
Specification for Medium Voltage Automatic Metal-Enclosed Capacitor Banks

- Solar Plant Application -

Brown text is related to arc flash hazard mitigation features that strive to either minimize the level and exposure to an arc flash event or reduce the probability that an arc flash event will occur. Consult NEPSI's technical note for more information about arc flash hazard mitigation at www.nepsi.com.

1 General

- 1.1 This specification is for a medium voltage three phase metal-enclosed automatic capacitor bank consisting of _____ steps of _____ MVAR at _____ kV. The entire bank shall be automatically switched via Automatic Voltage Regulation (AVR) Control System via a Modbus interface to a Allen Bradley PLC. All controls, switching devices, and protection features are enclosed in an all-welded compartmentalized steel enclosure. The bank shall come fully assembled and ready for interconnection. All exceptions to this specification shall be clearly stated with your bid. If no exceptions are taken, the bid should include the phrase "no exceptions have been taken".
- 1.2 The ratings of the bank and associated switchgear, switching devices, capacitors, fuses, and all other applicable components shall have ratings designed for application on the following system:

Nominal System Voltage, (Kv).....	_____	kV
Maximum System Voltage, (Kv).....	_____	kV
System BIL, (Kv).....	_____	kV
Three Phase Short Circuit Rating at Capacitor Bank (RMS Symmetrical Amps).....	_____	kA

(Optional – Arc Flash Hazard Mitigation) For Arc Flash Hazard Mitigation – Consider increasing equipment BIL by one level. A higher BIL will provide more strike distance and creep distance at a fraction of the cost and will result in equipment that is less likely to flash over or fail.

2 Compliance with Standard & Codes

The metal enclosed automatic capacitor bank shall conform to or exceed the applicable requirements of the following standards and codes:

ANSI C29.9	Wet-Process Porcelain Insulators – Apparatus, Post Type
ANSI C29.18	American National Standard for Insulators – Composite - Post Type
ANSI/IEEE C37.99	Guide for Protection of Shunt Capacitor Banks
ANSI C57.13	Standard Requirements for Instrument Transformers
IEEE C37.20.7-2007	Guide for Testing Metal-Enclosed Switchgear Rated Up to 38kV for Internal Arcs
ANSI C84.1	Voltage Rating for Electric Power Systems and Equipment (60Hz)
ASTM A 123	Standard Specification for Zinc Coating (Hot-Dipped Galvanized) Coatings on and Steel Products
CBC	California Building Code

ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
IEEE18	Standards for Shunt Capacitors
IEEE C37.012-2005	Application Guide for Capacitance Current Switching for AC High Voltage Breakers
IEEE C57.16	IEEE Standard Requirements, Terminology and Test Code for Dry-Type Air-Core Series-Connected Reactors
IEEE C57.19.00	General Requirements for Instrument Transformers
IEEE C57.19.01	Performance Characteristics and Dimensions for Outdoor Power Apparatus Bushings
IEEE693	Recommended Practices for Seismic Design of Substations
NEC	National Electrical Code, NFPA 70
NEMA CP 1	Shunt Capacitors
NESC C2	National Electrical Safety Code
NFPA – 70E	Standard for Electrical Safety in the Work Place

3 Product Listing

- 3.1 The capacitor bank control panel shall be UL508A Certified for both Canadian and US products.
- 3.2 The capacitor bank shall be “listed” per OSHA (in the USA) and the Standards Council of Canada (in Canada) to the following standards.
- For products shipping to the United States, IEEE C37.20.3-2001
 - For products shipping to Canada, C22.2 No. 190-M1985+G11 + G12 (R2004)

A copy of the NRTL Certificate showing compliance with the above shall be included with the bid.



4 Enclosure Construction

- 4.1 The manufacturer of the enclosure shall also be the assembler of the capacitor bank. This is to ensure the highest degree of control with respect to critical enclosure manufacturing processes such as cleaning and surface preparation, welding, priming, and painting. Verification of enclosure manufacturing by supplier (on-site visit, photos, raw material invoices) may be required. No exceptions allowed.
- 4.2 The capacitor bank shall consist of a compartmentalized enclosure with NEMA 3R construction that will house all components, including fuses, capacitors, switches and associated controls. All components shall be accessible and removable from the front of the enclosure. Bolted panel construction, transclosure style, and switchgear cubicle style enclosures will not be allowed and will be rejected. For Arc Flash Hazard Mitigation it is recommended that the equipment be placed outside in switchgear yard. Arc blast dissipates at a rate which approximates the inverse-square rule for distance. Keeping workers away from the equipment is an easy way to ensure worker safety. Save on E-house/switchgear room space, put this equipment outdoors.
- 4.3 The enclosure shall be fabricated from 11-gauge cold rolled A60 galvaneal steel. The roof shall be cross-kinked or gabled to allow for watershed.
- 4.4 The doors shall be flush and removable in the open position. They shall be equipped with stainless steel hinges and hinge pins, and 3-point stainless steel latching handles. The handles

shall be pad lockable. All doors providing access to high voltage compartments shall be equipped with door stays to hold doors in the open position.

- 4.5 (Optional – Arc Flash Hazard Mitigation) The door shall be capable of withstanding the effects of an internal arcing fault.
- 4.6 (Optional – Arc Flash Hazard Mitigation) A Fluke Cv400 ClirVu 95MM (4 in) Infrared Window shall be provided on the air disconnect door to allow for infrared inspection without having to open door.
- 4.7 The compartment containing the incoming air disconnect switch and ground switch (if supplied) shall be equipped with an internal hinged protective barrier door to guard against inadvertent entry to the terminals of the load-interrupter switch. Access to any portion of the air disconnect switch shall be blocked by this protective door, while allowing access to main fuses (if supplied).

(Optional – Arc Flash Hazard Mitigation) The internal hinged protective barrier door shall be key interlocked with the upstream feeder breaker.
- 4.8 The base of the enclosure shall be equipped with C4x5.4 or C6x8.2 (as required) structural steel channel. Removable steel lifting plates consisting of 1/2" or 1" (as required) steel shall be located at each corner. Formed channel bases will not be accepted.
- 4.9 All ventilation louvers shall be located on the front, (you may also specify back or sides) of the enclosure and shall be equipped with 2" (5.08 cm) 20x20x2 MERV 5 Fiberglass filters. Filters shall be removable while bank is energized. Live parts shall not be accessible while filters are removed.
- 4.10 All fasteners and associated hardware, inside and out, shall be stainless steel. Externally accessible hardware shall not be used for support of high-voltage components or switch-operating mechanisms within the capacitor bank.
- 4.11 Thermostatically Controlled Strip Heaters shall be supplied in all non-ventilated compartments. When determined by the manufacturer, a thermostatically controlled fan or ventilator shall be supplied.
- 4.12 Each door of the enclosure shall be equipped with self-adhesive vinyl warning signs that comply with ANSI Z535.4 Product Safety Label Standard dated July 1, 2002. The Incoming Compartment sign shall state

Warning Label Requirements per above section	
	
<p><i>Electric arc flash hazard. Will cause severe injury or death. Wear proper protective equipment before opening or performing diagnostic measurements while energized. (See NFPA 70E)</i></p>	<p><i>HAZARDOUS VOLTAGE. Contact may cause electric shock or burn. Turn off and lock out system power before servicing.</i></p>

4.13 Where applicable the following Caution and Danger Tags shall be utilized. Tags shall be UV rated and shall be blind riveted on the enclosure and shall have a minimum size of: 2.75" x 2.25".

Danger and Caution Tag Schedule



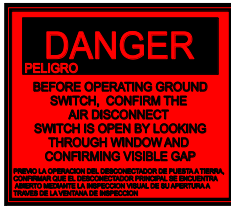
Above tag to be placed on all bolted access doors that are not equipped with key interlocks.



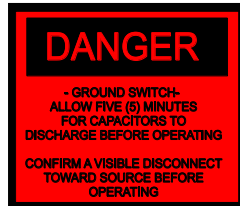
Above tag to be placed on all capacitor bank access doors.



Above tag to be placed on air-disconnect internal barrier door.



Above tag to be placed above all ground switches



Above tag to be placed above ground switch



Above tag to be placed above non-load break disconnect switch

4.14 The capacitor bank shall be name plated with a riveted 3" x 5" stainless steel nameplate containing the following minimum information:

- Nominal System Voltage
- Maximum System Voltage
- Number of Steps, Stages, and Switching Sequence
- kvar per step and kvar of each stage
- BIL

34.5 KV CAPACITOR BANK							
VOLTAGE: 34.5 kV		FREQUENCY: 60 HZ		DATE: 11-17-08			
CONNECTION: UNGROUNDED WYE				BIL: 150 KV			
SERIAL #: #####							
TOTAL KVAR: 20,000				MAX. SYSTEM VOLTAGE: 38 KV			
KVAR/STEP: 10,000		SWITCHED STAGES: 2		SEQUENCE: 1:1			
CUSTOMER NAME: #####							
STAGE	FIXED	- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	
KVAR	N/A	10,000	10,000	-	-	-	
AMPS	N/A	167.5	167.5	-	-	-	
JOB NAME: #####							
CAP RATING: QTY ##, ### KVAR, ##,### KV CAPS/STEP - 2 BUSHING							
Northeast Power Systems, Inc 66 Carey Road Queensbury, NY 12804				NEPSI			
Phone: 518-792-4776							
Webpage: WWW.NEPSI.COM							
POWER FACTOR CORRECTION AND HARMONIC FILTERS							

Typical Name-Plate

4.15 The enclosure shall have a continuous 1/4" x 2" tin-plated ground bus that spans the full width of the enclosure. The bus shall be located near the front of the enclosure to allow for grounding of capacitors during maintenance as well as for providing a ground connection for the incoming cable shield wire. Non-oxidation compound shall be used at all locations where contact with enclosure steel is made. The tin-plated bus shall terminate on a pre-threaded (1/2" x 12 thread) externally welded stainless steel ground pad located on two corners of the enclosure. The ground pad shall accept a standard two-hole compression lug. See picture below for details.



4.16 The enclosure shall be prepared and painted with a high-solid epoxy coating as specified below. The paint shall be ANSI gray 61 – Munsell No. 8.3G 6.10/0.54.

Surface Preparation:

All steel surfaces shall be prepared per SSPC-SP2, 3, 6, 7, 10, 11 or the paint manufacturer's recommendations. Exceptions to the manufacturer's requirements shall be approved by the paint manufacturer and provided with the submittal documents.

Paint Specification:

All surfaces, inside and out, shall be top coated with a High-Solid Epoxy paint with a dry film thickness of 2 to 3 mils. The minimum acceptable measure total dry film thickness shall not be less than 2 mils.

The paint utilized shall have the following properties:

- Salt Spray (ASTM B117) 5500 Hours with no face blistering
- Humidity (ASTM D2247) 5500 Hours with no face corrosion or blistering
- Gloss retention (ASTM G53) QUV-B bulb: Greater than 50% gloss retention at 26 weeks.
- Elongation (ASTM D5222) 14%
- Abrasion resistance (ASTM D4060) 1kg load/1000 cycles, CS-17 wheel: 53 mg weight loss.
- Impact resistance (ASTM D2794): Direct 24 in.lb and Reverse 6 in.lb.
- Adhesion, elcometer (ASTM D4541): 2700 PSI
- NFPA Class A Qualification

Paint shall also provide excellent chemical resistance to splash, spillage, fumes and weather for acidic, alkaline, salt solutions (acidic, neutral, and alkaline salt solutions), fresh water, solvents and petroleum product environments.

Upon request, the manufacturer shall provide supporting documents (surface preparation procedures as well as paint manufacturer's paint specifications) showing the above requirements are met. Failure to comply with this request will be cause for cancellation of order.

4.17 (Optional – Arc Flash Hazard Mitigation) Infrared Sightglasses shall be provided for viewing internal components of all medium voltage compartments of the metal-enclosed power capacitor bank. At least one sightglass shall be provided for every 3 linear feet (1 meter) of enclosure length. Sightglasses shall be arc-flash tested to a maximum of 40kA in accordance with IEEE and IEC standards, and shall be NEMA Type 3/12 (IP65) rated.

4.18 (Optional – Arc Flash Hazard Mitigation) Ultrasound Inspection Ports shall be provided on each door for consistent and quality acoustic data identifying potentially hazardous faults such as arcing, tracking, and corona before the occur.

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- 4.19 (Optional – Arc Flash Hazard Mitigation) The enclosure shall be of an arc resistant design and shall include integral (specify back or top – NEPSI recommends back for outdoor gear with a fenced off protective zone and top for indoor gear) pressure release flaps to facilitate a controlled release of arc created overpressures, smoke, and gasses. (For indoor applications, an enclosed arc-chamber with arc duct exit shall be provided. Field assembly of the arc chamber and arc-duct shall be by the installation contractor. Where venting is intended to penetrate an external wall, the vent shall be covered such that it meets all specified environmental requirements (e.g., rain-tight, dust-tight, vermin-proof)). Arc exhaust location shall be shown on equipment drawings.

Arc Resistant Construction Types (specify one):

- Type 1 – gives the equipment arc resistant protection on the front only.
 - Type 2 – gives the equipment arc resistant protection on the front, rear, and sides of the gear.
 - Type 1D-SR-SL – gives the equipment arc resistance protection on the front, right side, and left side.
- 4.20 The internal barrier door and external door providing access to interrupter switch and ground switch shall be provided with a wide-view window constructed of an impact-UV-resistant material, to facilitate checking of switch position(s) without opening the doors.
- 4.21 The capacitor compartment shall also be equipped with wide-view windows constructed of an impact-UV-resistant material, to facilitate checking of capacitors and capacitor fuses without opening the doors or de-energizing the bank.

(Optional – Arc Flash Hazard Mitigation) A Fluke Cv400 ClirVu 95MM (4 in) Infrared Window shall be provided to allow for infrared inspection without having to open doors.

5 Incoming Air Disconnect Switch

- 5.1 The capacitor bank shall be supplied with an external chain operated disconnect switch. The switch shall have a minimum rating of 135% of the capacitor bank's nominal current rating and shall have a 40-kA RMS momentary asymmetrical rating. This switch shall be interlocked with the vacuum switches/breakers to prevent it from being opened while the capacitor stages are energized. The switch shall be pad-lockable in either the open or closed position. Acceptable disconnect supplier: ABB or PowerCon. The disconnect switch shall be manufactured per ANSI C37.20.4, C37.22, and C37.72.
- 5.2 The Air Disconnect Switch shall be located in a separate compartment that is isolated from the capacitor compartment and the low voltage control compartment by a steel barrier. In addition to the exterior enclosure door, a protective hinged door (behind the exterior door) shall be provided before access to the switch is allowed. When requested by the customer, this door shall be equipped with interlocks that ensure the upstream disconnect is open before allowing access.
- 5.3 (Optional – Arc Flash Hazard Mitigation) The air disconnect switch shall be equipped with a motor operator for remote electrical opening and closing.

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- 5.4 (Optional – Arc Flash Hazard Mitigation) The air disconnect switch terminals or shall be equipped with medium voltage indicators that flash when voltage is present.

6 Ground Switch

- 6.1 An externally operated ground switch shall be provided to ground the load-side terminals of the air disconnect switch. The ground switch shall be pad-lockable in either the open or closed position. The ground switch must be tested in accordance with ANSI/IEEE standards. Test reports shall be furnished upon request.
- 6.2 The ground switch shall be interlocked with the air disconnect switch to prevent closing of the ground switch when the air disconnect switch is in the closed position. In addition, the air disconnect switch shall not be operable when the ground switch is closed. Acceptable Supplier: ABB or PowerCon.

7 Lightning/Surge Arresters

- 7.1 The capacitor bank shall be equipped with metal-oxide, polymer housing station class lightning arresters. The arresters shall be located in the incoming compartment. The lightning arresters shall be manufactured under ANSI standard C62.11. The rating of the lightning arrester shall be recommended by the capacitor bank supplier based on the system grounding and voltage level. Acceptable surges arrester supplier: GE

8 Stage Switches

- 8.1 Each stage of the capacitor bank shall be equipped with an ABB VD4-CS 40.5kV, 31.5kA, 185kV BIL 1200 amp transient-free breaker for switching the capacitor stages on and off. No exceptions.
- Nominal Voltage Rating: 34.5kV
 - Maximum Voltage Rating: 38kV
 - BIL: 185kV
 - Fault Interruption Rating: 31.5kA
 - Making Capacity Rating: 104kA Peak
 - Switch Equipped servo motor synchronous closing control for transient free switching
 - Continuous Current Rating: 1200 Amps
 - Capacitive Switching Current: 1200 Amps
 - C2 Rated, tested to 10,000 electrical operations
 - Control Voltage/Motor voltage: 125VDC
 - Heater voltage: 120VAC
- 8.2 The control system shall prevent the stage switch(s)/breaker(s) from operating more than once in a 5-minute period.
- 8.3 The ABB VD4-CS shall be located in an isolated compartment that is separate from the main

incoming compartment, the capacitor compartment, and the control compartment.

- 8.4 The stage switch(s)/breaker(s) shall be interlocked with the capacitor bank's air disconnect switch and ground switch. The interlock system shall prevent the operation of the air disconnect switch when any of the stage switch(s)/breaker(s) are in the closed position.

9 Capacitors

- 9.1 The automatic capacitor bank shall be equipped with all-film, low loss, double-bushing capacitors rated _____ kvar (total of _____ per stage, _____ for the entire bank). The capacitors shall be designed, manufactured, and tested to meet and/or exceed all applicable NEMA and ANSI/IEEE standards. Capacitors must be manufactured in North America and shall be manufactured by Cooper or GE.
- 9.2 Each capacitor shall contain an internal discharge resistor to reduce the stored voltage to 50 volts or less within 5 minutes from disconnection.
- 9.3 The capacitors shall be connected in ungrounded double wye and shall be protected from sustained over voltages due to capacitor unit failure by a blown fuse detection system.
- 9.4 The capacitors shall be located in a compartment that is separate from the main incoming compartment, and CapSwitcher Compartment. One capacitor compartment shall be supplied per stage.
- 9.5 Capacitors shall be mounted on C4x5.4 structural steel channel. The capacitors shall be removable from the front of the enclosure.
- 9.6 (Optional – Arc Flash Hazard Mitigation) Consider using capacitors that have an extra 10% voltage margin on them for increased reliability. Don't forget, kvar output varies by the voltage squared and that more kvar will be required.

10 Capacitor Protection

- 10.1 Each capacitor shall be protected by a current limiting fuse that is equipped with a blown fuse indicator. Fuses shall be clip mounted to allow for easy change-out and shall be visible and accessible from the front of the enclosure.
- 10.2 Each capacitor stage shall be equipped with a blown fuse protection system. The protection system shall utilize direct fuse sensing, and in addition to detecting a blown fuse, shall also protect the fuse from over-load using a built-in thermal element. Both a blown fuse condition, and an overloaded fuse condition, should result in the control system taking the stage off-line. As an alternative to or in addition to direct fuse sensing, a neutral a neutral CT (connected in the neutral of a wye-wye connected capacitor bank) and an over-voltage relay may be specified for detection of a blown fuse.

11 Phase and Ground Bus

- 11.1 All phase and ground bus shall be Tin-plated for maximum conductivity and corrosion resistance. The bus shall be square edge. Bolted bus-to-bus connections shall be made with 3/8" – 13 stainless-steel bolts with two stainless steel flat washers, one under the bolt head and one under the nut and with a stainless steel split lockwasher between the flat washer and the

nut. The bus shall not have a current density greater than 1200 amps/in². Where expansion capability is required, the bus shall be rated for the maximum capacity of the bank.

- 11.2 The ground bus shall be located near the front base of the enclosure to allow for placement of field installed ground clamps. The bus shall run the full width of the enclosure and shall be pre-punched for connection of equipment ground conductor(s) and cable shield wires. The ground bus shall connect to stainless steel ground pads located on the ends of the enclosure to allow for external connection to the substation ground grid.
- 11.3 The bus supports, bus, and interconnections shall withstand the stress associated with the available short-circuit current at the capacitor bank.
- 11.4 (Optional – Arc Flash Hazard Mitigation) All main phase bus shall be insulated with heavy wall anti-track heat shrinkable tubing designed for insulating medium voltage bus bar. Insulation must be tested to ANSI C37.20.2 standards.

12 Interlocks

- 12.1 The capacitor bank shall be equipped with a keyed interlock system to prevent unauthorized and out of sequence entry into the capacitor bank.
- 12.2 The interlock scheme shall include the upstream protective device (where necessary), the capacitor banks air disconnect switch, ground switch, and the doors of the enclosure. The interlock scheme shall function as follows:
 - 1) Turn all capacitor stages off manually with A1 key interlock.
 - 2) Upon a waiting period of 5 minutes use the “A1” key to unlock the air disconnect switch. Open the Air-Disconnect Switch and close the mechanically interlocked Ground Switch.
 - 3) Remove the “A2” key from the Ground Switch (Removing of the “A2” key shall lock ground switch in closed position” and proceed to the Air-Disconnect Switch External Compartment Door. Unlock the Air-Disconnect Switch Compartment Door and remove the “A3” key from the lock. (Note: Access to Air-Disconnect Switch terminals is prevented by the interior compartment door. This door can be interlocked with upstream breaker or load interrupter if desired. This would prevent access to terminals of switch unless upstream device was locked out.)
 - 4) Use the “A3” key to open the first door that has access to the capacitor compartment. (Upon turning of the “A3” key, the vacuum switches shall close to ground all components on the load-side of the vacuum switches.) Remove the “A4” key from the first capacitor bank compartment door and proceed to the second capacitor bank compartment door.
 - 5) Open the second capacitor bank compartment door, and proceed with the released key (if one is present) to the next door.
 - 6) The above procedure is repeated until all doors are open.
- 12.3 The keyed interlocks on the door shall be mounted behind the enclosure doors with the key-holes protruding through the doors. No adjustment or alignment of locks shall be required. The locks shall be equipped with stainless steel spring covers. The keyed interlock system shall allow all doors to be opened at one time. Master Key interchanges or externally mounted key interlocks shall not be provided.

13 Controls

- 13.1 The controls as presented below are preliminary in nature. Once awarded a contract, the exact details of the control logic shall be determined based on operation constraints of the customer.

It is expected that a programmable logic controller will be utilized as an interface between the metal-enclosed capacitor bank control and protection and the customers AVR controller. It is expected the control interface will utilize Modbus communication.

- 13.2 All low voltage controls (where practical) shall be isolated from the high voltage compartments. All controls shall be accessible while the bank is energized. The control compartment shall form an integral part of the enclosure (no externally mounted control compartments shall be allowed). The control compartment shall allow for bottom or top entry of customer control wires without having to enter the medium voltage compartment. The controls compartment shall be equipped with a swing out panel to allow access to panel mounted controls.
- 13.3 The PLC system will except control signals from the AVR to turn stages on and off. The metal-enclosed bank controller will equalize the stage switching within the metal-enclosed bank. In addition the metal-enclosed bank controller will prevent stages from turning on that have not be de-energized for 5-minutes and those with blown fuses.
- 13.4 The complete control circuit shall be protected by a main circuit breaker.
- 13.5 The Medium Voltage Capacitor Bank Control System shall be listed under UL 508A for Industrial Control Panels.
- 13.6 UL Rated Control Power Circuit Breakers shall be utilized in the control circuit for switching and protection of key control components.
- 13.7 (Optional – Arc Flash Hazard Mitigation) The control and protection system shall be remotely mounted from the main equipment enclosure. The remote enclosure shall be NEMA 1 rated for indoor application. All interconnection wiring shall be supplied by the installing contractor. Terminal blocks in the main equipment enclosure shall be located in a marshalling cabinet. Remote I/O blocks may be used when required in the marshalling cabinet.
- 13.8 (Optional – Arc Flash Hazard Mitigation) The capacitor bank shall be equipped with an ABB UFES (Ultra Fast Earthing Switch) that will provide active arc fault protection for the entire capacitor bank. The UFES system shall be supplied complete with electronic detection and tripping unit, primary switching element, arc sensors and trip cables. The system shall be installed and ready for operation. A transfer trip must be wired out to terminal blocks for tripping upstream feeder breaker in event of fault.
- 13.9 (Optional – Arc Flash Hazard Mitigation) The control system shall be equipped with a “maintenance switch” that enables instantaneous settings on the capacitor bank feeder breakers (and stage breakers when present) to reduce trip times when workers are near the equipment. The switch shall also inhibit all stage switching to reduce the probability of arc flash event from switch failure or switch restrike while workers are nearby.
- 13.10 (Optional – Arc Flash Hazard Mitigation) The capacitor bank shall be equipped with an arc flash detection relay that provides high speed tripping of the capacitor bank feeder breaker in the event of an arc flash fault. The relay and optics shall be installed and tested at the factor before shipment. The fast trip relay output shall be wired to terminal blocks for connection to capacitor bank feeder breaker.

14 Supplier Quality System

- 14.1 The supplier shall have third party certification by an internationally recognized accreditation

body to the most recent version of the ISO 9001 standard for quality management systems. The certification certificate shall be provided with the quote.

- 14.2 Supplier shall be authorized to label equipment as compliant with IEEE C37.20.3-2001 "Standard for Metal-Enclosed Switchgear" and C22.2 No. 190-M1985 "Capacitors for Power Factor Correction". The certification certificate shall be provided with the quote.
- 14.3 Supplier shall be factory certified through periodic inspection by UL to apply UL and C-UL labels on their control panels. The certification certificate shall be provided with the quote.
- 14.4 Supplier shall have on staff, experienced, licensed professional engineers (PE's) with degrees in Power Engineering (preferably with advanced degrees) as evidence of technical proficiency.
- 14.5 Supplier must provide a medium voltage metal enclosed customer list with contact information for the purpose of reference checks. The customer lists shall be provided with the quote.
- 14.6 Supplier must allow factory audits to occur at mutually agreed upon dates between the customer and supplier.

15 Submittals

- 15.1 Upon issue of a purchase order, the supplier shall provide 3 copies of approval drawings. The submittals shall include:
- Installation Instructions
 - Single Line and three line diagrams
 - Pad and cable entry drawings
 - Drawings showing component layout
 - Data sheets for all internal components
 - Material listing

16 Bid Requirements

- 16.1 Supplier must provide an Inspection Test Plan (ITP) detailing all tests, tests reports, and certifications and their schedule for submission from date-of-award.
- 16.2 Supplier must provide a Supplier Document List (SDL) detailing all submittal and close-out documentation that will be provided, along with a submittal schedule (in weeks after award).
- 16.3 Supplier must state all exceptions in the Bid. If no exceptions are taken, the supplier must state that there are no exceptions.
- 16.4 Supplier must have optional extended warranty and field service agreements available. These policies shall be provided with the bid.
- 16.5 Supplier must provide their written quality policy with the Bid.
- 16.6 Quotes are to be FOB factory, freight allowed.

17 Testing and Test Reports

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- 17.1 All components shall be tested in accordance with the relevant standards. Tests to be conducted shall be included in an Inspection Test Plan (ITP), and provided with the bid. At a minimum, the tests included in this section shall be included in the ITP.
- 17.2 A Power-Frequency 1-Minute Withstand Test and a Lightning-Impulse Withstand Test shall be conducted by the assembler in accordance with IEEE C37.57-2003 (2010), IEEE C37.20.3, and IEEE Std. 4 - 2013. The Test Voltages shall be in accordance with C37.20.3-2013 Table 1. Multiple impulse test shall be conducted to demonstrate insulation levels while all switches are open and while all switches are closed. The customer shall have the right to witness the test. No exceptions allowed.
- 17.3 Partial Discharge Testing shall be conducted in accordance with IEEE C37.301, *IEEE Standard for Partial Discharge Measurement In High Voltage Switchgear*, or CSA C22.2 No. 31-14 *CSA Standard for Switchgear Assemblies* (for projects shipping into Canada). The customer shall have the right to witness the test. No exceptions allowed.
- 17.4 (For harmonic filters only) Sweep Frequency Resonance Analysis (SFRA) shall be conducted on all phases and all branches of the harmonic filter. The test reports shall provide a impedance profile report overlaid on the theoretical or specified filter impedance profile. Additionally, all tuning frequencies shall be identified. A Megger FRAX150 SFRA Test Set shall be utilized for this test, no exceptions. A digital file in addition to the paper report shall be provided with the FAT test results.
- 17.5 All relays and control devices shall be programmed, tested, and calibrated prior to shipment. The results of the calibration shall be issued with the test report. Relay and control settings shall be documented and included with the equipment installation, commissioning, and maintenance instructions.
- 17.6 Air Disconnect Switch shall include the following test: Contact Resistance Test, HiPot Test (1 min) at standard voltage per applicable standard, and operation test.
- 17.7 Lightning Arresters shall include the following test: Reference Voltage, Residual / Discharge Voltage, Partial Discharge Test, Power Frequency Test.
- 17.8 Instrument Transformers shall include the following: Turns Ratio Test, Polarity Check, Insulation Test, and Excitation Test per IEEE Std. C57.13.
- 17.9 Capacitors shall include the following test: Leak test, low voltage capacitance test, ground test over-voltage, capacitance and loss measurement, discharge resistor measurement, and visual inspection for damage.
- 17.10 The equipment shall be fully assembled and tested prior to shipment. Certified test reports in accordance with the vendors inspection test plan (ITP) shall be issued and approved prior to shipping.
- 17.11 The client reserves the right to witness any and all tests performed at no additional cost. Sufficient notification shall be given to allow client's representative(s) to be present for the tests. A minimum of 15 working days shall be allowed.

18 Acceptable Product & Suppliers

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- 18.1 Suppliers must offer a minimum 1-year warranty and have available extended warranty programs.
 - 18.2 Supplier must be able to meet testing requirements.
 - 18.3 The supplier must have a current ISO 9001 certification and be certified by an independent ISO accredited firm. The ISO 9001 certificate shall be provided with the bid.
 - 18.4 Supplier must show that they are a regular supplier of medium voltage automatic metal-enclosed capacitor banks. Product literature and a list of customers that have purchased similar products shall be supplied upon request.
 - 18.5 Suppliers must be able to provide performance guarantee in regards to harmonics and power factor.
 - 18.6 The supplier will be responsible for cable coordination.
 - 18.7 Acceptable Suppliers are as follows:

Northeast Power Systems, Inc.
66 Carey Road
Queensbury, NY 12804

Phone: 518-792-4776
Fax: 518-792-5767

Webpage: www.nepsi.com
Quote request: sales@nepsi.com

