

SECTION 264313 – SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Type 1 surge protective devices.
 - 2. Enclosures.
 - 3. Conductors and cables.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. NRTL: Nationally recognized testing laboratory.
- F. OCPD: Overcurrent protective device.
- G. SCCR: Short-circuit current rating.
- H. SPD: Surge protective device.
- I. Thermally Protected MOV: An electronic component with a significant non-ohmic current-voltage characteristic.
- J. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device. Type 1 SPDs can be used anywhere in the facility and do not require external over-current protection devices
- K. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- L. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include electrical characteristics, specialties, and accessories for SPDs.
2. Include Shop Drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.
3. Copies of manufacturer's catalog data, technical information and specifications on equipment proposed for use.
4. Copies of documentation stating that the SPD is listed by UL to UL 1449 4th Edition, category code VZCA.
5. Copies of actual let-through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
6. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50kHz and 100MHz verifying the device's noise attenuation. Must show multiple attenuation levels over a range of frequencies. Test criteria must be based on 6 ft (1.8 m) of lead length.
7. NRTL certification of listing to UL 1449.
 - a. Tested values for VPRs.
 - b. Inominal ratings.
 - c. MCOV, type designations.
 - d. OCPD requirements.
 - e. Manufacturer's model number.
 - f. System voltage.
 - g. Modes of protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Copies of test reports from a third party, recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per-mode basis using the 8 x 20 microsecond wave shape. Test data on an individual module are not acceptable.
- C. Copies of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
- D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions within 20 years from date of Substantial Completion.

- 1. Warranty includes damage caused by lightning strikes or transient utility faults.

PART 2 PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ABB Electrification Products Industrial Solutions; Current Technology – SL3 Series, Selenium and Thermally protected metal-oxide varistor hybrid SPD or comparable product by one of the following:

- 1. ASCO; 560 Series.

- 2. Joslyn

- B. Source Limitations: Obtain devices from single source from single manufacturer.

- C. Standards:

- 1. Listed to UL 1449, 4th Edition as a Type 1 SPD and UL 1283.

- 2. Comply with NFPA 70.

- D. Product Options:

- 1. Include integral disconnect switch.

- 2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.

- 3. Include indicator light display for protection status. Indicator light shall change color to indicate percentage of protection remaining: Green 100-70 percent, Orange 70-40 percent, and Red <40 percent.

- 4. Include audible alarm, with an alarm disable button.

- 5. Include two sets of NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.

- 6. Include surge counter.

- E. Performance Criteria:

1. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL 1449, section 37.7.3. MCOV values based on the component's value or on the 30-minute 115 percent operational voltage test, section 38 in UL 1449, will not be accepted.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 200 kA for service entrance locations and not less than 200 kA for Panelboard locations.
3. Unit shall have no more than 10 percent deterioration or degradation of the UL 1449 4th Edition Voltage Protection Rating (VPR) when exposed to a minimum of 15,000 repeated category C3 (20kV/10kA) surges. SPD manufacturer must provide a test report validating the repetitive surge test was performed.
4. Protection Modes UL 1449 4th Edition VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). Three-phase, four-wire circuits, (120/240) split-phase shall be as follows and comply with test procedures outlined in UL 1449, section 37.6.
 - a. System Voltage: 240/120, 208/120.
 - 1) Mode: L-N:
 - a) MCOV: 150.
 - b) B3 Ringwave 6kV, 500A: 490.
 - c) C3 Combined Wave, 20kV, 10kA: 980.
 - d) UL 1449 Fourth Edition VPR Rating: 700.
 - 2) Mode: L-G:
 - a) MCOV: 150.
 - b) B3 Ringwave 6kV, 500A: 570.
 - c) C3 Combined Wave, 20kV, 10kA: 980.
 - d) UL 1449 Fourth Edition VPR Rating: 700.
 - 3) Mode: N-G:
 - a) MCOV: 150.
 - b) B3 Ringwave 6kV, 500A: 640.
 - c) C3 Combined Wave, 20kV, 10kA: 1170.
 - d) UL 1449 Fourth Edition VPR Rating: 700.
 - 4) Mode: L-L:

- a) MCOV: 300.
 - b) B3 Ringwave 6kV, 500A: 500.
 - c) C3 Combined Wave, 20kV, 10kA: 1600.
 - d) UL 1449 Fourth Edition VPR Rating: 1200.
- 5. SCCR: The rating of the SPD shall be 200kAIC without the need for upstream over current protection.
 - 6. Inominal Rating: 20 kA.
 - 7. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B. These test criteria must be based on 6-inch (13-mm) lead length.
 - 8. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.
 - 9. SPD unit shall be able to prevent common temporary overvoltage's and high-impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and intermediate current TOVs (as specified in UL 1449 article 39.3 and 39.4) can be caused by a loss of the neutral conductor in a split-phase or three-phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:
 - a. 1 cycle: 120 percent at 30A, 130 percent at 100A, 150 percent at 500A, 160 percent at 1000A.
 - b. 10 cycles 130 percent at 30A, 150 percent at 100A, 160 percent at 500A, 160 percent at 1000A.
 - c. 30 cycles 140 percent at 30A, 150 percent at 100A, 160 percent at 500A, 160 percent at 1000A.
 - 10. Unit shall be able to withstand multiple TOVs without damage to the MOVs by shunting current away from the MOVs during the overvoltage. SPD must have the ability to withstand >100 TOVs with a source current of 30A, duration of 30 cycles, with 10s between TOV events.
 - 11. The service entrance protector shall incorporate a combination of Thermally Protected MOV and Selenium technology allowing for transient surge, temporary and sustained over voltage protection.
 - 12. SPD shall be externally mounted to the switchgear and/or panelboard. Internally mounted SPDs will not be accepted.

2.2 TYPE 4 SURGE PROTECTIVE DEVICES (SPDs)

- A. Type 4 SPDs are not approved for field installation.

2.3 SERVICE ENTRANCE.

A. Basis-of-Design Product: Current Technology - Select3 or SL3 Series 200kA per mode surge rating.

1. SPD's shall have the following features:

- a. Integral Disconnect Switch: Device shall have an optional NEMA-compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
 - 1) Switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
 - 2) Switch shall be rated for 600 V ac and fully surge rated.
 - 3) SPD device shall be tested to UL 1449 4th Edition listed with the integral disconnect switch and the UL 1449 VPR ratings shall be provided.
 - 4) Integral disconnect switch shall be capable of withstanding the published maximum surge current magnitude without failure or damage to the switch.
 - 5) Line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.
- b. UL 1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.
- c. UL 1449 Nominal Discharge Surge Current Rating: 20kA.
- d. SCCR Rating of the SPD: 200kAIC without the need for upstream over-current protection
- e. SPD shall be listed as Type 1 SPD, suitable for use in Type 1 or Type 2 applications.
- f. SPD shall have monitoring options to include time/date stamp, duration and magnitude for the following power quality events, sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase. SPD monitoring shall track surge protection and display it as a percentage of remaining protection. SPD shall provide a surge counter with three categories to be defined as Low Level surge (100A-500A) Medium Level surge (500A-3,000A), and High Level surge (>3,000A). The SPD shall have remote communications via ModBus or Ethernet. The unit shall have tri-color LED indicators for instant verification of power and protection status of each phase. The SPD shall have Form-C contacts rated at 5 A and 250 V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of the unit or loss of AC power.

2.4 PANEL SUPPRESSORS

A. Basis-of-Design Product: Transguard3 or TG3 Series 200kA per mode surge rating or approved equivalent.

B. SPDs: Comply with UL 1449, Type 1.

1. SPDs with the following features and accessories:
 - a. Electrical Noise Filter: Each unit shall include a high-performance EMI/RFI noise-rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.
 - b. SPD shall include an EMI/RFI noise-rejection filter for all L-N modes as well as a removable filter in the N-G mode.
 - c. Integral Disconnect Switch: Device shall have an optional NEMA-compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
 - 1) Switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
 - 2) The switch shall be rated for 600 V ac.
 - 3) SPD device shall be tested to UL 1449 4th Edition listed with the integral disconnect switch and the UL 1449 VPR ratings shall be provided.
 - 4) Integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
 - 5) Line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.
2. The UL 1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.
3. UL 1449 Nominal Discharge Surge Current Rating shall be 20kA.
4. SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.
5. SPD shall be listed as Type1 SPD, suitable for use in Type 1 or Type 2 applications.
6. SPD shall have monitoring options to include time date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase). SPD monitoring shall track surge protection and display it as a percentage. SPD shall provide a surge counter with three categories to be defined as Low Level surge (100A-500A), Medium Level surge (500A-3,000A), and High Level surge (>3,000A). SPD's remote communications via ModBus or Ethernet. The unit shall have tri-color LED indicators for instant verification of power and protection status of each phase. The SPD shall have Form-C contacts rated at 5 A and 250 V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of the unit or loss of AC power.

2.5 ENCLOSURES

- A. Indoor Enclosures: NEMA 4/12.
- B. Outdoor Enclosures: Type 3R.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Termination leads from the SPD to the intended protected load shall be kept as short and straight as possible, avoiding 90 degree bends in the wire. If the installation lead length must exceed 5 feet (1.5 m), then the SPD manufacturer shall provide a low-impedance cable system to minimize the additional lead lengths impact to the installed performance of the SPD.
 - 1. Basis of Design Product: Current Technology model HPI, a high-performance, low-impedance cable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions, applicable NEC codes, local codes, and the requirements of the authority having jurisdiction.
- B. If an OCPD or disconnect is desired for installation of SPD, it must be in accordance with UL 1449 and manufacturer's written instructions.
- C. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
 - 2. Do not exceed manufacturer's recommended lead length.
 - 3. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. SPDs that do not pass tests and inspections will be considered defective.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. SPD manufacturer's technician shall perform a system checkout and start-up in the field to ensure proper installation, operation, and to initiate the warranty of the system. Technician will be required to do the following:
 - 1. Verify voltage clamping levels utilizing a diagnostic test kit, comparing factory benchmark readings to installed readings.
 - 2. Verify N-G connection.
 - 3. Record information to a product signature card for each product installed.
- B. Unit may be installed on either the line or load side of the main service disconnect.
 - 1. If installed on the line side, unit shall be installed with an integral disconnect.
 - 2. If installed on the load side, unit shall be installed on the largest breaker size available.
 - 3. If installed lead length exceeds 5 ft (1.5 m), Installer shall use a low-impedance (HPI) cable to reduce the lead length's effect on the installed performance of the SPD
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313