White Paper

National Electrical Code (NEC)
Requirements for Surge Protective Devices
In the United States, The National Electrical Code® (NEC®) sets forth installation requirements for electrical systems and equipment, including Surge Protective Devices (SPDs).¹ The NEC provides guidance regarding where SPDs should and should not be used and how they may be installed in electrical power distribution systems. The following narrative identifies and describes key provisions of the NEC.

**CODE ADOPTION**

In any review of the NEC, it is important to understand its revision and adoption process. The NEC is revised once every three years, then republished as a new edition. In the United States, any new edition becomes effective locally after it is formally adopted by a state or local agency having jurisdiction. Because the timing of adoption by each state differs, four different editions of the NEC were in effect in the United States on August 1, 2018. In addition, three states had not adopted any edition for state-wide use. The status of effective editions is shown in Figure 1.

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Most states that have not adopted the latest version of the NEC have initiated a review process for adopting an edition of the code. While the latest edition of the code may not be required locally when a project is designed, many NEC changes are made to improve safety. Because updates typically do not conflict with older provisions, designing to the latest edition can improve overall facility design. Applicable local codes should also be reviewed.

For instance, Pennsylvania currently uses the 2008 NEC, and is presently reviewing the 2014 edition for adoption. When planning projects, it is important to know the edition in effect for the project location and to monitor the status of adoption processes in the project location.

**ESSENTIAL NEC PROVISIONS**

*Article 285 – Surge Protective Devices*

Essential provisions regarding SPDs have been part of the NEC through several editions. Added in 2002 and amended thereafter, *Article 285 – Surge Protective Devices, 1000 Volts or Less* describes types of SPDs and the corresponding locations for their installation. The article also presents basic but important provisions regarding the use of SPDs. These include requirements to connect SPDs to each ungrounded connector at the point of use; installing only listed SPDs; and using leads that are no longer than necessary and avoiding unnecessary bends.

Article 285 also prohibits certain uses of SPDs, and prohibits installing SPDs where voltages or fault currents exceed device ratings. Those ratings include the *Short-Circuit Current Rating* required by Article 285.7. These ratings can be found on a manufacturer’s product data sheet. A data sheet example is shown in Figure 2.

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4 Ibid.
5 Ibid. p. 70-133.
6 Ibid. p. 70-132.
7 Ibid.
Article 708 - Critical Operations Power Systems

In 2008, Article 708 - Critical Operations Power Systems (COPS) was added to the NEC in response to events such as terrorist attacks and hurricanes in the United States. Article 708.2 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.” Examples of facilities that utilize COPS include hospitals, data centers, police stations, 9-1-1 call centers, or critical portions of larger facilities. Important provisions for these facilities include:

- 708.20(D) - Surge Protective Devices, which states, “Surge protective devices shall be provided at all facility distribution voltage levels.”

- 708.14(4) - Wiring of HVAC, Fire Alarm, Security, Emergency Communications and Signaling Systems, which states, “Listed secondary protectors shall be provided at the terminals of the communication circuits.”

Installation of SPDs in a power system regulated by Article 708 must support the selective coordination practices applied to overcurrent devices, which must be specified by a professional engineer or other qualified person. Specific requirements are provided in Article 708.54.

SUBSEQUENT NEC CHANGES

In October of 2014, the Fire Protection Research Foundation issued a document entitled, Data Assessment for Electrical Surge Protection Devices - Phase 1, Final Report. This report surveyed and summarized the impacts of transient overvoltages to electrical power distribution systems and equipment.

The findings influenced the development and adoption of new NEC Code articles requiring SPDs to be installed to protect the emergency power system of regulated facilities. The most important 2014 and 2017 NEC changes regarding SPDs include those in the following sections.

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8 Ibid. p. 70-600.
9 Ibid. p. 70-602.
10 Ibid.
11 Ibid. p. 70-604.
12 Fire Protection Research Foundation, Data Assessment for Electrical Surge Protection Devices - Phase 1, Final Report. Quincy, Massachusetts, 2016
Article 700

The provisions of Article 700 - Emergency Systems apply to

“... electrical safety emergency systems consisting of circuits and equipment intended to supply, distribute, and control electricity for illumination, power, or both, to required facilities when the normal electrical supply or system is interrupted.”\(^\text{13}\)

Circuits and equipment that provide illumination, ventilation, elevator, fire alarm, and fire pump functions to allow occupants to safely exit a building are all examples of Emergency Systems under Article 700. Within the section, Article 700.8 - Surge Protection requires that a listed SPD be installed in or on the switchboards and panelboards of all emergency systems to protect equipment from hazards associated with transient overvoltages.\(^\text{14}\) The article does not further specify the characteristics of SPDs that should be used.

Because Article 517 – Healthcare Facilities references Article 700, certain systems in healthcare facilities are impacted by Article 700 provisions. Article 517.26 states, “The life safety branch of the essential electrical system shall meet the requirements of Article 700, except as amended by Article 517.”\(^\text{15}\) To understand the reference, it is important to understand how Article 517 defines the Life Safety Branch, which is shown in Figure 3 as part of a facility’s Essential Electrical System.

The NEC defines the Life Safety Branch as, “A system of feeders and branch circuits supplying power for lighting, receptacles, and equipment essential for life safety that is automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source.”\(^\text{16}\) Examples of equipment served by the Life Safety Branch include:

- illumination for egress
- exit signage
- alarm and alerting systems
- communications systems
- generator locations and generator accessories
- elevators
- automatic doors

Consequently, these systems must be protected by installing SPDs on the panelboards and switchboards that serve them.

\(^{14}\) Ibid. p. 583.
\(^{15}\) Ibid. p. 423.
\(^{16}\) Ibid. p. 70-419.
OTHER IMPORTANT PROVISIONS

Article 620 - Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts

Article 620 sets for requirements elevators, dumbwaiters, escalators, moving walks, platform lifts, and stairway chairlifts, and was updated in the 2017 Edition. Within the section, Article 620.51 provides various requirements for the disconnecting means that must be provided for this equipment. It further states, “Where any of the disconnecting means in 620.51 has been designated as supplying an emergency system load, surge protection shall be provided.”

Article 645 - Critical Operations Data Systems

Article 645.2 defines a Critical Operations Data System as, “An information technology equipment system that requires continuous operation for reasons of public safety, emergency management, national security, or business continuity.” Article 645.18 requires surge protection for all such systems.

Article 670 – Industrial Machinery

Article 670 addresses “the definition of, the nameplate data for, and the size and overcurrent protection of supply conductors to industrial machinery.” Because electronic safety devices must be able to protect people from injury at all times, installing surge protection devices can protect equipment from surges to help ensure proper and safe operation. Article 670.6 thus requires that industrial machinery with electronic interlocks must have surge protection devices installed.

Article 695 – Fire Pumps

Other electronic safety devices that must work when needed include fire pumps that supply fire suppression systems. Article 695.15 states, “A listed surge protective device shall be installed in or on the fire pump controller.” An ASCO Power Technologies Fire Pump Controller is shown in Figure 4.

SUMMARY

Triennial revisions to the NEC make it important to track the editions of the code that is in effect for a project location. The NEC articles referenced herein constitute the bulk of requirements regarding the location and use of SPD in power distribution system. A look-up table summarizing key SPD-related NEC requirements is provided as follows.

<table>
<thead>
<tr>
<th>Article</th>
<th>Application</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>517</td>
<td>Healthcare Facilities</td>
<td>517.2, 517.26</td>
</tr>
<tr>
<td>620</td>
<td>Elevators/Escalators</td>
<td>620.51</td>
</tr>
<tr>
<td>645</td>
<td>IT/Data Systems</td>
<td>645.18</td>
</tr>
<tr>
<td>670</td>
<td>Industrial Machinery</td>
<td>670.6</td>
</tr>
<tr>
<td>695</td>
<td>Fire Pumps</td>
<td>695.15</td>
</tr>
<tr>
<td>700</td>
<td>Emergency Systems</td>
<td>700.1, 700.8</td>
</tr>
</tbody>
</table>

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17 Ibid. p 70-508.
18 Ibid. p. 70-528.
19 Ibid. p. 540.

Figure 4: Providing SPDs on fire pump controllers helps ensure reliable operation during an emergency event.