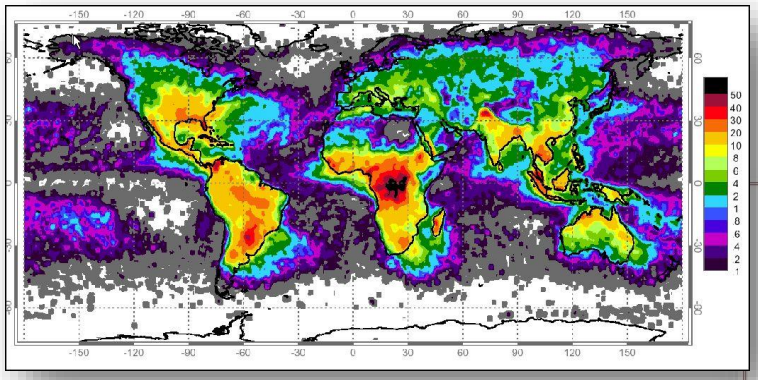
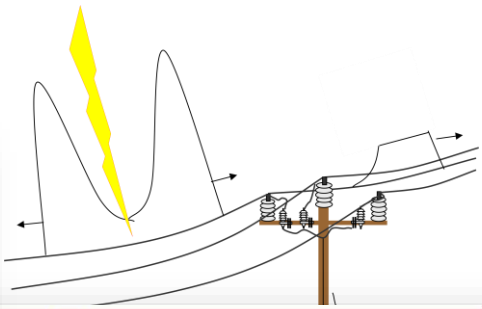
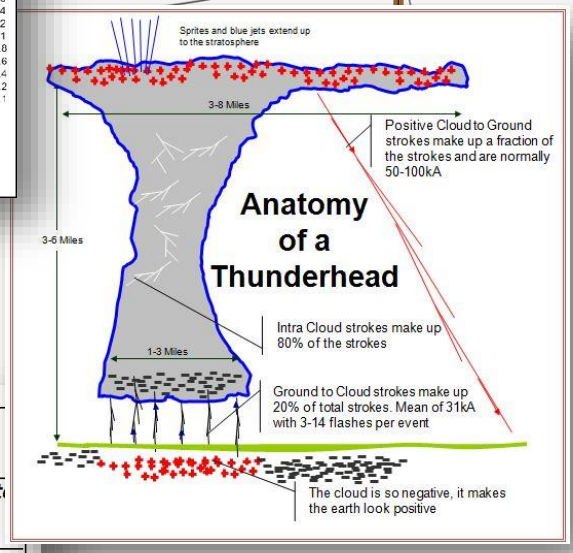
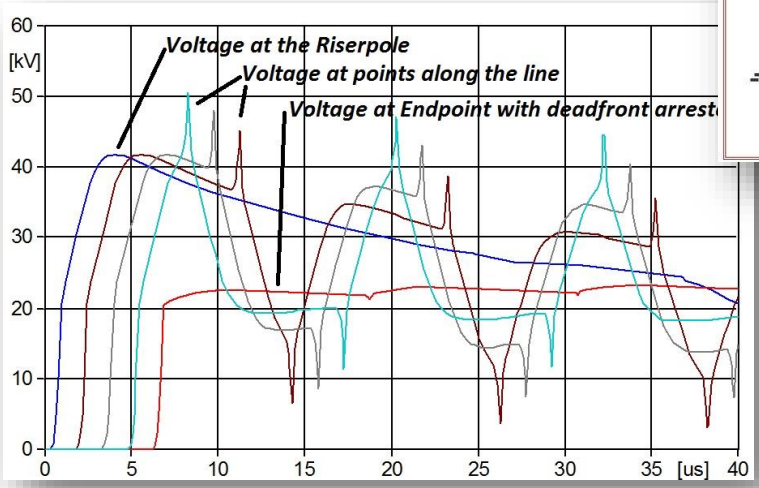
ArresterWorks

1.5 Day Power Systems Surge Protection Seminar



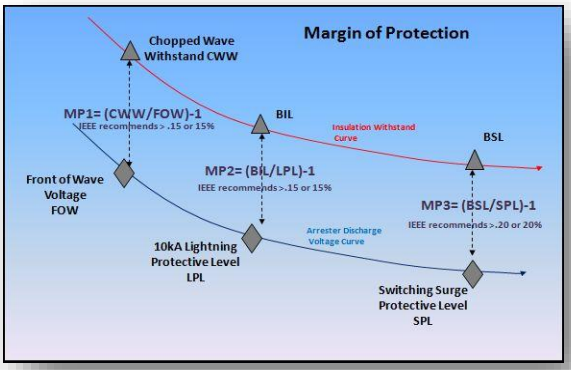






1.5 Day Seminar Overview

Lightning is the second or third most significant cause of outages on most power systems. Mitigation of the effect of lightning is seldom understood and can often be improved. This in-depth course is



designed for those responsible for the reliability of substations, distribution systems, and transmission systems. We will cover ways to improve the lightning performance of distribution and transmission lines by using arresters and other means.

What Attendees Will Learn

- **Surge fundamentals**: lightning, switching, faults, ferroresonance, line drops, and others
- **How to select the most appropriate type of lightning protection**: Shielding, lightning rods, arresters, no protection, and possibly underground
- **The difference between arrester types**: Station, transmission line, distribution, secondary, liquid immersed, elbow, riser pole, and more
- **What the ratings of an arrester really mean** and how to compare one manufacturer to another
- **Margin of protection fundamentals** along with insulation coordination fundamentals
- **Separation Distance Fundamentals**
- **Arresters failures:** How to avoid, assess, and test in the field
- **Insulation Coordination Fundamentals**
- **How to Calculate the Value of an Arrester**
- **Disposal and life cycle management** of arresters
- **What standards govern arresters** and system improvements?
- **Trends in the industry in lightning protection**
- **New Charge Transfer Rating Overview**

Including a review of how to apply this new rating to your system

Materials

Each attendee will receive an Overvoltage Protection workbook based on the slide presentation that can be used as a reference for years to come.

Who Should Attend

- Anyone new to the industry who wishes to learn the fundamentals of lightning protection
- Reliability engineers and other reliability personnel responsible for continuous improvement
- Power system operations and maintenance supervisors
- Power engineering personnel who wish to broaden their scope of system understanding
- Linemen interested in learning more about surge protection.

Instructor

Jonathan Woodworth, Consulting Engineer, ArresterWorks, started his career at Fermi National Accelerator Laboratory in Batavia, IL after receiving his Bachelor's degree in Electronic Engineering from The Ohio Institute of Technology in 1972. As an Engineering Physicist at Fermi Lab, he was an integral member of the high energy particle physics team in search of the elusive quark. In 1979 he joined the design engineering team at McGraw Edison (later Cooper Power Systems) in Olean, NY. Returning to school after many years in industry, Jonathan received his MBA from St. Bonaventure University in 1995. Jonathan was employed for 28 years at Cooper Power System where he served as Engineering Manager for 13 years. Additionally he held the position of Arrester Marketing Manager for 7 years.

In 2007 Jonathan along with business and life partner Deborah Limburg started up Arrester Works a surge protecting Consultantsy that serves the surge protection industry worldwide.

Jonathan is very active in the IEEE and IEC standard associations previously serving as Chair of the Surge Protective Devices Committee of IEEE PES, Chair of the NEMA High Voltage Arrester Section, and currently Co-Convener of the IECTC37 MT4 committee responsible for IEC Arrester Standards and Convenor of the IEEE High Voltage Arrester Test Standard Working Group.

Jonathan can be contacted at
jwoodworth@arresterworks.com

Surge Protection Seminar Outline

1) **What is an arrester?**
2) **How does an arrester work?**
3) **Why Do We Need Arresters?**
   a) Insulation Protection
      i) Types of Insulation
      ii) BIL and CFO and 60 Hz
   b) The lightning Surge
   c) The Switching Surge
   d) Traveling Wave Phenomena.
      i) The lightning Surge.
         (1) Following a Surge from Cloud to Ground
4) **A Look Back at how it was done before**.
5) **Where are arresters applied and Why?**
   a) Dist Trans
   b) Station Trans
   c) Station Entrance
   d) Dist Cap Banks
   e) Dist Open Points
   f) Dist and Trans Riser Poles
   g) Regulators
   h) Station Cap Banks
   i) Underbuilt System Protection
      i) The Backflash
   j) Line Protection
   k) Reclosers
   l) Dead End Insulators
   m) Underground Cabinets
   n) Switchgear Cabinets
   o) Generators
   p) Motors
   q) Sheath Voltage Limiters
   r) Transformer Secondaries
   s) Whole House Protectors
   t) Point of Use Protectors
6) **Lightning Masts and Shield Wires**
   a) Step Potential
   b) Induced Potential
7) **How is an Arrester Built**
   a) Dissecting an arrester (A hands on demo of arrester disassembly)
   b) Components: Disks, Housings, Modules, Insulating Hangers, Leads, Ground Lead Disconnector, Mounting Brackets,
   c) Virtual Factory Tour
   d) The Routine Factory Tests that Ensure Arrester Quality
   e) Tour into the Heart of a MOV disk with Scanning Electron Microscope
8) **Why Arresters Fail**
9) **Types of Arresters**
10) **Types of Power Systems and Why they require different arresters**
11) **Safety Considerations and Arresters**
    a) GLD contains black powder
    b) Disposal
12) **Arrester Installation Considerations**
    a) Lead Length
    b) Cross Arm vs. Tank Mounting
    c) Horizontal Mount
    d) Suspension Mount
    e) Fuse Blowing
    f) Down Ground
    g) Ground Considerations
       i) With Equipment
       ii) Without Equipment
    h) Installation Considerations for Line Protection
13) **Wildlife Protectors**
    a) Types
    b) Effectiveness
    c) Issues
14) **How to Select an Arrester**
    a) 7 Step method
15) **Arrester Electrical Characteristics**
    a) Discharge Voltage
    b) Charge (A new means of assessing energy handling)
    c) TOV
    d) Leakage Distance
    e) Strike Distance
    f) Classification
    g) Grading Ring and Corona
16) **Arrester Mechanical Characteristics**
    a) Cantilever Strength
    b) Tensile Strength
    c) Insulating Hanger Strengths
    d) Connector Torque Strength
17) **Field Testing of Arresters**
    a) If a Hipot tester is available, we will test several arresters from the store room both old and new.
18) **Lab Testing of Arresters**
    a) MOV Conduction Mechanisms
19) **How Arrester Standards Ensure a good Quality Arrester**
    a) Making sure an arrester is properly tested
20) **Insulation Coordination of Substation Fundamentals**
    a) Deterministic vs Probabilistic Analysis
    b) Determining when to use a line entrance arrester