Transient Voltage and Surge Protection

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TRANSIENT VOLTAGE and SURGE PROTECTION for SSL

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What is a TVSS?

- A TVSS is a Surge Protective Device (SPD) that is generally meant for installation on the load side of the primary overcurrent disconnect of low voltage power distribution systems.

Note:

- The term **TVSS** has been phased out of all of the technical standards and has been replaced by the term **SPD**. More specifically, a device formerly known as **TVSS** has now become known as a **Type 2** Surge Protective Device.

- Transient Voltage Surge Suppressors are now classified as a Surge Protection Devices (SPD) per UL 1449 3rd edition

- SPD are differentiated by various types based on the location they are placed in the electrical system

UL's "Type" Terminology

Type 1 — 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.

Type 2 — Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.

Type 3 — Point-of-utilization SPDs, installed at a minimum conductor length of 30 ft from the electrical service panel to the point of utilization, e.g., cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (30 ft) is exclusive of conductors provided with or used to attach SPDs. (example – Surge Outlet strips)

Type 4 – Component SPDs and component assemblies (example – MOVs used within other UL listed enclosures).

SPD Terminology

- **Single Impulse Surge Rating (KA rating)**

"The Maximum 8x20us Surge Current Amps a SPD can withstand 1 time without performance degradation of more than 10%"

- *"kA" also known as "Max Surge Current Rating"*

- *Only mode ratings are supported by TVSS standards*
- *Available Modes are L-N, L-G, N-G, L-L*

SPD Terminology

MCOV Maximum Continuous Operating Voltage

- The maximum rms voltage that may be continuously applied between the connection terminals of the SPD. Per NEC Art. 285, no TVSS shall be installed on an electrical system where the MCOV rating of the TVSS is less than the maximum continuous phase-to-ground power frequency voltage at the point of application.

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PERFORMANCE AND RATINGS

Nominal Discharge Current - I_n

- Value is selected by the manufacturer
  - Type 1 SPDs can be either I_n = **10kA or 20kA**
  - Type 2 SPDs can be I_n = **3kA, 5kA, 10kA or 20kA**
  - Nominal discharge current level is marked on the label of SPD as I_n
- Test subjects SPD to a total of 15 impulses
- In order to successfully pass test:
  1. SPD cannot create a shock or fire hazard during the test
  2. Nothing in the surge path can open at any time during or after the test (includes all internal and external devices, such as fuses and/or circuit breakers)
- Ideal is for Type 2 SPD to have I_n = 20kA

Abnormal Overvoltage Tests

- Abnormal Overvoltage Testing requirements first emerged in the 2nd Edition of UL 1449, effective 1996.
- The TVSS must not become a fragmentation or fire hazard when subjected to elevated phase voltage and subsequent follow current sufficient to drive the Metal Oxide Varistors into a failed condition.
- Testing is performed at Limited Current Levels up to 5 amperes and Maximum Levels up to 200kA. Max. AIC ratings are assigned and are required to be marked on TVSS by UL and NEC.
- 2007 requirements included testing at intermediate levels of 100, 500 and 1000 AIC.

IEEE C62.41

- IEEE C62.41 provides information on surge voltages that are propagated in low-voltage ac power circuits.
- Provides practical basis for the selection of voltage and current tests for surge withstand of electronic/electrical equipment.
- Key topics addressed:
- Origin of Surge Waveshapes
- Rate of Occurrence and Voltage Levels in Unprotected Circuits
- Waveshapes of Representative Surge Voltages, Energy and Source Impedance
- Location Categories relative to position from Service Entrance
- Representative Surge Waveforms for each category
- Street Lighting is considered a C service entrance location

Voltage Protection Rating (VPR)

- An IEEE C62.41 category C, low 6kV/3000A (8/20 usec) combination surge wave is now used to benchmark SPD clamping performance.
- Application of the test wave is done both prior to and after the Nominal Discharge Current Test I_n is performed.
- Average clamping numbers result in the UL assigned Voltage Protection Rating (VPR) for each protected mode.
- Surge Test Current is 6X greater than previous UL 1449 2nd Edition SVR test, which used a non-standard 6kV/500A combination surge wave.

Voltage Protection Rating (VPR)

- Higher current levels will yield higher VPR ratings, when compared to 2nd edition SVR ratings for an identical

63.2 The voltage protection rating (VPR) shall be assigned for each mode of protection provided. This value is obtained by comparing the measured limiting voltage obtained from 37.1.1 to the nearest value in Table 37.2. The average of the measured limiting voltage as specified in 37.1.1 shall not exceed the manufacturer's marked VPR from Table 63.1. In addition, no individual measurement of measured limiting voltage may exceed the marked VPR rating by more than 10 percent.

Table 63.1
Voltage protection rating (VPR)

Measured limiting voltage[a]	Minimum voltage protection rating (V)
330 or less	330
331 – 400	400
401 – 500	500
501 – 600	600
601 – 700	700
701 – 800	800
801 – 900	900
901 – 1000	1000
1001 – 1200	1200
1201 – 1500	1500
1501 – 1800	1800
1801 – 2000	2000
2001 – 2500	2500

Typical SVR range for 120/208V TVSS (in OLD 2nd Edition)

Typical VPR range for 120/208V SPD (in NEW 3rd Edition)

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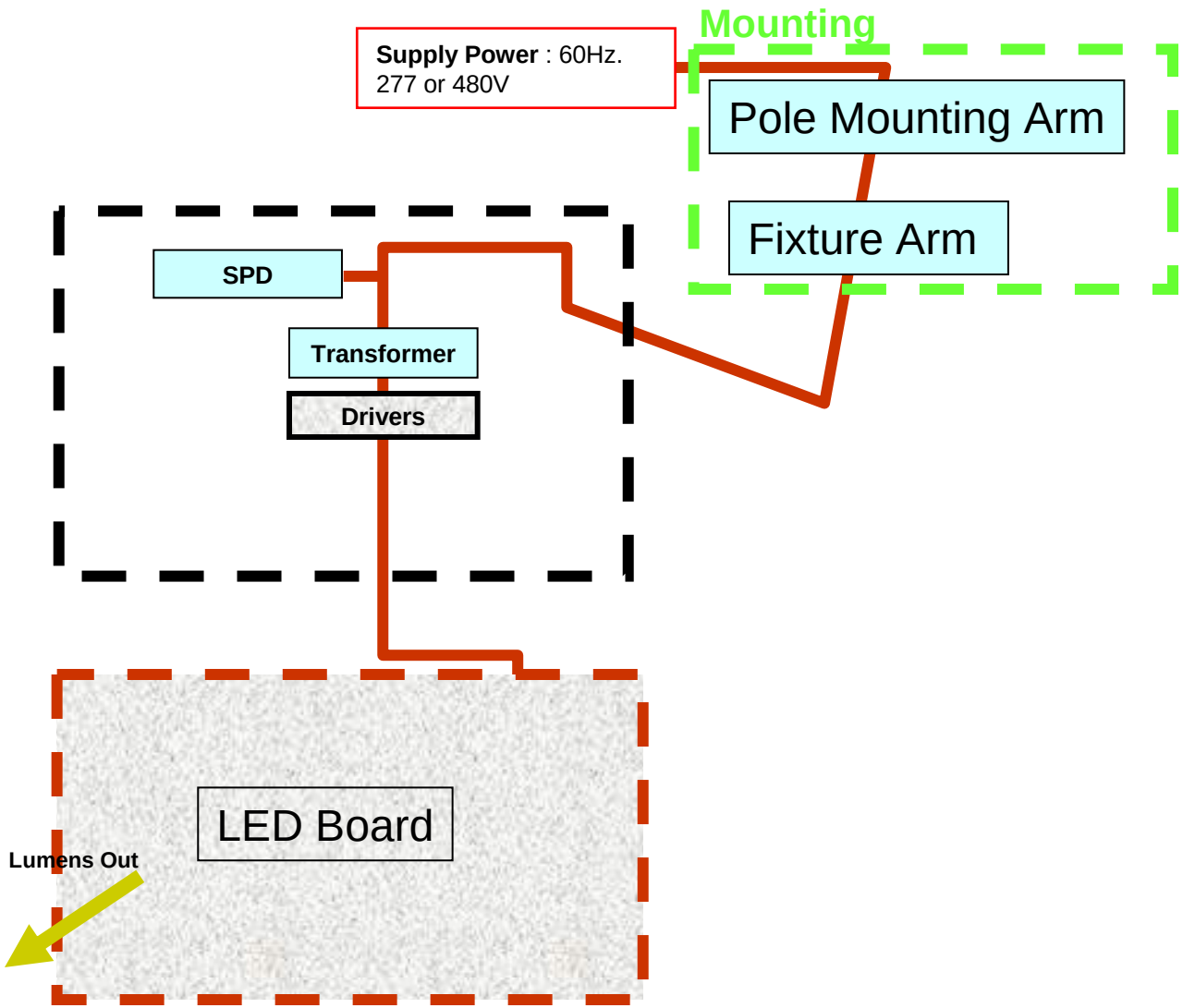
APPLICATION of SPD to SSL

Diagram


Mounting
Supply Power : 60Hz.
277 or 480V
Pole Mounting Arm
Fixture Arm
SPD
Transformer
Drivers
LED Board
Lumens Out

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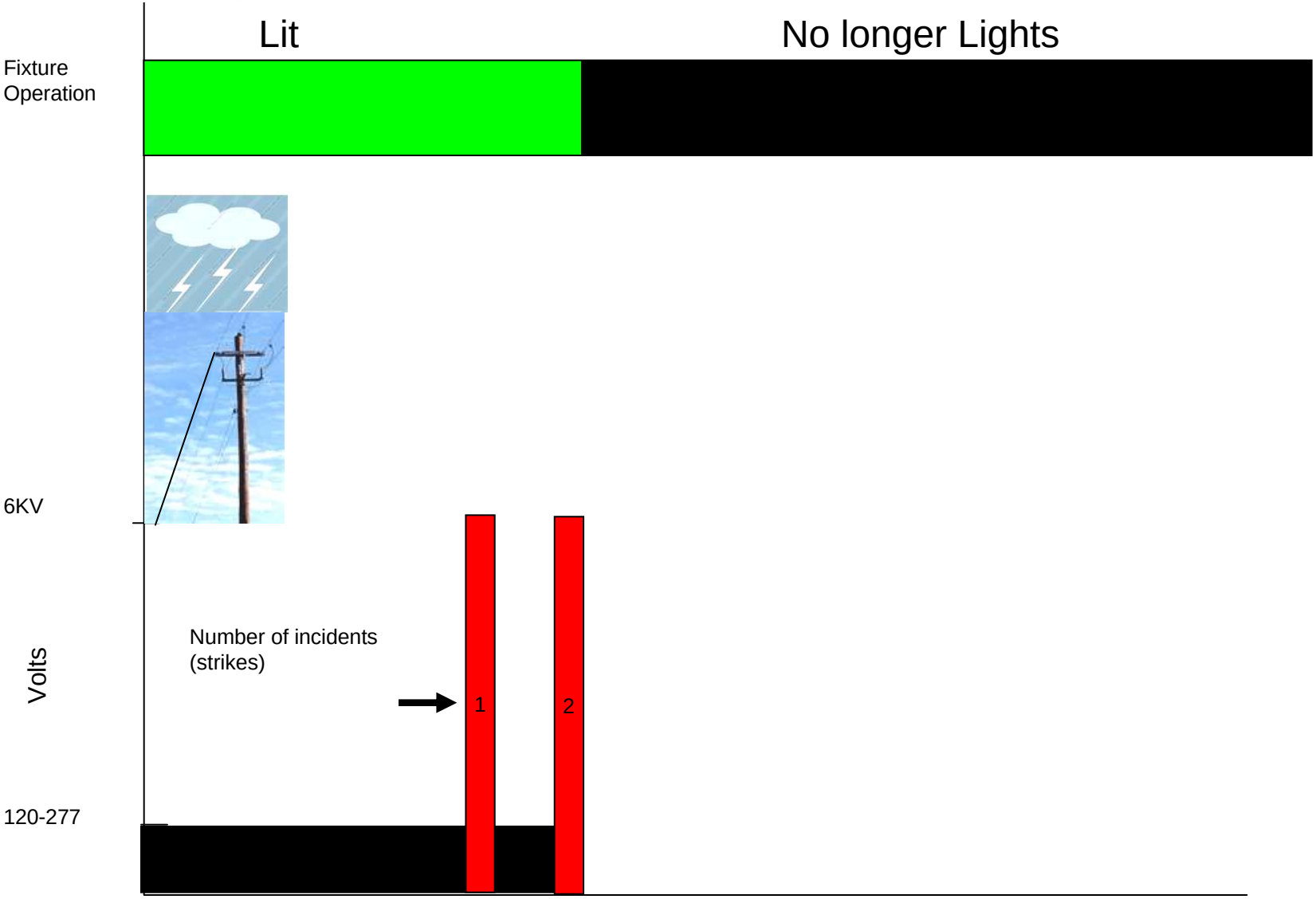

Two “strikes” and you’re out!

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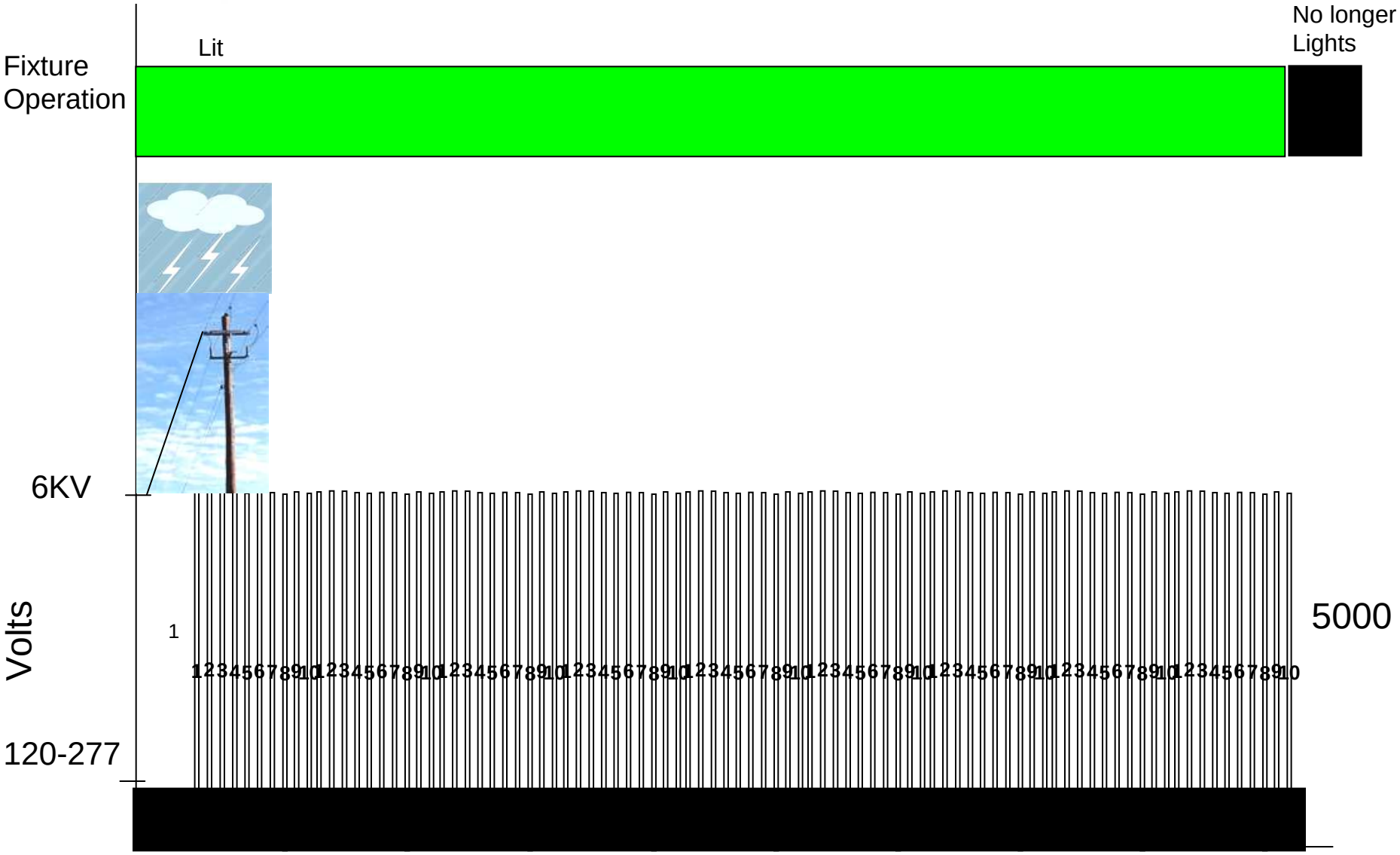

Five thousand "strikes" and you're out!

CONCLUSION

- SSL are a key component in the drive for cities to become "green."
- In order for SSL to have performance and reliability required for the application, it must be protected from surges caused by its location
- There should be an extremely high level of confidence (90% or greater) that the surge protection device be robust and reliable (99% or better) in order to meet both the higher magnitude and quantity of surges within its environment
- The SPD must also be designed for a long operational life, 10 years or more given cost and location.

Thank you for your attention