

SECTION 16671
SURGE PROTECTIVE DEVICES (SPDs)
LOW VOLTAGE AC SURGE PROTECTION FOR ELECTRICAL DISTRIBUTION
SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability, the ac surge protection shall be attached onto electrical distribution equipment such as switchgear, switchboards, panelboards, busway, or motor control centers. Refer to related sections for surge requirements.

1.02 RELATED SECTIONS

- A. Section 16426A – Metal Enclosed Drawout Switchgear (Magnum DS) – Low Voltage
- B. Section 16426B – Metal Enclosed Drawout Switchgear (DSII) – Low Voltage
- C. Section 16428 – Switchboards – Low Voltage (Compartmentalized Feeders)
- D. Section 16429 – Switchboards – Low Voltage (Group Mounted)
- E. Section 16431 – Switchboards – Low Voltage (Commercial Metering)
- F. Section 16466 – Busway – Low Voltage
- G. Section 16470 – Panelboards
- H. Section 16482 - A & B – Motor Control Centers – Low Voltage

1.03 REFERENCES

SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449, 3rd Edition)

A. Submittals

1. For Review/Approval the following information shall be submitted to the Engineer:
2. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Intertek (ETL), Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratorys (NRTL). Compliance may be in the form of a file number that can be verified on ETL's or UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).

3. Electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins
2. Product sheets

1.04 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 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 SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

PRODUCTS

1.07 MANUFACTURERS

- A. Innovative Technology
- B. Eaton
- C. Cutler Hammer

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

1.08 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 not be less than 125% -of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. 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 – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

LN= Line to Neutral

LL= Line to Line

LG= Line to Ground

NG= Neutral to Ground

Wye System: LN-A Phase, LN-B Phase, LN-C Phase, LG-A Phase, LG-B Phase, LG-C Phase, NG

Delta System: LL-A Phase, LL-B Phase, LL-C Phase, LG-A Phase, LG-B Phase, LG-C Phase

Single Phase System: LN-A Phase, LN-B Phase, LG-A Phase, LG-B Phase, NG

High Leg Delta: LN-A Phase, LN-B Phase, LN-C Phase, LG-A Phase, LG-B Phase, LG-C Phase, NG

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system with a Phase to Phase Peak Surge Current greater than 120KA shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having a Phase to Phase Peak Surge Current greater than 120KA and an I_n less than 20kA shall be rejected.
6. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system with a Phase to Phase Peak Surge Current less than 80KA shall have a 10kA I_n rating regardless of their SPD Type (includes Types 1 and

Type 2) or operating voltage. SPDs having a Phase to Phase Peak Surge Current less than 80kA and an I_n less than 10kA shall be rejected.

7. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120 3 Phase	480Y/277 3 Phase	120/240 1 Phase	240 Delta	480 Delta
L-N; L-G; N-G	600V	1000V	600V	1000V	1500V
L-L	900V	1800V	900V	1000V	1800V

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. 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 replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

4. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
 - a. Protection Status Indicators - Each unit shall have a solid-state indicator light that reports the status of the protection on each phase.
 - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
5. Overcurrent Protection

The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

6. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
7. Safety Requirements
 - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
 - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
 - c. SPDs shall be factory sealed in order to prevent access to the inside of the unit. SPDs shall have factory installed phase, neutral, ground and remote status contact connections factory installed.

1.09 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments. The maximum ANSI/IEEE Let-Through Voltage Ratings for the device shall not exceed the following:

Maximum ANSI/IEEE Category A1 – 2000 Volts, 67 Amps Let-Through Voltage Ratings, 6” of lead length, Positive Polarity, From Zero Reference.

System Voltage	120/240 1 Phase	208Y120 3 Phase	480Y277 3 Phase	240 Delta	480 Delta
L-L	90V	90V	100V	70V	60V
L-G	100V	100V	120V	590V	1100V
L-N, N-G	60V	60V	70V	N/A	N/A

Maximum ANSI/IEEE Category C3 – 20,000 Volts, 10,000 Amps Let-Through Voltage Ratings, 6” of lead length, Positive Polarity, From Zero Reference.

System Voltage	120/240 1 Phase	208Y120 3 Phase	480Y277 3 Phase	240 Delta	480 Delta
L-L	1240V	1240V	2060V	1260V	2120V
L-G	1000V	1000V	1580V	1420V	2130V
L-N, N-G	890V	890V	1370V	N/A	N/A

Maximum ANSI/IEEE Category B3/C1 – 6000 Volts, 3000 Amps Let-Through Voltage Ratings, 6” of lead length, Positive Polarity, From Zero Reference.

System Voltage	120/240 1 Phase	208Y120 3 Phase	480Y277 3 Phase	240 Delta	480 Delta
L-L	900V	900V	1640V	860V	1990V
L-G	550V	550V	1050V	850V	1840V
L-N, N-G	520V	520V	980V	N/A	N/A

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	300 kA	150 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	80 kA	40 kA

- C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs.
- D. All SPDs installed on the load side of the service entrance disconnect shall be Type 2 SPDs.
- E. Type 1 SPD's shall not incorporate capacitors in their construction.
- F. Type 2 SPD's shall meet UL 1283 standards for noise attenuation. (See Section 1.08-B-3 of this specification.

1.10 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
 - 1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - 2. The panelboard shall be capable of re-energizing upon removal of the SPD.
 - 3. SPD connected to a factory specified circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the factory specified circuit breaker.
- B. Applications Installation (SPD mounted external to electrical assembly)
 - 1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.
- C. Switchgear, Switchboard, MCC and Busway Requirements
 - 1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs

shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

2. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
3. If the Switchgear, Switchboard, MCC or Busway does not provide internal disconnecting means, the SPD shall be connected through an external disconnect. The disconnect shall be built in to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
4. All monitoring and diagnostic features shall be visible from the front of the equipment.

1.11 ENCLOSURES

- A. All enclosed equipment shall have NEMA 4 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure.

EXECUTION

1.12 EXAMINATION

1.13 FACTORY AND FIELD TESTING

- 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
- B. The unit must have a factory authorized technician perform a field start up procedure as per factory specifications. After start up the factory authorized technician will provide a start up report to the owner.

1.14 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

1.15 WARRANTY

- A. The manufacturer shall provide a full twenty (20) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.