

# MASTER GUIDEFORM SPECIFICATION

## SECTION 16610 – SURGE PROTECTIVE DEVICE (SPD) 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 CODES AND REFERENCE

- A. Qualification Data: Products shall be tested and listed by a Third Party testing lab or U.S. Department of Labor/OSHA approved NRTL

Agency Approval/Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

- 1. All SPDs shall be tested and listed to ANSI/UL 1449-2006 (UL 1449 3rd Edition) & Complimentary Listed to UL 1283 by a Nationally Recognized Testing Laboratory (NRTL) (i.e. CSA, UL, etc)

- B. Applicable Documents:

- 1. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
- 2. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- 3. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- 4. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
- 5. IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment - Clause 8.6.1
- 6. National Fire Protection Association (NFPA) 70 (N.E.C.) –2002 – Article 285
- 7. ANSI/UL 1449-2006 Surge Protective Devices
- 8. IEEE Std C62.72™-2007 – IEEE Guide for the Application of Surge-Protective Devices for Low-Voltage (1000 V or less) AC Power Circuits

#### 1.3 SUMMARY

- A. Section includes field installed SPDs for low-voltage power distribution equipment.

#### 1.4 GLOSSARY AND ACRONYMS

- A. **SPD:** Surge Protective Device(s), both singular and plural.
- B. **NEC/CEC:** National Electric Code / Canadian Electric Code

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- C. **Sinewave Tracking:** Voltage independent, dedicated circuitry intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. The performance of sinewave tracking circuitry is defined by the level to which it mitigates Ring Wave transients and can be demonstrated in the test results of IEEE C62.41.2-2002, Category A Ring Wave (2kV).
- D. **Voltage Protection Rating (VPR)** A rating selected from a list of preferred values as detailed in ANSI/UL 1449-2006 and assigned to each mode of protection. The value of VPR is determined as the nearest highest value taken from a list of preferred values as detailed in ANSI/UL 1449-2006 to the measured limiting voltage determined during the transient-voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.
- E. **Maximum Continuous Operating Voltage (MCOV)** – The maximum designated root mean-square (rms) value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- F. **Nominal Discharge Current (I<sub>n</sub>)** – Peak value of the current, selected by the manufacturer from a list of values specified in ANSI/UL 1449-2006, through the SPD having a current waveshape of 8/20 where the SPD remains functional after 15 surges using the test procedure described in ANSI/UL 1449-2006.
- G. **Type 1 SPD** – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device.
- H. **Type 2 SPD** – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel.
- I. **Type 4 SPD** – Recognized Component SPDs, including discrete components as well as component assemblies, which bear specific conditions of acceptability.
- J. **Modes Of Protection:** Electrical paths where the SPD offers defense against transient overvoltages. e.g. Each Line to Neutral (L-N), Line to Ground (L-G), Line to Line (L-L) and Neutral to Ground (N-G).
- K. **Per Phase Ratings:** ‘Per-Phase’ ratings for a three-phase Wye-connected SPD are determined by multiplying the kA per mode times the number of **discrete modes of protection (directly connected suppression components)**, minus the value for the Neutral to Ground mode, divided by the number of phases.
  - Per-Phase = (((kA per mode) X (# of modes))-(N-G mode kA)) / (# of phases)

### 1.5 SUBMITTALS FOR REVIEW

- A. **Product Data:** For each type of product indicated, include all required testing and pertinent manufacturer information described herein section 1.6, rated capacities, maximum continuous operating voltage, weights and dimensions, electrical characteristics interconnecting wiring requirements, accessories, and ANSI/UL 1449-2006 VPRs.
- B. Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Std 1100-2005, Clause 8.6.1. and **incorporate 10 individual dedicated discrete modes of protection for three-phase wye systems, including direct Line-to-Line components. (Reduced-Mode variations will not be accepted).**

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- C. Warranty duration and replacement policy.
- D. Manufacturer's installation instructions
- E. Provide a table indicating which panel/switchboard/equipment each SPD will serve. Table shall include project name, panel name, voltage/phase, and SPD model number to be provided, submittals will not be approved without this table.

Panel/Switchboard Name	Volts, Phase	SPD Model Number

### 1.6 SUBMITTALS FOR INFORMATION

- A. IEEE Std C62.41.2<sup>TM</sup>-2002 test reports. Include complete let-through voltage/measured limiting voltage test data, test graphs and scope traces for each and every mode for each product submitted for Category's C, B, A (including Cat A, 2 kV, 67 A, 100 kHz ring wave at both 90 & 270 degree electrical phase angles). Testing shall be conducted as follows:

**Test Parameters:** Positive Polarity, Net voltages are peak ( $\pm 10\%$ ). All tests are static (un-powered) except 150 V MCOV modes. Let-through voltages on static tests calculated by subtracting sinewave peak from let-through measured from zero. 150 V MCOV mode let-through voltages measured from the insertion point on the sinewave. Each phase is the average of the 3 modes. In order to duplicate the results, the specified mode must be tested for all three phases (except N-G) and averaged together. (Individual mode or shot results may not vary by more than 10%. *Scope Settings: Time Base = 10 microseconds, Sampling Rate = 250 Megasamples/sec. These settings assure Let-through voltages test results are accurate*). **All tests performed with 6" lead length (external to the enclosure), simulating actual installed performance per the ANSI/UL 1449-2006 standard.**

- B. Let-through voltages furnished within this testing **must not exceed** the following to be considered for approval, no exceptions:

**Service Entrance 120/208 V 3Ph Wye** (IEEE Cat C High Current Driven Surge Test Results (10 kA)) (L-N 915 V) (L-L 1120 V) (L-G 1030 V) (N-G 1180 V)

**Service Entrance 277/480 V 3Ph Wye** (IEEE Cat High Current Driven Surge Test Results (10 kA)) (L-N 1050 V) (L-L 1345 V) (L-G 1270 V) (N-G 1575 V)

**Distribution 120/208 V 3Ph Wye** (ANSI/UL 1449-2006 VPRs): (L-N 500 V) (L-G 500 V) (L-L 1000 V) (N-G 500 V)

**Distribution 277/480 V 3Ph Wye** (ANSI/UL 1449-2006 VPRs): (L-N 1000 V) (L-G 1000 V) (L-L 1800 V) (N-G 1200 V)

**Branch 120 V** (IEEE Cat A Ringwave (2 kV)) Test Results (@ 270° phase angle): (L-N 40 V) (L-L 40 V) (L-G 60 V) (N-G 60 V)

**Branch 277 V** (IEEE Cat A Ringwave (2 kV)) Test Results (@ 270° phase angle): (L-N 60 V) (L-L 130 V) (L-G 80 V) (N-G 60 V)

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- C. Certificates of Conformity: For SPDs, certifying compliance with an NRTL listing/certification to the following standards:
  - 1. ANSI/UL 1449-2006 (UL 1449 3rd Edition)
  - 2. UL 1283 (Type 2 SPDs Only)

### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Closeout Submittal shall include operation, installation and specification data in closeout submittals.
- B. Certification: By Electrical Contractor (Installer) that installation complies with manufacturer's instructions (SEE FINAL INSPECTION SECTION OF THIS SPECIFICATION).
- C. Warranty duration and replacement policy

### 1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in **[NFPA 70] [CEC]**, by a NRTL testing agency, and marked for intended location and application.
- B. Manufacturer's Qualifications: Manufacturer must have at least 10 years experience in the engineering, design and manufacture of permanently connected SPDs. Manufacturer operates a Quality System Certified manufacturing facility as ISO 9001:2000 Compliant
- C. Certificate of Declaration that product is CE Low Voltage Directive Compliant

### 1.9 COORDINATION

- A. Coordinate location of field installed SPDs to allow adequate clearances for maintenance.
- B. SPDs shall be rated for the class and category of service necessary for the application per the ANSI/IEEE Std C62.41.2<sup>TM</sup>-2002 and IEEE Std C62.72<sup>TM</sup>-2007 (Categories C, B, A)

### 1.10 FUSING

- A. Provide as a minimum, over-current, over temperature protection in the form of component-level thermal fusing to ensure safe failure and mitigate thermal runaway. This component-level fusing shall be an integral part of the MOV itself, and not silver wire (or other) independently layed across each MOV.
- B. Provide integral short circuit current fusing with each device. The fusing will be independent of the "component-level" fusing and specifically for over-current protection and shall be constructed utilizing surge rated, cartridge fuses and not rated 'silver-fuse-wire' (or other).
- C. The use of any mechanical or electro-mechanical thermal/over-current protection (i.e. moving parts and/or springs and shutters), in combination with or for the protection of the suppression elements are expressly prohibited and will be rejected.

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- D. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449-2006 (a.k.a. UL 1449 3<sup>rd</sup> Edition).

### 1.11 WARRANTY

- A. The manufacturer shall provide unlimited free replacement of the entire SPD (not just modules, components or sub-assemblies) for all inoperable SPDs during the warranty period. Acceptable manufacturers listed below that do not meet the warranty as standard shall submit a letter extending the warranty with the product submittal
  - 1. Warranty Period: Minimum warranty shall be Twenty-Five (25) years from date of installation.
  - 2. Maintenance Restrictions: No SPD shall be supplied which requires scheduled preventative-maintenance or replaceable parts (other than replaceable LEDs or batteries for diagnostic circuits). Units requiring functional testing, special test equipment, or special training to monitor SPD status are not acceptable. SPDs shall require no routine maintenance. SPDs are considered non-repairable items and shall be fully replaced upon failure.

## PART 2 - PRODUCTS

### 2.1 ACCEPTICAL MANUFACTURER

- A. The listing of a manufacture as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirement, provide products by the following manufacture(s) or “prior-approved” equal as described above. All SPD’s on this project must be provided by the same SPD manufacturer.

The SPD listed below is an indication of the minimum quality and quantity to be expected on this project.

- 1. Surge Suppression Incorporated  
109 Melvin St. P.O. BOX 1212  
Destin, Fl. 32540-1212  
Tel. 888-987-8877
- 2. XXXXXX
- 3. XXXXXX

### 2.2 SERVICE ENTRANCE SPDs

- A. Manufacturers: Subject to compliance with requirements, **provide specific model numbers listed by one of the following only, no model # variations or substitutions are permitted**

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B. All SPDs on the entire project must be provided by the same SPD manufacturer to ensure commonality and ease of Owner maintenance.

C. Surge Suppression Incorporated Advantage Unit

Peak-Surge Current Shall be **300 kA per phase**

**SSI 'ADVANTAGE' MODEL #'S:**

**SMLB3Y2K (277/480 VAC Wye) / SMLB3Y1 (120/208 VAC Wye) / SMLB3N4 (480 VAC Delta)**

D. SPDs shall be:

1. Listed to ANSI/UL 1449-2006 (a.k.a. UL 1449 3rd Edition) and Complimentary Listed to 1283
2. SPD shall be Type 2 SPD, Type 4 SPDs are not permitted
3. SPD shall have a Nominal Discharge Current Rating of 20 kA per mode for all modes.
4. The Maximum Continuous Operating Voltage (MCOV) shall be as follows:

Nominal System Voltage	Mode	MCOV
120/208 Wye	L-N	150 V
	L-L	300 V
	L-G	150 V
	N-G	150 V
277/480 Wye	L-N	320 V
	L-L	550 V
	L-G	320 V
	N-G	320 V

5. The SPD shall have Voltage Protection Ratings (VPRs) as follows:

Nominal System Voltage	Mode		VPR
120/208 Wye	L-N	150 V	600 V
	L-L	300 V	1000 V
	L-G	150 V	600 V
	N-G	150 V	600 V
277/480 Wye	L-N	320 V	1200 V
	L-L	550 V	1800 V
	L-G	320 V	1200 V
	N-G	320 V	1200 V

6. LED indicator lights for power and protection status.
7. Permanently-mounted, parallel connected.
8. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that "crowbar" (e.g. spark gaps, gas tubes, SCR's, etc.) are not allowed.
9. Self-restoring and fully automatic.
10. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
11. The SPD shall be tested and listed by an NRTL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.

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12. Bi-directional, thermal stress reducing, encapsulated, custom parallel and solid state circuit configuration.
13. SPD system shall provide discrete protection for all 10 modes for a three-phase Wye-connected SPD. Distinct and independent protection circuitry for each mode is required. **Reduced mode SPDs with only 3, 4 or 7 dedicated, distinct, independent protection modes in its voltage configuration are not acceptable and are not to be submitted.**

### 2.3 DISTRIBUTION PANELBOARD SPDs (400 A & Larger)

- A. Manufacturers: Subject to compliance with requirements, **provide specific model numbers listed by one of the following only, no model # variations or substitutions are permitted**
- B. All SPDS on the entire project must be provided by the same SPD manufacturer to ensure commonality and ease of Owner maintenance.
- C. Peak-Surge Current Shall be **240 kA per phase**

1. Surge Suppression Incorporated:

**SSI 'ADVANTAGE' MODEL#'S:**

**LSEA3Y2 (277/480 VAC Wye) / LSEA3Y1 (120/208 VAC Wye) / LSEA3N4 (480 VAC Delta)**

- D. SPDs shall be:
  1. Listed to ANSI/UL 1449-2006 (UL 1449 3rd Edition) and Complimentary Listed to UL 1283.
  2. SPD shall be Type 2 SPD, Type 4 SPDs are not permitted.
  3. SPD shall have a Nominal Discharge Current Rating of 10 kA per mode for all modes.
  4. The Maximum Continuous Operating Voltage (MCOV) shall be as follows:

Nominal System Voltage	Mode	MCOV
120/208 Wye	L-N	150 V
	L-L	300 V
	L-G	150 V
	N-G	150 V
277/480 Wye	L-N	320 V
	L-L	550 V
	L-G	320 V
	N-G	320 V

5. The SPD shall have Voltage Protection Ratings (VPRs) as follows:

Nominal System Voltage	Mode	VPR
120/208 Wye	L-N	600 V
	L-L	1000 V
	L-G	600 V
	N-G	600 V

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277/480 Wye	L-N L-L L-G N-G	1200 V 1800 V 1200 V 1200 V
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6. LED indicator lights for power and protection status.
7. Permanently-mounted, parallel connected.
8. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” (e.g. spark gaps, gas tubes, SCR’s, etc.) are not allowed.
9. Self-restoring and fully automatic.
10. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
11. The SPD shall be tested and listed by an NRTL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.
12. Bi-directional, thermal stress reducing, encapsulated, custom parallel and solid state circuit configuration.
13. SPD system shall provide discrete protection for all 10 modes for a three-phase Wye-connected SPD. Distinct and independent protection circuitry for each mode is required. **Reduced mode SPDs with only 3, 4 or 7 dedicated, distinct, independent protection modes in the voltage configuration are not acceptable and are not to be submitted.**

### 2.4 BRANCH PANELBOARD SUPPRESSORS (Less Than 400 A)

- A. Manufacturers: Subject to compliance with requirements, **provide specific model numbers listed by one of the following only, no model # variations or substitutions are permitted**
- B. All SPDs on the entire project must be provided by the same SPD manufacturer to ensure commonality and ease of Owner maintenance.
- C. Peak-Surge Current Shall be **120 kA per phase w/ the standard tracking unit or w/Sine-wave tracking (see section 1.6 for sinewave tracking compliance requirements)**
  1. Surge Suppression Incorporated:  
  
**SSI ‘ADVANTAGE’ MODEL #'S:**  
  
**SKLA3Y2 (277/480VAC) / SKLA3Y1 (120/208VAC) SKLA3N4 (480VAC Delta)**  
  
**CKLA3Y2 (277/480VAC) / CKLA3Y1 (120/208VAC) / CKLA3N4 (480VAC Delta)**
- D. SPDs shall be:
  1. Listed to ANSI/UL 1449-2006 (a.k.a. UL 1449 3rd Edition) and Complimentary Listed to UL 1283.
  2. SPD shall be Type 2 SPD. Neither Type 1 SPDs nor Type 4 SPDs are permitted.
  3. SPD shall have a Nominal Discharge Current Rating of 10 kA per mode for all modes.
  4. The Maximum Continuous Operating Voltage (MCOV) shall be as follows:



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Nominal System Voltage	Mode	MCOV
120/208 Wye	L-N	150 V
	L-L	300 V
	L-G	150 V
	N-G	150 V
277/480 Wye	L-N	320 V
	L-L	550 V
	L-G	320 V
	N-G	320 V

5. The SPD shall have Voltage Protection Ratings (VPRs) as follows:

Nominal System Voltage	Mode	VPR
120/208 Wye	L-N	600 V
	L-L	1000 V
	L-G	600 V
	N-G	600 V
277/480 Wye	L-N	1200 V
	L-L	1800 V
	L-G	1200 V
	N-G	1200 V

6. LED indicator lights for power and protection status.
7. Incorporate "True" sine-wave tracking based on the results of the Category A (2kV) Ring Wave Measured Limiting Voltages. Products utilizing basic EMI/RFI filter performance or tracking circuits in the L-N mode only are not allowed (see section 1.6 of this specification for specific requirements).
8. Permanently-mounted, parallel connected.
9. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that "crowbar" (e.g. spark gaps, gas tubes, SCR's, etc.) are not allowed.
10. Self-restoring and fully automatic.
11. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
12. SPD system shall provide discrete protection for all 10 modes for a three-phase Wye-connected SPD. Distinct and independent protection circuitry for each mode is required. Reduced mode TVSS with only 3, 4 or 7 dedicated, distinct, independent protection modes in the voltage configuration are not acceptable and are not to be submitted.
13. The SPD shall be tested and listed by an NRTL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.
14. Bi-directional, thermal stress reducing, encapsulated, custom parallel and solid state circuit configuration.

**\*HEALTHCARE FACILITY NOTE: SPD manufacturer is to remove the sine-wave tracking circuitry in the N-G mode. The SPD itself however must still incorporate the standard threshold N-G mode circuitry within the device.**

2.5 SPD Options: One for each unit S = Surge Counter

NONE D1= Disconnectand Switch

NONE AC = Alarm and dry contacts

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ONE UNIT LP = Remote Lights

## 2.6 ENCLOSURES

- A. Indoor Enclosures: NEMA 1 or better.
- B. Outdoor Enclosures: NEMA 4 or better for outdoor/wet locations.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install SPDs in strict accordance with manufacturer's instructions and the NEC [or CEC].
- B. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.
- C. Install SPDs with conductors between SPD and the branch circuit breaker as short and straight as possible. When possible do not exceed manufacturer's recommended lead length. In the case where the lead length exceeds 18 inches the installer must contact the SPD manufacturer for installation assistance.
- D. Install the SPDs immediately adjacent to the switchboard or panelboard being protected.
- E. SPDs must be installed to a disconnecting switch or breaker rated for (minimum) 30-amps in the panel per manufacturer's installation instructions to ensure a means of disconnecting the SPD from the service without de-energizing the panel or the connected loads. The use of direct bus bar connected SPDs is expressly prohibited and will be rejected.
- F. Do not energize service entrance equipment or panelboards until SPDs are properly installed and connected.
- G. Do not perform insulation resistance tests of the distribution wiring equipment with the SPDs installed. Disconnect all SPDs (all Phase, Neutral and Ground connections) before conducting insulation resistance tests, and reconnect immediately after the testing is over.

### 3.2 FIELD QUALITY CONTROL

- A. Field Service: Electrical Contractor shall inspect, test, and adjust components, assemblies, and equipment installations, including connections to strictly comply with this specification.
  - 1. Verify that electrical wiring installation complies with manufacturer's written installation requirements and NEC requirements
  - 2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
  - 3. Complete startup checks according to manufacturer's written instructions, if applicable.

Prepare test and inspection reports as follows:

**\*ENG. NOTE: Select Paragraph B. for small projects with minimal SPD devices. Select paragraph C. for large projects with numerous (10 or greater) SPD devices.**

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- B. The SPD installation shall be certified by a licensed electrician that the installation is in accordance with the manufacturer's recommendations, **[NEC][CEC]** requirements and the requirements of the specification above. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documents/manual.
  
- C. The SPD installation must be inspected and certified by a factory-trained representative of the SPD manufacturer. In completing this start-up, the factory-trained inspector shall furnish the Engineer with a letter/report stating that all SPDs are the correct specified model numbers, in the correct locations and equipment designations and installed in strict accordance with the intent of this specification and the requirements of the manufacturer. The Contractor must make the manufacturer aware of the available dates to perform this inspection and must give at least 45 days notice of the required deadline date. The cost for this service must be included in the package price of the SPD device and is to be part of the construction bid package. The inspection will include one, on-site visit, with the electrician to view the work if existing electrical equipment is involved and one on-site inspection on completion of work, accompanied by the report as stated above. Subsequent visits to correct problems created by the installer and not in accordance with the intent of the requirements of this specification and the installation instructions furnished by the manufacturer as noted in the report will be the ultimate responsibility of the Contractor and will be billed on a time and travel reimbursable basis until the Engineer receives final satisfactory certification from the manufacturer of the specified system.

END OF SECTION