JONATHAN J. WOODWORTH

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Areas of Expertise

- Surge arrester design and application (41 years of experience)
- Insulation Coordination Studies using transient software simulations
- Teaching Overvoltage Protection of Power Systems
- Surge Arrester Manufacturing
- Arrester Product Marketing (International and Domestic)
- Surge Arrester Application Training
- FACTS Equipment Protection
- Engineering Management
- IEEE and IEC Standards Management and Development
- Product Design and Patents
- High Voltage Substation Inspections and Transformer Protection

Insulation Coordination Activities

Insulation Coordination Classes

Since 2017, ArresterWorks has offered Insulation Coordination classes online to engineers around the world. These classes consist of 10 hours of online contact and 5 hours of homework. The class has been attended by more than 30 engineers in the past three years.

Example of Completed Insulation Coordination Studies

Project Title	ArresterWorks Client	Description
500kV 30 Mile Substation 2010	Power Engineers	Recommended location of arresters in a 500kV substation
Maine Power Reliability Project (1)	Power Engineers	Studied 5 substations and recommended arrester location and ratings. Verified margins of protection
Maine Power Reliability Project (2)	Power Engineers	Studied 3 substations and recommended arrester location and ratings. Verified margins of protection
Pepco St Charles Generating Station including Kelson Ridge Station	SNV Lavalin	Study of Generator and Substation. New construction of Gas Generator. Located arresters and CCVTs to mitigate surges.
Fenix Power Peru (SA)	SNV Lavalin	Insulation Coordination Study to determine cause of failure of equipment.
Diablo Canyon Nuclear Power Plant Arrester Failure Study	PG&E	Study of power plant arrester failures and how to avoid in the future
220kV GIS Substation	Matelec sal (Lebanon)	Complete ICS of three GIS substations verifying arrester ratings and locations
Greenpac Industrial Distribution Substation	Greenpac Inc Niagara Falls US	Study of a transformer failure in an industrial substation to determine cause of failure and location of arresters to reduce risk.
CP LNG GIS Substation	Kiewit	Study of a compact GIS substation to determine location of arresters.
Eastman Chemical System Study	Eastman Chemical Inc	Studied industrial distribution substations and coordinated location of arresters.
FAA National Headquarters System Study	United States FAA	Studied the distribution system of the complex and recommended location and ratings of arresters.
Fairview Energy Center	Kiewit	Study of Combined Cycle Generator and Station
Texas Distribution System Analysis	EPRI	Study of a shielded distribution system and its reliability.
Scout Arrester Application	Dominion Power	Study of distribution system and underground circuits
10MVA Generator Failures	Monte Rio Power (Dominion Republic)	Study of 15kV Generator failure

Standards Activities

Institute for Electrical and Electronics Engineers *IEEE SPD Website*

Past Chair of the Surge Protective Devices Committee, the IEEE Power Engineering Society Technical Committee responsible for standards development for surge protective devices (all categories of surge arresters). For the past 30 years, I have held many roles from taskforce participant, working group convenor, secretary, and vice chair. As chair of WG 3.4.14, I was responsible for the 1997 publication of IEEE/ANSI standard C62.22 “Application Guide for Surge Arresters above 1000 Volts RMS”. The working group consisted of over 20 task forces and 30 members. We published the standard precisely on schedule as outlined in 1993. As secretary to the SPD, I organized four major meetings from locating meeting locations, to all financial management of the meeting.

From 2012 to 2020 I was the chair of the working group responsible for IEEE C62.11 I am currently leading a taskforce charged with the responsibility of a comprehensive review of all tests in C62.11. I successfully got the 2020 edition of C62-11 published.

As of Jan 2021, I am now the chair of the IEEE Working group that is responsible for IEEE 1313.1 and 1313.2, the Insulation Coordination Standards. We are starting on a big update of these two standards.

International Electrotechnical Commission (IEC) *IEC Website*

Since 1994, I have chaired and co-chaired the working group (TC37 WG9 and MT4) of the IEC Surge Protective Devices Committee. In this function I have coordinated the activities of 5-10 working group members in the development of a Gapped MOV standard that was published in 2001. Presently involved a task force for the development of an 60099-4 Test Rationale. I am presently the US National Committee Technical Advisor to TC37.

National Electrical Manufacturers Association (NEMA) *Nema*

As chair of Section 8LA Surge Protective Devices, I had the honor of leading the NEMA joint activities of all North American Arrester Manufacturers. The manufactures involved in this endeavor are Hubbell, Cooper, MacLean, Siemens and ABB. We met twice yearly and strategize on how to best effect the standards on behalf of the manufacturers.

Professional Experience IEEE Distinguished Lecturer (Surge Protection of Power Systems)

2016 – Present

IEEE Distinguished Lecturers are engineering professionals who help lead their fields in new technical developments that shape the global community. These experts:

- Specialize in the field of interest of their Society/Council
- Travel to various technical and regional groups, such as Society and Technical Council Chapters, to lecture at events

ArresterWorks: An International Independent Consulting Firm

2008 to Present - Principal Consulting Engineer

Started ArresterWorks in January 2008 to utilize my arrester knowledge as an independent consulting engineer. The purpose of ArresterWorks is to consult to the arrester industry as well as maintain an Informational Website on the subject of High Voltage Arresters.

As principal consultant all aspects of surge protection engineering projects are included in ongoing activities. They include:

- Preparing proposals with regard to engineering projects
- Performing Insulation Coordination Studies including protection of substation transformer windings and bushings.
- Performing Forensic Analysis of Arresters
- Expert Witnessing for Legal Cases
- Participate in Standards Writing and Standards Management
- Write Quarterly Column on Surge Protection for International Trade Journal (Woodworth On Arresters)
- Teach Surge Protection Classes
- Maintain world famous website on Surge Protection of High Voltage Arresters
- Consult with Arrester Manufacturers on Arrester Design and Production Issues
- High Voltage Substation Inspections for adequate Surge Protection for transformers and lines.
- Coordination of Transformer BIL and Arrester Characteristics for insulation Cooridination ➢ 500kV Nuclear Plant Substation inspection for adequate surge protection.
- Modeling 230-500kV Air Insulated and Gas Insulated Substations for adequate protection of transformers and lines.
- Third Party Surge Arrester and Capacitor Bank inspections.

A Partial List of Clients Served

Preformed Line Products
Crompton Greaves
Pauwels
Pacific Gas and Electric
Entergy
Florida Power and Light
Portland General Electric
Cooper Power Systems
NEMA
US FAA
CEATI
INMR
Tridelta
Monte Rio Power
Tenessee Valley Authority
Progress Energy
Gerogia Transmission Power
Engineers Inc.
Duke Power
Massachusetts Institute of Technology
IEEE

Overvoltage Protective Training Seminar Locations

Portland General
Florida Power and Light
Entergy
Tridelta (Germany)
Tennesee Valley Authority
Balize Electric (Balize)
Maratime Electric
Nova Scotia Electric
New Brunswick Electric
IEEE Summer Meeting
Crompton Greaves (India)
Duke Power
Precise Electric (Thailand)
Electricos International (Colombia)
PLP (Brazil)
Siemens (Germany)

COOPER POWER SYSTEMS: A Division of Cooper Industries
1979 thru 2007

2004 to 2007 – Arrester Product Engineering Manager

Managed all engineering functions for the Cooper Arrester product line including product development, technology development and personnel development

Responsibilities

- Lead a 15 person product development team in all aspects of arrester development
- Lead representative IEEE and IEC industry standards groups
- Actively participate in FACTS Protector design and production
- Development of MOV/Capacitive couplers for HV power systems
- Implementing and practicing stage/gate product development methods
- Development of Zinc Oxide disk and process for arresters products
- Oversight of University-Industrial projects
- Responsible for maintenance/upgrades of 115/34.5kV substation for factory and test facility.

Accomplishments include:

- Paper and Presentation on the Development of Arrester Standards in IEC and IEEE. (Nov 2005 Hong Kong INMR World Conference) INMR Site
- Paper and Presentation on the transportation issues with Arresters today. Brazil INMR World Congress 2007
- Introduction of the world's first Broadband Over Power Line (BPL) Arrester/Coupler

- Leading the IEEE standards in a realistic review of all arrester tests
- Steering the NEMA Arrester Section in the development an Industry Development Committee
- Successfully implementing DOT requirements for transportation of arresters
- Routinely lead WEB based training sessions to utilities and customers around the world arrester application issues.
- 500kV Series Capacitor Bank inspecitons in Finland and Brazil. Tested arresters on site.

1996 to 2004 – Arrester Product Line Manager

Managed all marketing functions for an (annual sales volume) product line, including sales force training, production planning, marketing communication functions, and personnel management.

Responsibilities included:

- Business Development of Cooper's core technology (Metal Oxide Varistor manufacturing) where it can best be utilized in new markets (both international and domestic markets).
- Product Development Leadership, including product introductions, new product identification and justification, market studies and engineering guidance.

Accomplishments include:

- Presentations on a variety of topics, including:
- Presentation on Transmission Line Arrester Applications at INMR World Conference in Marbella Spain (Nov 2003) INMR site
- Low Voltage Arrester Application (to the Tennessee Valley Authority Maintenance and Operations Association)

- Overvoltage Protection (to the California Utility Association)
- Chair of the international working group (IEC TC37 WG9) that wrote the test standard for gapped MOV arresters.
- Chair of the IEEE Surge Protective Devices Subcommittee
- Developed a 4 hour course and manual to train substation design engineer's proper overvoltage protection schemes. Presented the course at numerous utilities and for CEU credit.

As product line manager, I was instrumental in the preparation of product literature that includes colored brochures, catalog sections instruction sheets. Along with hard copy literature, I personally prepared and presented power point presentations, facilitated product website development (Cooper Products) and developed several Excel based calculators that demonstrate product features. These sales tools are the means by which we reach 100+ sales engineers and manufacturing reps to promote our products.

1987 to 1996, Product Engineering Manager

Managed a department of 22 engineers and technicians involved with the design of high- and low- voltage arresters and fuses.

Responsibilities included:

- Concept evolution and patent administration.
- Feasibility studies, market studies, and design studies.

- Quality implementation in design and manufacturing.
- Ceramic process development and control.
- Design and manufacturing CAD system administration.
- Marketing assistance with customers.
- Management of over 20 engineers and technicians, both locally and at an R&D department in the Wisconsin facility
- I routinely worked with patent attorneys involving a minimum of 5 patents at all times as patent administrator.

Accomplishments included:

- New products developed and introduced under my leadership:
- UltraSIL housed Arrester Gapped MOV Arrester,
- Polymer Housed Distribution Arrester,
- Low Voltage High Energy Arrester, and
- Compact Interchangeable Current Limiting Fuse (ELF).
- A U.S. patent (No. 4930039) pertaining to the polymer housed arrester.

1979 to 1987, Design Engineer

Developed arresters and metal oxide varistors as part of a team of engineers and technicians.

The metal oxide disk development was in its infancy when I started this endeavor. I was instrumental in the introduction of this technology to Cooper Power Systems as the lead electrical test engineer. The arrester produced then and now is from 120 volts ac to 360,000 volts ac. They are used from residential to substations applications all over the world. Actively worked in test lab and 115/34.5kV substation to test arresters from 10kV to 360kV.

FERMI NATIONAL ACCELERATOR LABORATORY (U.S. Department of Energy facility)
1973 to 1979 Fermilab

Operations Chief and Engineering Physicist at the 15-foot Bubble Chamber which at that time was on the cutting edge in high energy particle targets. I was intimately involved in the design and operation of mechanical, electrical, cryogenic, vacuum and hydraulic systems.

Education

Masters of Business Administration (MBA marketing and finance), 1995, St. Bonaventure University (Olean, NY)
Bachelors of Electronic Engineering Technology, 1972, The Ohio Institute of Technology (Columbus, Ohio)

Authored and Co-authored Publications

1. J.J. Woodworth, “Substation Overvoltage Protection Workshop”, Text for Cooper Power System’s workshop on same subject. 2000-2001
2. J.J.Woodworth , “The Station Arrester’s Problematic Joule Rating”, The Line March 2001

3. L.J. Kojovic, J.J Woodworth, G.L. Goedde, “The use of I2T Withstand to Characterize the Energy Handling Capability of Surge Arresters” IEEE/PES Summer Power Meeting , Vancouver BC, July 2001
4. L.J. Kojovic, J.J. Woodworth, G.L.Goedde, “Series Graded Gapped Arrester Provides Reliable Overvoltage Protection in Distribution Systems”, IEEE/PES Winter Power Meeting, Columbus Ohio, Feb. 2001
5. J.J.Woodworth, “IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating –Current Systems”, C62.22-1997. Chair of Working Group and Editor
6. Jonathan Woodworth “Lightning Protection: Improving Reliability Through the Use of Surge Arresters” , *Utility Automation & Engineering T&D* April, 2005
7. Woodworth, J. J. and H. E. Fletcher, Technical paper presented to the See Overhead Committee, Annapolis, Maryland May 10, 1990 entitled "New Surge Arrester Technology Offers Substantial Improvement in Protection and Reliability," pp. 1-7, Cooper Power Systems (May 1990).
8. J.J. Woodworth, “Emerging Transportation Issue with Distribution Arresters” INMR World Congress Rio de Janeiro Brazil (April 2007)
9. J.J. Woodworth, “Arrester Standards: A Critical Review” INMR World Congress Hong Kong (Nov 2005)
10. J.J. Woodworth, “Externally gapped line arresters a critical design review”, 2014 IEEE T&D Conference Proceedings
11. J.J. Woodworth, “Arrester 2050”, 2015 INMR World Congress Munich Germany 2012 EGLA paper at IEEE T&D show
12. Shawn Allen, J.J.Woodworth, “Reduciton of Losses in Transmission Lines by the Replacement of Shield Wires with Arresters” Final Project Report to NYSERDA for project 28816 Feb 2014
13. J.J. Woodworth, M. G. Comber, Improvements in IEEE C62.11 test Standards, IEEE T&D Conference 2012

Patents In all cases below, I was the primary concept inventor even if not listed first on patent

US Patent	5594613	Surge arrester having controlled multiple current paths
US Patent	4930039	Fail Safe Surge Arrester
US Patent	5708555	Surge Arrester having controlled multi current paths
US Patent	7656639	Retainer for Surge Arrester
US Patent	7675728	Fire Safe Arrester Isolator
US Patent	8711538	Externally Gapped Line Arrester (ArresterWorks Patent)
US Patent	9543745	Arrester Bypass Devices