Northeast Power Systems, Inc.

Statement of Qualifications

Commitment to Quality, Expertise, and Service

ISO 9001: 2015

(updated 12-Oct-2018)

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II. Introduction

NORTHEAST POWER SYSTEMS, INC. (NEPSI) is the leading world supplier of medium-voltage metal-enclosed capacitor banks and harmonic filter banks (See Attachment B for product literature). NEPSI's equipment is used by industrial, commercial, and utility power system owners and operators with voltages from 2.4kV through 38kV to correct power factor and improve power quality.

III. History

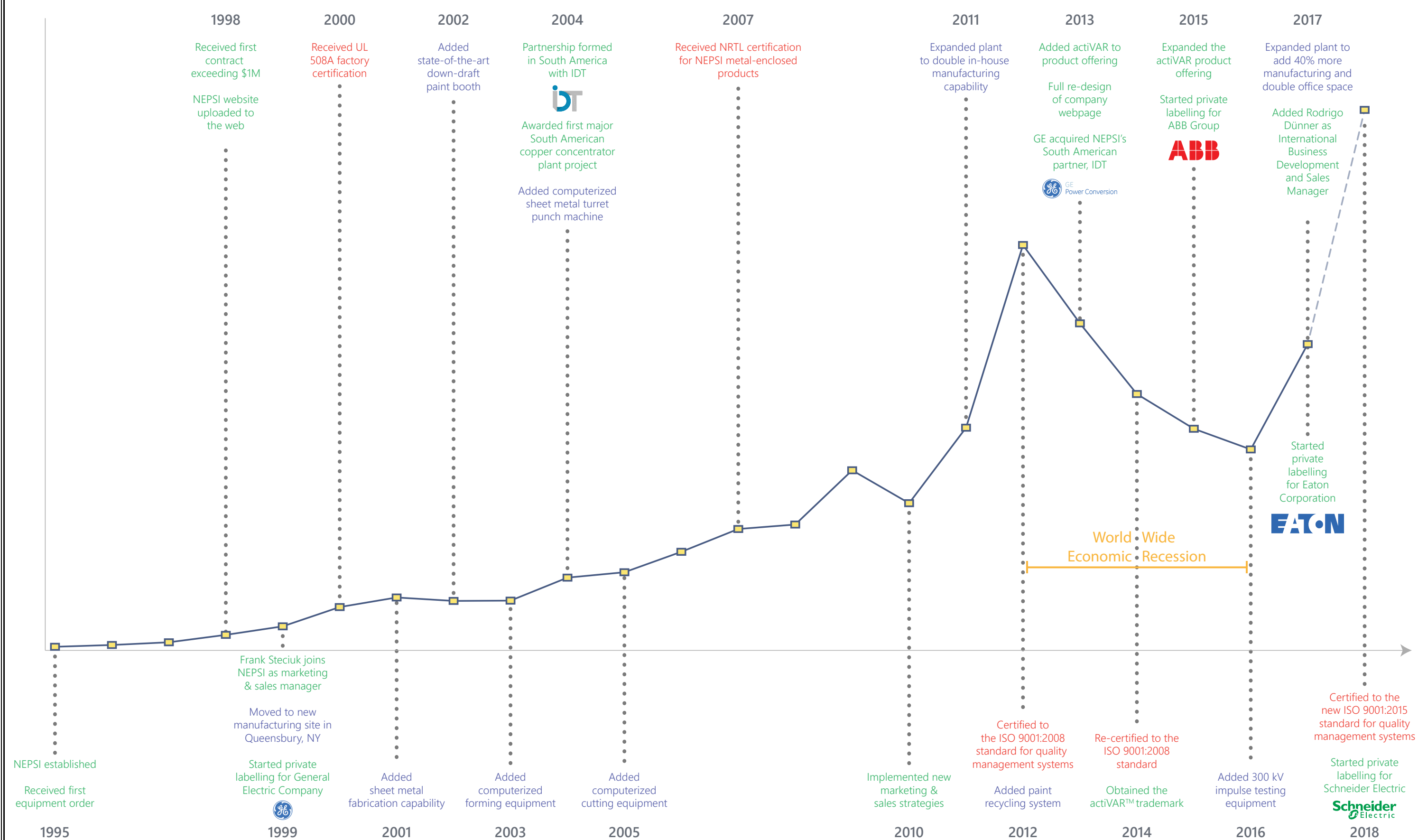
NORTHEAST POWER SYSTEMS, INC. (NEPSI) was established and incorporated in February 1995 and has seen steady growth through 2013. NEPSI's started private labeling its products and services in 1999 to several large equipment suppliers and manufacturers, including the General Electric Company. NEPSI acquired market share from existing competitors by providing better service, competitive pricing, higher value, and technical innovation. At the same time, NEPSI increased the size of the "metal-enclosed" market by introducing companies and specifying engineers to the economic advantages of using metal-enclosed equipment compared to conventional technology (elevated stack-rack equipment). Metal-enclosed equipment is the more economic choice, as this equipment is a pre-packaged totally engineered solution requiring less engineering, labor, maintenance, footprint area, and ultimately lower total cost of ownership.

NEPSI has increased its manufacturing capability several times since its inception in 1995. In 1999 NEPSI moved its home base from Albany, NY to a brand new site in Queensbury, NY. Over the next two years, NEPSI more than doubled its manufacturing area and became vertically integrated by adding metal fabrication equipment and a down-draft paint booth that allowed for even higher production capacity and control over the metal-enclosures, a key component to NEPSI's product offering. In 2011, meeting increasing demand for product and to accommodate larger complex filter systems, NEPSI expanded the Queensbury facility and again doubled its manufacturing capacity.

NEPSI's product offering has evolved since its inception. Beginning with smaller systems and including low voltage power factor correction, NEPSI now offers a more focused product line of large medium-voltage metal-enclosed capacitor bank and harmonic filter systems. These larger systems require high reliability, integrated protection, control, and communication systems and are often applied in challenging environments and remote locations.

NEPSI's capacitor and harmonic filter bank control and protection systems have become increasingly sophisticated and are now offered with multiple automation and control strategies, architectures, and solutions for every application size and complexity. We can integrate with DCS systems applied on large complex and geographically distributed industrial processes, to smaller applications requiring simple PLC controllers. No matter how big or small, our control and protection systems are designed, built, and tailored to the requirements of every process and facility.

A History of Growth



NEPSI continues to improve its products, processes, and operating systems to meet customer needs and enhance customer satisfaction, while meeting the complex business specifications and maintaining a safe and responsible work environment. To this end, in 2012 NEPSI sought and was certified to ISO 9001:2015-QMS standard for quality management systems.

IV. Vision Statement

"To be the world's premier supplier of medium-voltage metal-enclosed capacitor banks and harmonic filter systems"

V. Mission Statement

"Our mission is to be the preferred and most trusted name for the supply of medium-voltage metal-enclosed capacitor banks and harmonic filter system by delivering outstanding value, continuous innovation, and exceptional service to our customers.

VI. OUR GUIDING PRINCIPLES

- Exceed customer expectations
- Live the Golden Rule (treat others with courtesy and respect)
- Be a leader
- Participate and contribute
- Pursue excellence
- Work as a team
- Share knowledge
- Keep it simple (make it easy for customers to do business with us and for us to work together)
- Listen and communicate

VII. Quality Assurance

Our ISO 9001:2015-certified Quality Management System (QMS) ensures we deliver quality services and products to our customers. Externally audited each year and re-certified every three years, our QMS is the backbone of our operations as a company. It provides our staff with a comprehensive set of tools that allow us to more effectively and efficiently fulfill our mission of consistently over delivering on our promise.

NEPSI Quality Policy

Northeast Power Systems, Inc. (NEPSI) is committed to be an established and recognized world leader in providing quality products and services to our customers. In pursuit of this goal, we will continually improve our products, processes and operating systems to enable us to meet customer needs and enhance customer satisfaction, while meeting the needs of our business and maintaining a safe and responsible work environment. Each member of the NEPSI organization will apply their talent, both individually and in teams, to support our quality effort. NEPSI will be in compliance with all applicable regulatory and environmental requirements.

VIII. Qualifications

Since its inception in 1995, **Northeast Power Systems, Inc. (NEPSI)** has provided Metal-Enclosed Capacitor Banks and Harmonic Filter Banks and related engineering and support services to owners and operators of small and large industrial, commercial, and utility power systems. The owners and top level management of NEPSI have over 50 years of combined experience in the design, application, construction, testing, and commissioning of capacitor banks and harmonic filter systems. Our staff includes professional engineers with advanced degrees in Power Engineering as well as manufacturing engineers that specialize in quality.

Our electric power engineers and top level personnel have worked at major companies involved in the power industry including General Electric (GE), NY Power Pool, Power Technologies, Inc. (PTI), and Electric Power Consultants doing advanced power system analysis, measurement, application, and simulation for major industrials and utilities around the world. This experience in power engineering principles and simulation provides NEPSI with the background and analysis tools required for the application and design of large complex systems.

Our employees are qualified and trained in the assembly, fabrication, and testing of our equipment to industry-recognized standards including IEEE, ANSI, UL, CSA, and IEC standards. Our fabricators are equipped with state-of-the-art CNC fabrication and welding equipment and are routinely qualified and tested to industry standards. Our outgoing inspection, test, and commissioning technicians are trained and equipped with state-of-the-art test instruments to ensure our equipment meets applicable standards and are tested and ready for operation when they reach our customers' sites.

IX. Facilities

Owner:	Northeast Power Systems, LLC
Location:	66 Carey Road Queensbury, NY 12804
Zoning:	Light Industrial
Property Area:	5.8 Acres
Construction Type:	Metal, Pre-engineered 25,480 SF (includes office space)

X. Fabrication Equipment

Fabrication Equipment: State of the art fabrication equipment includes, Down Draft Paint Booth with 10 Ton Lift, Paint Waste Recycling System CNC Controlled Siena LVD Strippit Punch Press, Cincinnati 12' CNC Hydraulic Press Break with CNC Back Guage, Cincinatti 12' Mechanical Shear with CNC Back Guage, Notchers, MIG and TIG welders, various manual controlled punch presses, CNC controlled steel cutting saw. C180 CNC Laser and Summa DC4SX and other smaller bus bar punches and benders.

XI. Test Equipment

Equipment:

High Voltage Inc. VLF (Very Low Frequency), Hipot 0 to 50kV AC
High Voltage Inc. VLF HiPot, 0 to 120kV AC
High Voltage Inc. Portable DC HiPot/Megohmmeter, Hipot 0 to 75kV DC
High Current Test Equipment for Thermal Testing Iron-Core Reactors (0 to 2000 amps, 60HZ)
Tektronix TDS 3014b 100MHS DPO Transient Recorder
Doble TDR100 Circuit Breaker Diagnostic Test Instrument
Megger MIT515 Insulation Resistance Tester, 0 to 10kV DC (portable)
Vitrek V4 AC/DC/IR/GB Hipot Electrical Safety Tester
Hioki 9624-50 PQA – Hiview Pro Power Quality Analyzer
Multi-Amp SR-90 Relay Test Set
Sensorlink "Litewires" Fiber Optic Coupled Current and Voltage Sensors
Megger DLRO (Digital Low Resistance Ohmmeter) 200 Amp
FLUKE Ti20 Thermal Imager
Instek LCR Meter
Megger TTR20 Transformer Polarity and Ratio Test Set (CT & PT)
PowerMetrix PowerMaster 7335 Integrated Current and Voltage Source
Behlman AC Current Supply, 0 to 50 amps, 1 Hz to 1000 Hz

XII. Disaster Recovery

NEPSI's maintains daily off-site and onsite backup of all critical data to ensure your project information remains secure and available now and in the future.

XIII. Partial Experience/Customer List

Nearly all of Northeast Power Systems, Inc. revenue is derived from the supply and service of medium-voltage metal-enclosed capacitor banks and harmonic filter banks. Attachment A provides a partial experience/customer list for products sold by NEPSI since 2000. NEPSI's customer base crosses all industries including utility, mining, chemical, wind, solar, petroleum, university, government, and general industrial applications. NEPSI has sold into all industries and all environments.

NEPSI is the leading world supplier of metal-enclosed power capacitor banks and harmonic filter banks with products located in all industries and all environments

XIV. Certifications

PRODUCT AND CORPORATE CERTIFICATIONS

IEEE C37.20.3-2001/*TUV Rheinland Certification*

IEEE Standard - Standard for Metal-Enclosed Switchgear

For product shipping to locations within the United States, NEPSI is authorized by TUV Rheinland of North America to **label** capacitor banks and harmonic filter systems as compliant with the IEEE C37.20.3-2001 "Standard for Metal-Enclosed Switchgear" (see attached TUV certificates US 72131588). TUV Rheinland is an OSHA approved NRTL and has the authority through periodic inspection of our production facilities to allow NEPSI to apply the TUV label indicating our equipment is compliant with IEEE C37.20.3-2001.

This certification allows NEPSI to meet specification and local code requirements that require "Listing" or "labeling" per OSHA. This T-Mark directly replaces the UL mark and is should be acceptable to USA electrical inspectors requiring listed or labeled products.

C22.2 No. 190-M1985/TUV Rheinland Certification

CSA Standard - Capacitors for Power Factor Correction

For product shipping to locations within Canada, NEPSI is authorized by TUV Rheinland of North America to **label** our capacitor and harmonic filter systems as compliant with C22.2 No. 190-M1985 "Capacitors for Power Factor Correction" (see attached TUV certificates US 72131588). TUV Rheinland is an SCC (Standards Council of Canada) approved NRTL and has the authority through periodic inspection of our production facilities, to allow NEPSI to apply the TUV label indicating our equipment is in compliant with IEEE C22.2 No. 190-M1985

The certification allows NEPSI to meet specification and local code requirements that require "Listing" or "labeling" per SCC. This T-Mark directly replaces the CSA mark and should be acceptable to Canadian electric inspectors requiring listed products.

ANSI C57.16 – 1996

IEEE Standard for Requirements, Terminology, and Test Code for Dry-Type Air-Core Series Connected Capacitors

NEPSI's Iron-Core Harmonic Filter Reactors are third party tested by KEMA for withstand of dielectric tests in accordance with ANSI C57.16 – 2000 *"IEEE Standard for Requirements, Terminology, and Test Code for Dry-Type Air-Core Series-Connected Reactors"* to 150Kv BIL.

UL 508A and C-UL 508A

UL 508A Industrial Control Panels

NEPSI is factory certified through periodic inspection by UL to apply UL and C-UL Labels on our control panels which form an integral part of the capacitor bank and harmonic filter system. UL's safety mark is the most credible, accepted, and sought after certification mark in North America.

Seismic Certification

Uniform Building Code (UBC)- Seismic/Wind/Snow Certification

NEPSI has many capacitor bank and harmonic filter bank designs that have been Seismic Certified to Zone 4. In addition to seismic certification, wind and snow certifications, where applicable, have also been completed.

ISO9001:2015

ISO QMS (Quality Management System)

NEPSI's **third** party certification by TUV Rheinland, an internationally recognized accreditation body, to ISO9001:2015 demonstrates our commitment to quality, customer satisfaction, and continuous improvement of our company's product and operations.

EMPLOYEE CERTIFICATIONS

In addition to the above certifications, our field and factory technicians as well as our assemblers and fabricators receive training and certifications from various organizations. Key certifications include:

FireTrace – Factory trained technician for the installation, maintenance and service of the complete FireTrace product line.

Mine Safety and Health Administration – Safety program administered by the US Department of Labor allowing our field technicians to work on mine sites that require this safety program.

American Welding Society (AWS) – NEPSI's fabricators are certified by AWS for welding

Attachment - A

NEPSI Partial Experience List

(Updated 4-2-15)

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2000	Ark Valley Electric Coop	2.4	3.60	3	3	Automatic Capacitor Bank	1	Utility
2000	Mishawaka Utilities, IN	12.47	1.80	3	2	Automatic Capacitor Bank	7	Utility
2000	Public Service Electric & Gas	4.16	5.40	2	2	Automatic Capacitor Bank	1	Utility
2000	Reading Municipal Light Department, MA	13.8	3.60	1	1	Pad Mount Capacitor Bank	4	Utility
2000	Kissimmee Utility	13.2	6.00	1	1	SCADA Controlled Capacitor Bank	2	Utility
2000	Minnkota Power Cooperative	13.2	2.00	5	5	Single-Tuned Automatic Harmonic Filter	2	Utility
2001	Alliant Energy	13.2	2.10	7	3	Automatic Capacitor Bank	2	Utility
2001	Pasadena	17.2	5.40	1	1	Automatic Capacitor Bank	4	Utility
2001	Sacramento Municipal Utility District	12.47	3.60	2	2	Automatic Capacitor Bank	8	Utility
2001	United Illuminating	14.4	7.20	1	1	Capacitor Bank	3	Utility
2001	Pend Oreille Mining	12.47	1.50	fixed		Notch Harmonic Filter	2	Mining
2001	Hoosier Energy, IN	12.47	9.00	3	3	Single-Tuned Automatic Harmonic Filter	1	Utility
2002	Naval Station Ingleside	12.47	2.40	3	2	Automatic Capacitor Bank	1	Government
2002	City of Burbank	34.5	18.00	3	3	Automatic Capacitor Bank	1	Utility
2002	Maquoketa Municipal Utility	12.47	2.40	2	2	Automatic Capacitor Bank	1	Utility
2002	Nashville Electric Service	23.9	9.90	3	3	Automatic Capacitor Bank	3	Utility
2002	Syed Bhais	11	2.5-5.4	6	3	Automatic Capacitor Bank	2	Utility
2002	Mountaineer Wind Energy	34.5	9.00	6	3	Automatic Capacitor Bank	1	Wind Energy
2002	Mountaineer Wind Energy	34.5	9.00	3	3	Automatic Capacitor Bank	1	Wind Energy
2002	Utiliserve for Ottawa, KS	12.47	0.60	1	1	Capacitor Bank	2	Utility
2002	BC Hydro	25.20	0.60	1	1	Notch Harmonic Filter	1	Utility
2002	Hoosier Energy, IN	12.47	2.90	3	3	Notch-Tuned Harmonic Filter	2	Utility
2002	Hudson Municipal Light Board	14.4	8.80	3	3	Notch-Tuned Harmonic Filter	1	Utility
2002	Burlington Electric	13.8	1.80	2	2	Pad Mount Capacitor Bank	1	Utility
2003	Delano Public Utilities	12.47	1.20	3	2	Automatic Capacitor Bank	1	Utility
2003	Sparks	4.16	0.30	3	2	Automatic Capacitor Bank	1	Utility
2003	Hoosier Energy, IN	12.47	5.90	2	2	Automatic Harmonic Filter	1	Utility
2003	Roseville	12	1.20	1	1	Pad Mount Capacitor Bank	1	Utility
2004	East Fairfield Limestone	12.47	2.10	7	3	Automatic Capacitor Bank	1	Mining
2004	Peru Mining	10	1.55	3	2	Automatic Capacitor Bank	1	Mining
2004	White Lime Co	25	3.00	3	3	Automatic Capacitor Bank	1	Mining

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2004	Consumers Energy	8.32	1.80	2	2	Automatic Capacitor Bank	1	Utility
2004	Sacramento Municipal Utility District	12.47	3.60	2	2	Automatic Capacitor Bank	25	Utility
2004	NSTAR	14.4	9.60	fixed		Capacitor Bank	6	Utility
2004	Cielo Wind Farm	34.5	0.58	fixed		Notch Tuned Harmonic Filter	1	Wind Energy
2004	BGE	13.2	1.20	1	1	Pad Mount Capacitor Bank	1	Utility
2004	City of Melrose (MN)	7.2	0.90	1	1	Pad Mount Capacitor Bank	3	Utility
2004	American Superconductor	12.47	4.35	4	4	Single-Tuned Automatic Harmonic Filter	1	Semiconductor
2004	American Superconductor	12.47	5.80	5	5	Single-Tuned Automatic Harmonic Filter	1	Semiconductor
2004	Scottish & Southern	33		fixed		Single-Tuned Harmonic Filter	1	Wind Energy
2005	Alliant Energy	4.16	0.60	2	2	Automatic Capacitor Bank	1	Utility
2005	Nashville Electric Service	23.9	9.90	3	3	Automatic Capacitor Bank	8	Utility
2005	AMEC for Erie Wind	34.5	24.00	3	3	Automatic Capacitor Bank	1	Wind Energy
2005	AMEC for Teck-Pogo	4.16	1.80	1	1	Capacitor Bank	2	Mining
2005	DeBeers Dimond Mining	13.8	0.37	1	1	Notch Tuned Harmonic Filter	1	Mining
2005	Kingsbridge Wind Farm	27.6	0.15	fixed		Notch Tuned Harmonic Filter	1	Wind Energy
2005	Reading Municipal Light Department, MA	13.8	3.60	1	1	Pad Mount Capacitor Bank	10	Utility
2005	Escondida Mining	13.8	6.58	2	2	Single-Tuned Automatic Harmonic Filter	1	Mining
2005	ERCO	13.2	48.14	5	5	Single-Tuned Automatic Harmonic Filter	1	Chemical
2005	Escondida Mining	13.8	9.87	3	3	Single-Tuned Automatic Harmonic Filter	1	Mining
2006	Anglo American	15	36.00	fixed		Automatic Capacitor Bank	1	Mining
2006	Atlas Copco Drilling	7.2	0.33	1	1	Automatic Capacitor Bank	1	Mining
2006	Canadian Natural Resources Ltd (CNRL)	34.5	9.98	4	4	Automatic Capacitor Bank	5	Mining
2006	Barton County Electric Coop	12.47	2.4-4.8	1	1	Automatic Capacitor Bank	3	Utility
2006	City of Highland	13.2	3.00	2	2	Automatic Capacitor Bank	1	Utility
2006	AMEC	4.16	3.22	fixed		Harmonic Filter	2	Mining
2006	American Superconductor	12.47	5.40	4	4	Multi-Tuned Automatic Harmonic Filter Bank	3	Semiconductor
2007	Chile	13.2	2.50	3	3	Automatic Capacitor Bank	1	Mining
2007	Montana-Dakota Utilities	12.47	4.80	2	2	Automatic Capacitor Bank	1	Utility
2007	AMEC	34.5	18.00	3	3	Automatic Capacitor Bank	2	Wind Energy
2007	American Superconductor	33	9.90	1	1	Automatic Capacitor Bank	2	Wind Energy
2007	American Superconductor	33	7.43	1	1	Automatic Capacitor Bank	3	Wind Energy
2007	FL Smidth	13.8	18.00	6	6	Automatic Harmonic Filter Bank	2	Mining

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2007	Mantos de la Luna	23	1.80	2	2	Automatic Harmonic Filter Bank	1	Mining
2007	Semiconductor Facility	34.5	50.00	6	6	Automatic Multi-Tuned Harmonic Filter Bank	1	Semiconductor
2007	Codelco	6.3	4.00	fixed		Harmonic Filter	1	Mining
2007	Manto Verde	23	1.05	5	5	Multi-Tuned Automatic Harmonic Filter Bank	1	Mining
2007	San Diego Gas & Electric	12.47	6.00	4	3	SCADA Controlled Capacitor Bank	12	Utility
2007	Cedar Creek Wind Farm	34.5	4.00	2	2	SCADA Controlled Capacitor Bank	2	Wind Energy
2008	Butler Ridge	34.5	22.00	2	2	Automatic Capacitor Bank	1	Wind Energy
2008	American Superconductor	22	8.84	6	6	Automatic Harmonic Filter Bank	2	Semiconductor
2008	John Deere	34.5	6.02	1	1	Automatic Harmonic Filter Bank	1	Wind Energy
2008	Ditec	12.47	15.10	fixed		Capacitor Bank	1	Mining
2008	Barrick Cortez Gold Mining	13.8	2.38	fixed		Harmonic Filter	2	Mining
2008	Franke	18	2.57	4	4	Harmonic Filter	1	Mining
2008	Edison Mission Energy	34.5	6.56	fixed		Harmonic Filter	1	Wind Energy
2008	National Grid	13.2	3.0-9.0	2	2	SCADA Controlled Capacitor Bank	3	Utility
2008	Linden Interconnection VFT	17.5	25.00	1	1	SCADA Controlled Harmonic Filter Bank	3	Utility
2009	Alliant Energy	13.2	9.60	4	4	Automatic Capacitor Bank	2	Utility
2009	Nextera Point Beach Nuclear	13.8	15.00	5	5	Automatic Capacitor Bank, Voltage Control	1	Utility
2009	Southern Cooper	4.16	0.55	1	1	Harmonic Filter	1	Mining
2009	Capricorn Ridge Wind Farm	34.5	6.50	fixed		Harmonic Filter	1	Wind Energy
2009	Carmen de Andacollo	13.8	33.60	4	4	Multi-Tuned Automatic Harmonic Filter Bank	1	Mining
2009	San Diego Gas & Electric	12.47	7.20	4	4	SCADA Controlled Capacitor Bank	7	Utility
2009	Xcel Energy	13.8	9.60	2	2	SCADA Controlled Capacitor Bank	2	Utility
2009	Armenia Mountain	34.5	23.40	4	4	SCADA Controlled Capacitor Bank	1	Wind Energy
2010	General Mills	12.47	3.60	4	4	Automatic Capacitor Bank	1	Food Processing
2010	Hershey Chocolate Factory	13.2	2.40		2	Automatic Capacitor Bank	1	Food Processing
2010	Midwest Scrap	4.16	4.80	2	2	Automatic Capacitor Bank	1	Metal Processing
2010	Spectra Energy	4.16	0.90	3	2	Automatic Capacitor Bank	4	Natural Gas
2010	Spectra Energy	4.16	1.20	4	3	Automatic Capacitor Bank	2	Natural Gas
2010	Targa Resources	12.47	3.00	2	2	Automatic Capacitor Bank	2	Natural Gas
2010	Houston Refinery	2.4	1.80	3	3	Automatic Capacitor Bank	2	Petroleum
2010	Hemlock Semiconductor	34.5	25.00	5	3	Automatic Harmonic Filter	2	Semiconductor
2010	Tia Maria Mining	23	12.25	5	5	Automatic Harmonic Filter Bank	2	Mining/Rectifier
2010	Transcanada	4.16	6.78	2	2	Automatic Harmonic	1	Natural Gas

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
						Filter Bank		
2010	Bath Iron Works - EL Flowers	12.47	2.10	3	3	Automatic Harmonic Filter Bank	3	Marine/Shipyard
2010	City of Toledo	4.16	4.05	3	3	Automatic Harmonic Filter Bank	1	Utility
2010	Formosa Plastics	13.8	24.42	6	6	Automatic Multi-Tuned Harmonic Filter Bank	2	Chemical
2010	Chevron Phillips Chemical	2.4	1.75	1	1	Capacitor Bank	2	Chemical
2010	Targa Resources	12.47	1.20	fixed		Capacitor Bank	1	Natural Gas
2010	BG&E	34.5	1.80	fixed		Capacitor Bank	1	Utility
2010	Harrow Wind Farm - AMEC	27.6	1.90	2		Capacitor Bank	2	Wind Energy
2010	Montezuma I Wind Farm	34.5	3.10	fixed		C-High Pass Filter	1	Wind Energy
2010	Nextera/FPL - Montezuma	34.5	3.10	fixed		C-High Pass Filter	1	Wind Energy
2010	Basell USA	13.8	10.80	fixed		Fixed Notch Filter	1	Chemical
2010	Danieli Automation	34.5	3.50	fixed		Harmonic Filter	1	Chemical
2010	Kinder Morgan/Ruby Pipeline	13.8	8.34	fixed		Harmonic Filter	1	Natural Gas
2010	Georgia Pacific - Halsey	12.47	8.47	fixed		Harmonic Filter	1	Paper
2010	National Grid	13.2	7.20	2	2	SCADA Controlled Capacitor Bank	6	Utility
2010	Xcel Energy	13.8	1.20	1	1	SCADA Controlled Capacitor Bank	2	Utility
2010	Xcel Energy	13.8	9.60	2	2	SCADA Controlled Capacitor Bank	2	Utility
2010	Chestnut Flats Wind Farm	34.5	9.20	2	2	SCADA Controlled Capacitor Bank	1	Wind Energy
2010	Port Alma II Wind Farm - AMEC	34.5	18.00	3	3	SCADA Controlled Capacitor Bank	1	Wind Energy
2011	Guam Air Force Base	13.8	9.00	3	3	Automatic Capacitor Bank	2	Government
2011	Conoco Phillips Buckeye NM	4.16	3.00	6	4	Automatic Capacitor Bank	2	Petroleum
2011	M3 - Mercedes	13.8	7.20	3	3	Automatic Capacitor Bank	1	Mining
2011	Targa Resources	2.4	0.68	3	2	Automatic Capacitor Bank	1	Natural Gas
2011	Targa Resources	2.4	0.90	6	3	Automatic Capacitor Bank	1	Natural Gas
2011	Targa Resources	4.16	1.50	5	3	Automatic Capacitor Bank		Natural Gas
2011	Targa Resources	12.47	3.00	2	2	Automatic Capacitor Bank	2	Petroleum
2011	Eli Lilly	13.2	1.80	3	2	Automatic Capacitor Bank		pharmaceutical
2011	University of Alabama	12.47	2.70	3	2	Automatic Capacitor Bank	1	University
2011	University of South Alabama	12.47	15.50	7	7	Automatic Capacitor Bank	1	University
2011	Kaneohe Bay Hawaii	11.5	0.60	3	2	Automatic Capacitor Bank	2	Utility
2011	Northeast Utilities	14.4	12.60	2	2	Automatic Capacitor Bank	3	Utility
2011	Old Dominion	34.5	9.60	1	1	Automatic Capacitor Bank	4	Utility
2011	Lameque Wind Farm	12	3.90	3	3	Automatic Capacitor Bank	1	Wind Energy

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2011	DRG/MSD	13.8	4.00	3	3	Automatic Harmonic Filter	2	Waste Water Treatment
2011	Codelco Ventanas	6	4.00	3	3	Automatic Harmonic Filter Bank	1	Mining
2011	Hoosier Energy, IN	12.47	1.97	1	1	Automatic Harmonic Filter Bank	1	Utility
2011	Hemlock Semiconductor	12.47	6.40	8	8	Automatic Multi-Tuned Harmonic Filter Bank	1	Semiconductor
2011	Climax Mining	13.8	18.79	5	5	Automatic Multi-Tuned Harmonic Filter Bank	2	Mining
2011	Anglo American - BCO	12	3.00	3	2	Capacitor Bank	1	Mining
2011	Atlas Copco	7.2	0.33	1	1	Capacitor Bank	4	Mining
2011	Chilean Power Group - CGE	13.2	7.00	1	1	Capacitor Bank	1	Utility
2011	Harbor Wind	12.47	0.78	1	1	Capacitor Bank	1	Wind Energy
2011	Montezuma II Wind Farm	34.5	8.04	fixed		C-High Pass Filter	1	Wind Energy
2011	Vasco Wind Farm	34.5	8.03	fixed		C-High Pass Filter	1	Wind Energy
2011	IP Pine Hill Bus 2	13.8	6.02	fixed		Harmonic Filter	2	Paper
2011	Saint Gobain	4.16	5.00	5	3	Harmonic Filter	1	Glass
2011	AMEC Chow	3.45	0.60	3	2	Harmonic Filter	1	Mining
2011	Anglo American Mantos Blancos	6.3	4.01	4	4	Harmonic Filter	2	Mining
2011	Dynapower	0.38	0.33	5	5	Harmonic Filter	2	Mining
2011	Mueller METSO	13.2	3.20	1	1	Manual Controlled Capacitor Bank	6	Mining
2011	Copper Mountain	24.94	13.94	4	4	Multi-Tuned Harmonic Filter Bank, DCS Controlled	4	Mining
2011	Copper Mountain	4.16	3.66	3	3	Multi-Tuned Harmonic Filter Bank, DCS Controlled	2	Mining
2011	Yaffe Metals	4.16	2.20	2	2	SCADA Controlled Capacitor Bank	1	Metals
2011	BG&E	13.8	7.20	2	2	SCADA Controlled Capacitor Bank	5	Utility
2011	National Grid	13.2	7.20	3	2	SCADA Controlled Capacitor Bank	3	Utility
2011	Xcel Energy	13.8	9.60	2	2	SCADA Controlled Capacitor Bank	1	Utility
2011	Demsey Ridge	34.5	31.50	3	3	SCADA Controlled Capacitor Bank	1	Wind Energy
2011	Sand Bluff Wind Farm	34.5	30.00	3	3	SCADA Controlled Capacitor Bank	1	Wind Energy
2011	Sandy Ridge Wind Farm	34.5	15.00	3	3	SCADA Controlled Capacitor Bank	1	Wind Energy
2012	Gettysburg Energy Works	13.2	1.50	5	5	Automatic Capacitor Bank	1	Bio Fuel/Generation
2012	Evonik	12.47	3.00	3	3	Automatic Capacitor Bank	2	Chemical
2012	Penasquito	34.5	3.00	2	2	Automatic Capacitor Bank	2	Mining
2012	Targa Resources	12.47	3.00	2	2	Automatic Capacitor Bank	1	Natural Gas
2012	Teak Midstream	24.94	8.00	10	4	Automatic Capacitor Bank	1	Natural Gas
2012	Wynnewood Refinery	13.2	3.60	2	2	Automatic Capacitor Bank	2	Petroleum

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2012	Wynnewood Refinery	4.16	3.60	2	2	Automatic Capacitor Bank	1	Petroleum
2012	Texas A&M	13.8	2.40	2	2	Automatic Capacitor Bank	2	University
2012	Texas State University of Performing Arts	12.47	2.40	7	3	Automatic Capacitor Bank	2	University
2012	UC Berkeley	12.47	5.40	6	3	Automatic Capacitor Bank	2	University
2012	Agighiol Wind Farm, Romania	30	5.00	1	1	Automatic Capacitor Bank	1	Wind Energy
2012	EPC	34.5	19.00	3	2	Automatic Capacitor Bank	1	Wind Energy
2012	Gebeleisis Wind Farm, Romania	20	8.00	2	2	Automatic Capacitor Bank	1	Wind Energy
2012	Manitioba Hydro	12.47	8.00	4	4	Automatic Capacitor Bank, Voltage Control	4	Utility
2012	Hemlock Semiconductor	34.5	30.00	3	3	Automatic Harmonic Filter	2	Semiconductor
2012	Wacker Silicones	13.8	9.80	2	2	Automatic Harmonic Filter Bank	4	Chemical
2012	Project Delta	13.8	6.03	3	2	Automatic Harmonic Filter Bank	4	Comercial
2012	GreenPac	12.47	2.68	1	1	Automatic Harmonic Filter Bank	4	Paper
2012	Johns Manville	2.4	1.50	3	2	Automatic Harmonic Filter Bank	1	Industrial
2012	Andritz - Mississippi Lime	4.16	0.60	1	1	Automatic Harmonic Filter Bank	1	Mining
2012	BHP Escondida	4.16	1.25	7	3	Automatic Harmonic Filter Bank	2	Mining
2012	Alabama Power	12.47	0.71	1	1	Automatic Harmonic Filter Bank	1	Utility
2012	Mount Milligan	25	24.26	6	6	Automatic Multi-Tuned Harmonic Filter Bank	1	Mining
2012	Mount Milligan	25	15.21	5	5	Automatic Multi-Tuned High-Pass Harmonic Filter Bank	2	Mining
2012	Atlas Copco	7.2	0.33	1	1	Capacitor Bank	2	Mining
2012	New Gold	13.8	3.60	fixed		Capacitor Bank	1	Mining
2012	Candelaria Mining	23	2.20	4	4	Capacitor/Reactor Bank	1	Mining
2012	Quallity Wind Farm	34.5	10.50	1	1	C-High Pass Filter	1	Wind Energy
2012	Summerhaven Wind Farm	34.5	12.80	1	1	C-High Pass Filter	1	Wind Energy
2012	California Valley Solar Ranch	34.5	60.00	5	5	Grid Controlled Capacitor Bank	1	Solar
2012	Lanxess	13.8	3.50	4	4	Harmonic Filter	1	Chemical
2012	Solae	4.16	5.09	3	3	Harmonic Filter	1	Food Processing
2012	Dow Corning- Simcala	13.8	20.00	4	4	Harmonic Filter	1	Metal
2012	Adelaide Brighton Cement	11	0.90	fixed		Harmonic Filter	1	Mining
2012	Keuhne Chemical	25	4.72	1	1	Harmonic Filter , Manual Control	1	Chemical
2012	Georgia Pacific - Rincon	13.8	15.05	1	1	Harmonic Filter , Manual Control	1	Paper
2012	Conestoga Wind Farm	34.5	5.60	fixed		High Pass Filter	1	Wind Energy
2012	Ensign Wind Farm	34.5	10.23	fixed		High Pass Filter	1	Wind Energy
2012	Muller/METSO	13.2	2.40	1	1	Manual Controlled Capacitor Bank	1	Miningrals

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2012	Ohio State University	13.8	7.20	1	1	Manual Controlled Capacitor Bank	6	University
2012	Vale Inco	13.8	11.70	4	4	Multi-Tuned Automatic Harmonic Filter Bank	4	Industrial/Rectifier
2012	Molycorp	12	12.58	4	4	Multi-Tuned Automatic Harmonic Filter Bank	1	Industrial/Rectifier
2012	Codelco Radomiro Tomic	22.9	6.39	4	4	Multi-Tuned Automatic Harmonic Filter Bank	3	Mining
2012	Rocanville Potash	13.8	16.05	4	4	Multi-Tuned Automatic Harmonic Filter Bank	1	Mining
2012	Colorado Salt Products	13.2	2.15	3	3	Multi-Tuned Harmonic Filter Bank, Remote Controlled	1	Industrial/Rectifier
2012	National Grid	13.2	7.20	2	2	SCADA Controlled Capacitor Bank	6	Utility
2012	Xcel Energy	13.8	9.60	2	2	SCADA Controlled Capacitor Bank	3	Utility
2012	Erieau Wind Farm	34.5	15.00	3	3	SCADA Controlled Capacitor Bank	1	Wind Energy
2012	Blackwell Wind Farm	34.5	7.40	1	1	SCADA Controlled Capacitor Bank	1	Wind Energy
2013	Canadian Natural Resources Ltd (CNRL)	34.5	7.50	3	3	Automatic Capacitor Bank	3	Mining
2013	Targa Resources	12.47	1.20	2	2	Automatic Capacitor Bank	2	Natural Gas
2013	Targa Resources	12.47	3.00	4	3	Automatic Capacitor Bank	1	Natural Gas
2013	Kinder Morgan Coal	12.47	1.30	3	2	Automatic Capacitor Bank	2	Petroleum
2013	SAMREF	34.5	12.00	2	2	Automatic Capacitor Bank	2	Petroleum
2013	Targa Resources	12.47	1.20	2	2	Automatic Capacitor Bank	2	Petroleum
2013	Cortland College	13.8	1.20	3	2	Automatic Capacitor Bank	2	University
2013	District Of Columbia Water & Sewer Authority	13.8	7.00	3	3	Automatic Capacitor Bank	3	Waste Water Treatment
2013	East Lake St. Clair Wind Farm	34.5	24.00	2	2	Automatic Capacitor Bank	1	Wind Energy
2013	Holcim Cement	4.16	0.80	3	3	Automatic Harmonic Filter	1	Cement
2013	Gerogia pacific	13.8	17.96	3	3	Automatic Harmonic Filter	1	Paper
2013	Johns Manville	13.8	2.00	6	3	Automatic Harmonic Filter	1	Industrial
2013	Archer Daniels Midland (ADM)	13.8	12.00	3	3	Automatic Harmonic Filter Bank	2	Food Processing
2013	Showa Denko Carbon	12.47	9.96	5	5	Automatic Harmonic Filter Bank	2	Industrial/Rectifier
2013	Boleo Mining	13.8	7.20	3	3	Automatic Harmonic Filter Bank	1	Mining
2013	Canadian Natural Resources Ltd (CNRL)	34.5	5.00	2	2	Automatic Harmonic Filter Bank	5	Mining
2013	Canadian Natural Resources Ltd (CNRL)	34.5	9.98	4	4	Automatic Harmonic Filter Bank	4	Mining
2013	Codelco Teniente Mining	34.5	13.80	3	3	Automatic Harmonic Filter Bank	1	Mining
2013	Trinity Manufacturing	22.9	7.10	3	3	Automatic Multi-Tuned Harmonic Filter Bank	1	Chemical
2013	Outotec	34.5	12.85	5	5	Automatic Multi-Tuned Harmonic Filter Bank	2	Mining/Rectifier

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2013	Kwale Miningral Sands	11	3.00	2	2	Automatic Notch-Tuned Harmonic Filter Bank	2	Mining
2013	Chevron Phillips Chemical	13.8	6.00	fixed		Capacitor Bank	2	Chemical
2013	BASF	13.8	7.20	fixed		Capacitor Bank	8	Chemical
2013	TRW Automotive	13.8	1.50	fixed		Capacitor Bank	1	Automotive
2013	Targa Resources	4.16	0.90	fixed		Capacitor Bank	6	Petroleum
2013	OmniSource	4.16	2.25	fixed		Capacitor Bank	1	Scrap Steel
2013	Morenci	13.8	11.00	3	3	C-High Pass Harmonic Filter, DCS Controlled	2	Mining
2013	Antelope Valley Solar Ranch	34.5	24.00	2	2	Grid Controlled Capacitor Bank	1	Solar
2013	Antelope Valley Solar Ranch	34.5	48.00	4	4	Grid Controlled Capacitor Bank	3	Solar
2013	Antelope Valley Solar Ranch	34.5	24.00	2	2	Grid Controlled Capacitor Bank	3	Solar
2013	Mountain View Solar	34.5	2.40	1	1	Manual Controlled Capacitor Bank	1	Solar
2013	Westlake Chemical	34.5	14.69	3	3	Multi-Tuned Automatic Harmonic Filter Bank	4	Chemical
2013	National Grid	13.2	7.20	2	2	SCADA Controlled Capacitor Bank	7	Utility
2013	National Grid	23	7.20	2	2	SCADA Controlled Capacitor Bank	2	Utility
2013	National Grid	34.5	6.20	2	2	SCADA Controlled Capacitor Bank	1	Utility
2013	National Grid	13.8	7.20	2	2	SCADA Controlled Capacitor Bank	4	Utility
2013	Xcel Energy	13.8	9.60	2	2	SCADA Controlled Capacitor Bank	4	Utility
2013	Black Spring Ridge Wind Farm	34.5	28.00	2	2	SCADA Controlled Capacitor Bank	1	Wind Energy
2013	Cape Scott Wind Farm	34.5	18.00	2	2	SCADA Controlled Capacitor Bank	2	Wind Energy
2013	Port Dover Wind Farm	34.5	18.00	2	2	SCADA Controlled Capacitor Bank	1	Wind Energy
2013	Copano Energy	13.8	9.90	4	6	SVC/Harmonic Filter	1	Natural Gas
2013	NLMK	6.9	9.72	3	3	SVC/Harmonic Filter	1	Steel
2013	Conoco Phillips	4.16	1.20	2	2	Capacitor Bank	1	Petroleum
2013	Shell Deer Park Refining Co.	4.16	0.90	1	1	Capacitor Bank	2	Petroleum
2013	Canadian Natural Resources Ltd (CNRL)	34.5	2.50	3	3	Automatic Capacitor Bank	2	Mining
2013	Albchem	25	16.68	fixed		Multi-Tuned Fixed Harmonic Filter Bank	1	Chemical
2013	Georgia Pacific - Rincon	13.8	17.96	3	3	Automatic Harmonic Filter Bank	1	Paper
2013	Recurrent Energy	12	0.13	fixed		Capacitor Bank	1	Solar
2013	ENEL Green Power	23	14.10	2	2	Automatic Harmonic Filter Bank	2	Wind Energy
2013	Recurrent Energy	12	4.20	4	4	Capacitor / Shunt Reactor Bank	1	Solar
2013	Nextera	34.5	2.40	1	1	Capacitor Bank	1	Solar
2013	Teak Midstream	24.94	5.00	5	5	Automatic Capacitor Bank	1	Gas
2014	Targa Resources	4.16	0.90	fixed		Fixed Capacitor Bank	3	Gas
2014	Targa Resources	4.16	1.00	fixed		Fixed Capacitor Bank	3	Gas

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2014	Bougault Industries	4.16	1.00	3	5	Automatic Harmonic Filter Bank	1	Manufacturing
2014	Chevron Phillips Chemical	13.8	6.00	fixed		Fixed Harmonic Filter Bank	2	Petroleum
2014	National Grid	34.5	6.14	2	2	Capacitor Bank - 1 Fixed, 1 Switched	1	Utility
2014	Valero	12.47	8.84	fixed		Fixed Capacitor Bank	2	Oil Refinery
2014	SA Recycling	4.16	3.00	fixed		Fixed Capacitor Bank	1	Recycling
2014	Gemenele Wind Farm	20	6.00	fixed		Fixed Capacitor Bank	1	Wind Energy
2014	Phillips 66 Sweeny Refinery	13.8	3.30	fixed		Fixed Capacitor Bank	2	Oil Refinery
2014	National Grid	13.2	3.60	fixed		Fixed Capacitor Bank	2	Utility
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	1	Utility
2014	Devco	11	0.15	fixed		Fixed Capacitor Bank	2	Manufacturing
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	2	Utility
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	1	Utility
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	1	Utility
2014	National Grid	23	7.20	2	2	Automatic Capacitor Bank	2	Utility
2014	Enbridge Pipeline	4.16	3.31	3	3	Automatic Harmonic Filter Bank	1	Pipeline
2014	University of Alabama	12.47	2.70	2	3	Automatic Capacitor Bank	1	University
2014	Enbridge Pipeline	12.47	7.20	2	3	activAR	2	Pipeline
2014	First Quality Tissue	12.47	7.75	6	6	Automatic Harmonic Filter Bank	1	Paper
2014	National Grid	13.2	7.20	2	2	Automatic Capacitor Bank	2	Utility
2014	Trinity Manufacturing	22.9	7.07	3	3	Automatic Harmonic Filter Bank	1	Chemical
2014	ArcelorMittal	13.8	27.17	3	3	activAR + PFC	1	Steel/Rolling Mill
2014	Antelope Valley Solar Ranch - Expansion	34.5	12.00	1	1	Expansion Project to Existing Capacitor Banks	1	Solar
2014	Suncor	4.16	0.90	fixed		Fixed Capacitor Bank	2	Mining
2014	Sunbelt Transformer	4.16	0.63	1	1	Harmonic Filter Bank	1	Manufacturing
2014	Yokohama Tire Co.	12.47	1.50	2	2	Automatic Harmonic Filter Bank	1	Manufacturing
2014	Northeast Ohio Medical University	12.47	1.20	3	4	Automatic Capacitor Bank	1	University
2014	Skyonics	13.8	9.19	3	3	Automatic Harmonic Filter Bank	2	Chemical
2014	Atlas Edwards	4.16	6.30	7	7	Automatic Capacitor Bank	4	Gas
2014	National Grid	4.16	1.80	1	1	Switched Capacitor Bank	2	Utility
2014	Copper Mountain	25	0.05	fixed		RC Snubber	6	Mining
2014	New Boston Air Force Station	12.47	0.45	fixed		Fixed Capacitor Bank	1	US Military
2014	Teck Mining Company	13.8	19.74	4	4	Automatic Harmonic Filter Bank	1	Mining
2014	Red Chris Mining	24.9	23.00	5	5	Multi-Tuned Automatic Harmonic Filter Bank	1	Mining

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	1	Utility
2014	DCP Midstream	12.47	3.00	3	3	Automatic Capacitor Bank	1	Gas
2014	Terrane Metals Corp. - Mt. Milligan	25	0.05	fixed		RC Snubber	6	Mining
2014	Colonial Pipeline	4.16	24.00	4	4	activAR	1	Pipeline
2014	Indiana University	34.5	7.20	fixed		Fixed Capacitor Bank	1	University
2014	ENAP - Oil/Gas	12	3.50	3	3	Automatic Capacitor Bank	1	Petroleum
2014	Kinder Morgan	13.8	24.00	2	3	actiVAR	1	Pipeline
2014	Enbridge Pipeline	12.47	9.55	2	2	actiVAR	1	Pipeline
2014	Bombardier	4.16	9.55	3	6	acitVAR	1	Manufacturing
2014	National Grid	13.2	3.30	fixed		Fixed Capacitor Bank	1	Utility
2014	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	2	Utility
2014	Enbridge Pipeline	4.16	4.00	3	4	Automatic Capacitor Bank	2	Pipeline
2014	QEP	4.16	2.00	3	3	Automatic Harmonic Filter Bank	3	Cryogenic Plant
2014	Atlas Pipeline	7.2	1.20	1	1	Automatic Capacitor Bank	1	Pipeline
2014	Riviere Du Moulin Wind Energy	34.5	21.50	2	2	C-HP Automatic Harmonic Filter Bank	2	Wind Energy
2014	Long Island Railroad	26.8	0.05	fixed		RC Snubber	2	Rail
2014	Engleside Chemical Plant	13.8	4.80	3	3	Automatic Harmonic Filter Bank	2	Chemical
2014	Codelco Teniente Mining	33	14.07	3	3	Automatic Harmonic Filter Bank	1	Mining
2014	National Grid	12.47	7.20	2	2	Switched Capacitor Bank	1	Utility
2014	Subaru	12.47	3.60	2	3	Automatic Harmonic Filter Bank	2	Automotive
2014	National Grid	13.8	7.20	2	2	Switched Capacitor Bank	2	Utility
2014	BHP Biliton	13.8	1.50	3	7	Automatic Capacitor Bank	2	Mining
2015	Escondida Water Supply Project	6.9	6.00	3	5	Automatic Capacitor Bank	8	Mining
2015	Reinecke Compressor Station	4.16	2.40	2	2	Automatic Capacitor Bank	1	Gas
2015	Transcanada	4.16	7.50	2	3	actiVAR	3	Pipeline
2015	PSEG	4.16	5.40	2	2	Switched Capacitor Bank	1	Utility
2015	Morenci	13.8	9.00	2	2	Automatic Capacitor Bank	1	Mining
2015	Roosevelt Wind Farm	34.5	37.80	3	3	Filter Ready Automatic Capacitor Bank	3	Wind Energy
2015	Tesla Motors	12.47	7.20	2	2	Automatic Capacitor Bank	4	Automotive
2015	VAI Midrex	13.8	8.00	4	4	Automatic Harmonic Filter Bank	2	Steel
2015	BASF	13.2	5.04	5	14	Automatic Capacitor Bank	2	Chemical
2015	National Grid	13.2	3.60	2	2	Automatic Capacitor Bank	1	Utility
2015	University of Massachusetts - Amherst	13.8	4.80	3	4	Automatic Harmonic Filter Bank	4	University

Year	Customer	KV	MVAR Per Bank	# of Steps	# of Stages	Description	Qty	Industry
2015	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	2	Utility
2015	ReEnergy - Black River	13.2	6.00	3	3	Automatic Harmonic Filter Bank	2	Generation
2015	RE Barren Ridge Solar	34.5	15.60	4	4	Automatic Capacitor Bank	1	Solar
2015	Koch Nitrogen Company	4.16	0.60	fixed		Fixed Capacitor Bank	4	Mine
2015	BASF	13.8	9.00	2	2	Automatic Capacitor Bank	4	Chemical
2015	National Grid	13.8	7.20	2	2	Automatic Capacitor Bank	1	Utility
2015	DC Water District	13.8	8.49	3	3	Automatic Capacitor Bank	3	Waste Water Treatment
2015	NASA	13.8	5.40	3	6	Automatic Capacitor Bank	3	Research/Test
2015	Targa Resources	4.16	4.20	3	5	Automatic Harmonic Filter Bank	2	Gas
2015	Port Neal	4.16	0.15	fixed		Fixed Capacitor Bank	4	Fertilizer
2015	Redwood Solar	34.5	3.00	1	1	Automatic Harmonic Filter Bank	2	Solar
2015	Atlas Pipeline	4.16	6.30	7	7	Automatic Capacitor Bank	4	Pipeline
2015	Sanridge Energy	25	5.00	3	6	Automatic Capacitor Bank	2	Petroleum
2015	Minera Media Luna	13.8	9.90	3	3	Automatic Capacitor Bank	1	Mine
2015	Dominion Energy	4.16	6.00	3	3	Automatic Capacitor Bank	4	Utility
2015	Shaw Renewable/Red Horse Wind/Solar	34.5	24.00	3	3	Automatic Filter Ready" Capacitor Bank	1	Renewable
2015	Sierra Solar	34.5	6.00	1	1	Automatic Capacitor Bank	1	Solar
2015	Lawrence Livermore National Security	12.47	2.40	1	1	Automatic Capacitor Bank	1	Comercial
2015	National Grid	12.47	7.20	2	2	Automatic Capacitor Bank	1	Utility

Attachment - B

Product Literature

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Medium Voltage Metal-Enclosed Harmonic Filter Systems

General

NEPSI's **armorVAR™,** medium voltage metal-enclosed harmonic filter banks are custom designed for application on industrial, commercial, and utility power systems that require medium voltage power factor correction, var and voltage support, and mitigation from harmonic resonance or harmonic distortion. NEPSI's filter systems are equipped with all switching, all protection, and all control. They come fully assembled and ready for interconnection. They are well suited for applications that are remote, require a high level of reliability, are at high-altitude, where footprint comes at a premium, and at high altitude and wind/snow load locations.

Product Scope

- Voltage range: 2.4kV through 38kV (60kV BIL through 200 kV BIL)
- System frequency: 50 or 60 Hertz systems
- Reactive power rating: 0.5MVAR to 100 MVAR
- Filter types: C-high-pass (damped filters), high-pass, notch (band pass), double-tuned, and multi-tuned
- Single-step, multi-step, and fixed filter banks
- Equipped with all switching, all protection, all control
- Seismic, wind, and snow load certification
- Applicable industries: Mining, Chemical, Petroleum, Commercial, General Industrial, Wind & Solar

Bulletin: 200-00 Rev. Date: 9/25/2015

Ratings

The **armorVAR™** is rated and configured to meet customer requirements for voltage, basic insulation level (BIL), available short circuit current, reactive power rating, frequency, and filter performance. Internal components such as disconnect and grounding switches, circuit breakers, capacitors, capacitor switches, and capacitor fuses are chosen based on their ratings, costs, availability, and NEPSI's experience with the supplier's quality, service, and reliability.

Rating	Range of Available Ratings
Bank Configuration:	Single Step/Multiple Step/Fixed Step Multi-tuned/Single-Tuned
Filter Types:	Notch (Band-Pass), High-Pass, C-High-Pass, Multi-Tuned, Double-Tuned
Operating Voltage (line-to-line):	2.4kV – 38kV
Operating Frequency:	50 Hertz | 60 Hertz
Reactive power output:	0.5MVAR – 100 MVAR (500kvar – 100,000 kvar)
Tune frequency (Hz)	85 Hz 2100 Hz (1.4th Harmonic – 35th harmonic)
High-Pass (damping) resistor rating:	1 Ohm to 1000 Ohms 10kW/Phase - 200kW/Phase
Short circuit (asymmetrical momentary):	16kA - 61kA
Impulse withstand voltage (Basic Insulation Level):	60kV – 200 KV (third party tested)
Short-time withstand voltage (1 minute 50/60 Hertz):	19kV – 80kV
Control voltages:	AC Volts: 110, 115,120, 220, 50/60hz DC Volts: 24, 48, 110, 125, 220
Operating temperature range:	-50°C to +55°C -58°F to 131°F
Maximum altitude without de-rating:	1,000 Meters 3,300 Feet
Enclosure:	(NEMA): 1, 3R, 4X, 12 | (IEC): IP10, IP14, IP56, IP52 Arc Resistant Enclosure Designs NEC Class 1 & 2 Div. II
Seismic:	As specified - Prior certification to Zone 4
Wind	As specified - Prior certification to 190 mph (305.7 km/h)
Snow Load	As specified - Prior certification to 22.96 feet (7 meters)
Capacitor fusing:	Internally fused | Externally fused
Standards | Codes: NEPSI designs and builds their equipment to a hosts of national and international standards, including CSA, ANSI, and IEC. Consult with NEPSI for standards not listed.	• IEEE Std. 1036-2010, *IEEE Guide for the Application of Shunt Power Capacitors* • IEEE Std. 18-2012, *IEEE Standard for Shunt Power Capacitors* • IEEE C37.*99-2012, IEEE Guide for the Protection of Shunt Capacitor Banks* • IEEE 519-2014, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems* • Standard IEC 61000-2-4:2002, *Environment— Compatibility levels in industrial plants for low-frequency conducted disturbances* • UL-347, *High Voltage Industrial Control Equipment* • UL-508, *Industrial Control Panels* • UL-50, *Standard for enclosures for Electrical Equipment* • ANSI C37.20.2, *IEEE Standard for Metal-Clad Switchgear*

Equipment Configuration

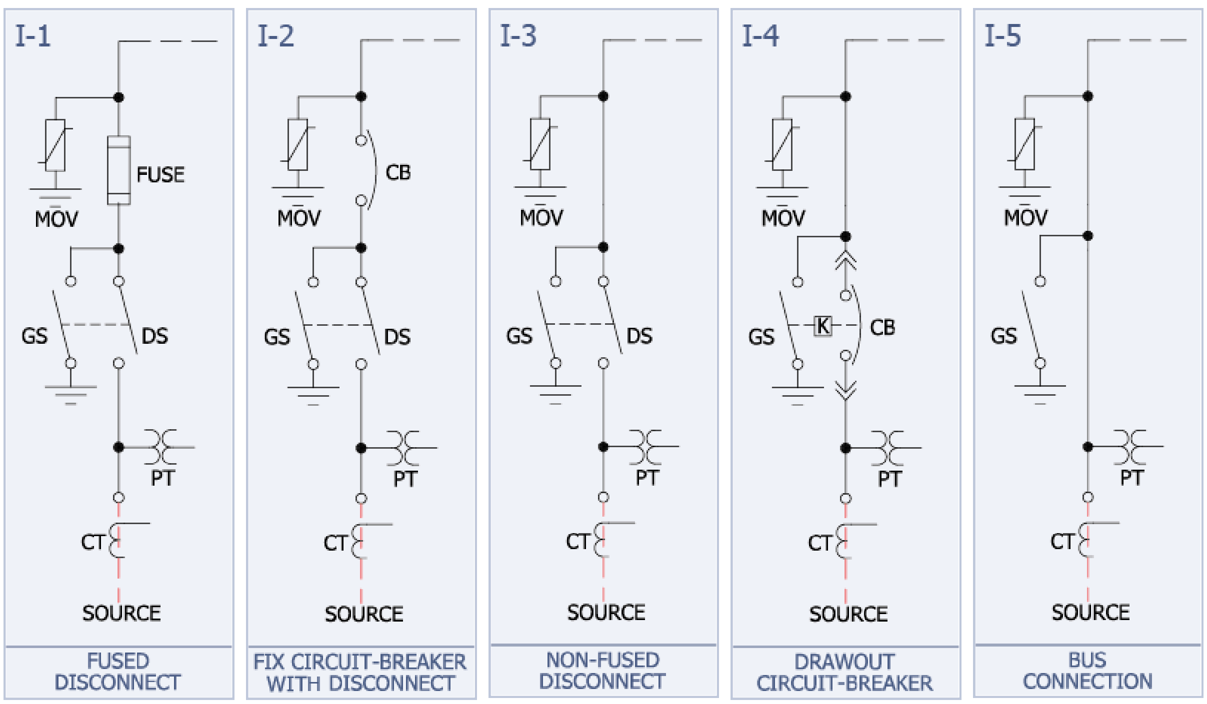
NEPSI's **armorVARs™** are custom designed, configured, and rated to mitigate site-specific harmonic voltage, harmonic current, and system power factor. They may be equipped with or without switching and disconnecting means as required by the customer and can come in a variety of configurations based on customer site requirements and preferences.

Sections 1, and 2 that follow provide details on most of the available options.

1 Incoming Compartment Configuration Options

The incoming compartment of the armorVAR® is available with a range of options based on system ratings and customer preference. Generally, all filter systems should be equipped with a “visible break” and a grounding switch to allow for safe maintenance of the equipment. The “visible break” may be accomplished using a disconnect switch or a draw-out circuit breaker. Short circuit protection should also be provided and can be accomplished with main incoming fuses or a main incoming breaker. Only consider a bus connection when a visible break and short circuit protection are available on the filter bank feeder cables.

Incoming compartment configurations include the following:



Accessories For Incoming Compartment

The following items are available for placement in the incoming compartment. On simpler systems, CPT’s or PT’s can serve double duty as both protection/control signals and control power for the filter system. Roof bushings provide a simple means to connect to overhead bus in a substation yard. Key interlocks help ensure proper sequence of operation and safe entry into the enclosure. Lightning arresters provide transient voltage surge protection for the equipment in case of lightning strikes or breaker/switch restrike/prestrike.

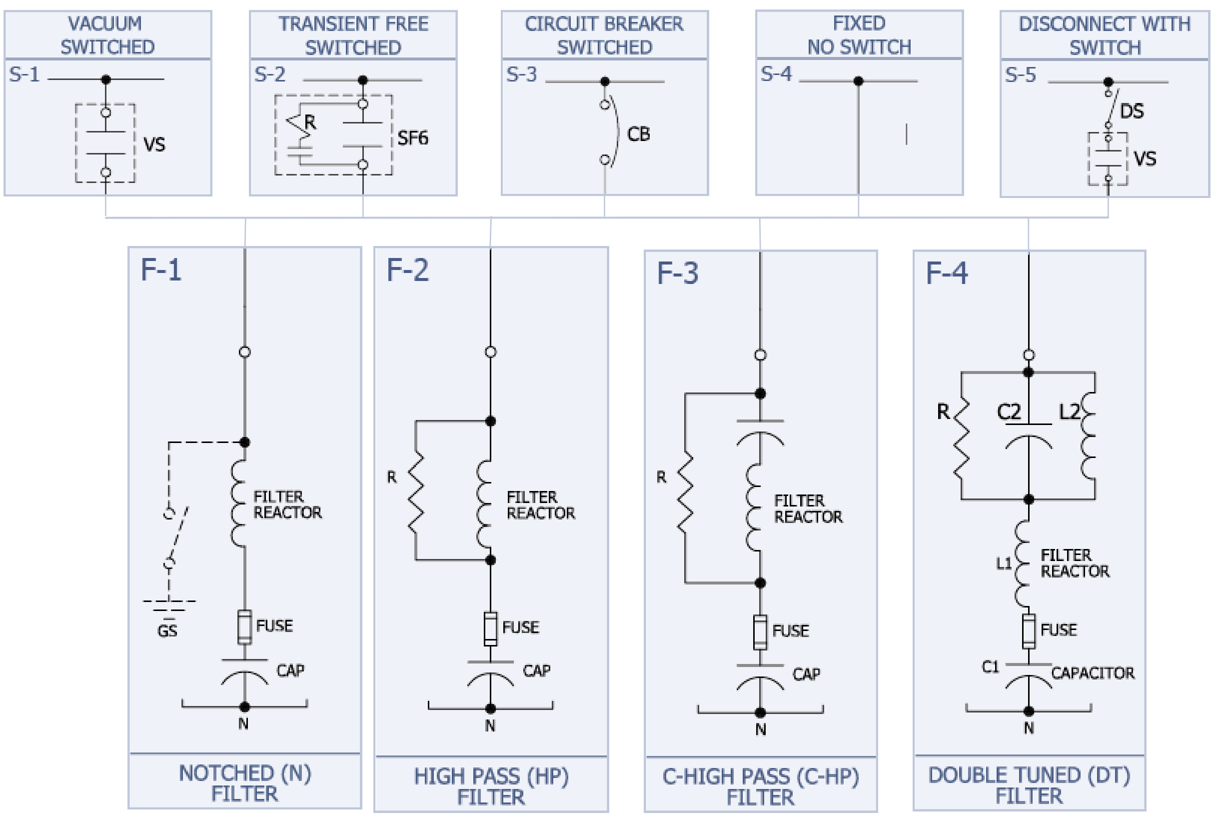
PT	POTENTIAL TRANSFORMER	MOV	SURGE ARRESTER		ROOF BUSHING OVERHEAD BUS
CT	CURRENT TRANSFORMER	CPT	CONTROL POWER TRANSFORMER	K	KEY INTERLOCK

2 Stage | Filter Branch Options

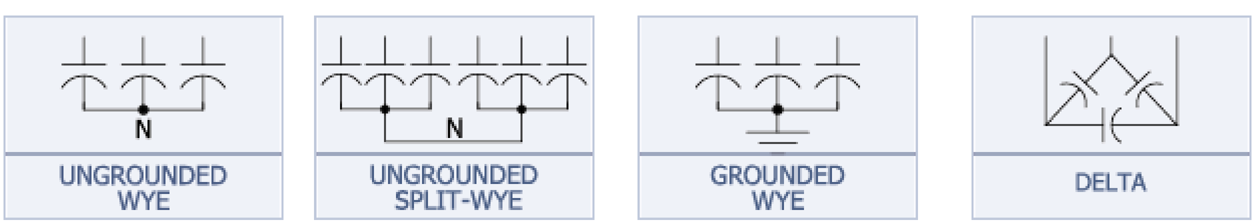
Each filter stage or filter branch can be switched by a number of different types of devices, depending on ratings; devices include vacuum contactors, vacuum switches, and SF6/vacuum circuit breakers. The individual branches/stages may also be equipped with an isolation switch or draw-out device to facilitate partial shutdown and maintenance of the filter system. Choose the technology that suits your application (S-1 through S-6) and work with NEPSI to determine the correct rating and best manufacturer.

A number of filter configurations are available. Notch filters (F-1) provides the best filtering at their tune frequency but are more susceptible to non-characteristic harmonic resonance and resonance due to stray capacitance. High-pass filters (F-2) help dampen these concerns but have high losses, especially at low tuning frequencies. In such cases, consider a C-HP filter where such losses are high or where a significant amount of dampening is required.

Work with NEPSI to determine what filter works best on your system.



The harmonic filter can be connected in a number of different ways depending upon bank rating and protection requirements. Typically, harmonic filters are provided with an ungrounded wye or ungrounded split-wye connection, but a grounded wye and Delta connection are also available.



Control Options

NEPSI's **armorVAR™** can be furnished with a fully integrated control and protection system that can form and integral part of the equipment or be remotely mounted in the E-house. In either case, your control system will be fully assembled, tested, and calibrated at the factory, relieving your contractors of costly onsite setup and commissioning cost.

Filter Bank Control Options	Typical Control Features
• Power Factor Control	• On | OFF | Auto & Local | Remote Controls • Stage status indication • Circuit Breaker Control Switches
• Voltage Control	• Power quality meters on all main or on all filter branches/ stages
• Harmonic Voltage / Current Distortion Control	• Control power circuit breakers for all branch circuits, lights, strip heaters, thermostatically controlled fans
• Remote / SCADA Control	• 5-Minute Discharge | re-energization timers • Key interlocks to dictate sequence of operation and safe entry into enclosure
• Remote control by plant DCS / EMS system	• PT/CT test and short switches

Protection Options

The **armorVAR™** is furnished with host of protection options to keep your system up and running with minimum downtime.

All stages are protected against short circuit, overload, over-voltage, harmonic over-current, harmonic over-voltage, over-temperature, and unbalance operation from blown capacitor fuses. Protective relays and ancillary protective devices are chosen based on function, cost, reliability, and customer preference.

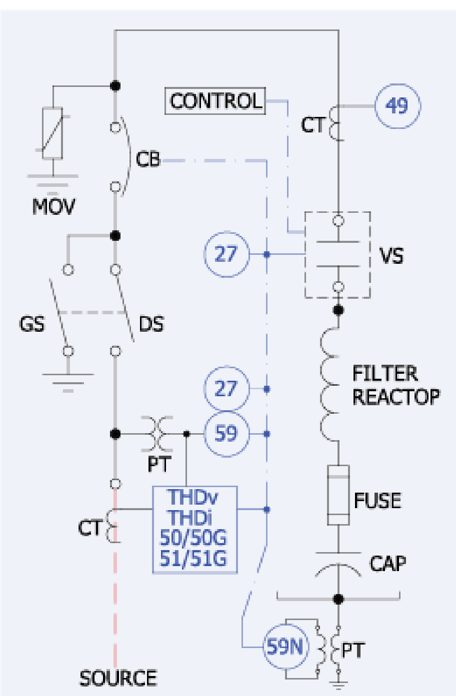
The Table on the following page summarizes the protection device numbers that are typically provided with NEPSI's **armorVAR™**.

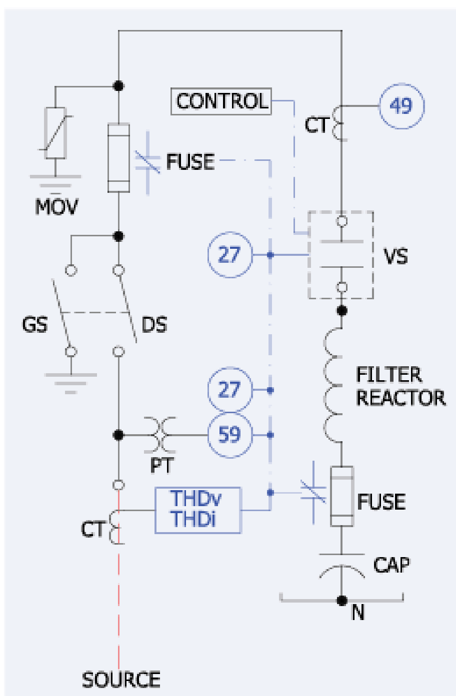
FULL FEATURED FILTER BANK CONTROL AND PROTECTION SYSTEMS
Protection & Control for all size systems
Design | Build | Program | Commission

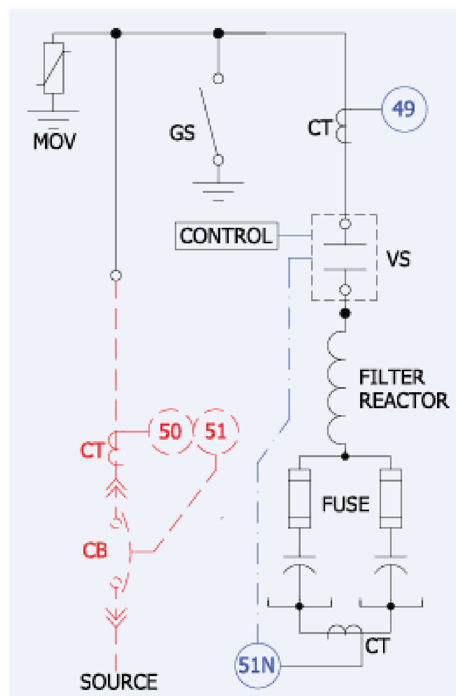
Protection Type	Designation	Description
Short Circuit and Overcurrent Protection	50/51 50/51G	Phase and Ground Short Circuit Protection
Over-Voltage/ Under Voltage	59/27	Over-voltage and Under Voltage Protection
Neutral Unbalance (Blown Fuse Detection)	59N or 51N or 51G or Direct	Relay or direct fuse sensing to detect a capacitor fuse operation. This is critical since a blown fuse condition will change filter de-tuning, lower var output, lower performance, and possibly create system resonance.
Over-Load	49	Over-load protection of the high-pass resistors (if provided), iron-core reactors, and thyristor valves. Relay is sensitive to RMS current associated with the filter's fundamental current and harmonic current.
Harmonic Voltage & Current Distortion	I_{THD}, V_{THD}	Protection against harmonic resonance, high voltage & current distortion, and harmonic overload
Over-Temperature	26	Protection for the thyristor valves, capacitors, and iron-core reactors. Also protects against fan failure.
Arc Flash Detection & Mitigation	Arc Flash	Arc flash detection relays as well as the ABB UFES system for fast detection and clearing of arcing faults.

Typical Protection System

Typical relay protection diagram for the **armorVAR™.** Protection systems are custom designed based on customer preference, customer relay plattform, budget, and cost of equipment.







armoVAR® Ordering Guide

The **armorVAR®** is custom built to meet your requirements. Feel free to contact NEPSI for a quote or to discuss your specific application.

Additionally, visit our webpage at www.nepsi.com and follow the product page link to metal-enclosed harmonic filter banks. There you will find additional information, including:

- Guide form specifications
- Component Cut Sheets and Instruction Manuals
- Pictures of Equipment and Components
- Technical Resources, including spread sheet design tools, relay settings tools, and design calculators

Power System Studies

NEPSI performs power system studies to evaluate the expected performance of our metal-enclosed products. Studies offered by NEPSI include:

- Stability
- Motor Starting
- Load flow
- Reactive Power / Var Flow Studies
- Coordination
- Voltage Drop | Voltage Rise Analysis
- Harmonic Analysis
- Short Circuit
- Protective Coordination

Our Power System Studies are tailored to your needs and project requirements.

armorVAR ™ - Project Showcase

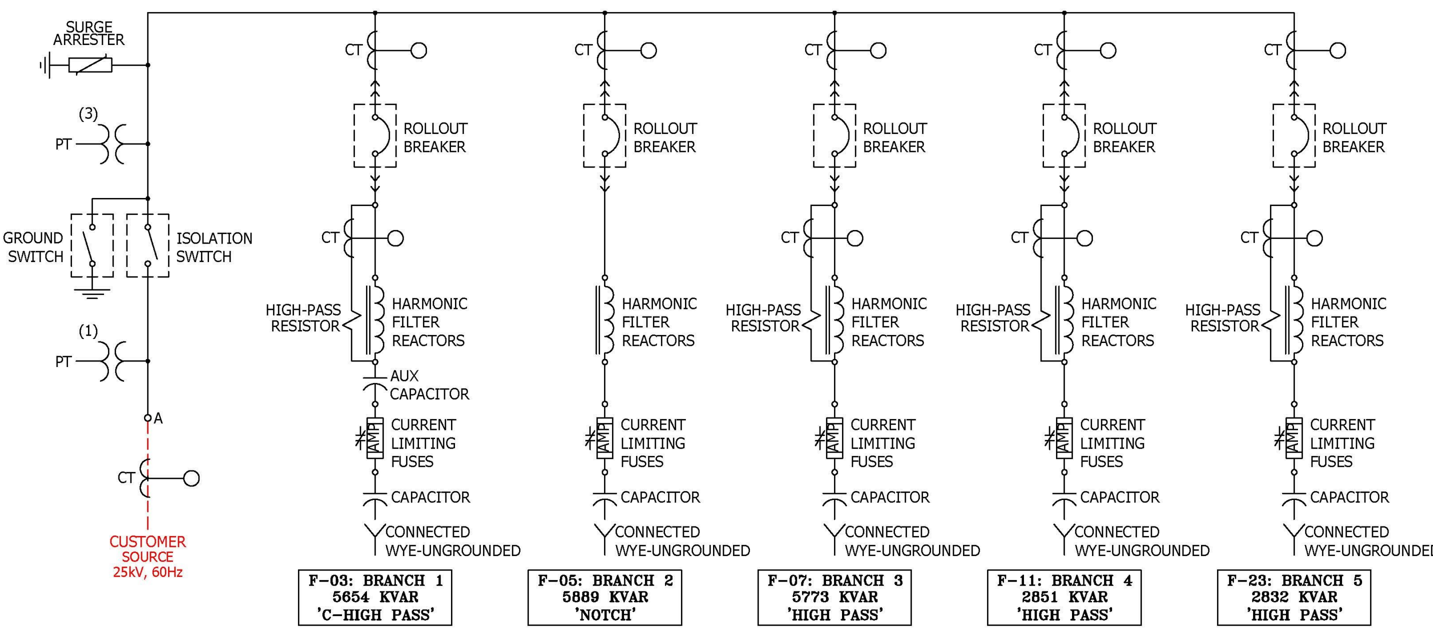
The below filter system supplies reactive power and harmonic filtering to Red Chris Mine's 30,000-tonne-per-day mill, which includes two 9,000 HP variable frequency drives. This all-inclusive design encompassed all protection, control, switching, disconnecting, and interlocking requirements.

This metal-enclosed system was chosen instead of an open-rack filter system due to the remoteness of the mine and its harsh arctic environment, which sits at the tree line at an elevation of 1,500 meters with temperatures that vary from average lows of -21°C (-6°F) in January to average highs of 9°C (48°F) in July with extremes ranging from -50°C(-58°F) to 30°C (86°F).

RED CHRIS MINE - BRITISH COLUMBIA

C-High Pass, High Pass, and Notch Filter Branches

23 MVAR, 24.9 kV, 5-Stage, All-Inclusive Harmonic Filter System



Bulletin: 200-00 Rev. Date: 9/25/2015

NEPSI
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www.nepsi.com | sales@nepsi.com

Medium Voltage Metal-Enclosed Power Capacitor Banks

General

Northeast Power System's (NEPSI's) medium voltage metal-enclosed power capacitor banks are an economic, compact, and easy to maintain source of reactive power for commercial, industrial, and utility power systems. Whether the need is to meet a utility interconnect requirement at a renewable power plant, or to meet a power factor penalty at an industrial facility, or to increase system capacity and reduce losses on a utility distribution system, NEPSI's metal-enclosed power capacitor banks are the best choice.

Our capacitor banks are custom built to your requirements, and are shipped fully tested, assembled, and ready for interconnection; containing all switching, all protection, and all control. When compared to an "open-rack" capacitor bank, they are easier to engineer, procure, install, commission, maintain, and take up less space. Combining this with NEPSI's "filter ready" design, the ability to quickly and easily convert a capacitor bank to a filter bank, the metal-enclosed capacitor bank is the most cost effective design.

Product Scope

- Voltage range: 2.4kV through 38kV (60kV BIL through 200 kV BIL)
- System frequency: 50 or 60 Hertz systems
- Reactive power rating: 0.5MVAR to 100 MVAR
- Single-step, multi-step (up to 15 steps), and fixed power capacitor banks
- "***Harmonic Filter Ready***" designs to incorporate high-pass, C-high-pass, and notch filter designs
- Equipped with all switching, all protection, all control
- Seismic, wind, and snow load certification
- Applicable industries: Solar, Wind, Electric Utility, General Industrial, Petroleum

Bulletin: 100-00 Rev. Date: 10/09/2015

Ratings

The **armorVAR™** is rated and configured to meet customer requirements for voltage, basic insulation level (BIL), available short circuit current, reactive power rating, and frequency. Internal components such as disconnect and grounding switches, circuit breakers, capacitors, capacitor switches, and capacitor fuses are chosen based on their ratings, costs, availability, and NEPSI's experience with the supplier's quality, service, and reliability.

Rating	Range of Available Ratings
Bank Configuration:	Single Step/Multiple Step/Fixed Step
"**Filter Ready Designs**"	Notch (Band-Pass), High-Pass, C-High-Pass, Multi-Tuned, Double-Tuned tuning point, reactor, current, type of harmonic filter determined at time of conversion
Operating Voltage (line-to-line):	2.4kV – 38kV
Operating Frequency:	50 Hertz | 60 Hertz
Reactive power output:	0.5MVAR – 100 MVAR (500kvar – 100,000 kvar)
Short circuit (asymmetrical momentary):	16kA - 61kA
Impulse withstand voltage (Basic Insulation Level):	60kV – 200 KV (third party tested)
Short-time withstand voltage (1 minute 50/60 Hertz):	19kV – 80kV
Control voltages:	AC Volts: 110, 115,120, 220, 50/60hz DC Volts: 24, 48, 110, 125, 220
Operating temperature range:	-50°C to +55°C -58°F to 131°F
Maximum altitude without de-rating:	1,000 Meters 3,300 Feet
Enclosure Rating:	(NEMA): 1, 3R, 4X, 12 | (IEC): IP10, IP14, IP56, IP52 Arc Resistant Enclosure Designs: Type 1, Type 1D-SR-SL, Type 2 Hazardous Location: NEC Class 1 & 2 Div. II
Enclosure Materials:	Steel: 11 gauge Galvaneel, optional 12 gauge 409 or 316 steel. Paint: Salt Spray Rating: 5,500 Hr.
Seismic:	As specified - Prior certification to Zone 4
Wind	As specified - Prior certification to 190 mph (305.7 km/h)
Snow Load	As specified - Prior certification to 22.96 feet (7 meters)
Capacitor fusing:	Internally fused | Externally fused
Standards | Codes: NEPSI designs and builds their equipment to a hosts of national and international standards, including CSA, ANSI, and IEC. Consult with NEPSI for standards not listed.	• IEEE Std. 1036-2010, *IEEE Guide for the Application of Shunt Power Capacitors* • IEEE Std. 18-2012*, IEEE Standard for Shunt Power Capacitors* • IEEE C37*.99-2012, IEEE Guide for the Protection of Shunt Capacitor Banks* • IEEE 519-2014, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems* • Standard IEC 61000-2-4:2002*, Environment— Compatibility levels in industrial plants for low-frequency conducted disturbances* • UL-347*, High Voltage Industrial Control Equipment* • UL-508*, Industrial Control Panels* • UL-50*, Standard for enclosures for Electrical Equipment* • ANSI C37.20.2, *IEEE Standard for Metal-Clad Switchgear*

Equipment Configuration

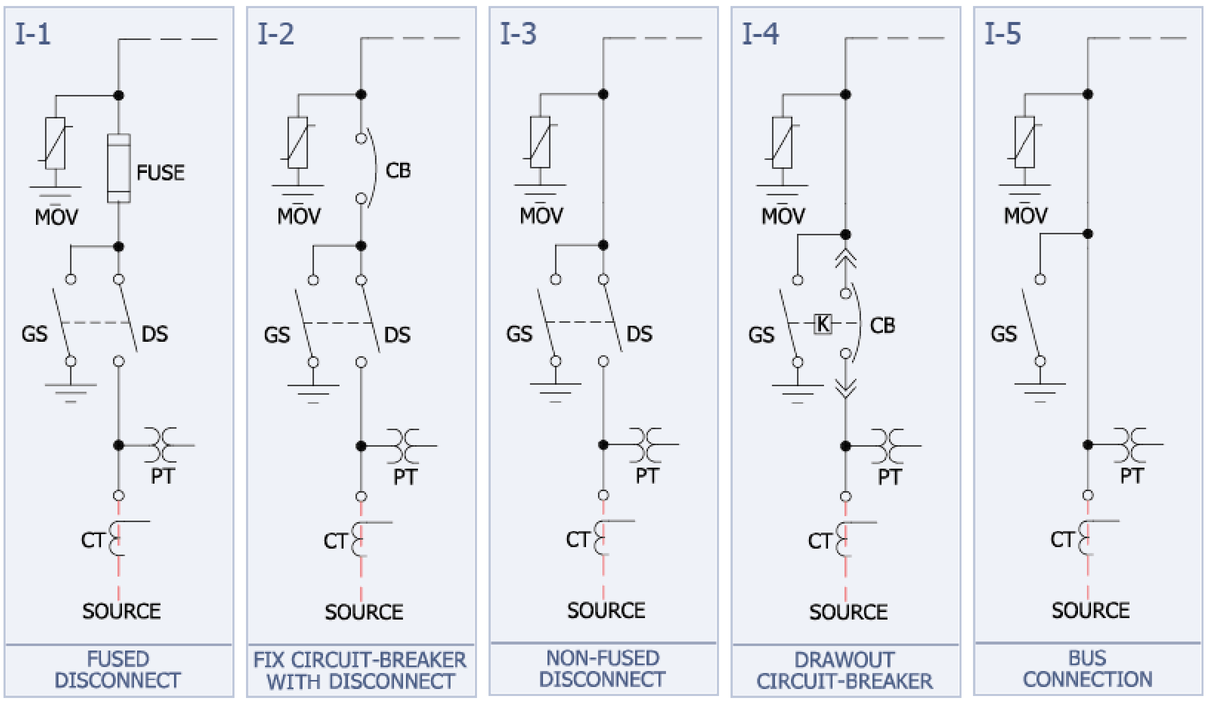
NEPSI's **armorVARs™** are custom designed to meet your requirements. From choice of incoming compartment to capacitor switching device, to type and rating of capacitor. NEPSI chooses components based on customer preference, suitability, cost, availability, and reliability.

Sections 1, and 2 that follow provide details on most of the available options.

1 Incoming Compartment Configuration Options

The incoming compartment of the armorVAR® is available with a range of options based on system ratings and customer preference. Generally, all capacitor banks should be equipped with a “visible break” and a grounding switch to allow for safe maintenance of the equipment. The “visible break” may be accomplished using a disconnect switch or a draw-out circuit breaker. Short circuit protection should also be provided and can be accomplished with main incoming fuses or a main incoming breaker. Only consider a bus connection when a visible break and short circuit protection are available on the capacitor bank feeder cables.

Incoming compartment configurations include the following:



Accessories For Incoming Compartment

The following items are available for placement in the incoming compartment. On simpler systems, CPT’s or PT’s can serve double duty as both protection/control signals and control power for the filter system. Roof bushings provide a simple means to connect to overhead bus in a substation yard. Key interlocks help ensure proper sequence of operation and safe entry into the enclosure. Lightning arresters provide transient voltage surge protection for the equipment in case of lightning strikes or breaker/switch restrike/prestrike.

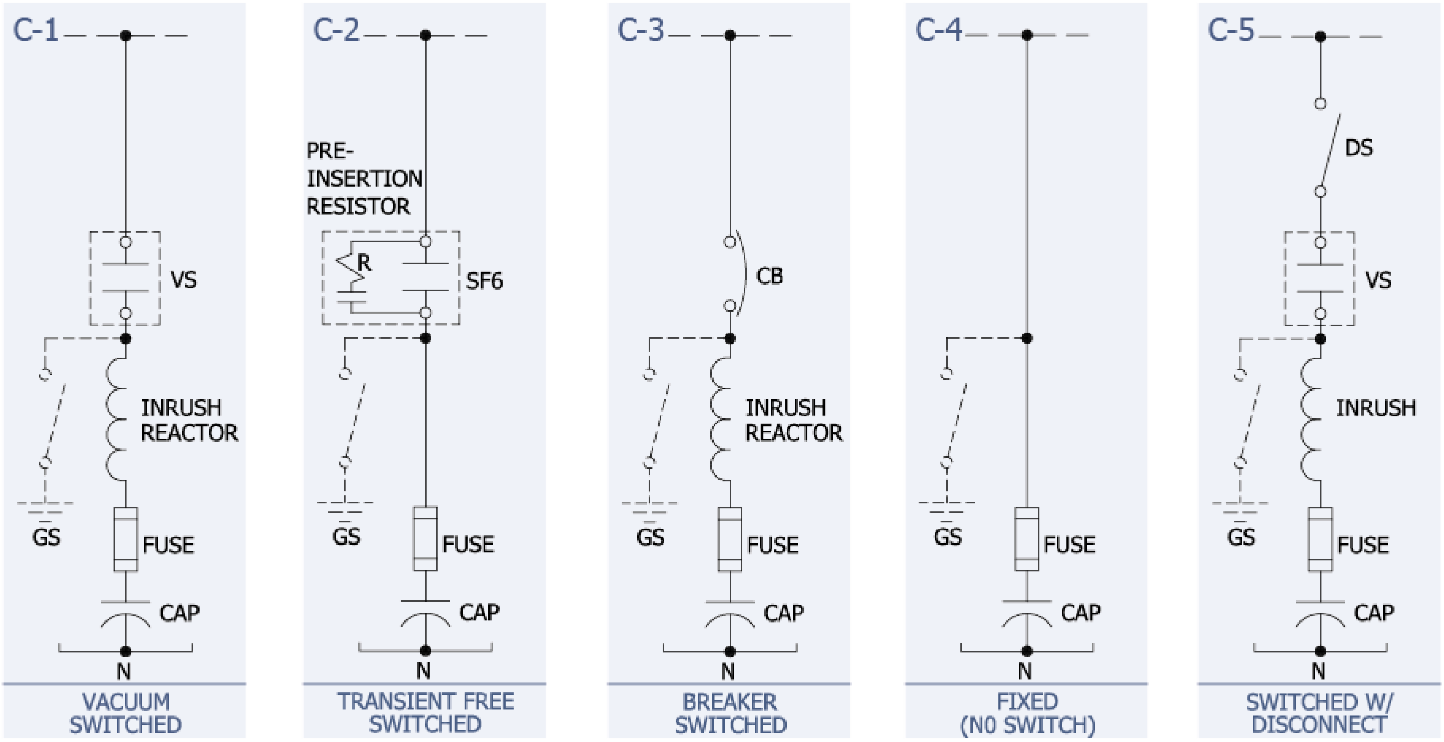
PT	POTENTIAL TRANSFORMER	MOV	SURGE ARRESTER		ROOF BUSHING OVERHEAD BUS
CT	CURRENT TRANSFORMER	CPT	CONTROL POWER TRANSFORMER	K	KEY INTERLOCK

2 Capacitor Compartment Configuration Options

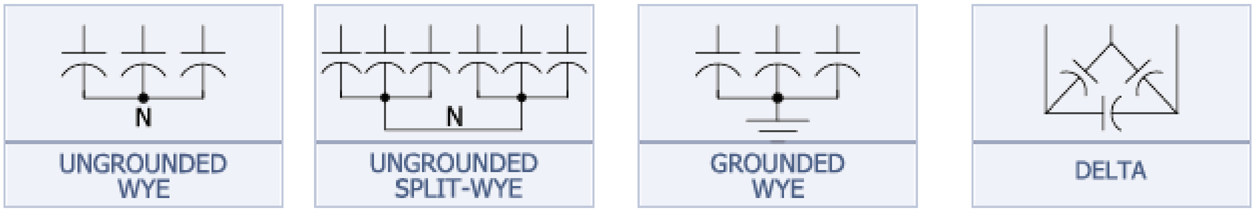
The capacitor compartment may consists of one capacitor bank or multiple capacitor stages. A capacitor bank or stage normally consists of the capacitors, capacitor fuses, and where applicable, a switching device and transient inrush reactors. Typical bank or stage configuration options are provided below. The capacitor bank/stage compartment is compartmentalized and isolated from the incoming compartment to allow for maintenance and repair.

For system voltages at or above 24.9kV, NEPSI recommends option (C-2), a Southern States CapSwitcher® or option (C-3) a vacuum or SF6 circuit breaker. Optional ground switches provide a secondary means of capacitor discharge and ensure capacitors are discharged should a capacitor discharge resistor fail.

Transient inrush reactors are not required for option C-2, but are required for all other systems involving back-to-back capacitor switching. Inrush reactor ratings are based on system voltage, stage reactive power rating, and switching device rating. Consult the resource page at NEPSI.com for further information.



The capacitor bank can be connected in a number of different ways depending upon bank rating and protection requirements. Typically, capacitor banks are provided with an ungrounded wye or ungrounded split-wye connection, but a grounded wye and Delta connection are also available.



Control Options

NEPSI's **armorVAR™** can be furnished with a fully integrated control and protection system that can form and integral part of the equipment or be remotely mounted in the E-house. In either case, your control system will be fully assembled, tested, and calibrated at the factory, relieving your contractors of costly onsite setup and commissioning cost.

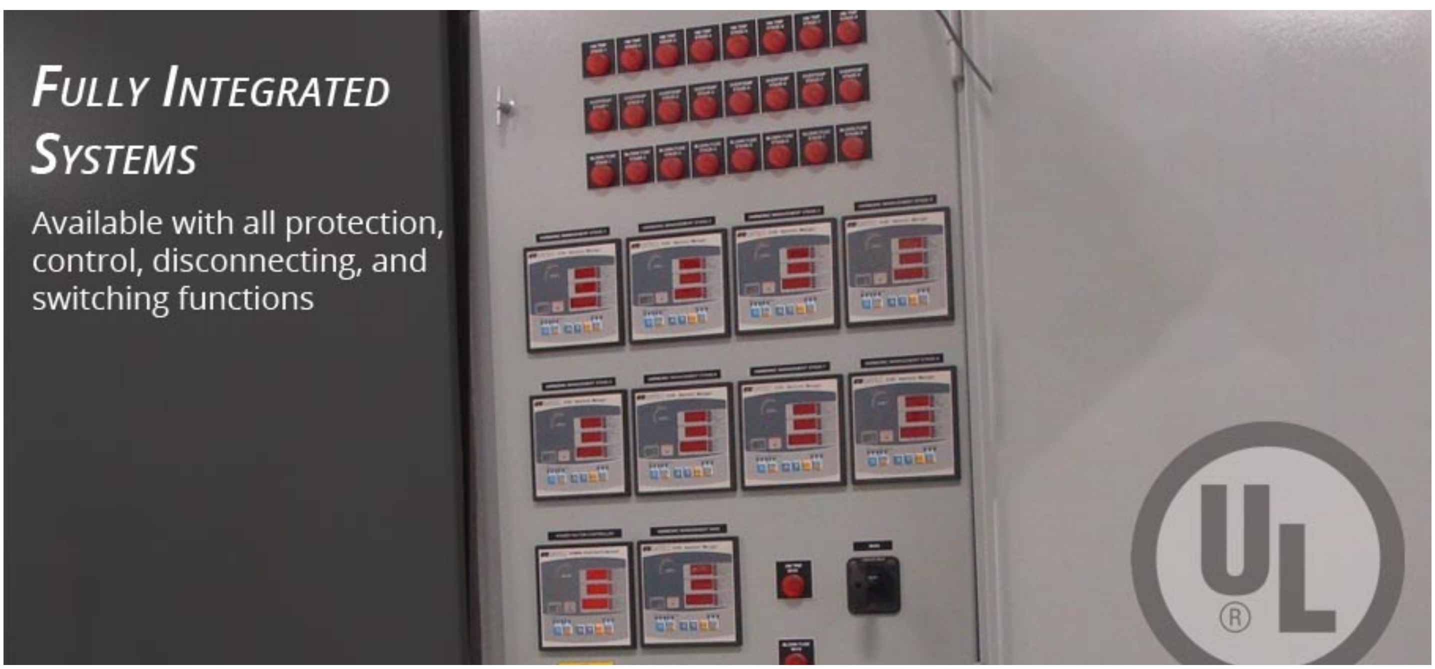
Capacitor Bank Control Options	Typical Control Features
• Power Factor Control	• On | OFF | Auto & Local | Remote Controls • Stage status indication • Circuit Breaker Control Switches
• Voltage Control	• Power quality meters on all main or on all filter branches/ stages
• Harmonic Voltage / Current Distortion Control	• Control power circuit breakers for all branch circuits, lights, strip heaters, thermostatically controlled fans
• Remote / SCADA Control	• 5-Minute Discharge | re-energization timers • Key interlocks to dictate sequence of operation and safe entry into enclosure
• Remote control by plant DCS / EMS system	• PT/CT test and short switches

Protection Options

The **armorVAR™** is furnished with host of protection options to keep your system up and running with minimum downtime.

All stages are protected against short circuit, overload, over-voltage, harmonic over-current, harmonic over-voltage, over-temperature, and unbalance operation from blown capacitor fuses. Protective relays and ancillary protective devices are chosen based on function, cost, reliability, and customer preference.

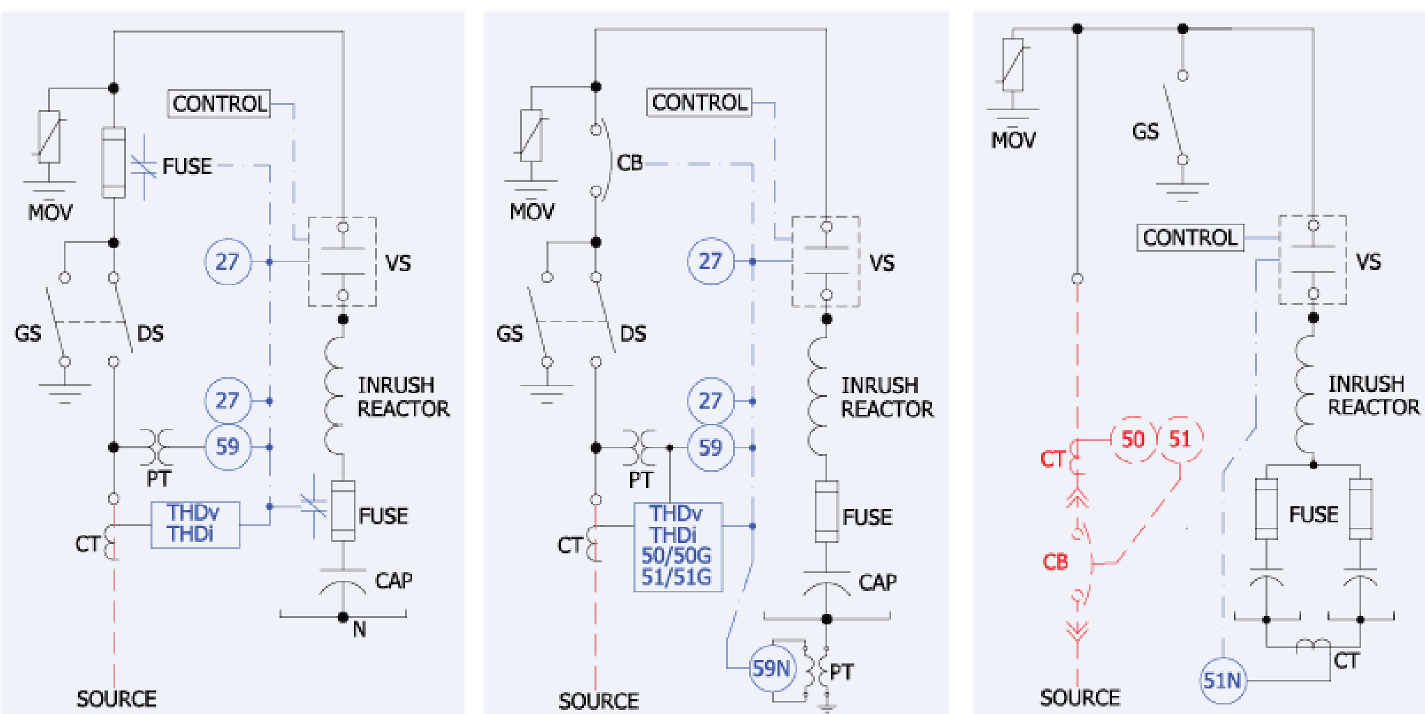
The Table on the following page summarizes the protection device numbers that are typically provided with NEPSI's **armorVAR™**.



Protection Type	Designation	Description
Short Circuit and Overcurrent Protection	50/51 50/51G	Phase and Ground Short Circuit Protection
Over-Voltage/ Under Voltage	59/27	Over-voltage and Under Voltage Protection
Neutral Unbalance (Blown Fuse Detection)	59N or 51N or 51G or Direct	Relay or direct fuse sensing to detect a capacitor fuse operation. This is critical since a blown fuse condition will change filter de-tuning, lower var output, lower performance, and possibly create system resonance.
Over-Load	49	Over-load protection of the high-pass resistors (if provided), iron-core reactors, and thyristor valves. Relay is sensitive to RMS current associated with the filter's fundamental current and harmonic current.
Harmonic Voltage & Current Distortion	I_{THD}, V_{THD}	Protection against harmonic resonance, high voltage & current distortion, and harmonic overload
Over-Temperature	26	Protection for the thyristor valves, capacitors, and iron-core reactors. Also protects against fan failure.
Arc Flash Detection & Mitigation	Arc Flash	Arc flash detection relays as well as the ABB UFES system for fast detection and clearing of arcing faults.

Typical Protection System

Typical relay protection diagram for the **armorVAR™.** Protection systems are custom designed based on customer preference, customer relay plattform, budget, and cost of equipment.



armoVAR® Ordering Guide

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- Component Cut Sheets and Instruction Manuals
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- Technical Resources, including spread sheet design tools, relay settings tools, and design calculators

Power System Studies

NEPSI performs power system studies to evaluate the expected performance of our metal-enclosed products. Studies offered by NEPSI include:

- Stability
- Motor Starting
- Load flow
- Reactive Power / Var Flow Studies
- Coordination
- Voltage Drop | Voltage Rise Analysis
- Harmonic Analysis
- Short Circuit
- Protective Coordination

Our Power System Studies are tailored to your needs and project requirements.

armorVAR ™ - Project Showcase

Meeting the Demand of the Solar Industry

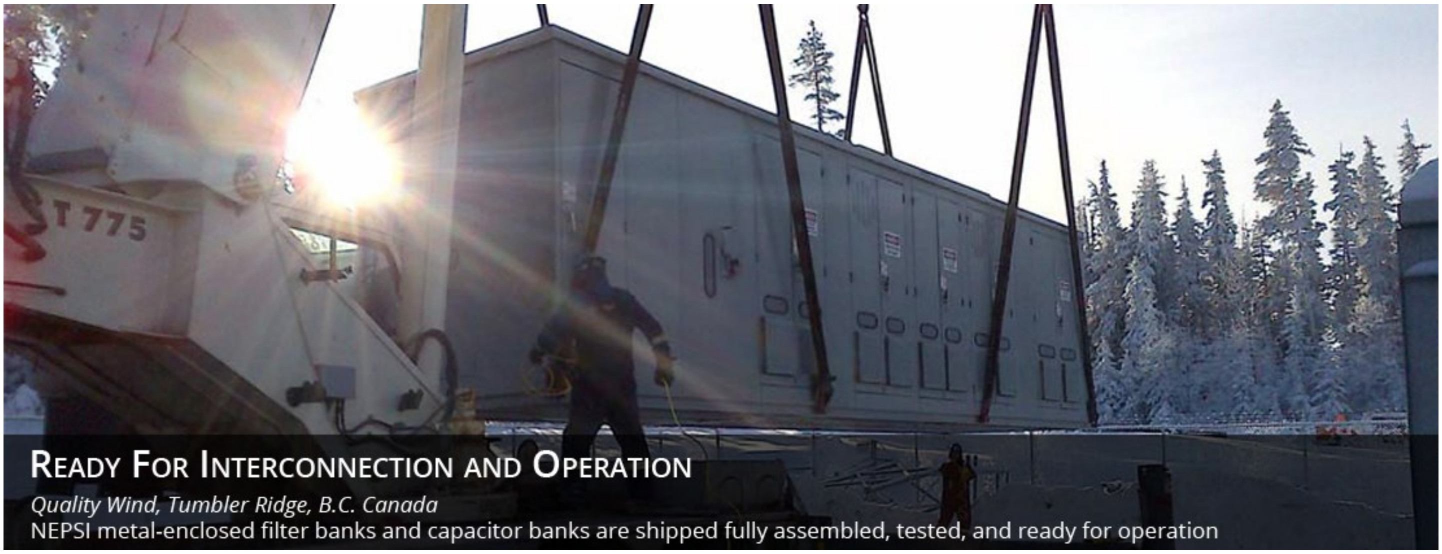
Sunpower, California Valley Solar Ranch, California

Metal-enclosed capacitor bank, 34.5kV, 150kV BIL, 60MVAR, 5 Stages of 12 MVAR

Small Industrial Automatic Filter Application

Johns Manville, Ohio

13.8kV, 60HZ, 110kV BIL, 2 MVAR, 6 Step Automatic Harmonic Filter Bank



Ready For Interconnection and Operation

Quality Wind, Tumbler Ridge, B.C. Canada

NEPSI metal-enclosed filter banks and capacitor banks are shipped fully assembled, tested, and ready for operation

NEPSI
Northeast Power Systems, Inc.

66 Carey Road | Queensbury, NY | 12804
Ph: (518) 792-4776 | Fax: (518) 792-5767
www.nepsi.com | sales@nepsi.com

Medium Voltage Metal-Enclosed Thyristor-Switched Harmonic Filter Banks

General

NEPSI's **actiVAR**®, Medium Voltage Metal-Enclosed Thyristor-Switched Harmonic Filter Banks are custom designed for power systems requiring instantaneous var support to mitigate voltage sags, voltage flicker, and high inrush currents associated with large dynamic loads and motor starting.

The **actiVAR**® samples your phase voltage, load, and line currents at rates exceeding 7,000 times a second, analyzes them in real-time, and instantly changes state to match your load requirements. Adjusting 60 times a second on each phase, the **actiVAR**® effectively stiffens your supply voltage.

Industries with large dynamic loads like pump stations, welders, shredders, rolling mills, and arc furnaces benefit from this product and have seen paybacks in less than 1 year with improved voltage stability, plant productivity, and power factor improvement.

Product Scope

- Operating Voltage: 2.4kV through 24.9kV
- Impulse Withstand Voltage: 60kV BIL - 125kV BIL
- Reactive power rating: 0.5 MVAR to 100 MVAR (binary step design, 1 to 15 steps)
- Filter Type(s): Notch (Band Pass), High-Pass, Multi-tuned
- Metal-Enclosed: NEMA 1, 3R, 4X, 12 | IEC IP10, IP14, IP56, IP52
- Comes fully assembled, tested, and ready for interconnection
- Integral air-disconnect /ground switch, fixed or draw-out circuit breaker
- Integral protection and control system

Ratings

The **actiVAR®** is rated and configured to meet customer requirements for voltage, basic insulation level (BIL), available short circuit current, reactive power rating, and frequency. Internal components such as disconnect and grounding switches, circuit breakers, capacitors, capacitor switches, thyristor valves, and capacitor fuses are chosen based on their ratings, costs, availability, and NEPSI's experience with the supplier's quality, service, and reliability.

Rating	Range of Available Ratings
Bank Configuration:	Thyristor Switched: Single Step/Multiple Step Hybrid Design: Thyristor & static switched filter banks
Filter Types:	Notch (Band-Pass), High-Pass, C-High-Pass, Multi-Tuned
Operating Voltage (line-to-line):	2.4kV – 24.9kV
Operating Frequency:	50 Hertz | 60 Hertz
Reactive power output:	0.5MVAR – 100 MVAR (500kvar – 100,000 kvar)
Tune frequency (Hz)	85 Hz 2100 Hz (1.4th Harmonic – 35th harmonic)
High-Pass (damping) resistor rating:	1 ohm to 1000 ohms 10kW/Phase - 200kW/Phase
Short circuit (asymmetrical momentary):	16kA - 61kA
Impulse withstand voltage (Basic Insulation Level):	60kV – 125 KV
Short-time withstand voltage (1 minute 50/60 Hertz):	19kV – 60kV
Control voltages:	AC Volts: 110, 115,120, 220, 50/60hz DC Volts: 24, 48, 110, 125, 220
Operating temperature range:	-50°C to +55°C -58°F to 131°F
Maximum altitude without de-rating:	1,000 Meters 3,300 Feet
Enclosure:	(NEMA): 1, 3R, 4X, 12 (IEC): IP10, IP14, IP56, IP52
Seismic:	As specified - Zone 4
Capacitor fusing:	Internally fused | Externally fused
Performance Standards:	CBEMA (*Computer and Business Electronic Manufacturers Association*), curve referenced in ANSI/IEEE Std. 446-1987 SEMI (*Semiconductor Equipment and Materials International*), F47-0706, F49-0200, and F50-0200s IEEE 519, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems* ITIC (*Information Technology Industries Council) tolerance curve)* IEEE 1453, Recommended Practice for measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems

Equipment Configuration

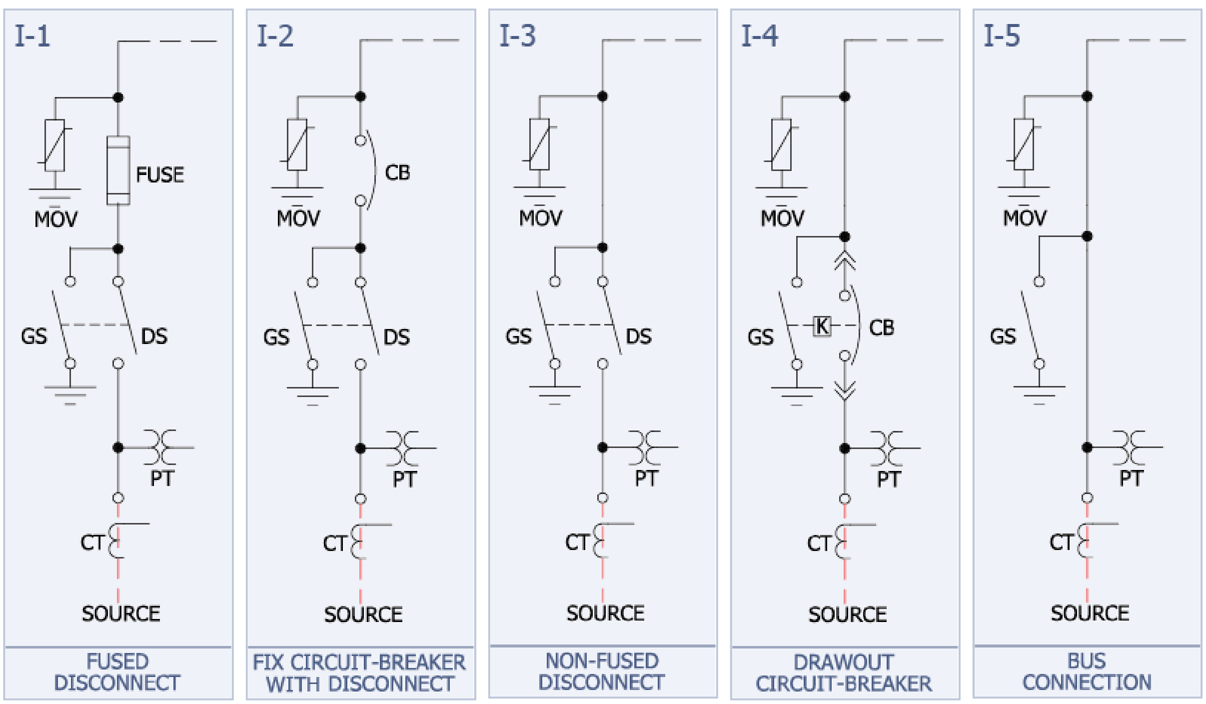
NEPSI's **actiVARs**® are custom designed, configured, and rated to mitigate site-specific voltage sags, flicker, harmonic distortion and system power factor. Depending upon the performance objectives, the **actiVAR**® may also include conventionally switched filter stages. These less costly stages use standard capacitor switches to provide "slow VARs" for power factor correction and harmonic attenuation, reserving the Thyristor-switched stages to provide "fast VARs" for mitigating voltage sags and voltage flicker.

Sections 1, 2, and 3 that follow provide details on some of the available options.

1 Incoming Compartment Configuration Options

The incoming compartment of the actiVAR is available with a range of options based on system ratings and customer preference.

Typical configurations include some of the following:



Accessories For Incoming Compartment

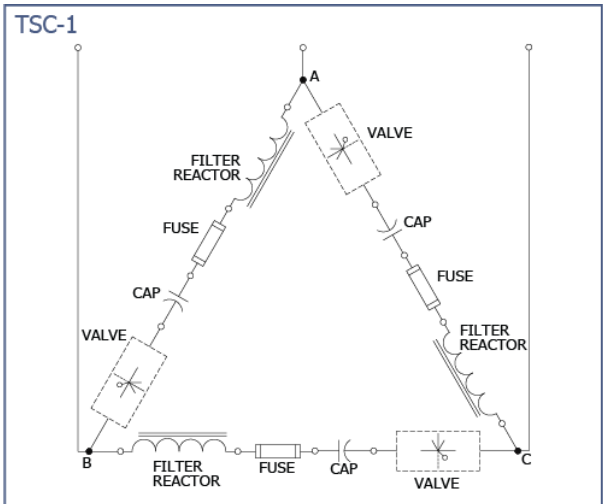
The following items are available for placement in the incoming compartment

PT	POTENTIAL TRANSFORMER	MOV	SURGE ARRESTER		ROOF BUSHING OVERHEAD BUS
CT	CURRENT TRANSFORMER	CT	CURRENT TRANSFORMER	K	KEY INTERLOCK

2 Thyristor-Switched Stage Configuration Options ”Fast VArs”

Thyristor-switched harmonic filter stages utilize thyristor valves to provide "fast VArs” for the mitigation of rapid voltage sags and flicker . If additional VArs are needed for power factor correction and harmonic filtering, use of less-expensive conventionally-switched filter stages, as explained under heading three on the following page, is highly recommended.

Delta Valve Configuration



DELTA CONNECTED

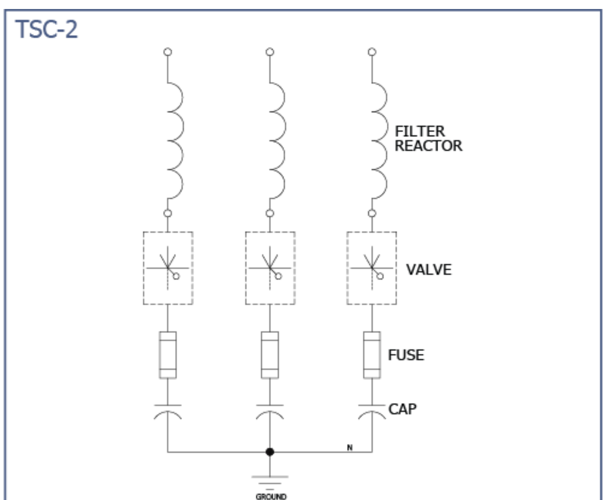
The Delta Valve configuration utilizes thyristor valves connected in a Delta configuration. Voltage ratings of the valves, reactors, and capacitors are rated based on the system line-to-line voltage rating. Current within the Delta valve is 57% of the current outside the Delta. Details of this valve configuration are as follows:

System Application Voltage: 2.4kV – 13.8kV

Valve Ratings:
Transient Current Limit: 500 amps
(with or without fins)

Continuous Current Rating: 180 amps
(with fins)

Wye-Grounded Valve Configuration



WYE CONNECTED

The Wye-Grounded valve configuration utilizes thyristor valves connected in grounded-wye configuration. Voltage ratings of the valves, reactors, and capacitors are rated based on the system's line-to-neutral voltage rating. Higher system application voltage ratings are possible with this configuration. Details of this valve configuration are as follows:

System Application Voltage: 2.4kV – 24.9kV

Valve Ratings:
Transient Current Limit: 500 amps
(with or without fins)

Continuous Current Rating: 180 amps
(with fins)

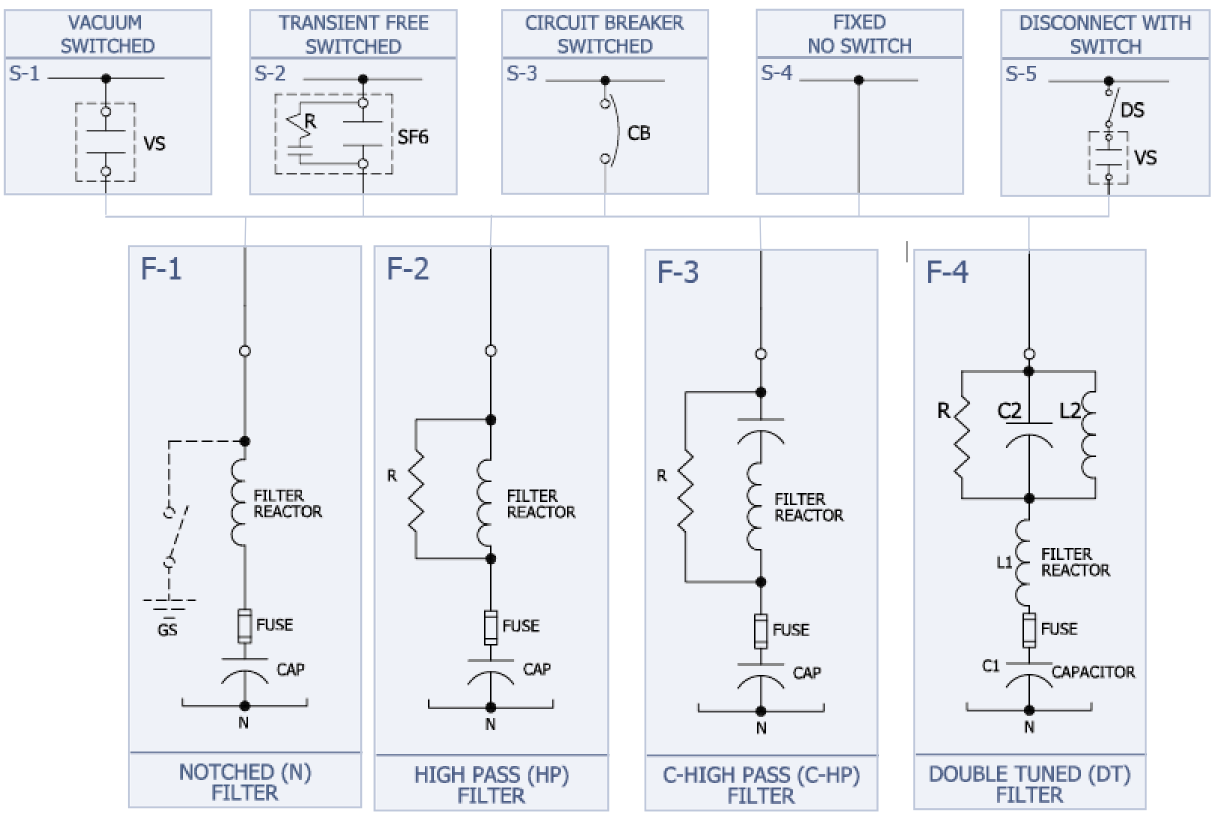
Restriction: Valve configuration for grounded-wye system only. Resistance-grounded, high-impedance grounded, or Delta systems must use the delta connected valve configuration.

3 Conventionally Switched Stage Configuration Options "Slow VArs"

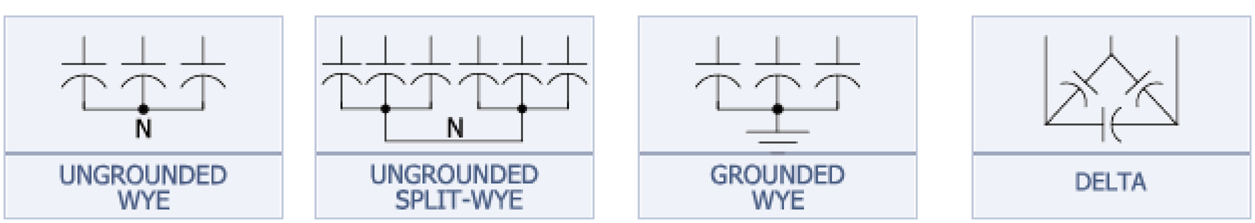
Conventionally-switched harmonic filter stages do not respond fast enough to mitigate voltage flicker and voltage sags, but are economical and effective for power factor correction and harmonic filtering.

The conventionally-switched stages consist of capacitors, capacitor fuses, capacitor switching devices, and harmonic filter reactors. Ungrounded wye, grounded wye or delta configurations can be used alongside the thyristor-switched stages.

Typical filter bank stage configuration options include some of the following:



The harmonic filter can be connected in a number of different ways depending upon bank rating and protection requirements. Typically, harmonic filters are provided with an ungrounded wye or ungrounded split-wye connection, but a grounded wye and Delta connection are also available.



Control Options

NEPSI's **actiVAR®** is furnished with a fully integrated control and protection system that dynamically controls system voltage by gating the **actiVAR's®** thyristor valves in response to measured power system parameters at a rate of 3 times per cycle.

Additionally the **actiVAR's®** controls conventionally switched harmonic filter stages with response times of 30 seconds to a minute to maintain average power factor and to mitigate harmonic distortion.

Standard Features	Conventionally-Switched Stage Control Options
Thyristor switched stage control for dynamic voltage control	Power Factor Control
Conventionally switched stage control for power factor control and harmonic mitigation	Var Control
Fully integrated HMI display	Voltage Control
Integrally mounted or remotely located control panel	Harmonic Voltage / Current Distortion Control
Remote access to all controller functions	Remote | SCADA Control | DCS Control

Protection Options

The **actiVAR®** is furnished with host of protection options to keep your system up and running with minimum downtime.

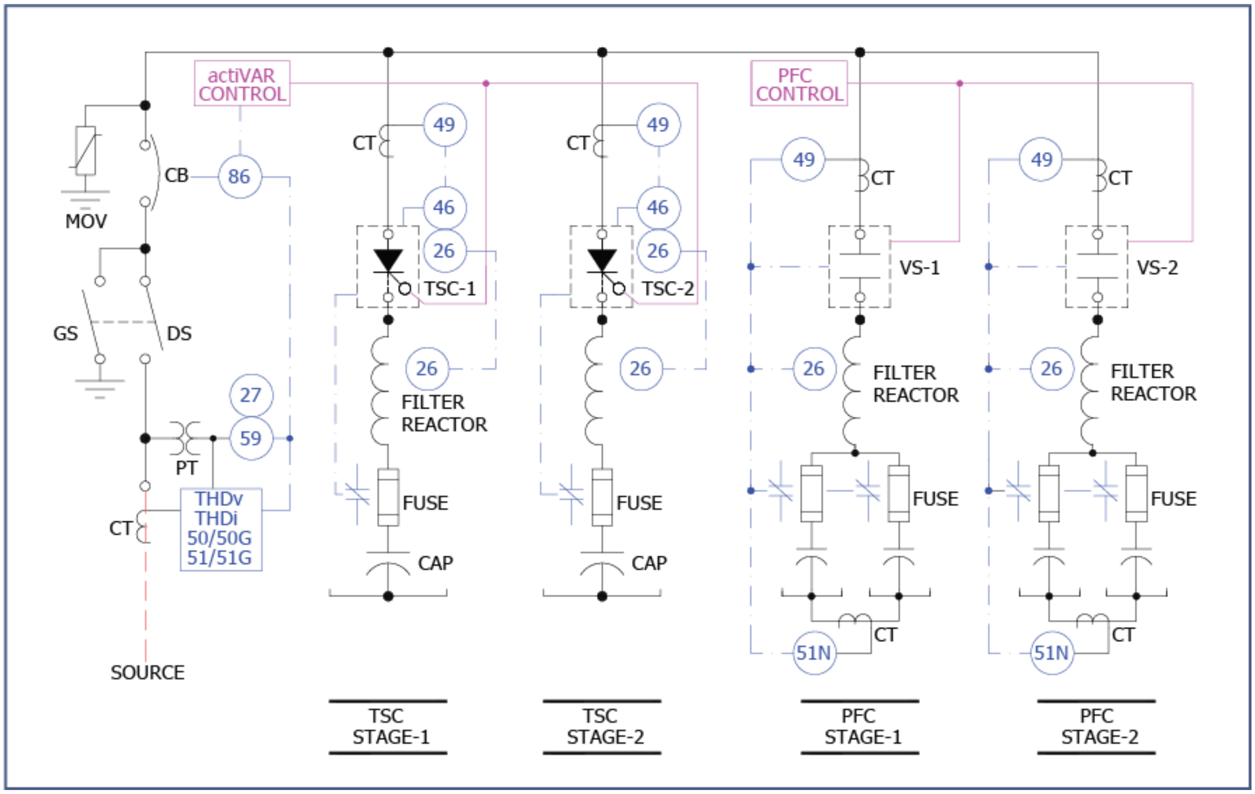
All stages, whether conventionally or thyristor switched, are protected against short circuit, overload, over-voltage, harmonic over-current, harmonic over-voltage, over-temperature, and unbalance operation from blown capacitor fuses. Protective relays and ancillary protective devices are chosen based on function, cost, reliability, and customer preference.

The Table on the following page summarizes the protection device numbers that are typically provided with NEPSI's **actiVAR**.

Protection Type	Designation	Description
Short Circuit and Overcurrent Protection	50/51 50/51G	Provided by upstream feeder breaker, main incoming breaker (if provided), or main incoming current limiting fuses (if provided).
Over-Voltage	59	Protect harmonic filters and power system from over-voltage. Backup to the SVC and PFC control which use voltage as a primary or secondary control input.
Under-Voltage	27	Under voltage protection system is provided to disconnect the “fast VArs” in the event of a power interruption or a “fast VArs” control malfunction.
Neutral Unbalance (Blown Fuse Detection)	59N Or 51N or 51G or Direct	Relay or direct fuse sensing to detect a capacitor fuse operation. This is critical since a blown fuse condition will change filter de-tuning, lower var output, lower performance, and possibly create system resonance.
Harmonic Voltage & Current Distortion	I_{THD}, V_{THD}	Protection against harmonic resonance, high voltage & current distortion, and harmonic overload
Over-Temperature	26	Protection for the thyristor valves, capacitors, and iron-core reactors. Also protects against fan failure.
Over-Load	49	Over-load protection of the high-pass resistors (if provided), iron-core reactors, and thyristor valves. Relay is sensitive to RMS current associated with the filter's fundamental current and harmonic current.

Typical Protection System

Typical relay protection diagram for the **actiVAR™**. The "actiVAR" control and "TSC" stages provide "fast" VArs. The "PFC" control and “PFC” stages provide "slow" VArs for power factor correction and harmonic mitigation.



actiVAR® Bank Ordering Guide

The **actiVAR®** is custom built to meet your requirements. Feel free to contact NEPSI for a quote or to discuss your specific application.

Additionally, visit our webpage at www.nepsi.com and follow the product page link to Thyristor-Switched Harmonic Filter Banks. There you will find additional information, including:

- Guide form specifications
- Component Cut Sheets and Instruction Manuals
- Pictures of Equipment and Components
- Technical Resources

Power System Studies

NEPSI performs power system studies to evaluate the expected performance of our **actiVARs®**. Required studies may include some or all of the following:

- Stability
- Motor Starting
- Load flow
- Reactive Power / Var Flow Studies
- Coordination
- Voltage Drop | Voltage Rise Analysis
- Harmonic Analysis
- Short Circuit
- Protective Coordination

Our Power System Studies are tailored to your needs and project requirements.

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Transformer Surge Protection
- RC Snubbers -

General

NEPSI's RC Snubbers protect medium-voltage transformer primary windings from high frequency voltage transients. Key applications requiring RC Snubber protection include:

- Medium voltage transformers switched with primary side vacuum or SF6 circuit breakers.
- Transformers that are fed with short feeder cables or short bus duct runs.
- Dry-type and cast-coil-type transformers and some liquid-filled transformers.

Product Scope

- Operating Voltage: 2.4kV through 34.5kV (38kV Max)
- Impulse Withstand Voltage: 60kV BIL - 200kV BIL
- Surge Capacitance Rating (μF): 0.125, 0.25, 0.5, 1, or as specified
- Surge Resistance Rating: 30 Ohms to 200 Ohms, 1kW/Phase
- Phase-to-Phase and Phase-to-Ground MOV's (lightning arresters) rated for your application to 48kV Duty Rating; Heavy Duty Distribution Class or Station Class
- Integral protection, control, and monitoring systems
- Integral air-disconnect /ground switch
- Metal-Enclosed Design: NEMA 1, 3R, 4X, 12 | IEC IP10, IP14, IP56, IP52
- Comes fully assembled, tested, and ready for interconnection

Product Benefits

- Protect against inter-turn insulation failure
- Extend transformer life
- Reduce the likelihood of circuit breaker pre-strike, re-strike, and re-ignition
- Reduce the magnitude and rate-of- rise of voltage transients
- Dampen resonant transients
- Reduce production downtime due to insulation failures
- Easy installation

Bulletin: 820-00 Rev. Date: 10/09/2015

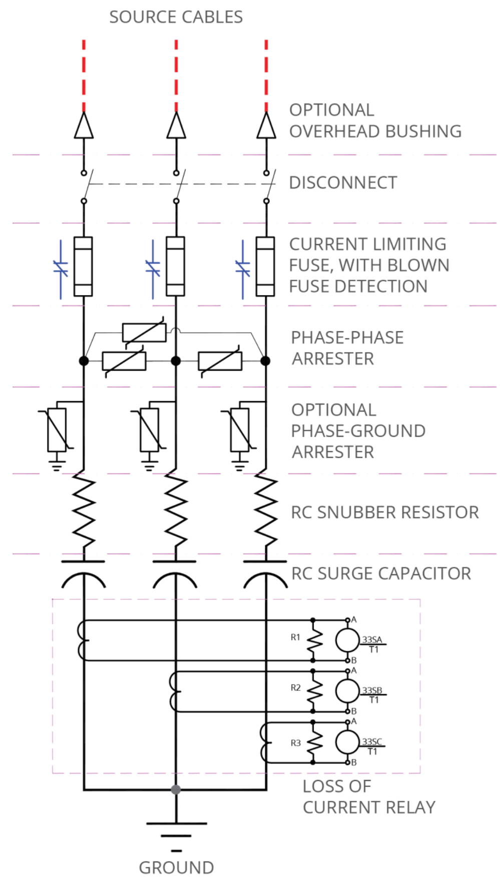
RC Snubber Ordering Guide

RC Snubbers manufactured by NEPSI are custom built to meet your requirements. In general, they are composed of a combination of a capacitor and a resistor (as shown in the figure to the right) to reduce the magnitude and frequency of a transformer transient terminal voltage. Fuses are often applied for short circuit protection and to disconnect the RC Snubber should it fail.

Resistance value are most often rated 30 ohms as this value of resistance is suitable for virtually all installations.

Lightning arresters, if not included in the transformer terminal box are provided to limit the magnitude or peak voltage associated with phase-to-phase and phase-to-ground transients. These are rated based on system grounding.

Other supporting equipment, such as an air- disconnect switch, current loss detection, and blown fuse detection are also available with our systems.



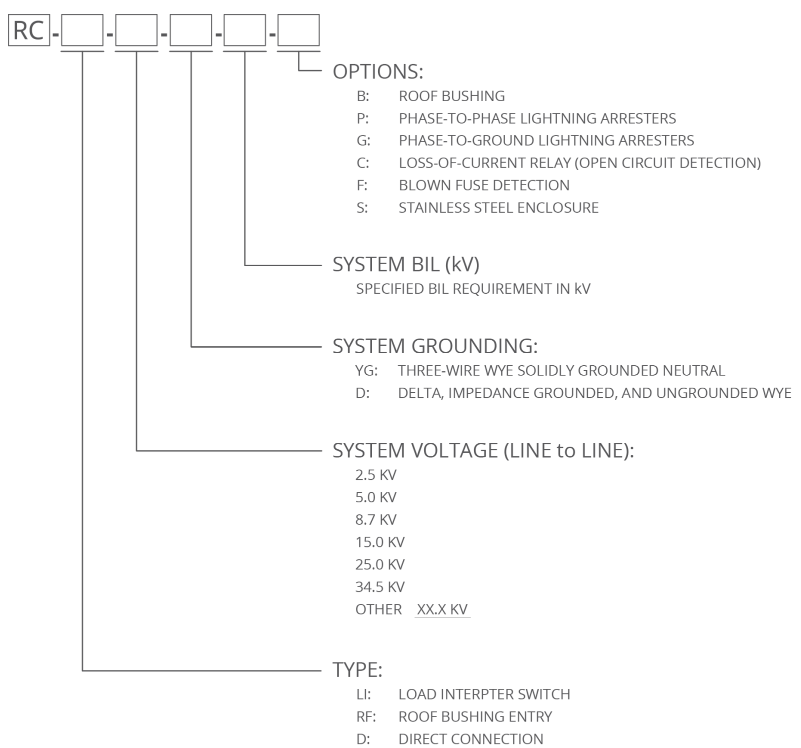
Part Number Creation

Example Part Number Creation

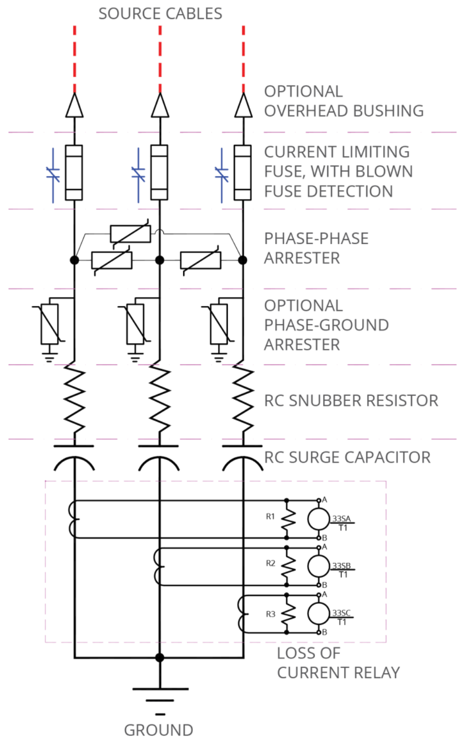
The Part Number for a RC Snubber rated for application on a 24.9kV three-wire solidly ground system requiring phase-to-phase lightning arresters, phase-to-ground lightning arresters, and blown fuse detection would have the following part number:

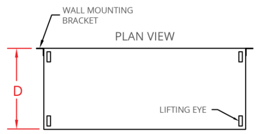
RC-D-24.9-YG-150-PGF

Contact the NEPSI for options and voltages not shown.

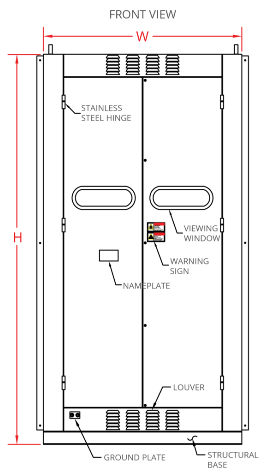


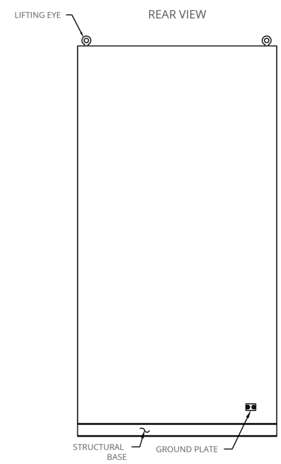
RC Snubber - Direct Connection



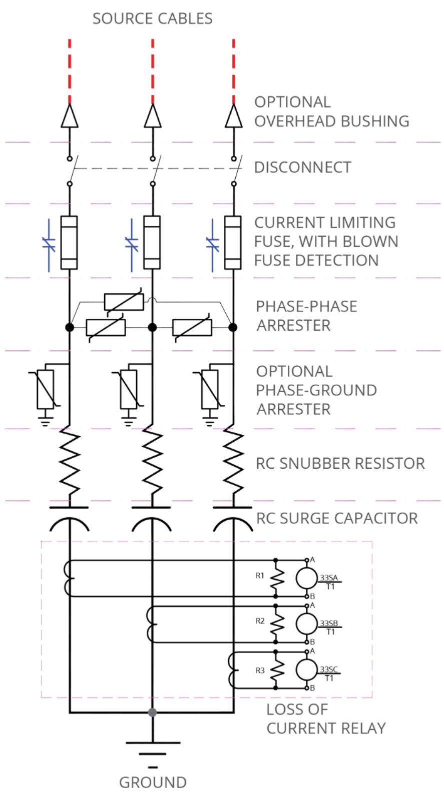


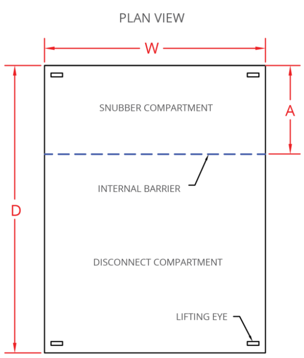
RC SNUBBER WITHOUT DISCONNECT				
NOMINAL VOLTAGE (KV)	DIMENSIONS / WEIGHT			
	H (in)	W (in)	D (in)	Wt (lbs)
2.5	96	30	12	420
5.0	96	30	16	490
8.7	96	30	16	490
15.0	96	40	20	525
25.0	108	48	24	650
34.5	120	60	24	760



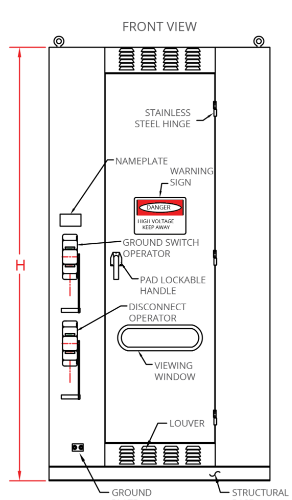


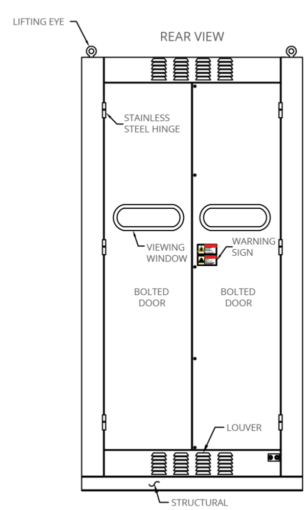
RC Snubber - With Optional Disconnect Switch





RC SNUBBER WITH DISCONNECT					
NOMINAL VOLTAGE (KV)	DIMENSIONS / WEIGHT				
	H (in)	W (in)	D (in)	A (in)	Wt (lbs)
2.5	96	30	72	12	3500
5.0	96	30	76	16	3500
8.7	96	30	76	16	3500
15.0	96	40	80	20	4000
25.0	108	48	84	24	4300
34.5	120	60	84	24	4800





Other NEPSI Products and Services

Metal-Enclosed Harmonic Filter Banks

NEPSI's Medium Voltage Metal-enclosed Harmonic Filter Banks are custom designed for application on industrial, commercial, and utility power systems that require medium voltage power factor correction, var and voltage support, and mitigation from harmonic resonance or harmonic distortion. The harmonic filter banks are configurable as fixed or automatic controlled with 1 or more stages at voltages from 2.4kV through 38kV (60kV BIL through 200kV BIL).

Available filter types include C-High-Pass (damped filters), High-Pass, Notch (Band-Pass), double-tuned, and multi-tuned filters. NEPSI's filters find wide application in many different industries including wind, mining, paper, chemical, and petroleum - See more at: http://nepsi.com/products/metal-enclosed-harmonic-filter-banks\ for additional information.

actiVAR ®- Thyristor Switched Harmonic Filter Bank

NEPSI's actiVAR® is a fast switching thyristor switched harmonic filter bank that provides near instantaneous reactive power (VARS) on a cycle-by-cycle basis. This product provides voltage sag and voltage flicker mitigation for large dynamic loads and large synchronous and induction motor starts.

Where soft starters (RVSS) are not capable of meeting utility voltage sag/inrush limits, or simply fail to provide adequate voltage support for the motor to start, the actiVAR® is a much more economical alternative when compared to VFD drive that are being used for starting and not for process or speed control.

The actiVAR® cost benefits are compounded when multiple motors need to be started as one actiVAR® provides voltage and fast var support for all motor starts on your system.

Power System Studies

NEPSI performs power system studies to evaluate the expected performance of our metal-enclosed harmonic filter, power capacitor banks and **actiVARs®** products. Studies include the following:

- Stability
- Motor Starting
- Load flow
- Reactive Power / Var Flow Studies
- Coordination
- Voltage Drop | Voltage Rise Analysis
- Harmonic Analysis
- Short Circuit
- Protective Coordination

Our Power System Studies are tailored to your needs and project requirements.

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MSP™ - Medium Voltage Motor Surge Protection

Figure 1
NEPSI's Medium Voltage Motor Surge Protection equipment protects motor insulation from power system transients.

General

NEPSI's MSP™ (Motor Surge Protector) is designed to protect medium voltage motors and generators from voltage surges due to lightning and switching events. The MSP™ accomplishes this task better than any other product by decreasing the slope and crest of impending voltage surges to safe levels.

Application of the MSP™ is guaranteed to reduce the likelihood of motor failures, resulting in less down-time and higher productivity.

Product Scope

- Reduced medium voltage motor and generator failures from voltage surges due to lightning, faults, and switching events.
- Units can be custom designed for direct mounting to generators, motor, and compressor housing.
- Units can be supplied with over-current and differential protection current transformers. Reduced downtime and material waste from motor failure.
- Simple to install and requires no maintenance.
- MSP's are custom designed for many OEM's utilizing medium voltage motors and generators.

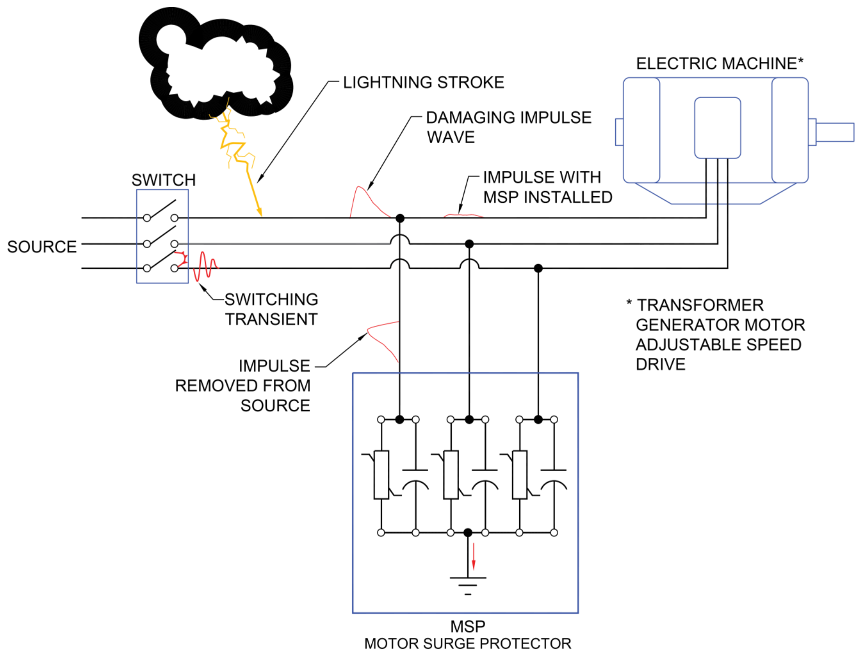

Figure 2
Principle operation of the MSP™ is to decrease the crest voltage and rate of rise of the impending surges. High rates of rise damage end turns while high crest voltages damage winding to core insulation. Both of these types of damaging surges are mitigated with NEPSI's MSP™.

Product Application

Due to the wavelength and travel time of lightning and switching transients, the MSP™ is most effective when placed as close as practical to the motor terminals with the ground leads being as short as possible. This will limit the surge voltage seen by the motor to the discharge voltage of the arrester. For best protection, one MSP™ should be placed at each medium voltage motor or generator. Where there are many small motors or explosion proof motors in hazardous locations, a single MSP™ at the motor control center is recommended.

The proper choice of MSP™ is based on the system and/or motor voltage and the system grounding. The order guide below can be used to determine the correct MSP™ for your application.

Standard Features

Enclosure
11 gauge galvanneal steel all welded construction, C2 structural steel channel base, bolted stainless steel hinged door. NEMA 1, 3R, 4X (optional), 12 | IEC IP10, IP14, IP56, IP52, NEC Class 1 & 2, Div. II designs also available.

Surge Capacitor
The MSP™ is equipped with hermetically sealed low-loss, low-inductance surge capacitors. Their capacitance rating is based upon the MSP™ voltage rating as shown in Table 1 below. The surge capacitor is equipped with discharge resistors that reduce the residual voltage on the capacitor to 50 volts in 5 minutes.

Wall mounting flanges
Allows the MSP™ to be mounted on suitable walls.

Surge/Lightning Arresters
The MSP™ is equipped with heavy duty, silicone rubber housed MOV distribution class lightning arresters incorporating the latest in metal oxide varistor (MOV) design techniques (Station Class are available as an option). The high track resistant, non-fragmenting silicone rubber housed arrester provides increased safety for personnel and equipment. The lightning arresters complies with the latest revision of ANSI/IEEE C62.11 "IEEE Standard for Metal Oxide Surge Arresters for AC Power Circuits.

Terminals
The MSP is provided with a Copper NEMA 2-hole pad for interconnection with customer wiring.

Operating Temperature
-40F (-40C) to +115F (+46C)

Warranty
1 year replacement parts per NEPSI's Standard Warranty.

Optional Features

Fuses
Increases system and equipment reliability by removing a failed MSP™. Blown fuse detection is provide through a set of dry contacts to alert plan personnel of a blown fuse.

Pecker-Head/Motor Terminal Mounting
The MSP™ can be custom designed for direct mounting to a motor or generator to act as a terminal box. The equipment can be equipped with a neutral grounding resistor, differential CT's, and ground CT to provide all fault sensing.

Differential current transformers
This option is shown in Figure 3, below. The differential CT's are placed inside the MSP™ and afford the highest level of protection for the motor or generator.

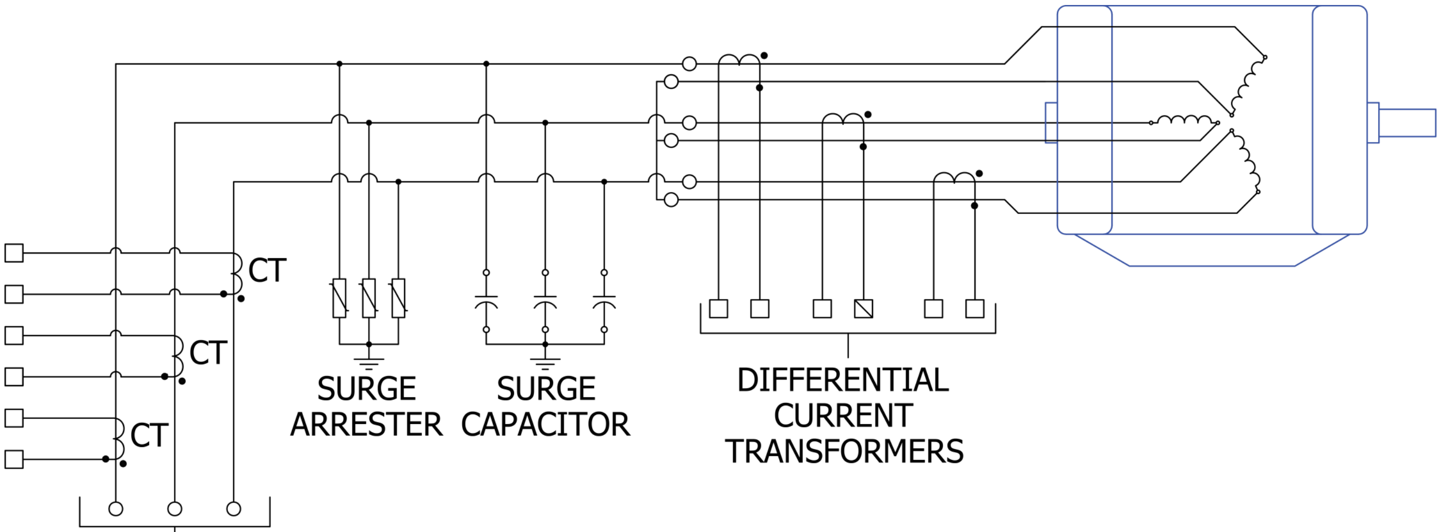

Figure 3
Three-line diagram of MSP™ equipped with differential current transformers and phase overcurrent transformers for connection to motor protection relays.

MSP™ Ordering Guide

The MSP™ can be ordered by choosing the part number from the table below based on the system voltage and type of grounding. Options are ordered by adding part number suffixes.

Table 1
MSP™ Standard Part Numbers

System Voltage		Recommended Part Number (kV RMS)		
Nominal	Maximum	Four-Wire Wye: Multi-grounded Neutral	Three-Wire Wye: Solidly Grounded Neutral	Delta, Resistive Grounded and Ungrounded Wye
2.4	2.54	-	-	MSP3A0240
4.16Y/2.4	4.4Y/2.54	MSP3A0416	MSP6A0416	MSP6A0416
4.16	4.4	-	-	MSP6A0416
4.8	5.08	-	-	MSP6A0690
6.9	7.26	-	-	MSP9A0690
8.32Y/4.8	8.8Y/5.08	MSP6A1380	MSP9A1380	-
12.0Y/6.93	12.7Y/7.33	MSP9A1380	MSP12A1380	-
12.47Y/7.2	13.2Y/7.62	MSP9A1380	MSP15A1380	-
13.2Y/7.62	13.97Y/8.07	MSP10A1380	MSP15A1380	-
13.8Y/7.97	14.52Y/8.38	MSP10A1380	MSP15A1380	-
13.8	14.52	-	-	MSP15A1380
20.78/12.0	22Y/12.7	MSP15A2400	MSP21A2400	-
22.86/13.2	24.2Y/13.87	MSP18A2400	MSP24A2400	-
23	24.34	-	-	MSP24A2400
24.94Y/14.4	26.4Y/15.24	MSP18A2400	MSP27A2400	-
		For Options Add Suffixes On Following Page		

For example, an MSP™ for a 500 HP motor that is on a 4.16kV resistive grounded system with the wall mounting brackets would have the following part number: MSP6A0416

Contact the factory or your nearest sales representative for options and voltages not shown above.

Table 2
MSP Part Suffixes

MSP™ OPTIONS	Model Number Suffix
Station Class Lightning Arresters	S
Pecker-Head/Motor-Generator Terminal Box Mounting	PHM
Current Limiting Fuses	CLF
Neutral Grounding Resistor	GR
Over-Current CTs	OVCT
Differential CTs	DCT####

For differential current transformer option specify the desired primary current rating of the CT where #### appears.

Table 3
MSP Dimensions Weights and Electrical Values

Part Number	H Height (Inches)	W Width (Inches)	D Depth (Inches)	Capacitance rating of Surge Capacitor (μF)	Surge Arrester Duty Rating (kV)	Weight (LBS)
MSP3A0240	39.0	43.0	24.0	0.5	3.0	310
MSP3A0416	39.0	43.0	24.0	0.5	3.0	310
MSP6A0416	39.0	43.0	24.0	0.5	6.0	310
MSP9A0690	43.0	43.0	24.0	0.5	9.0	420
MSP6A1380	47.0	43.0	24.0	0.25	6.0	420
MSP9A1380	47.0	43.0	24.0	0.25	9.0	420
MSP10A1380	47.0	47.0	24.0	0.25	10.0	420
MSP12A1380	47.0	47.0	24.0	0.25	12.0	420
MSP15A1380	47.0	47.0	24.0	0.25	15.0	420
MSP15A2400	47.0	47.0	24.0	0.125	15.0	470
MSP21A2400	51.0	51.0	28.0	0.125	21.0	470
MSP24A2400	51.0	51.0	28.0	0.125	24.0	470
MSP27A2400	51.0	51.0	28.0	0.125	27.0	470

Note: Add 8 inches to the width dimension if the current transformer option is chosen

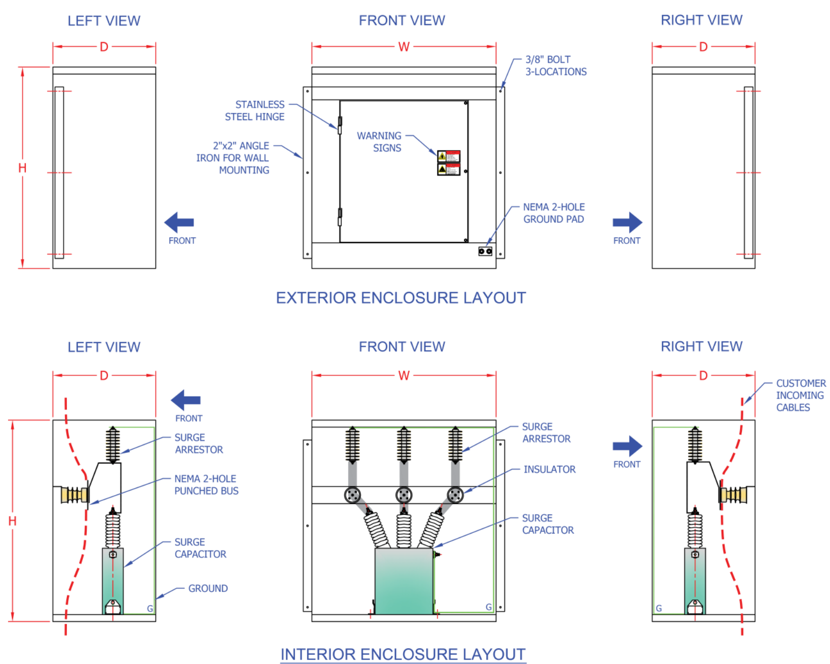

Figure 4
Approximate Layout for basic MSP™. Layout and dimensions may change without notice. Confirm layout and dimensions at order placement.

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MV-TVSS™
Medium Voltage Transient Surge Suppressor

General

NEPSI's MV-TVSS™ (Medium Voltage Transient Surge Suppressor) offers the first line of defense from lightning and switching transients for commercial and industrial power systems that have service or utilization voltages from 2.4kV to 15kV.

Figure: 1
NEPSI's medium voltage transient surge suppressors protect commercial and industrial power systems from transients originating from lightning and switching events.

Product Benefits

- Reduced insulation failures from transient voltage surges that originate on medium voltage networks.
- Provides an incoming line of defense for low voltage TVSS systems which may not be capable of handling the surge energy transmitted from medium voltage systems.
- Simple low cost installation
- Low maintenance.

Product Scope

- Operating Voltage: 2.4kV through 15kV
- Impulse Withstand Voltage (BIL): 60kV—200 kV
- MOV's: Phase-to-Phase and Phase-to-Ground rated for your application; heavy duty distribution class are standard, station class provided as an option.
- Current limiting fuses: Optional
- Metal-enclosed design: NEMA 1, 3R, 4X, 12 | IEC IP10, IP14, IP56, IP52, NEC Class 1 & 2, Div. II designs
- Surge Capacitor: Optional, 0.12µF—0.5 µF

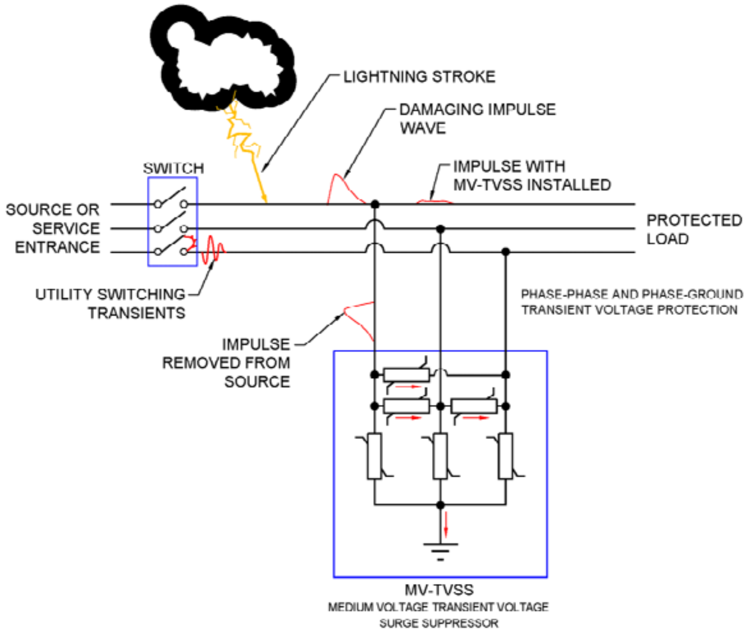


Figure: 2
The MV-TVSS™ provides transient voltage protection from surges originating on the high voltage system by shunting them to ground or across phases before they enter the low voltage system.

Bulletin: 800-00 Rev. Date: 9/24/2015

MV-TVSS™ Ordering Guide

Use table 1 to determine base part number of MVTVSS based on your power system ground and your system voltage. Table 2 provides approximate dimensions, while table 3 provides additional options that are not standard.

Table 1
MV-TVSS Standard Part Numbers

System Voltage		Recommended Part Number (kV RMS)		
Nominal	Maximum	Four-Wire Wye: Multi -grounded Neutral	Three-Wire Wye: Solidly Grounded Neutral	Delta, Resistive Grounded and Ungrounded Wye
2.4 4.16Y/2.4	2.54 4.4Y/2.54	- MVTVSS2	- MVTVSS3	MVTVSS1 MVTVSS4
4.16 4.8	4.4 5.08	- -	- -	MVTVSS5 MVTVSS6
6.9 8.32Y/4.8	7.26 8.8Y/5.08	- MVTVSS8	- MVTVSS9	MVTVSS7 -
12.0Y/6.93 12.47Y/7.2	12.7Y/7.33 13.2Y/7.62	MVTVSS10 MVTVSS12	MVTVSS11 MVTVSS13	- -
13.2Y/7.62 13.8Y/7.97	13.97Y/8.07 14.52Y/8.38	MVTVSS14 MVTVSS16	MVTVSS15 MVTVSS17	- -
13.8	14.52	-	-	MVTVSS18

Table 2
MV-TVSS™ Dimensions & Weights

Part Number	H Height (Inches)	W Width (Inches)	D Depth (Inches)	Weight (LBS)
MVTVSS-1 TO MVTVSS-9	43.0	43.0	24.0	310
MVTVSS-10 TO MVTVSS-18	51.0	47.0	28.0	390

Note: See Pages 3 & 4 for drawing detail. Consult Factory at order placement to confirm drawing dimensions.

Table 3
MV-TVSS™ Part Number Suffix Codes

MV-TVSS™ OPTIONS	Model Number Suffix
Painted Stainless Steel Enclosure	4X
Surge Capacitor	SCF
Current Limiting Fuses	CLF
Station Class MOV	SCMOV
NEC Class 1 & 2 Div. II design	NEC

Example Part Number Creation:
For example, a MV-TVSS™ for a 13.8kV multi-ground neutral system with current limiting fuses and station class lightning arresters would have the following part number: MVTVSS16-CLF-SCMOV

Contact NEPSI for options and voltages not shown.

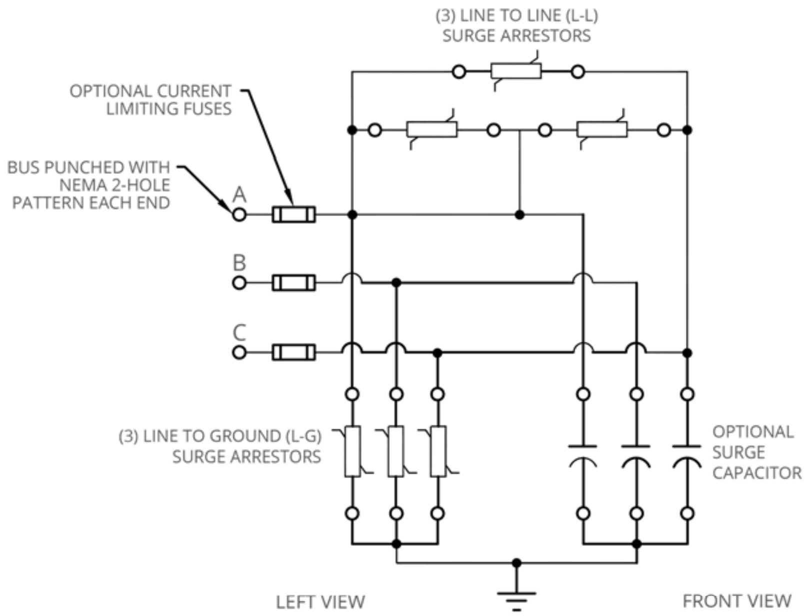
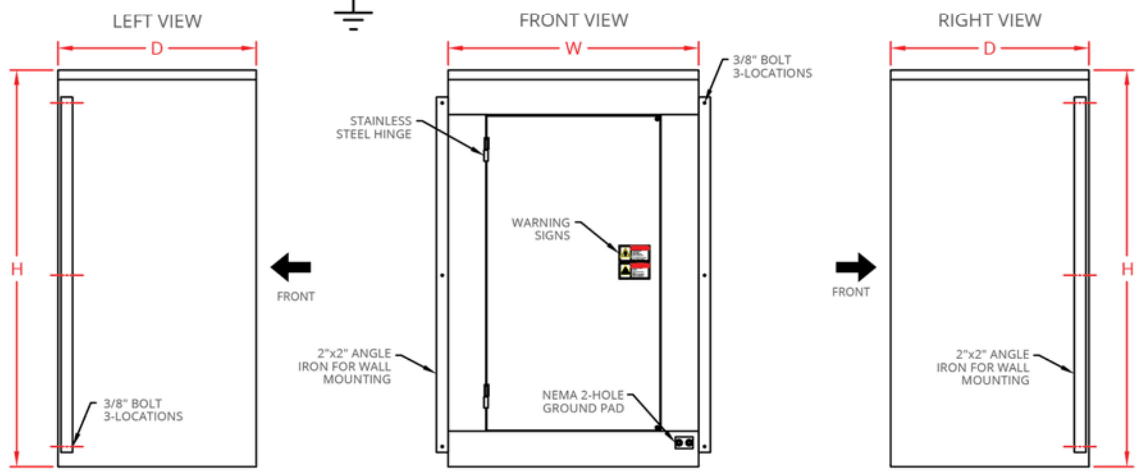


Figure 3

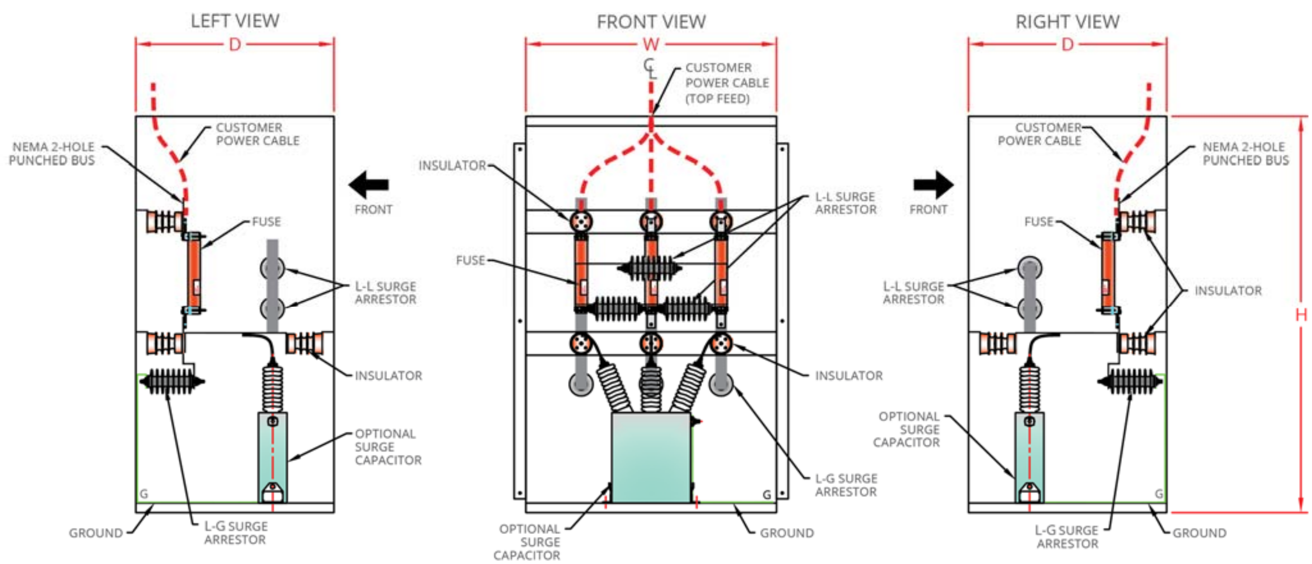
Three-line diagram, component layout, and enclosure drawing for MV-TVSS™ with surge capacitor, and optional current limiting fuses.

Notes:

Dimensions may change. Contact NEPSI for most current dimensions.



EXTERIOR ENCLOSURE LAYOUT



INTERIOR ENCLOSURE LAYOUT

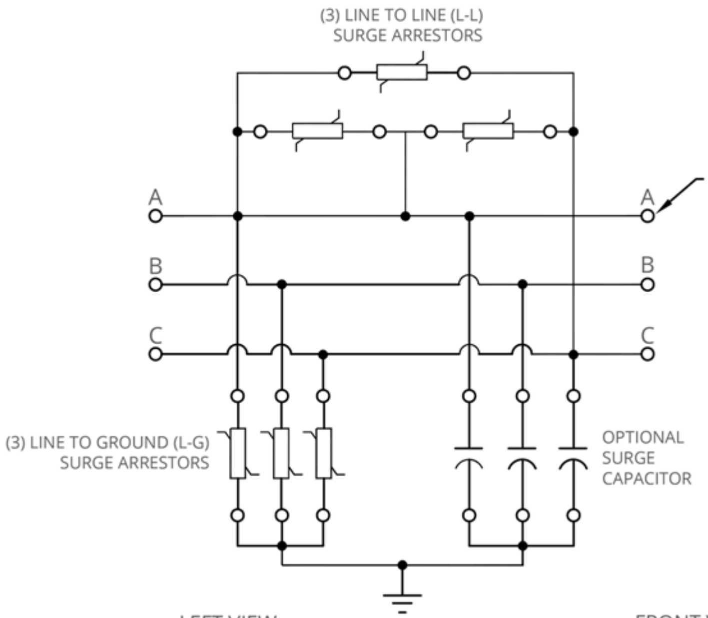
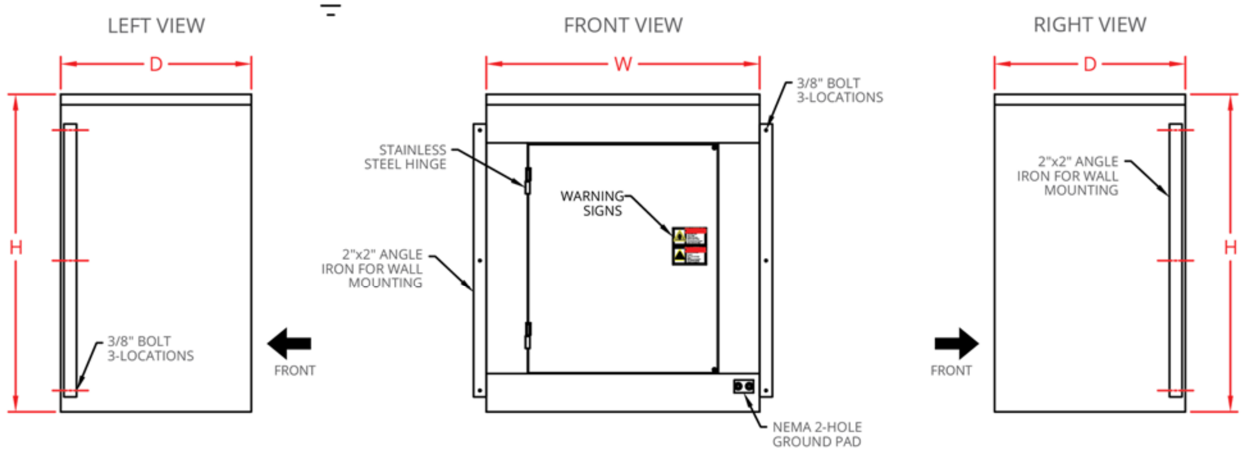


Figure 4

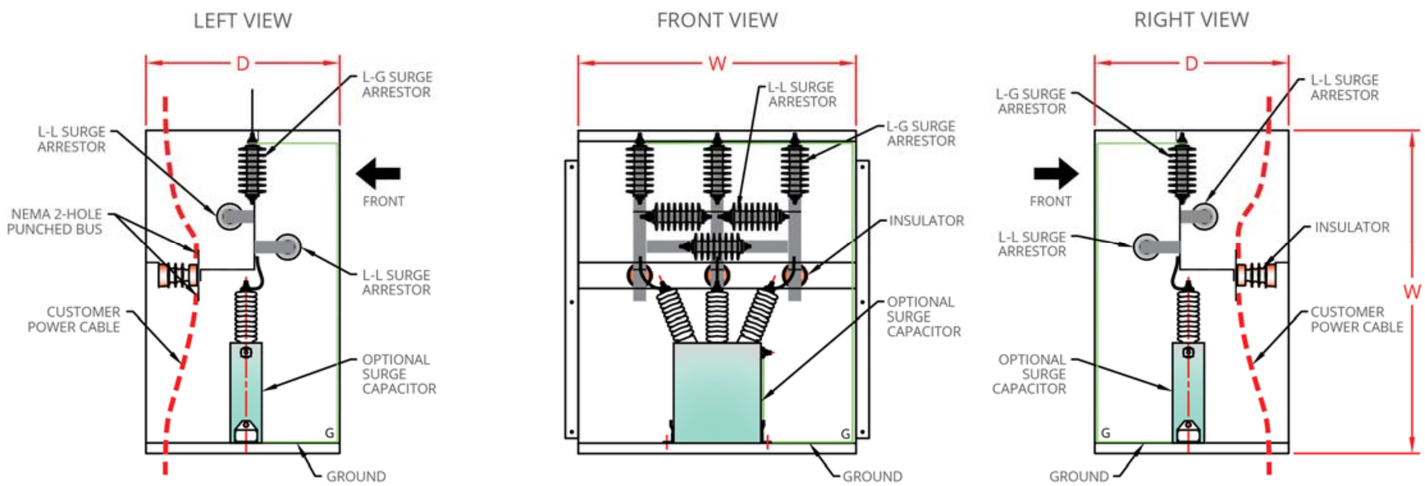
Three-line diagram, component lay-out, and enclosure drawing for MV-TVSS with surge capacitor.

Notes:

Dimensions may change. Contact NEPSI for most current dimensions.



EXTERIOR ENCLOSURE LAYOUT



INTERIOR ENCLOSURE LAYOUT

Northeast Power Systems, Inc.
66 Carey Road | Queensbury, NY | 12804
Ph: (518) 792-4776 | Fax: (518) 792-5767
www.nepsi.com | sales@nepsi.com

Harmonic Filter & Power Capacitor Bank Application Studies

Summary

This document describes NEPSI's standard Harmonic Filter and Capacitor Bank Engineering Evaluation. It outlines the typical analysis performed by NEPSI in evaluating the possible negative system impacts related to the installation and switching of medium voltage harmonic filter banks and shunt capacitor banks and the application of non-linear loads such as arc furnaces, variable speed drives, induction furnaces, rectifier systems, and cycloconverters.

The engineering evaluation described in this document is centered on the design, specification, and system impact of new and/or existing capacitor banks and harmonic filter banks and the installation of large non-linear loads.

The studies described in this document are general in nature, and illustrate the engineering capabilities of NEPSI. All evaluations vary to some degree, and are dependent upon system characteristics and the type of equipment.

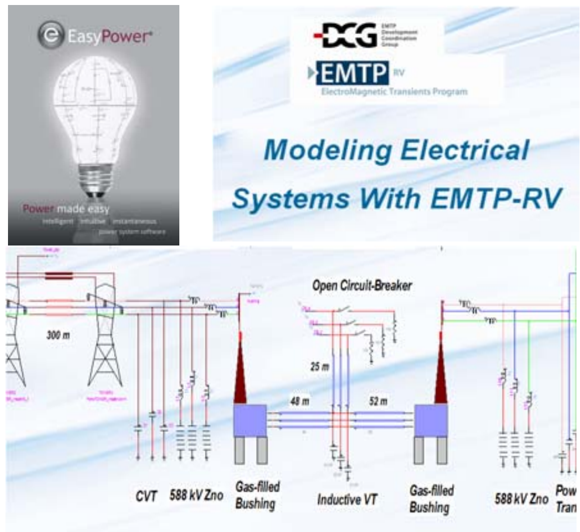


Figure-1: *NEPSI Power System Engineers Utilize Industry Standard and Accepted Software Packages to Perform all Power System Analysis.*

Introduction

The installation of a large shunt capacitor bank or harmonic filter bank or the addition of non-linear loads raises concerns primarily in the areas of harmonic distortion, harmonic resonance, switching surges, and possible over voltage conditions. It is prudent to perform a capacitor/harmonic filter bank evaluation before equipment is purchased so that any adverse conditions or added costs can be accounted for and identified in the design stage.

These concerns are typically evaluated by on-site power system measurements and digital simulations using sophisticated power system software. The measurements provide the ambient distortion levels, operating voltage, and other data required to validate and perform digital simulations. The digital simulations calculate system performance, and are used to predict and mitigate power system problems before they occur, so that special design requirements and cost can be accounted for in the planning stages.

Typical Scope of Work *Capacitor/Harmonic Filter Bank/Large Non-Linear Loads*	
Power system measurements and data collection	Filter/capacitor bank design and specification
Harmonic analysis	Transient Analysis
Short circuit analysis	Load flow analysis

Bulletin: 020-01 Rev. Date: 12/02/2013

Technical Approach

Task 1—Power System Measurement & Data Collection

The primary purpose of this task is to collect the necessary data to perform the power system evaluation and analysis for normal and abnormal system conditions as well as future system conditions or enhancements. It involves power system measurements, data validation, and discussions with plant personnel.

Data Collection and Validation

Data required to perform the power system analysis is typically collected by a NEPSI engineer while power system measurements are being taken. The data collected will typically consist of some or all of the following:

Typical Data Requirements *Data Required for Power System Evaluation*	
Short Circuit Impedance data, including one-line diagrams	Voltage Rating and locations of all capacitor banks and harmonic filter banks
Utility System Data	Normal and abnormal system conditions and operating practices
Digital Copy of system data if available	Equipment ratings and relay settings when necessary to perform study
Future Expansion and/or system changes	List of large non-linear devices

Power System Measurements

Power system measurements are taken to quantify the existing power factor, load level, operating voltage, harmonic distortion levels and other power quality concerns.

In some cases capacitor banks and or loads may have to be switched off to collect pertinent data, such as background distortion levels. If this switching operation is necessary, a plan to do so will be submitted in advance for consideration and approval.

Figure-2: *NEPSI utilizes several instruments for power quality monitoring including the Reliable Power Meter (RPM) by Fluke, the Fluke 43 for spot measurements, and the Hioki 3196 Power Quality Analyzer. NEPSI also uses the Lightwires Primary Power Analyzer (by SensorLink) when PT and CT signals are not available. This system allows for direct Medium Voltage Measurement of medium voltage overhead lines and bus bars using the Fluke 43.*

Task 2—Harmonic Analysis

Harmonic analysis involves the use of sophisticated computer programs to identify and predict potential harmonic problems and mitigation techniques. NEPSI's harmonic analysis program provides help in the identification of harmonic problems. Significant program output features include:

- Harmonic Impedance Scans
- Harmonic Amplification Scans
- Voltage and current distortion calculations
- Sensitivity analysis

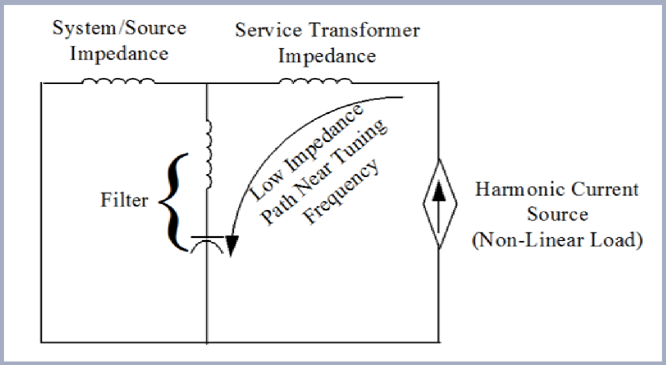


Figure 3: *Equivalent Circuit for Harmonic Analysis of a Simple System*

Harmonic Impedance Scans

Impedance scans are typically used to determine where resonant conditions exist. They are basically an impedance versus frequency plot of the system looking from the harmonic current source. Figure 4 shows such an impedance scan for various system configurations.

Typically, impedance scans are developed for normal and abnormal operating conditions as well as future expansions.

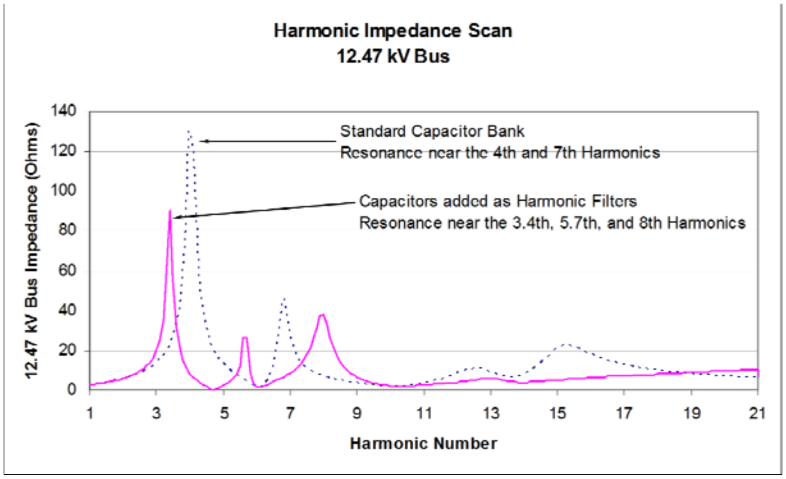


Figure 4: *Typical Impedance scan Showing Effect of Filter Bank and Capacitor Bank on System Impedance*

Current Amplification Scans

Current amplification plots have the same general appearance as impedance scans, but they have a totally different meaning. These plots show the current magnification/attenuation versus frequency at a given bus for a one amp injection at another bus in the system. These scans are typically used for finding localized resonant problems and would greatly aid in the identification of negative interaction between the plant's non-linear loads and the capacitor/filter bank. In addition to the scans above, voltage distortion calculations will be performed throughout the power system to confirm that the system meets IEEE 519 requirements for voltage and current distortion. Other standards or limits may be used at the request of the customer.

IEEE 519 Compliance Reports and Distortion Calculations

In addition to the scans above, voltage and current distortion calculations are performed throughout the power system to confirm that the system meets IEEE 519 requirements for voltage and current distortion. Other standards or limits may be used at the request of the customer.

Sensitivity Analysis

Sensitivity analysis is very important when doing harmonic analysis. Variations in capacitor and reactor impedances, as well as source impedance can greatly affect the voltage and current distortion calculations. This feature of NEPSI software will be utilized in this study to determine if any adverse system conditions exist due to slight variations in system and/or equipment impedances. The feature is especially useful in the design of harmonic filters where the worse case harmonic duties must be calculated.

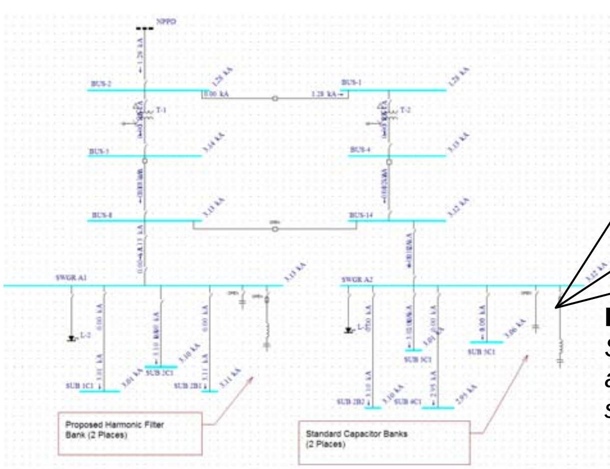
Data Requirements for Task 2—Harmonic Analysis

It is expected that the customer will provide the type, ratings, and location of harmonic generating loads and capacitors/filters within their power system as part of task one. Future harmonic load growth, as well as future system changes should also be provided.

Task 3—Short Circuit Analysis

A short circuit analysis is used to calculate system fault current levels to determine the interrupting and withstand adequacy of the power system equipment and associated protective devices. It also provides a guide in the selection and rating or setting of protective devices such as direct-acting trips, fuses, and relays.

The short circuit analysis described in this evaluation is typically limited to the major buses (nodes) and equipment connected directly to the capacitor/filter bank or large non-linear load. It may be expanded to include other busses at the customer's request, in which case a specific work scope would be developed. The short circuit calculation accounts for local generation, utility impedance, and short circuit current contributions from motors. The cases selected for the short circuit calculation will depict the power system configuration for which the three phase bolted fault short circuit currents will be at a maximum. All comparisons of interrupting device short circuit ratings or capabilities are to be based on this "worst case" condition.



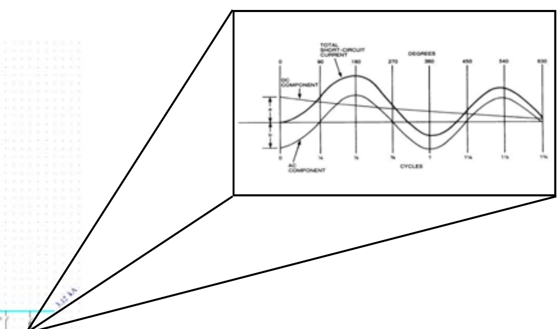


Figure 5: *The ESA Power System Analysis Software utilized By NEPSI employs algorithms in accordance with ANSI standards for determining short circuit duty ratings*

The short circuit study compares calculated short circuit duties with the first cycle and interrupting ratings of the medium and high voltage circuit breakers and fuses in the system. Low voltage device interrupting ratings (when involved) or capabilities will be compared against the first cycle fault magnitudes for each low voltage load center substation as defined in the scope of work. The load buses and equipment examined are those defined in the scope of work. Short circuit currents are calculated using R and JX impedance's by a digital computer in accordance with the American National Standards Institute (ANSI).

Typical deliverables from a short circuit analysis include:

- Recommendations
- Discussion of results and cases
- Table of breaker ratings and faults duties
- One-line diagram showing fault contributions
- Computer output with explanation of system configurations

Also included in the report will be a bus-to-bus listing of impedances used in the short circuit calculations. This listing is a part of the short circuit computer printout for each case calculated. The impedance listing and computer printout are referenced to the one-line diagram through the designated computer bus numbers and names.

Data Requirements for Task 3—Short Circuit Analysis
Typical data required for a short circuit analysis is as follows:

- One-line diagrams showing cable, transformers, breakers, reactors and motor equipment.
- Voltage and current rating and MVA sizes of equipment.
- Transformer impedances.
- Cable sizes and lengths.

Task 4—Load Flow Analysis

A load flow analysis is conducted to predict power flow magnitudes, power factor, voltage levels and losses in branches of the system based on the specified operating conditions. The results of the study are typically used to determine one or more of the following:

- Recommended transformer tap settings to maintain proper voltage level.
- Size of capacitor/filter banks to maintain an acceptable power factor and voltage level.
- Equipment rating (Ampacity).
- Contingency Analysis
- Losses

Typically, the load flow study will investigate system steady state load performance under normal and abnormal operating conditions. All significant system loads (watt and var components) and power sources (utility, co-gen, etc.) relating to the filter/capacitor bank installation are modeled. Where possible, system equivalents may be developed. The modeling can be expanded to include more of the system at the request of the customer, in which case, a specific work scope will be developed.

Data Requirements for Task 4—Load Flow Analysis
Typical data required for the load flow analysis is as follows:

- Load (MW and power factor) and process schedule.
- Voltage criteria on high and low voltage buses.
- Plant power factor requirements.
- Transformer tap ratings and settings.
- Normal and abnormal system conditions
- Impedance data.

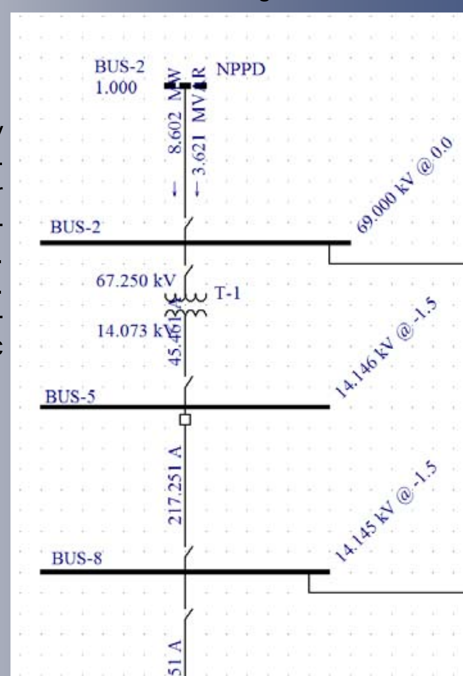


Figure 6: *The ESA Power System Analysis Software provides results of load flow analysis directly onto a one-line diagram for easy analysis of load flow results*

Task 5—Switching Surge Analysis

Switching surges occur during most switching operations. They occur during the transition when the system is changing from one steady state operating condition to another (this occurs during energization and de-energization of all equipment). The magnitude of the switching transient depends upon switching time and the resistive, capacitive, and inductive characteristics of the system. Capacitor switching and miss-operation of switches due to re-strike and pre-strike generally cause the more severe switching transients.

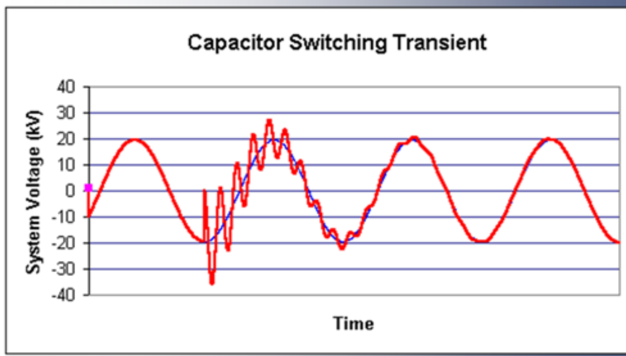


Figure 7: *Typical Waveform Plot Produced By EMTP*

The Electromagnetic Transients Program (EMTP) is typically used to investigate switching transients and can produce actual waveforms as shown in Figure 7. Transient simulation models may require more detail than 50/60 Hz models used in load flow, short circuit, and harmonic analysis programs. Due to this increased level of detail, the circuit elements of concern are usually modeled in detail, while the remainder of the system is modeled as a lumped circuit parameter.

For the application of capacitor banks and harmonic filter banks, switching surge analysis is usually conducted for one or more of the following reasons:

- Rating of transient inrush reactors for back-to-back switching operations
- TRV calculations on feeder circuit breakers
- Confirmation of switch ratings for inrush current and frequency
- Pre-insertion resistor rating and optimization
- Pre-strike and Re-strike evaluation

Data Requirements

Data required to do switching surge analysis is usually quite detailed. This data request will consist of data required to do short circuit and harmonic analysis but will require detailed data on components of concern.

Task 6 - Filter Bank/Capacitor Bank Design Specification

This task involves the design and specification of the capacitor/filter bank. It draws on the results from previous tasks. The Capacitor/Filter bank performance is usually evaluated as part of the load flow and harmonic analysis task. Short circuit requirements are evaluated in the short circuit analysis task. This task involves the functional specification of the specific components within the filter/capacitor bank to meet the performance requirements found necessary in the previous task. A guide form specification is provided so the customer can go out for competitive bid.

The specification will typically contain the following:

- Capacitor ratings
- Reactor ratings
- Filter bank configuration
- Protection requirements
- Switch requirements
- Disconnecting requirements
- Layout requirements
- Warranty requirements
- Transient inrush reactor requirements
- Control requirements

Figure 8 shows typical industrial and utility power system filters that are typically designed by Northeast Power Systems, Inc. The C-Type filter offers the advantage of low fundamental losses that are commonly found in other high pass filter designs.

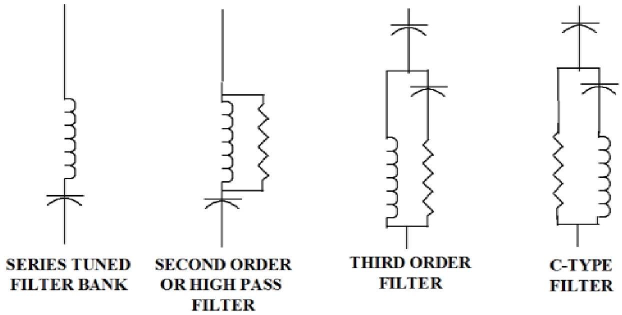


Figure 8: *Typical Harmonic Filter Designs*

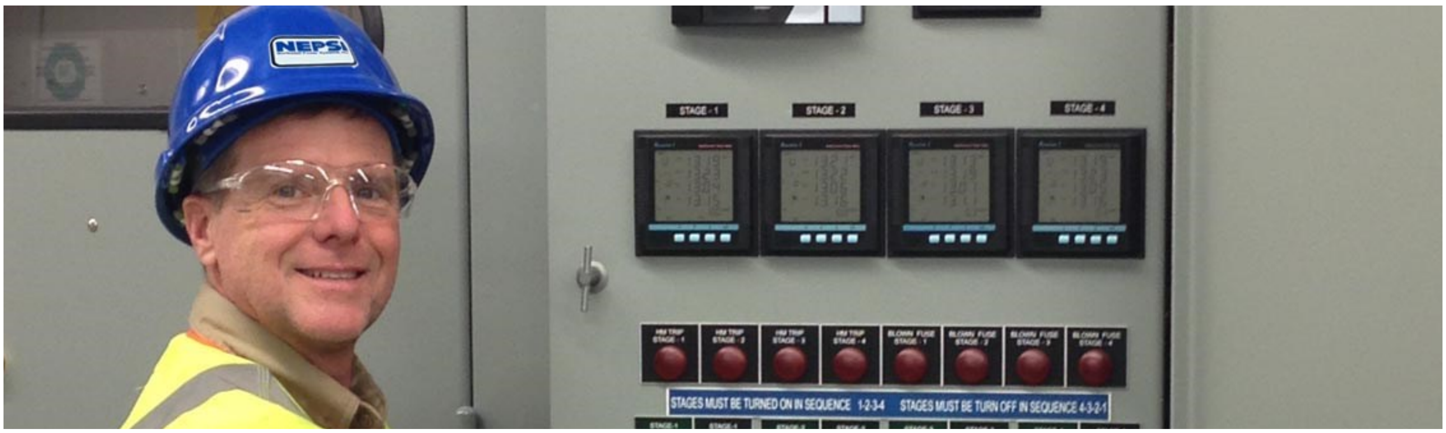
Figure 9: *Typical Harmonic Filter Bank Specified by Northeast Power Systems, Inc.*

Northeast Power Systems, Inc.

66 Carey Road | Queensbury, NY 12804
TEL: (518) 792-4776 | FAX: (518) 792-5767
www.nepsi.com | sales@nepsi.com

Start-up & Commissioning Services

Using Northeast Power Systems, Inc. (NEPSI) Start-up and Commissioning Services is the best way to ensure faster, safer, and more efficient implementation of your NEPSI built metal-enclosed power capacitor banks, harmonic filter banks, and actiVAR™ products. Leave it to NEPSI, the company that knows the equipment.



Plan for Success

NEPSI's Start-up & Commissioning Services provide the people and know how to ensure faster, safer, and more efficient installation and implementation of your medium-voltage metal-enclosed power capacitor banks and harmonic filter banks. With over 20 years of start-up and commissioning experience, NEPSI identifies issues before they become problems.

Proper start-up and commissioning of our metal-enclosed products and their associated control and protection systems is vital to their long-term health and operation. Improper installation and commissioning are the leading causes of premature failures, miss-operation, and poor performance. With NEPSI's Start-up & Commissioning Services, you can be assured that your equipment has been installed properly and meets the factory standards for operation. Get the most out of your equipment, hire NEPSI.

Right From the Start

NEPSI provides services during all key phases of your start-up operation:

- Receipt of equipment at site
- Pre-commissioning and installation checkout
- Start-up and live operation testing
- Operation and maintenance training
- Post-commissioning support

The Right People

- Experienced and specialized
- Trained for safety; MSHA, OSHA
- Routine drug screening
- Fully insured

Key Elements of Start-up & Commissioning

NEPSI's Start-up and Commissioning Services include some or all of the following:

Prior to site work

- ☑ Preparation of necessary documentation
- ☑ Preparation of start-up and shut-down procedures
- ☑ Contact with site contractors to ensure equipment is onsite and ready for commissioning

Pre-commissioning

- ☑ Physical inspection of equipment for damage
- ☑ Inspection and verification of proper installation
- ☑ Verification of internal and external power, grounding, and control wiring
- ☑ Confirmation that equipment passes NEPSI's factory tests

Commissioning

- ☑ Safe power-up of control panels, meters, and relays
- ☑ Verification of relay and meter function and accuracy
- ☑ Testing data communications to external devices
- ☑ Verification to equipment performance requirements
- ☑ Demonstration of safe and correct equipment operation

Post Commissioning

- ☑ Ongoing support and performance optimization
- ☑ Software changes to meet changing site requirements

Documentation

NEPSI provides a full documentation package for start-up and commissioning. Our documentation package includes:

- ☑ Site Observations
- ☑ Corrective actions taken
- ☑ Recommendations
    - Required for operation
    - Recommended but not required for operation
- ☑ NEPSI action items
- ☑ Customer action items
- ☑ Materials used
- ☑ Work Logs
- ☑ Installation checklist with exceptions listed
- ☑ Pre-commissioning checklist with exceptions listed
- ☑ Commissioning checklist with exceptions listed
- ☑ System Operating Parameters before and after equipment is put into operation.
- ☑ Operation concerns

Get Started Today

For a quotation customized to meet your particular service needs, please contact NEPSI. Also visits NEPSI's webpage http://www.nepsi.com/services for additional information on our services and metal-enclosed products.

Sustaining Your Operation

Once your metal-enclosed equipment is in operation, NEPSI offers a comprehensive range of services covering technical support, maintenance, upgrades, and continuing training for site personnel throughout the life of your system.

Attachment - C

Certifications

CERTIFICATE

TUV Rheinland of North America, Inc.
295 Foster Street, Suite 100, Littleton, MA 01460

TÜVRheinland®

Hereby certifies that

NEPSI
Northeast Power Systems, Inc.

66 Carey Road,
Queensbury, NY 12804

has established and maintains a quality management system for the

Design, Manufacturing, Sales and Service of Electrical Power Equipment including Capacitor Banks, Harmonic Filter Banks and Surge Protection for Power Factor Correction, Harmonic Mitigation and Voltage Support / Protection

An audit was performed and documented in Report No 3556.
Proof has been furnished that the requirements according to

ISO 9001:2015

are fulfilled.
Further clarification regarding the scope of this certificate and the applicability of ISO 9001:2015 requirements may be obtained by contacting TRNA.

Certificate Registration No.

74 300 3556

Certificate Issue Date
May 8, 2018

Certificate Expiration Date
April 17, 2021

ANAB ACCREDITED
ISO/IEC 17021
MANAGEMENT SYSTEMS CERTIFICATION BODY

Reissue Date: 5/8/2018

Certification of Management Systems

CERTIFICADO

TUV Rheinland of North America, Inc.
295 Foster Street, Suite 100, Littleton, MA 01460

Por el presente certifica que:

NEPSI
Northeast Power Systems, Inc.

66 Carey Road,
Queensbury, NY 12804

Ha establecido y mantiene un Sistema de Gestión de Calidad para:

Diseño, fabricación, venta y servicio de equipos de energía eléctrica incluyendo bancos de capacitores, bancos de filtros armónicos y protección contra sobretensiones para corrección de factor de potencia, mitigación armónica y soporte/protección de voltaje

A través de la auditoria realizada y documentada con No. de Reporte: 3556.
Probando que los requerimientos de la normativa:

ISO 9001: 2015

están cubiertos.
Las aclaraciones en el alcance de este certificado y la aplicabilidad de los requerimientos de ISO 9001: 2015 pueden obtenerse consultando a TRNA.

No. de Registro de Certificado

74 300 3556

Fecha de validez del Certificado
8 de mayo, 2018

Fecha de expiración del Certificado
17 de abril, 2021

ANAB ACCREDITED ISO/IEC 17021 MANAGEMENT SYSTEMS CERTIFICATION BODY

Certificación de Sistemas de Gestión

Certificate

TÜVRheinland

Certificate no. CU 72131588 01

License Holder:
Northeast Power Systems, Inc.
66 Carey Road
Queensbury NY 12804
USA

Manufacturing Plant:
Northeast Power Systems, Inc.
66 Carey Road
Queensbury NY 12804
USA

Test report no.: USA- 30572715 006

Client Reference: Paul Steciuk

Tested to: IEEE C37.20.3-2001
C22.2 No. 190-M1985 + GI1 + GI2 (R2004)

Certified Product: Medium-Voltage Metal-Enclosed Capacitor Bank and Harmonic Filter

License Fee - Units

Model Designation: MV-ACB, MV-AHFB
Rated Voltage: 2.4-38kV max.
Rated Power: 60000 kVar (capacitor bank)
60000 kVar (harmonic filter bank)
Rated Current: see Appendix (Constr. Data Form)
Protection Class: I
Special Remarks: To be installed according to the licensee's installation instructions.Site safety testing is required at installation, before equipment is placed into operation. No safety testing was performed during product evaluation. Replaces Certificate US72071127. 7

7

Appendix: 1, 1-4

Licensed Test mark:

TÜVRheinland
C US

Date of Issue (day/mo/yr)
19/07/2013

TUV Rheinland of North America, Inc., 12 Commerce Road, Newtown, CT 06470, Tel (203) 426-0888 Fax (203) 426-4009

333 Pfingsten Road
Northbrook, Illinois 60062-2096
United States Country Code (1)
(847) 272-8800
FAX No. (847) 272-8129
http://www.ul.com

Underwriters Laboratories Inc.®

File E200828 Vol 1 Issued 01/19/2000
Revised 02/04/2000

FOLLOW-UP SERVICE PROCEDURE
(TYPE L)

INDUSTRIAL CONTROL PANELS
(NITW,NITW7)

Manufacturer: NORTHEAST POWER SYSTEMS INC
(614921-001) CAREY INDUSTRIAL PK
66 CAREY RD
QUEENSBURY NY 12804

Applicant: SAME AS MANUFACTURER
(614921-001)

Listee: SAME AS MANUFACTURER
(614921-001)

This Procedure authorizes the above Manufacturer to use the marking specified by Underwriters Laboratories Inc. only on products covered by this Procedure, in accordance with the applicable Follow-Up Service Agreement.

The prescribed Mark or Marking shall be used only at the above manufacturing location on such products which comply with this Procedure and any other applicable requirements.

The Procedure contains information for the use of the above named Manufacturer and representatives of Underwriters Laboratories Inc. and is not to be used for any other purpose. It is lent to the Manufacturer with the understanding that it is not to be copied, either wholly or in part, and that it will be returned to Underwriters Laboratories Inc. upon request.

UNDERWRITERS LABORATORIES INC.

Robert H Levine

Robert H. Levine
Sr. Vice President and
Chief U.S. Operations Officer

N

GENERAL

PRODUCT COVERED:

USL, CNL Industrial control panels.

ENGINEERING CONSIDERATIONS (NOT FOR FIELD REPRESENTATIVE USE):

Products designated USL have been investigated using requirements contained in the Standard for Industrial Control Panels, UL508A.

Products designated CNL have been investigated using requirements contained in CAN/CSA C22.2 No. 14-M95, Industrial Control Equipment, CAN/CSA C22.2 No. 94-M91, Special Purpose Enclosures and CAN/CSA C22.2 No. 73-1953, Electrically Equipped Machine Tools.

FACTORY LOCATION AND IDENTIFICATION:

When more than one manufacturing location is indicated on the Authorization Page Addendum for the Procedure Volume, the factory identification code shall be marked on the product. The factory identification and associated manufacturing location are as follows:

Location	Factory Identification
Queensburg, NY	None

NEPSI's equipment has been seismic qualified for placement and application in high seismic zones as specified in 1997 UBC for Zone 4.

W. E. GUNDY & ASSOCIATES, INC.

P.O. Box 2900 Hailey, ID, 83333

Tel (208) 788-5989 ~ Fax (208) 788-5990

Email: wegai@mindspring.com Web: www.wegai.com

REPORT NO. 1214-02

SEISMIC ANALYSIS QUALIFICATION REPORT

REPORT PREPARED BY: W. E. GUNDY & ASSOCIATES, INC.

DATE SIGNED OR REVISED: 10/06

ADDRESS OF PREPARER:

P.O. BOX 2900
HAILEY, ID 83333

EQUIPMENT MANUFACTURED BY:

NORTHEAST POWER SYSTEMS, INC.
QUEENSBURY, NY

THIS IS TO CERTIFY THAT THE ABOVE NAMED EQUIPMENT AND SUPPORT, IF SUPPORT IS REQUIRED, MEETS OR EXCEEDS ALL OF THE REQUIREMENTS ACCORDING TO 1997 UBC, ZONE 4.

SIGNED:________________________

REGISTERED PROFESSIONAL ENGINEER
WILLIAM E. GUNDY
CE-26599
EXPIRES 3/08
CIVIL
STATE OF CALIFORNIA

1.a) Performance Criteria

The assembly was analyzed to withstand the effects of seismic load combined with the static dead load of the assembly. The seismic loading condition as specified in 1997 UBC, ZONE 4 was used. The applied loads are summarized in Appendix A.

The tank appendages and tank bracing, constructed of structural steel, were evaluated such that primary members were not stressed beyond the components allowable working loads. Limiting primary member stresses in this manner insures the functional capability of the unit during and after seismic events. No permanent deformation will occur.

4.0 Conclusions

The equipment and its major components and other supporting and restraining parts will withstand the stresses caused by forces resulting from the specified load conditions outlined and analyzed in this report.

NEPSI's Equipment has been wind qualified to 90mph and snow load qualified to 40 psf as specified in ASCE 7-05.

W. E. GUNDY & ASSOCIATES, INC.

P.O. Box 2900 Hailey, ID, 83333

Tel (208) 788-5989 ~ Fax (208) 788-5990

Email: wgundy@wegai.com Web: www.wegai.com

REPORT NO. 1214-03-R1

WIND & SNOW LOAD ANALYSIS QUALIFICATION REPORT

REPORT PREPARED BY: W. E. GUNDY & ASSOCIATES, INC.

DATE SIGNED OR REVISED: 8/09

ADDRESS OF PREPARER:

P.O. BOX 2900
HAILEY, ID 83333

EQUIPMENT MANUFACTURED BY:

NORTHEAST POWER SYSTEMS INC.
QUEENSBURY, NY

THIS IS TO CERTIFY THAT THE ABOVE NAMED EQUIPMENT MEETS OR EXCEEDS ALL OF THE REQUIREMENTS ACCORDING TO ASCE 7/05 EXCEPT FOR THE ANOMALIES NOTED.

SIGNED:______________________

1.a) Performance Criteria

The assembly was analyzed to withstand the effects of wind and snow loads combined with the static dead load of the assembly. The wind load is specified as a 90mph wind designed as specified in ASCE 7-05. The snow load is specified as 40 psf. The gravity dead load was combined with all load conditions.

The components and support members, constructed of structural steel were evaluated such that primary members were not stressed beyond 1.0 of the components allowable working loads. Limiting primary member stresses in this manner insures the functional capability of the unit during and after seismic events. No permanent deformation will occur.

4.0 Conclusions and Anomalies

The capacitor rack and major structural components will withstand the stresses caused by forces resulting from the specified load conditions outlined and analyzed in this report.

KEMA

Iron-Core reactors used by NEPSI are tested by third party testing laboratories

150kV BIL Iron-Core Reactor Test Results

KEMA-Powertest, LLC

Test Report # 13051-D

Equipment Tested:

11162, Serial No. 27519, Iron Core Aluminum Wound Reactor

Tested For:

Withstand of Dielectric

February 14, 2013

KEMA-Powertest, LLC 4379 County Line Road Chalfont PA 18914
T +1 215 822 4231 F +1 215 822 4267 www.kema.com

KEMA

REPORT OF PERFORMANCE NUMBER: 13051-D

EQUIPMENT TESTED: **11162, Serial No. 27519**
IRON CORE ALUMINIUM WOUND REACTOR

MANUFACTURER'S RATINGS:

Voltage:	35	kV Class
BIL:	150	kV
Frequency:	60	Hz
Continuous Current:	75	A
Number of Phases:	1	

DATES OF TEST: February 14, 2013

TESTED FOR: Withstand of Dielectric

The tests have been carried out in accordance with the client's instructions.

This report consists of 44 pages, and contains the results of tests performed at the KEMA-Powertest Laboratory on the above noted equipment. Publication or reproduction of the contents of this report in any form other than a complete copy is not permitted without written approval of KEMA-Powertest.

Measurement uncertainty can be verified by reviewing the instrument calibration records. The instruments used are calibrated on a regular basis and are traceable to the National Institute of Standards and Technology.

The results apply only to the specific devices tested and are recorded on the enclosed tables, oscillograms, photographs, etc. A table of contents is included on Page 2.

Richard J. Cubbage
Manager, Test Operations

February 21, 2013
Date

Form: ROP-3.R06

Revision #0 02/19/2013

KEMA

TEST SUMMARY

A. Discussion

The client submitted one PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor, in good condition, to be subjected to withstand of dielectric tests in accordance with the client's instructions. The test sample is rated 35 kV Class, 150 kV BIL, 75 A I_{CONT}, 60 Hertz, and single phase.

B. Test Requirements

The client requested tests to verify the ability of the PM 11162, Serial No. 27519, Iron Core Aluminum Wound Reactor to withstand dielectric in accordance with the client's instructions. These test requirements are summarized in the following table:

High Voltage Test			
Impulse Test			
Full Wave		Chopped Wave	
Voltage (kV)	Waveform (µs)	Voltage (kV)	Chopping Time (µs)
150	1.2 / 50	165	> 3.0

The impulse test sequence shall consist of applying one (1) reduced level impulse, one (1) full level impulse, one (1) reduced level chopped impulse, two (2) full level chopped impulses, and two (2) full level impulses, without causing damage or a flashover.

The impulse shall consist of a high voltage 1.2 / 50 µs wave with a crest of 150 kV.

Reference standard: ANSI/IEEE C57.16-1996, IEEE C57.12.91-2011, C57.12.01-1998

C. Test Results

The withstand of dielectric tests for the PM 11162, Serial No. 27519, Iron Core Aluminum Wound Reactor were performed in accordance with the test standards mentioned above and the client's instructions.

Detailed results are reported in the Impulse Test Record on pages 5-6 of this report.

This report will be forwarded to the client for evaluation.

IMPULSE TEST RECORD

TEST DEVICE: Power Magnetics Inc. - PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor **TEST NO.:** 13051-D

Atmospheric Conditions:

Date:	Time:	Bar. Pr. (mmHg):	T_D (°C):	Hum. (%):	RAD:	F_C: (Positive)	F_C: (Negative)
2/14/2013	9:15 AM	748	21	43	0.981	0.953	0.959
Date:	**Time:**	**Bar. Pr. (mmHg):**	**T_D (°C):**	**Hum. (%):**	**RAD:**	**F_C: (Positive)**	**F_C: (Negative)**

Initial Conditions: Tested as received. Elevated on insulators provided by customer.

TESTER: RP, DD

Trial #	Device Under Test	Grounded Parts		Charge Voltage (V)	Polarity	Test Voltage (kV)	Corrected Voltage (kV)	Time to Chop (ms)	Resulting Waveform	Remarks
1	C1	C0		24.8	Positive	72.1	75.7	-	Calibration	1
2	C1	C0		24.8	Positive	72.5	76.1	-	Reduced	2
3	C1	C0		49.2	Positive	143.2	150.3	-	Full	
4	Gap	Gap		27.2	Positive	79.7	83.6	2.22	Calibration	3
5	C1	C0		27.2	Positive	79.1	83.0	2.74	Reduced Chop	
6	Gap	Gap		54.0	Positive	158.3	166.1	3.72	Calibration	4
7	C1	C0		54.0	Positive	157.2	165.0	-	Full	5
8	C1	C0		54.0	Positive	157.2	165.0	-	Full	6
9	Gap	Gap		54.5	Positive	159.5	167.4	3.88	Calibration	
10	C1	C0		54.5	Positive	158.8	166.6	-	Full	5
11	C1	C0		55.0	Positive	160.0	167.9	-	Full	6
12	Gap	Gap		55.0	Positive	161.2	169.2	3.13	Calibration	
13	C1	C0		55.0	Positive	160.1	168.0	-	Full	5
14	C1	C0		55.0	Positive	161.3	169.3	5.07	Chop	
15	C1	C0		55.0	Positive	161.3	169.3	-	Full	5
16	Gap	Gap		55.0	Positive	160.1	168.0	3.41	Calibration	7
17	C1	C0		55.0	Positive	160.1	168.0	-	Full	5
18	C1	C0		55.5	Positive	161.2	169.2	-	Full	6
19	Gap	Gap		55.0	Positive	161.0	168.9	2.57	Calibration	
20	C1	C0		55.0	Positive	159.9	167.8	-	Full	5

Remarks: 1) Test circuit calibration with the test device in the circuit. Generator change to slow down tail time. 2) Client approved test circuit and setup. Resulting waveshape parameters: 1.15 μs front time, 45.5 μs tail time. 2) Configuration of Marx generator: 3 stages in series, R_F = 78 Ω, R_T = 67 Ω, R_G = 500 Ω. 3) Chopping gap set to distance of 85.5 mm. Chopping Gap does not allow sufficient control of chopping time. 4) Chopping gap set to distance of 200 mm. 5) Chopping gap did not flashover. Test will be repeated. 6) Chopping Gap did not flash over. Adjustment of settings. 7) Chopping gap set to distance of 195 mm.

IMPULSE TEST RECORD

TEST DEVICE: Power Magnetics Inc. - PM 11162, Serial No. 27519, Iron Core Aluminium Wound Reactor **TEST NO.:** 13051-D

Atmospheric Conditions:

Date:	Time:	Bar. Pr. (mmHg):	T_D (°C):	Hum. (%):	RAD:	F_C: (Positive)	F_C: (Negative)
2/14/2013	9:15 AM	748	21	43	0.981	0.953	0.959
Date:	**Time:**	**Bar. Pr. (mmHg):**	**T_D (°C):**	**Hum. (%):**	**RAD:**	**F_C: (Positive)**	**F_C: (Negative)**

Initial Conditions: Tested as received. Elevated on insulators provided by customer.

TEST OBSERVERS:

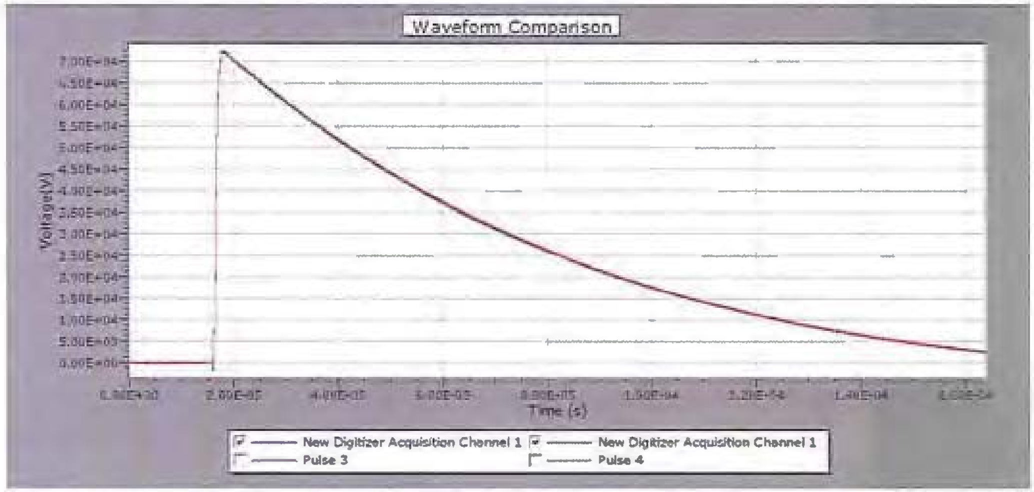
TESTER: RP, DD

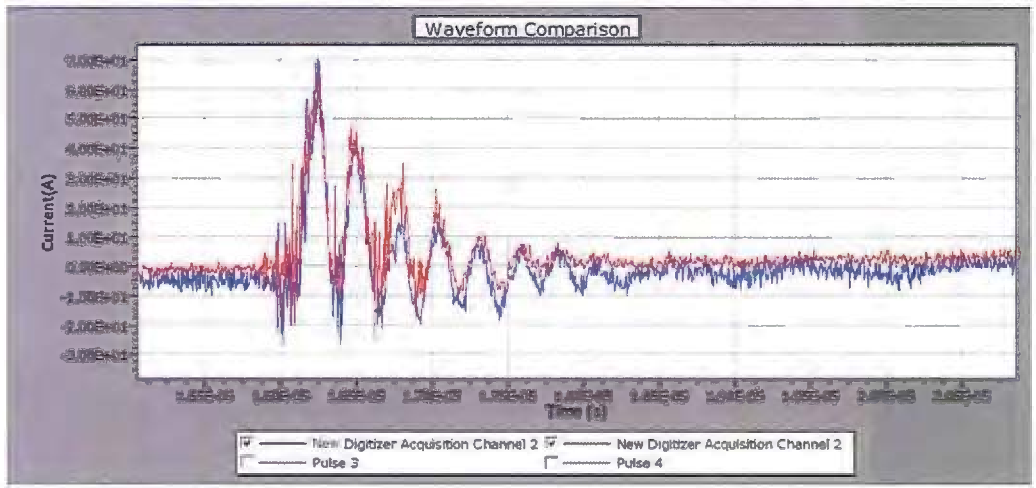
Trial #	Device Under Test	Grounded Parts		Charge Voltage (V)	Polarity	Test Voltage (kV)	Corrected Voltage (kV)	Time to Chop (ms)	Resulting Waveform	Remarks
21	C1	C0		55.7	Positive	161.9	169.9	3.82	Chop	
22	C1	C0		49.2	Positive	143.0	150.1	-	Full	
23	C1	C0		49.2	Positive	143.0	150.1	-	Full	1
24	C0	C1		24.8	Positive	72.0	75.6	-	Reduced	2
25	C1	C0		49.2	Positive	142.7	149.7	-	Full	
26	Gap	Gap		27.2	Positive	79.7	83.6	2.35	Calibration	3
27	C1	C0		27.2	Positive	78.8	82.7	2.16	Reduced Chop	
28	Gap	Gap		55.5	Positive	162.4	170.4	2.72	Calibration	4
29	C1	C0		55.5	Positive	161.0	168.9	4.62	Chop	
30	C1	C0		55.5	Positive	160.9	168.8	2.65	Chop	
31	C1	C0		49.2	Positive	143.0	150.1	-	Full	
32	C1	C0		49.2	Positive	142.8	149.8	-	Full	

Remarks: 1) End of first test sequence. Configuration will be reversed. 2) Start of second test sequence. C0 energized, C1 earthed. 3) Chopping gap set to distance of 85.5 mm. Chopping Gap does not allow sufficient control of chopping time. 4) Chopping gap set to distance of 195 mm. Chopping Gap does not allow sufficient control of chopping time.

KEMA

Desc:	Channel 1
File Name:	13382.jmx
Peak:	72.5 kV
Front Time:	1.152 us
Tail Time:	45.5 us
Desc:	Channel 1
File Name:	13411.jmx
Peak:	143.0 kV
Front Time:	1.202 us
Tail Time:	45.9 us
Desc:	
File Name:	
Peak:	
Front Time:	
Tail Time:	
Desc:	
File Name:	
Peak:	
Front Time:	
Tail Time:	
Desc:	Channel 2
File Name:	13382.jmx
Peak:	0.06 kA
Desc:	Channel 2
File Name:	13411.jmx
Peak:	0.12 kA
Desc:	
File Name:	
Peak:	
Desc:	
File Name:	
Peak:	





Corrected Voltage: 150.1kV

KEMA-Powertest, LLC

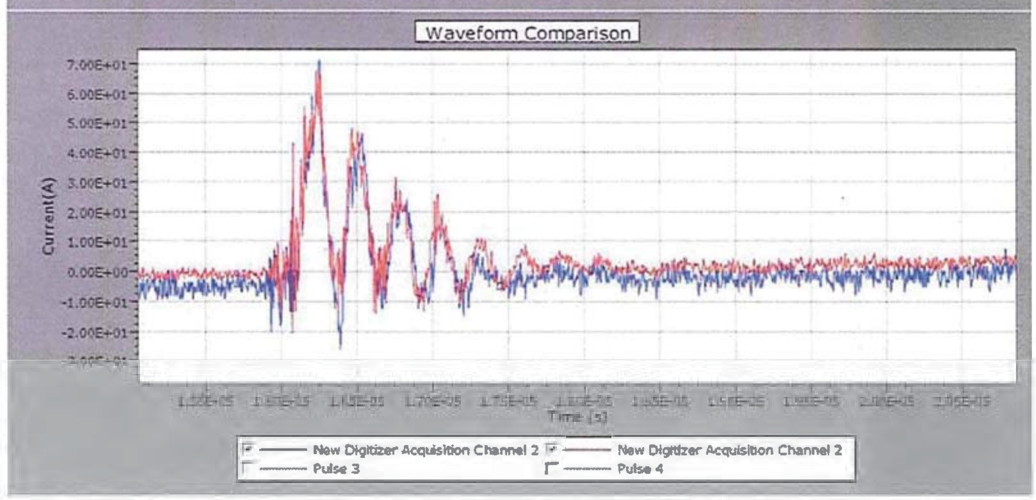
REPORT # 13051-D
WAVEFORM COMPARISON
TRIAL #22 vs. TRIAL #2

Type Wave:	Reduced
Description:	Channel 1
File Name:	13413.jmx
Peak:	72.0 kV
Front Time:	1.211 us
Tail Time:	45.6 us

Type Wave:	Full #1
Description:	Channel 1
File Name:	13420.jmx
Peak:	143.0 kV
Front Time:	1.202 us
Tail Time:	45.9 us

Type Wave:	Reduced
Description:	Channel 2
File Name:	13413.jmx
Peak:	0.07 kA
Front Time:	0.156 us
Tail Time:	55.6 us

Type Wave:	Full #1
Description:	Channel 2
File Name:	13420.jmx
Peak:	0.12 kA
Front Time:	0.206 us
Tail Time:	59.4 us



Corrected Voltage: 150.1kV

KEMA-Powertest, LLC

REPORT # 13051-D
WAVEFORM COMPARISON
TRIAL 31 vs. TRIAL 24

AWS D1.1/D1 . 1M:2006

WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD

Type of welder: Welder Qualification

Name: Henry Hughes — Identification No. 103-42-5958

Welding Procedure Specification No. AWS D1.1 — Rev: 0 — Date: 12-5-2008

Variables	*Record Actual Values Used in Qualification*	*Qualification Range*
Process / Type	GMAW	
Electrode (single or multiple)	Single Electrode	Single Electrode
Current/Polarity	DCEP	
Position	Flat 3G	Flat Vertical & Horizontal
Welding Progression	Stringers & Weaves	Stringers
Backing (Yes or No)	Carbon Steel Backing	With or Without Backing
Material/Spec.	P-8 To P-8	
Base Metal		
Thickness: (Plate)		
Groove	3/8" Plate Material	1/8" - 3/4" Max
Fillet	Not Applicable	All Size Fillet Welds
Thickness: (Pipe/Tube)		
Groove	Not Applicable	Not Applicable
Fillet	Not Applicable	Not Applicable
Diameter: (Pipe)		
Groove	Not Applicable	Not Applicable
Fillet	Not Applicable	Not Applicable
Filler Metal		
Spec. No	5.18	
Class	ER-70S-6	
F-No.	F-5	F-5
Gas/Flux Type	Argon (75%) CO2 (25%)	

VISUAL INSPECTION *(Acceptable* Yes or No) --- YES — **Guided Bend Test Results**

Type	Result	Type	Result

Fillet Test Results

Appearance	Acceptable	Fillet Size	Acceptable

Describe the location, nature, and size of any crack or tearing of specimen.

RADIOGRAPHIC TEST RESULTS

Film Identification #	Results	Remarks	Film Identification #	Results	Remarks
5958	Acceptable				

Interpreted by: Entec Consultants Inc. — *Test Number: ECI- 8885*

Organization Entec Consultants Inc. — *Date: 12-5-2008*

SCOTT L. BERNSTEIN CWI 06100971 QC1 EXP. 11/09

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded and tested in conformance with the requirements of Section 4 of AWS D1.1/D1.1M 2006 Structural Welding Code C/S

Authorized By: Peter Steciuk — *Date: 12-5-2008*

Northeast Power Systems Inc.

ControlLogix Certificate

Presented to

John Steciuk

In recognition of completing the Certificate Program as a Programmer of ControlLogix v.19

September 11, 2012

AUTHORIZED IACET PROVIDER 8.8 CEUs

Rockwell Automation Training Services is an approved Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102; (703) 506-3275. Rockwell Automation awards CEUs to participants who successfully complete this program.

LISTEN THINK SOLVE

Rockwell Automation

Certificate of Completion

This certificate is presented to

Mark Dickinson

of

NORTHEAST POWER SYSTEMS, INC

for the successful completion of the Firetrace Training Class. The recipient is now recognized as a Factory Certified Technician for the installation, maintenance and service of the complete Firetrace product line for a period of two (2) years from the issue date.

12/21/2012

Robert Gibbs, Vice President of Sales ***Issue Date***

FIRETRACE

AUTOMATIC FIRE SUPPRESSION SYSTEMS

10504

Certificate of Completion

This certificate is presented to

Karl Brennelsen

of

NORTHEAST POWER SYSTEMS, INC

for the successful completion of the Firetrace Training Class. The recipient is now recognized as a Factory Certified Technician for the installation, maintenance and service of the complete Firetrace product line for a period of two (2) years from the issue date.

12/21/2012

Robert Gibbs, Vice President of Sales

Issue Date

FIRETRACE

AUTOMATIC FIRE SUPPRESSION SYSTEMS

10503

Certificate of Completion

Presented to:

KARL BRENNEISEN

On 12/17/2012, KARL BRENNEISEN successfully completed the 10-Hour OSHA Outreach Training Course for General Industry.

Taylor Alan Sikes

OSHA Authorized Trainer

As an OSHA authorized trainer, I verify that I have conducted this OSHA outreach training class in accordance with OSHA Outreach Training Program requirements. I will document this class to my authorizing OSHA training organization. Upon successful review of my documentation, I will provide each student their completion card within 90 days of the end of the class.

OSHA TRAINING INSTITUTE EDUCATION CENTER

USF UNIVERSITY OF SOUTH FLORIDA

American Safety Council .com