- 0800-1700 Power System Protection (Mike T.)
- Issues facing power transformer protection
 - Transformer protection
 - Power transformers
 - Phase shifting transformers
 - Shunt capacitors and reactors
 - Consideration in protecting radial versus looped transmission lines
 - Detailed description of distance relaying and its application within our region for
 - Transmission line protection
 - Transmission line back-up protection
 - Overview and explanation of the most common types and the application of pilot protection schemes within the DAK region

Thursday, February 16

- 8:00-17:00 Power System Protection (Mike T.)
- Explanation and illustration of out-of-step protection
 - In-depth review of the advantages and disadvantages of automatic reclosing schemes
 - Detailed explanation of the purpose and application of special protective systems within the Dakotas subregion (utility instructors)
 - Overview of the design of substation bus configurations and how they are applied to the BES
 - Description of the application of I and E differential protection schemes to the different bus configurations
 - Description of the following systems in the DAK region (and how they are designed to avoid the associated collapse of the monitored element):
 - Under-voltage load shedding
 - Under-frequency load shedding

Registration form

Cost is \$1,200.00 per attendee. This includes breakfasts, breaks, and lunches.

Name _____

Company _____

Billing address _____

Phone _____

E-mail _____

NERC Cert# _____

Method of payment

Bill me Check

Hotel accommodations

Best Western - The Falls Inn and Suites (Bigwood Events Center)

A block of 10 rooms has been held from Sunday-Thursday for the week. Rooms are blocked under Otter Tail Power Company Training.

Room rate

\$89.99 for Otter Tail Power Company

\$89.00 for Government - single occupancy

Best Western Inn: 218-739-2211

Toll free: 1-800-293-2216

925 Western Ave., Fergus Falls, MN 56537

E-mail: www.bestwestern.com



For registration:

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