

## SECTION 16675 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

## PART 1 GENERAL

## 1.1 DESCRIPTION OF WORK:

- A. Extent of TVSS work is indicated by drawings and by requirements of this section.
- B. Types of TVSS equipment required for this project include the following:
  - 1. Category b or c for distribution panelboards.

## 1.2 QUALITY ASSURANCE:

- A. Manufacturers: firms regularly engaged in manufacture of TVSS equipment of types, ratings, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's qualifications: firm with at least 5 years of successful installation experience with projects utilizing rectifier and inverter work similar to that required for this project.
- C. The specified system shall be factory-tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, "hi-pot" tests at twice rated voltage plus 1000 volts per UL requirements, IEEE c62.41 category b surge tests, UL ground leakage test, and operation and calibration tests.
- D. The project shall be life cycle tested following suggested wait times as defined by ANSI/IEEE C62.45 (1987) and shall be capable of surviving 1000 sequential category C surges of 10,000 amps without failure.
- E. The system shall be UL listed as a complete system under UL 1449 (rev 7/2/87) standard for transient voltage surge suppressors (TVSS) and the rating shall be permanently affixed to the TVSS.

## 1.3 SUBMITTALS:

- A. Product data: submit manufacturer's data on TVSS equipment.
- B. Shop drawings: submit drawings of TVSS equipment indicating unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagrams.
- C. Operation and maintenance manual: the manufacturer shall provide an operation and maintenance manual containing installation, start-up, and operating instructions and a list of recommended spare parts for each system specified.
- D. Test reports: documentation of specified system's UL 1449 listing and clamping voltage ratings shall be provided. This shall include computer generated graphs and oscillograms. Tests shall follow procedures outlined in ANSI/IEEE C62.45 (1987) for installation category and applicable protection modes of TVSS.

## 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver TVSS equipment and accessories individually packaged in factory-fabricated containers. Mount units on shipping skids.

- B. Handle equipment carefully to prevent internal component damage, impact, breakage, denting, and scoring enclosure finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.
- C. Store equipment in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic.

#### 1.5 WARRANTY:

- A. The manufacturer shall provide a full five year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes.

### PART 2 PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: subject to compliance with requirements, provide TVSS products of the following:
  1. Current technology
  2. GE/Liebert

#### 2.2 SYSTEM DESCRIPTION:

- A. Environmental Requirements:
  1. Storage Temperature: -67 degrees F to +185 degrees F (-55 degrees C to +85 degrees C).
  2. Operating Temperature: -40 degrees F to +122 degrees F (-40 degrees C to +50 degrees C).
  3. Relative Humidity: Operation shall be reliable in an environment with 5 percent to 95 percent non-condensing relative humidity.
  4. Audible Noise: The audible noise level of the specified system shall be less than 45 dBA at 5 feet.
  5. Operating Altitude: The system shall be capable of operating up to an altitude of 12,000 feet above sea level.
  6. Magnetic Fields: Unit shall not generate appreciable magnetic field, and shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
- B. Electrical Requirements:
  1. System Operation Voltage: The nominal system operating voltage shall be 277/480 V 3 WYE, 4-wire plus ground, or as indicated on drawings.
  2. Maximum Continuous Operating Voltage (MCOV): The TVSS maximum continuous operating voltage shall not be less than 115 percent of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS overvoltage conditions. Each system shall be factory tested at the MCOV for at least one (1) hour.
  3. Operating Frequency: The operating frequency range of the system shall be at least 47 to 63 Hertz.
  4. Protection Modes: The TVSS shall provide protection as follows:
    - a. Line to line (Delta Configured System)

- b. Line to ground
  - c. Neutral to ground (Wye Configured System)
  - d. Line to neutral (Wye Configured System)
5. Performance Ratings: Provide TVSS surge current capacity based on an 1.2x50 microsecond 20KV open circuit voltage, 8x20 microsecond short circuit current Category C3 Bi-wave per ANSI/IEEE C62.41-1991 and C62.45-1995 standards as follows: (A balanced surge current capacity shall also be applied Neutral to Ground and Line to Neutral where neutrals are present in the system).

#### Service Entrance

Per Phase	400 kAmps
Line to Neutral	200 kAmps
Line to Ground	200 kAmps
Line to Line	200 kAmps

Subdistribution	
Per Phase	300 kAmps
Line to Neutral	150 kAmps
Line to Ground	150 kAmps
Line to Line	150 kAmps

Panelboards	
Per Phase	120 kAmps
Line to Neutral	60 kAmps
Line to Ground	60 kAmps
Line to Line	60 kAmps

#### 2.3 TVSS EQUIPMENT:

- A. Components: The system shall be a symmetrically balanced, metal oxide varistor (MOV) array system, constructed using surge current diversion modules. Each module shall be capable of withstanding over 1000 pulses of the 10 kAmps IEEE C62.41 Category C surge current without degradation of clamping voltage. The module shall consist of multiple gap-less metal oxide varistors, with each MOV individually fused. The modules shall be designed and constructed in a manner which ensures reasonable MOV surge current sharing. No gas tubes or silicon avalanche diodes shall be used. The status of each varistor shall be monitored and green LED shall be illuminated if the module is in full working order. When module performance is degraded, such as if one or more fuses or varistors have failed, the LED shall indicate a failed module.
- B. High Frequency Tracking Filter: The unit shall include a UL 1238 high-frequency extended range tracking filter. The filter shall provide for high frequency transient filtering of up to 5 dB attenuation (per MIL-STD E220A) for the band width extending from 100 KHZ to 100 MHZ. This filtering must remove low level surges and sharp wavefronts associated with fast rise-time transients, thus eliminating disturbances which may lead to "system upset".
- C. Connections: Terminals shall be provided for all of the necessary power and ground connections. The terminals shall accommodate wire sizes of #14 to #2/0 AWG for two conductors per required connection. The units shall use standard parallel wiring techniques.

- D. Internal Connections: All surge current diversion module intra-unit connections shall be by way of low impedance busbars or wiring. Surge current diversion modules shall use low impedance connections. All module mounting hardware and power wiring shall be captive or remain in place when a module is removed or replaced.
- E. Enclosure: The specified system shall be provided in a heavy duty NEMA 12 dusttight, and driptight enclosure with no ventilation openings. The cover of the enclosure shall be hinged and require a tool for access to internal components. A drawing pocket shall be provided inside the door for storage of unit drawings and installation/operation manual. Indication of surge current module status shall be visible without opening the door.
- F. Integral Test Point: The unit shall incorporate an integral test point allowing easy off-line diagnostic testing which verifies the operational integrity of the unit's suppression/filter system.

#### 2.4 ACCESSORIES:

- A. LED indicators shall be provided on the hinged front cover to redundantly indicate unit module status. Additionally, a Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.
- B. Integral Fused Disconnect Switch: The unit shall include an integral fused and safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility's distribution system. The switch shall be rated for 600 VAC. Each current-carrying, ungrounded circuit conductor connected to the facility's distribution system shall be individually fused with 200,000 AIC rated fuses in order to provide maximum fault current protection. The unit shall be UL 1449 Listed with the integral fused disconnect switch. The UL 1449 Suppression Rating for this configuration shall also be provided. (1.4.6 Performance Ratings.) Specify Integral Fused Disconnect Switch by adding a "DF" suffix to the model number.
- C. Diagnostic Test Set: A Diagnostic Test Set shall be provided which verifies the operational integrity of the unit's suppression system. The Diagnostic Test Set shall be self-contained and portable, and shall provide complete assurance of the unit's installation and capability without stressing the suppression system or posing detriment to continued operation. Specify Diagnostic Test Set as model number DTS 1000.

### PART 3 EXECUTION

#### 3.1 INSPECTION:

- A. Installer must examine areas and conditions under which TVSS equipment is to be installed, and notify contractor in writing of those conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

### 3.2 INSTALLATION OF TVSS EQUIPMENT:

- A. Install TVSS as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that TVSS installation complies with requirements of NEMA standards and NEC, and applicable portions of NECA's "standard of installation," for installation of units.
- B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of TVSS with other work.
- C. Install electrical protective devices, if any, for each TVSS unit.
- D. The installing contractor shall install the parallel TVSS with short and straight conductors as practically as possible. The contractor shall twist the TVSS input conductors together to reduce input conductor inductance.
- E. Field installation: the unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with #2 AWG copper conductor or larger and not be any longer than necessary, avoiding unnecessary bends. Notify engineer prior to installation if unit cannot be installed within manufacturer's required distances.

### 3.3 ADJUSTING AND CLEANING:

- A. Touch-up scratched and marred surfaces of equipment to match original finishes; remove dirt and construction debris.

### 3.4 FIELD QUALITY CONTROL:

- A. Upon completion of installation of TVSS equipment and after circuitry has been energized with rated power source, verify the equipment is operating properly. Where possible, correct malfunctioning units at site; otherwise remove and replace with new units and re-verify operation.

END OF SECTION 16675