
UNDERGROUND DISTRIBUTION AGENDA

SESSION 1 – MONDAY MAY 5TH

- 08:00 a.m. Introduction**
- Course objectives, schedule, manual, and format
 - Instructor and participant introductions
- 08:30 a.m. Introduction to Underground Distribution (UD)**
- History of UD systems
 - UD System Types
 - Advantages & disadvantages of UD systems
 - UD components
 - UD terminology
 - UD codes & standards
 - Prevailing UD practices
- 10:00 a.m. Break**
- 10:15 a.m. Introduction to Underground Distribution (continued)**
- 10:45 a.m. UD Policies & Customer Service Terms/Conditions**
- Mandatory vs. voluntary undergrounding
 - Main feeders
 - Service loops and customer services
 - OHD to UD conversion
 - Cost recovery methods
 - Customer connection requirements
 - Point of service
 - Easements/property rights
 - Joint-Use arrangements
 - Policy development exercise
- 12:00 Noon Lunch**
- 1:30 p.m. UD Planning & Design**
- Load estimating & diversity
 - Equipment and component loading
 - Reliability/sectionalizing/fault Interruption
 - Voltage regulation
 - Residential/commercial subdivisions & customers
 - Commercial developments & customers
 - Load estimating, planning, design & layout exercises
- 3:00 p.m. Break**
- 3:15 p.m. UD Planning & Design (continued)**
- Cable specifications
 - Cable Installation in underground structures
- 04:30 p.m. End of Session 1**

AGENDA

SESSION 2 – TUESDAY MAY 6TH

- 08:00 a.m. Introduction**
- Review/Q & A from Session 1
- 08:15 a.m. Cable Design and Application**
- Basic Design and Voltage Stress Management
 - Types & Construction
 - Conductor & Insulation Materials
 - Electrical and Mechanical Properties
 - Electrical Ratings & Loading Considerations
 - Cable Standards & Specifications
- 09:30 a.m. Medium Voltage Cable Manufacturing**
- Historical Perspective and Evolution
 - Water Treeing Insulation Failure
- 10:00 a.m. Break**
- 10:15 a.m. Medium Voltage Cable Manufacturing**
- Modern Cable Compounds, Manufacturing & Factory Testing
 - Latest Innovations
- 11:30 a.m. Lunch**
- 1:00 p.m. Cable Accessories: Design, Installation & Operation**
- Voltage Stress Relief
 - Terminations
 - Splices
 - Load-break Connectors – 200A
 - Dead-break Connectors – 600A
 - Installation Practices
 - Operating Practices
- 1:45 p.m. Cable Installation**
- Direct burial methods
 - Duct & Conduit methods
 - Basic Cable Installation Design
- 3:00 p.m. Break**
- 03:15 a.m. UD Transformers**
- Types & Applicable Standards
 - Construction & Features
 - Installation Considerations
 - Loading
 - Protection
 - Economics and Loss Evaluation
- 04:30 p.m. End of Session 2**

AGENDA

SESSION 3 – WEDNESDAY MAY 7TH

- 08:00 a.m. Introduction**
- Review/Q & A from Session 2
- 08:15 a.m. Basic UD Protection & Reliability Considerations**
- System & Component Grounding Practices
 - Overload and Fault Current Conditions
 - Overcurrent protection philosophy
 - Types & Functions of Overcurrent Protective Devices
 - Fault Current Indicators
 - Overvoltage Conditions
 - Overvoltage protection philosophy
 - Lightning Arresters
- 10:00 a.m. Break**
- 10:15 a.m. UD Safety and Operations**
- National Electrical Safety Code Part 3
 - National Electrical Safety Code Part 4
 - APPA Safety Manual (Reference Only)
- 12:00 Noon Lunch**
- 1:30 p.m. UD Inspection and Maintenance**
- NESC and Regulatory Requirements
 - Industry Practices
 - Inspection and Maintenance Methods
- 3:00 p.m. Break**
- 3:15 p.m. Course Wrap-Up**
- Open Discussion/Q & A
 - Quiz
 - Course Evaluation
- 04:30 p.m. End of Course**

UNDERGROUND DISTRIBUTION

LEARNING OUTCOMES

Upon completion of this course, participants will be able to successfully:

1. Describe the types of underground electric utility distribution systems in common use, as well as the components, terminology, and prevailing practices for their design and installation.
2. Research and identify the laws, codes and standards that establish accountabilities for the design, construction, operation and maintenance of underground systems.
3. Compare and contrast underground versus overhead electrical distribution with respect to safety, cost, reliability, and aesthetics.
4. Analyze their utility's (or a client utility's) underground service policies and guidelines for underground facilities and service to customers and developers including such elements as point of service, property rights, aid to construction, joint use trench/conduit systems, overhead to underground conversion, etc.
5. Through learning exercises, plan, design and arrange underground distribution systems giving consideration to customer load characteristics, equipment and component loading, reliability, voltage regulation, physical design parameters, and economics.
6. Describe the basic types and construction of low and medium voltage underground cable construction and apply basic principles of insulation, voltage stress relief, and thermal loading.
7. Describe and apply the principles that underlie the specification, design, installation, and operation of long-life underground cable systems. Prepare a cable specification that references appropriate national standards and incorporates state-of-the-art features and practices in cable manufacturing.
8. Identify and apply basic theoretical and practical techniques for installing cable and specifying the most commonly used cable accessories, including high-voltage splices, cable terminations, and elbow connector systems to properly install, operate and maintain a reliable underground distribution cable system.
9. Apply pad-mounted underground distribution transformers giving consideration to ANSI standards, kVA sizing, voltage ratings, primary and secondary cable connections, enclosure and other features, overcurrent and voltage surge protection, loss evaluation, and conditions of installation.
10. Apply basic protection and reliability principles based on an understanding of overload and fault current conditions, overvoltage conditions, protective devices and philosophies of overcurrent and overvoltage protection.
11. Summarize the requirements of the current edition of the National Electric Safety Code (NESC) that apply to underground distribution systems and incorporate these requirements into standards and practices for the design, installation, operation, and maintenance of these systems, including safe work practices.
12. Describe and apply accepted standards and practices for inspection, testing, and maintenance of underground line cables, components, equipment, and structures.