

SECTION 16280
INTEGRATED SURGE PROTECTION DEVICES

1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated Surge Protection Device (SPD)/Transient Voltage Surge Suppressor (TVSS); complete, including all materials, components and associated accessories and having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability, the SPD shall be integrated into the electrical distribution equipment such as panelboards, switchboards, etc.

B. Related Sections:

1. Section 16050 - Basic Electrical Materials and Methods
2. Section 16425 - Switchboards
3. Section 16470 - Panelboards

1.2 QUALITY ASSURANCE

A. The integrated surge protection devices and associated accessories shall be designed, manufactured, installed and tested in accordance with the latest editions and applicable sections of the following codes and standards:

1. National Fire Protection Association (NFPA) 70, National Electrical Code (NEC)
2. National Electrical Manufacturers Association (NEMA), NEMA LS-1
3. American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE), C62.41; C62.45
4. Underwriters Laboratory (UL):
 - a) UL 1020
 - b) UL 1283
 - c) UL 1449, 2nd Edition Revision Effective 2/9/2007 (UL 1449 Rev 2.5)

B. For the equipment specified herein, the manufacturer shall be ISO 9000 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The manufacturer must have a 24-hour response capability with field engineering personnel. The field service organization must have fully accredited, power system technicians/engineers who are capable of performing complete grounding, power quality analysis, and coordination studies. Factory trained sales personnel do not qualify as power system technicians/engineers.

E. The manufacturer of the SPD/TVSS equipment shall be the same manufacturer as the manufacturer of the low voltage distribution equipment in which the SPD/TVSS units are installed.

1.3 SUBMITTALS

- A. Submit to Engineer the following information in accordance with the requirements of section 16050 and General Conditions of Contract:
1. Descriptive bulletins
 2. Product sheets
 3. Upon request, following additional information shall be submitted to the engineer:
 - a) Provide verification that the SPD/TVSS device complies with the required UL 1449 (Rev 2.5) approvals.
 - b) Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
 - c) Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the devices noise attenuation equal or exceeds 50 dB at 100 kHz.
 - d) Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on both per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit to Engineer the following operation and maintenance information in accordance with the requirements of section 16050 and General Conditions of Contract:
1. Instruction books and/or leaflets
 2. Recommended renewal parts list
 3. Final as-built drawings

2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
1. Cutler-Hammer
 2. Square D
 3. Siemens
 4. General Electric
- B. All components shall be the product and assembly of the same manufacturer, or equivalent products of a number of manufacturers, which are suitable for use in a unified system.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

- A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 (2nd edition) Suppressed Voltage Rating (SVR) – The maximum SVR for the device must not exceed the following:

MODES	208Y/120	480Y/277
L-N; L-G; N-G	400V	800V
L-L	800V	1800V

6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:

Mode	208Y/120	480Y/277
L-N	560V	960V

7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:

Mode	208Y/120	480Y/277
L-N	160V	165V

B. TVSS Design:

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter –The Surge Protective Device shall have a High Frequency Extended Range Tracking filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating

in the attenuation frequencies:

Attenuation Frequency	50kHz	100kHz	500kHz	1MHz	10MHz	100MHz
Insertion Loss (ratio)	40	316	316	89	200	79
Insertion Loss (dB)	32	50	50	39	46	38

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
 - a) Each unit shall provide a solid state indicator light on each phase that shall indicate which phase(s) have been damaged.
 - b) Remote Status Monitor – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
 - c) Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
 - d) Event Counter – The TVSS shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
 - e) Push to Test – The TVSS shall be equipped with push-to-test feature that is designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self-test procedure. If the system is fully operational, the self-test will activate all indicator lights.
 - f) Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.
6. Optional Monitoring Diagnostics:
 - a) Non Volatile Memory – The TVSS shall at least be able to save the last 1000 events.
 - b) Network Communication – The TVSS shall have the ability to communicate via Ethernet 10BaseT port or Modbus to provide information to the network master drive.
 - c) Security – The TVSS monitoring diagnostics shall be password protected.
 - d) Protection Remaining – The TVSS shall indicate the level of protection remaining.
 - e) Total Harmonic Distortion (%THD) – The TVSS shall display Total Harmonic Distortion.
7. Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition, the manufacturer shall provide:
 - a) Individual Fusing: MOV’s shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.

- b) Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) Technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A.
 - c) All overcurrent protection components shall be tested in compliance with UL 1449 Rev 2.5 - Limited Current Test and AIC rating test.
- C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992
- 1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50µsec, 20kV open circuit voltage. 8 x 20µsec, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:
 - a) Service Entrance: 12000 impulse per mode.
 - b) Distribution Panelboard: 10000 impulse per mode.
 - c) Branch Location Panelboard: 9000 impulse per mode.

2.3 SYSTEM APPLICATION

- A. The TVSS applications covered under this section include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. The branch panel located TVSS shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.
- B. Surge Current Capacity - The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as shown in the following table:

Minimum total surge current and withstand Capability with compliance to ANSI/IEEE C62.41 AND NEMA LS1			
APPLICATION	Per Phase	Per Mode	Surge Withstand Capabilities ANSI/IEEE C3 Wave (10 kA)
Service Entrance Locations (Switchboards, Switchgear, MCCs, Main Panelboards)	240kA	120kA	12000
High Exposure Roof Top Locations (Distribution Panelboards)	160kA	80kA	10000
Branch Locations (Panelboards, MCCs, Busway)	120kA	60kA	9000

- C. Lighting and Distribution Panelboard Requirements:
 - 1. The TVSS application covered under this section includes lighting and distribution panelboards. The TVSS units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.
 - 2. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
 - 3. The TVSS shall be immediately installed on the load side of the main breaker.

4. The panelboard shall be capable of re-energizing upon removal of the TVSS.
 5. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path.
 6. The TVSS panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and TVSS device is not acceptable). TVSS units that use a cable connection do not meet the intent of this specification.
 7. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 8. The TVSS shall be of the same manufacturer as the panelboard.
 9. The complete panelboard including the TVSS shall be UL67 listed.
- D. Switchgear, Switchboard, MCC and Busway/ Bus Plug Requirements:
1. The TVSS application covered under this section is for switchgear, switchboard, MCC and Bus Plug locations. Service entrance located TVSS shall be tested and suitable for ANSI/IEEE C62.41 Category C3 environments.
 2. The TVSS shall be of the same manufacturer as the switchgear, switchboard, MCC and Bus Plug.
 3. The TVSS shall be factory installed inside the switchgear, switchboard, MCC and Bus Plug at the assembly point by the original equipment manufacturer.
 4. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.
 5. Provide a 30-amp disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.
 6. The TVSS shall be integral to switchgear, switchboard, MCC and Bus Plug as factory standardized design.
 7. All monitoring diagnostics features shall be visible from the front of the equipment.

3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with requirements of Section 16050 and manufacturer's recommendations.

3.2 TESTS

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

END OF SECTION