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# Reasons to Consider Surge Protection Enhancements

White Paper

# Reasons to Consider Surge Protection Enhancements

The need to replace surge protective devices (SPDs) or enhance surge protection strategies can be assessed after considering a number of factors. These include changes in (1) electrical codes, (2) UL safety standards, (3) the configuration and use of a power distribution system, (4) the condition of installed SPDs, and (5) newly available surge protection products. This document reviews these changes and provides guidance on whether to upgrade existing surge protection equipment.

## NATIONAL ELECTRICAL CODE® CHANGES

In the United States, the National Electrical Code (NEC®), also known as NFPA 70, is updated every three years, then adopted on a state-by-state basis. Because SPD-related changes have occurred in each recent edition, facilities using SPDs installed under older editions of the standard may not be equipped with the latest surge protection measures. If modification or expansion of a power distribution system is planned, then surge protection improvements may be required to comply with the latest codes. Even if such work is not planned, facilities may still benefit from the increased protection offered by new or revised NEC provisions.

Whether new NEC provisions are presently required at a particular facility could depend on the state in which the facility is located. State authorities individually evaluate and adopt new editions of the Code. Figure 1 shows the NEC version presently used by each state. Figure 2 illustrates the status of state proceedings to adopt new editions of the Code.

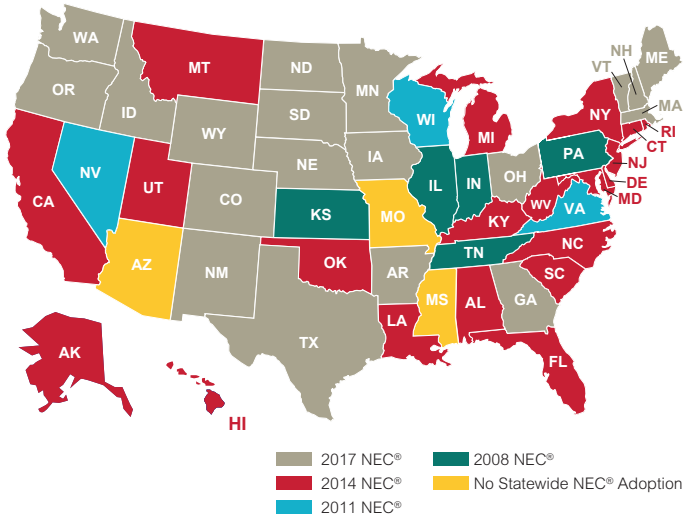


Figure 1: NEC in Effect - April 2018[1]

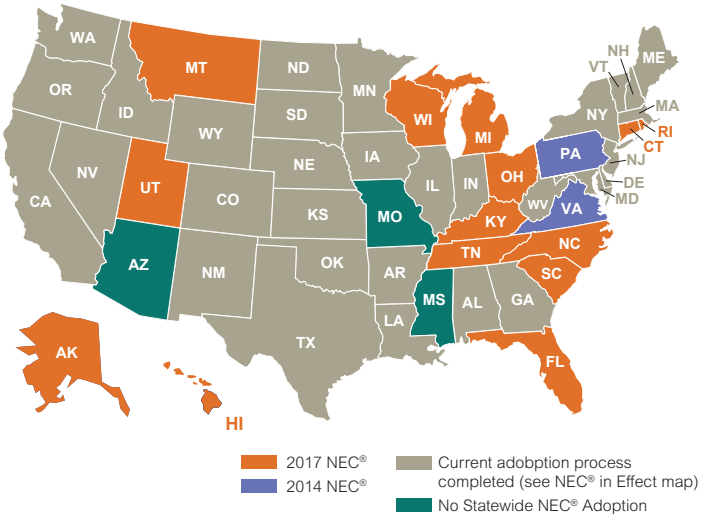


Figure 2: Status of NEC Adoption Processes - April 2018[2]

[1] National Fire Protection Association. NEC® Adoption Maps. https://www.nfpa.org/NEC/NEC-adoption-and-use/NEC-adoption-maps, viewed 5/23/18.
[2] Ibid.


### 2002 – Article 285 - Surge Protective Devices, 1000 Volts or Less

The 2002 Edition of the NEC required Short Circuit Current Ratings (SCCRs) to be placed onto surge devices, as follows: *"285.7 Short Circuit Current Rating. The SPD shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating."*[3]

Article 100 of the standard defines SCCR as *"The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria."*[4] If a facility is presently using SPDs without SCCRs, replacement should be considered using up-to-date units that have been subject to UL 1449 SCCR testing. The SCCRs are required to meet or exceed the available voltage and amperage of the protected circuit.

### 2008 – Article 708 - Critical Operating Power Systems

In 2008, *Article 708 - Critical Operating Power Systems* (COPS) was added to the NEC. This article defines COPS as *"Power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity."*[5] In addition, Article 708.20(D) states that *"Surge protection devices shall be provided at all facility distribution voltage levels."*[6] Consequently, if a power distribution system serves regulated operations, but is not equipped with SPDs at every voltage level, additional surge protection should be installed these locations to protect public or corporate interests.

### 2014 – Article 700.8 – Surge Protection [for Emergency Systems]

Article 700 applies to the installation, operation, and maintenance of Emergency Systems. It requires power to reach regulated loads within 10 seconds of an interruption of the normal electrical supply. The 2014 Edition added *Article 700.8 - Surge Protection*. In the 2017 Edition, this article states, *"A listed SPD shall be installed in or on all emergency systems switchboards and panelboards."*[7] Because Article 700 focuses on systems required to evacuate buildings during an emergency, placing additional SPDs at the panels that serve critical systems can protect the necessary emergency equipment.

[3] National Fire Protection Association. 2016. National Electrical Code® - 2017 (NEC). Article 285.7. p70-132.
[4] NEC, Article 100. p70-41.
[5] NEC, Article 708.2. p70-600.
[6] NEC, Article 708.20(D). p70-602.
[7] NEC, Article 700.8. p70-583.

## 2017 NEC CHANGES

In the latest NEC, the following surge protective device-related provisions were added:

- *Article 620 - Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts* - Moving people through a building is an essential capability that must be preserved when emergencies occur. Article 620.51(E) states, *"Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, surge protection shall be provided."*[8] Although Articles 700 and 708 may already apply surge protection requirements to some of these systems, the changes to Article 620 make surge protection universal for these types of equipment.

- *Article 645 - Information Technology Equipment* - Information technology applications range from standalone equipment that provides local functions to very large data centers that support many facilities. Proper and continuous operation of these systems is necessary to deliver critical services. Regardless of scale, Article 645.18 states that *"Surge protection shall be provided for critical operations data systems."*[9]

- *Article 695 - Fire Pumps* - *Article 695.15 - Surge Protection* states, *"A listed surge protection device shall be installed in or on the fire pump controller."*[10] Providing SPDs helps ensure the continuous operation of fire pump systems during and after surge events.

## UL 1449 CHANGES

Underwriters Laboratory publishes *UL 1449 – Standard for Safety – Surge Protective Devices*. Successive editions have expanded testing and rating requirements for SPDs as follows:

- 1998 - 2nd Edition – Under the first edition of the standard, SPDs were subject to testing using very high voltages and currents. The second edition added testing using a limited "slow burn" current of 5 Amps. This provision focused on using small steady-state currents that may cause an SPD to overheat and fail. The test method verifies safety by intentionally testing the sample SPD to either a stable condition or failure.

  2007 – Updated 2nd Edition – This update added requirements that filled a gap for testing SPDs at intermediate current levels, including 10, 50, 100, 500, and 1000 Amps. The testing changes required many manufacturers to update their SPD designs. The updated models provided significant safety advantages to users.

- 2009 – 3rd Edition – This update replaced the prior edition's *Suppressed Voltage Rating* with *Voltage Protection Ratings (VPRs)*. The associated testing further ensures that SPDs meet performance guidelines. This edition also added Nominal Discharge Current (iNominal) ratings, which are based on fifteen 8x20 microsecond impulses tested through every mode of the three sample SPDs used in VPR testing. The 3rd Edition also stipulated that 20kA iNominal Devices could be used to comply with UL96A Master Labelling requirements for lightning protection systems. Until the 3rd Edition of UL 1449 was published, UL96A surge arrestors typically were not subject to failure mode safety testing.

- 2014 – 4th Edition – This update added categories and standards for SPDs that may be used to protect the growing number of photovoltaic devices that supply electricity to power distribution systems.

## FACILITY CHANGES

Over time, various types of changes may increase a facility's susceptibility to impacts from transient overvoltages. First, the use of electronic equipment in buildings has increased steadily, and many types of electronic devices can be damaged by transient overvoltages. For example, advances in energy efficiency have led to the deployment of Light Emitting Diode (LED) lighting fixtures, and the drivers they use are susceptible to damages from transient overvoltages. (Our paper entitled *"Protecting Electronic Lighting Components from Transient Overvoltages"* provides specific detail and guidance.)

[8] NEC, Article 620.51. p70-508.
[9] NEC, Article 645.18. p70-528.
[10] NEC, Article 695.15. p70-580.

Facility security has become more important than ever, resulting in increased use of electronic surveillance equipment including cameras, digital video recorders, and access control systems. Because this equipment is often mounted outside of buildings, it can be particularly susceptible to lightning-related voltage effects.

The value of both a facility's electronic equipment and the activities it supports has also increased. For instance, electronic equipment may have been progressively installed at a medical outpatient facility to support every aspect of operation. The affected equipment ranges from sophisticated imaging devices to electronic medical record systems that must detail and transmit complex and interactive patient charts, and computerized billing systems that are key to maintaining cash flow. At such a facility, the consequences and business value of surge-related equipment damages can be profound. Notwithstanding changes in technology, a facility may have modified or expanded its power distribution system to support increasing quantities and amounts of electrical loads. For each of these reasons, surge protection strategies for existing facilities should be periodically reassessed.

## FACILITY CHANGES

When SPDs are properly specified and installed, they provide durable and effective protection against transient overvoltages. Nevertheless, conditions can arise that degrade SPD performance, such as sustained overvoltages, excessive surge currents, and normal wear-and-tear from shunting routine transient overvoltages. SPD degradation mechanisms are described in our prior paper entitled, *Common Causes of SPD Degradation*. In addition, facilities equipped with older SPDs may be using obsolete units that are no longer supported or under warranty by the manufacturer. This circumstance could complicate replacement if an unexpected failure were to occur.

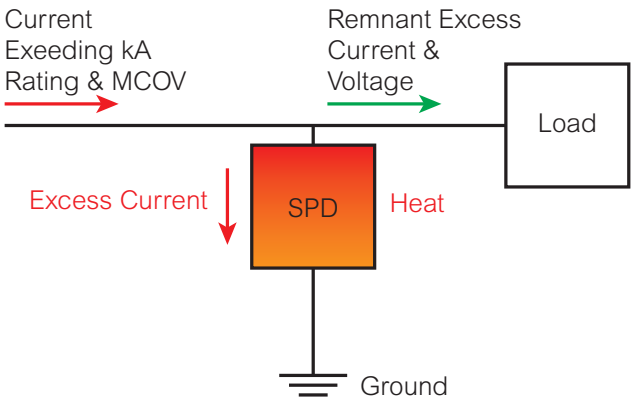


**Figure 3: Circuit activity during overvoltage/overcurrent conditions**

## NEWLY AVAILABLE TECHNOLOGIES

Advances in SPD features and functions range from simple device improvements to sophisticated and comprehensive solutions for monitoring and analyzing the occurrence and characteristics of transient overvoltages. Straightforward improvements include new indication features that signal the state of SPD function and condition. For instance, a single green indicator may signal that an SPD is functioning properly, or that the unit is merely connected to power. In either case, physical inspection is required to confirm full operability. By replacing the unit with an SPD featuring dry contacts and one or more LED indicators, users benefit from more comprehensive indication of SPD status as well as the capability to monitor conditions through a remote annunciator, a building management system, or ASCO's Critical Power Management System.

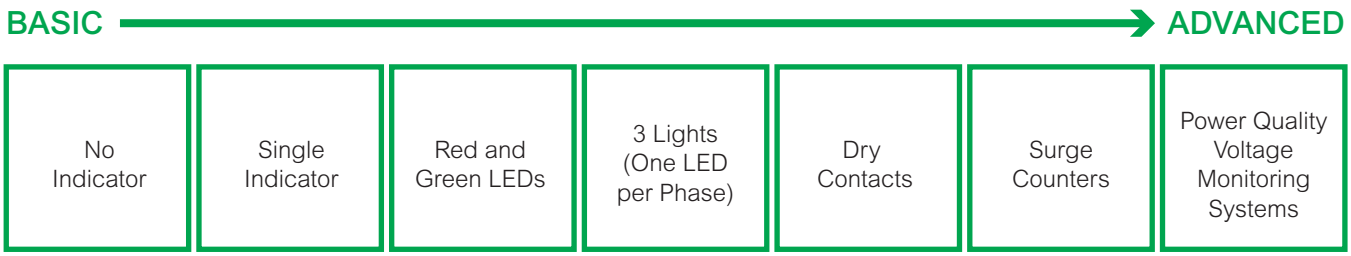


**Figure 4: SPDS are now available with a full range of indication features.**

For sophisticated applications, surge monitoring systems can offer detailed insight into surge-related activity. High-resolution voltage monitoring equipment can be used to detect and analyze both historic and real-time events. This information can be used to characterize surge exposures, verify SPD functionality, assess temporal changes in surge activity, and develop strategies for responding to changing conditions. At large facilities, multiple units can be used to evaluate transient overvoltages entering along each utility feed, and units can be deployed to monitor the surge exposure of individual high-value equipment.

## SUMMARY

Enhancement of surge protection strategies may be justified by changes in electrical codes, UL standards, a building's power distribution system, the condition of existing units, and new surge protection technologies. As the newest editions of the NEC are adopted, surge protection upgrades may be mandated whenever electrical systems are modified. When new UL 1449-listed SPDs are tested to the latest provisions of the standard, they offer greater assurance of safe and reliable operation in contemporary applications. Changes in power systems and available technologies combined with end of service life concerns can make SPD replacement and protection enhancement an important means of maintaining reliability and protecting electrical assets.


**Figure 5: Surge monitoring systems facilitate real-time, high-resolution voltage and current measurements that can aid in analysis and management of surge-related risks.**

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