Life Is On Schneider Electric

SPDs for Essential Power Systems in Health Care Facilities

White Paper

SPDs FOR ESSENTIAL POWER SYSTEMS IN HEALTH CARE FACILITIES

AN OVERVIEW OF SPD PROTECTION NEEDS

Health care facilities provide critical services to the public. To mitigate the impacts of potential power outages, electrical systems in health care facilities are subject to standards issued by several organizations. The National Fire Protection Association (NFPA) documents that apply to health care facilities include (1) the National Electric Code (NFPA 70), (2) the Standard for Health Care Facilities (NFPA 99), (3) the Life Safety Code (NFPA 101), (4) and the Standard for Emergency and Standby Power Systems (NFPA 110). The following narrative reviews NEC requirements for backup power systems and describes how surge protective devices (SPDs) can be applied to mitigate potential damages to equipment from transient overvoltages.

Division of Electrical System

Article 517 of the National Electric Code (NEC) splits the electrical system of a health care facility into essential and non-essential systems (Figure 1). The essential electrical system ensures the safety of people within the building, and is further divided into the equipment branch, the life safety branch, and the critical branch. For example, central vacuum or compressed air systems for surgical areas and HVAC equipment for patient care areas are connected to the equipment branch. The life safety branch includes equipment associated with the safety of patients and others within the facility, such as egress lighting, fire alarm, emergency communication, and automatic door systems. Elevators used for evacuating people are also served by the life safety branch. The critical branch of the emergency power system serves illumination and patient care systems in areas where anesthetizing gases are used and in infant nurseries, nurse's stations, and blood banks.

The non-essential electrical system includes circuits and equipment that would have no effect on life or safety if they became inoperable. Examples of non-essential systems include equipment used for administrative functions; non-emergency lighting; and comfort heating, ventilation, and air conditioning equipment. Non-essential information technology systems and data processing equipment may be connected to an uninterruptible power system or an optional power source as non-essential loads.

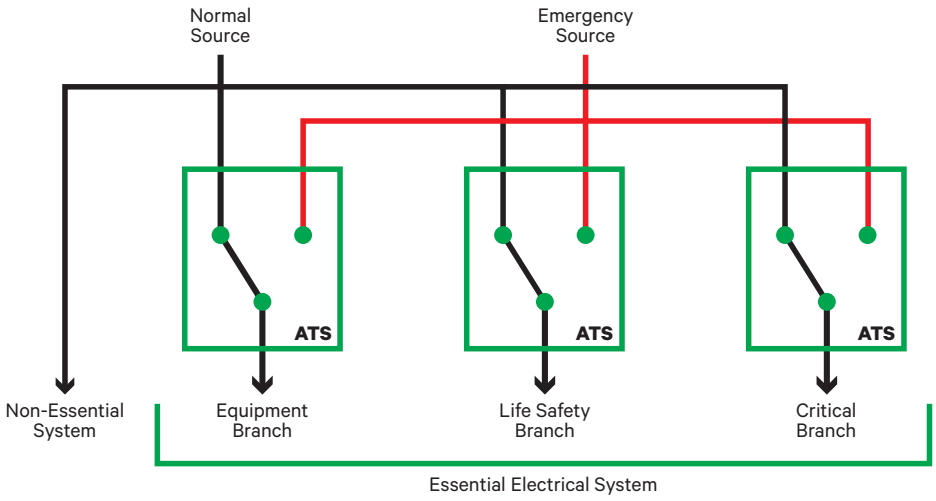

Figure 1: NEC Essential System Configuration

Applicability of Standards

Article 708 of the NEC specifies requirements for Critical Operating Power Systems, which power, HVAC, fire alarms, security, and signaling systems serving Designated Critical Operating Areas. Such systems may be so designated in codes by authorities having jurisdiction, or in facility engineering documentation. Article 708 requires that a risk assessment be conducted to evaluate potential impacts for natural and human-caused events. It also requires that a strategy be developed to mitigate hazards that will not otherwise be mitigated by other provisions of the NEC. Since overvoltage transients can result from normal operations

within and upstream of a facility as well as from natural and human-caused events, adequate surge protection should be provided on the essential electrical system and systems serving Designated Critical Operating Areas.

The IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits characterizes the surge environment in electrical systems by location, as shown in Figure 2 below. When applying surge protection, IEEE 1100 recommends a cascaded approach, with appropriate SPDs located at the service entrance, primary and secondary panelboards, and panelboards on secondary, separately derived systems. By applying SPDs that successively shunt excess voltage at the service entrance and primary and secondary distribution circuits, equipment can be provided with robust and effective protection from transient overvoltages. Figure 3 shows an example of a cascaded approach to applying SPDs in a facility.

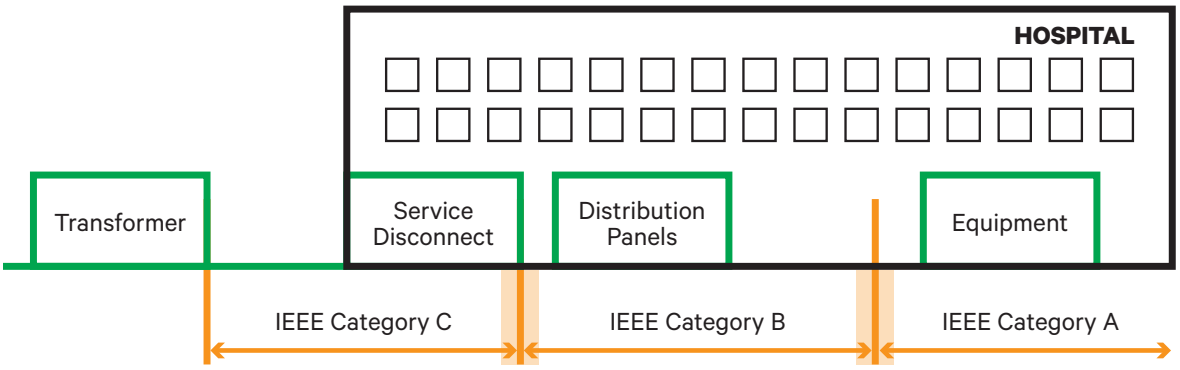

Figure 2: IEEE Location Categories

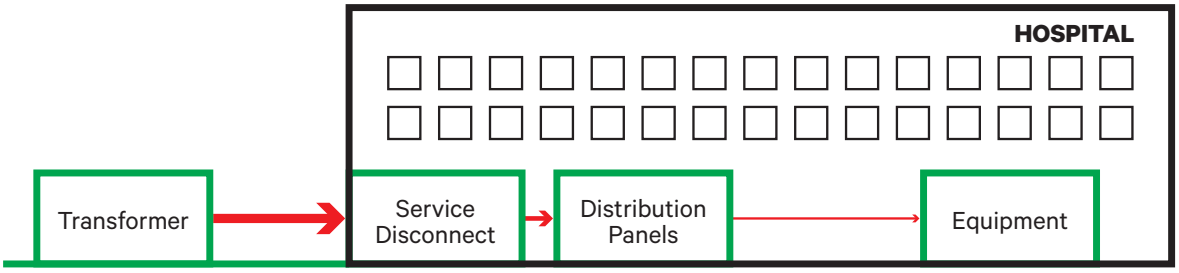

Figure 3: Cascaded SPDs reduce surge propagation through facility systems

Underwriters Laboratories' UL 1449 Standard for Safety, Surge Protective Devices addresses types of SPDs for AC power. This is harmonized with National Electrical Code (NEC®) Article 285. The locations for SPD types under UL 1449 are shown in Figure 4. Type 1 SPDs are intended for use between the utility transformer and the line side of the electrical disconnect at the service entrance, and thus have built in overcurrent protection. Type 2 SPDs may or may not have built in overcurrent protection, and are intended to be installed between the load side of the service entrance and at downstream locations. Type 3 SPDs are applied to protect equipment at the point of use.

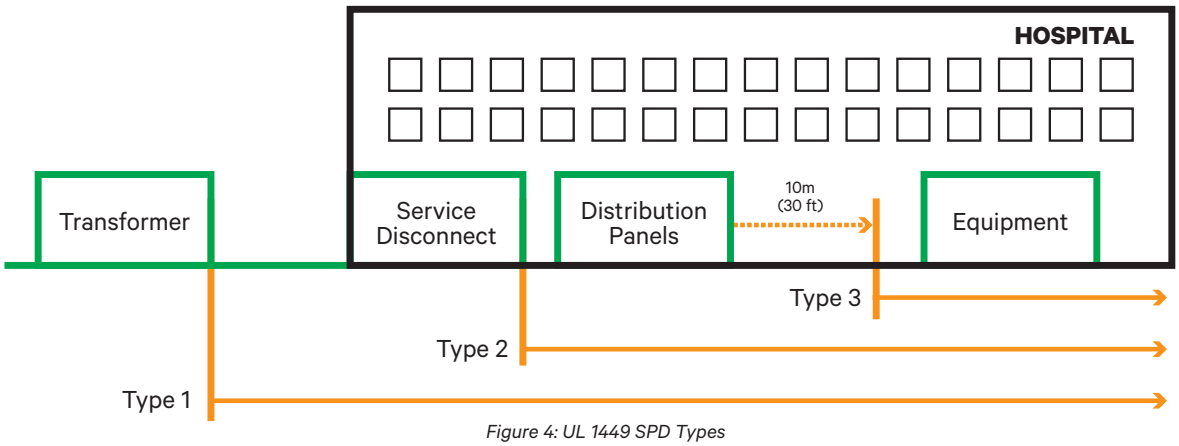

Figure 4: UL 1449 SPD Types

Elements Requiring Protection

Service Entrance

SPDs at the service entrance provide the primary level of defense against surges for sources external to the building such as lightning or utility switching events. When protecting service entrances, both the configuration of the conductors and the SPD locations require consideration. While codes recognize that SPDs can be installed on the load side of the service entrance, any servicing of the SPD could require shutting down utility power to access the device. For this reason, consideration should be given to installing protection on the load side of the service disconnect.

Transfer Switches

To properly protect transfer switch controllers and downstream loads, SPDs should be installed on both the normal and emergency terminals of the ATS. If the controllers are connected to external monitoring or control equipment, then SPDs should be applied to those circuits. If the neutral and the ground are bonded at the ATS terminals, these SPDS should provide Line-to-Line and Line-to-Ground protection.

Panelboards and Switchboards

To protect downstream equipment, the NEC requires that surge protection be applied to every voltage system in the facility. In addition, a listed SPD shall be installed in or on every switchboard and panelboard. The maximum available fault current at the installation location cannot exceed the Short Circuit Current Rating marked on the SPD.

Many SPDs are equipped with overcurrent protection designed to remove the SPD from service when internal surge protection components fail. Engineers should ensure that the SPD design will not conflict with NEC selective coordination requirements for other overcurrent protection devices in the system. These requirements can be met by installing the SPD on a dedicated circuit equipped with a circuit breaker immediately upstream of the device. This will also allow the SPD to be serviced without taking loads off-line and opening distribution panels.

Other Systems

Consideration must also be given to other systems and equipment within a health care facility. The requirement to protect equipment from transient overvoltages extends to internal communication systems needed for emergency use egress lighting, access control systems, and task lighting for critical operations; fire alarm and control systems; security camera equipment; and computer equipment associated with patient records. In addition, every conductor that enters a building is a potential pathway for overvoltage transients, and should be protected at the panel serving the circuit and at the loads. The protection of electronically controlled lighting equipment such as electronic ballasts and LED lights should also be addressed.

Application of SPDs

For applications associated with life safety, both NEC Article 708 and the Standard for Health Care Facilities (NFPA 99) require an assessment of potential hazards to the essential electrical system to adverse influences. These influences include transient conditions caused by lightning and the switching of electrical components.

To protect systems from potential overvoltage, SPDs are necessary to comply with the aforementioned codes and standards. Figure 5 shows the proper SPD placements with the primary circuits of an Essential System within a health care facility. A UL-1449 Type 1 SPD is connected at the service disconnect. Type 2 SPDs are located at (1) the non-essential distribution panel; (2) the normal terminals of the equipment branch, life safety branch, and critical branch ATSs; and (3) the equipment branch, life safety branch, and critical branch distribution panels. Figure 5 shows SPDs designated as (A) that are required for all systems were the emergency power source is contained within the same structure as the health care facility. When a generator is located outside of the building, the SPDs designated as (B) are required.

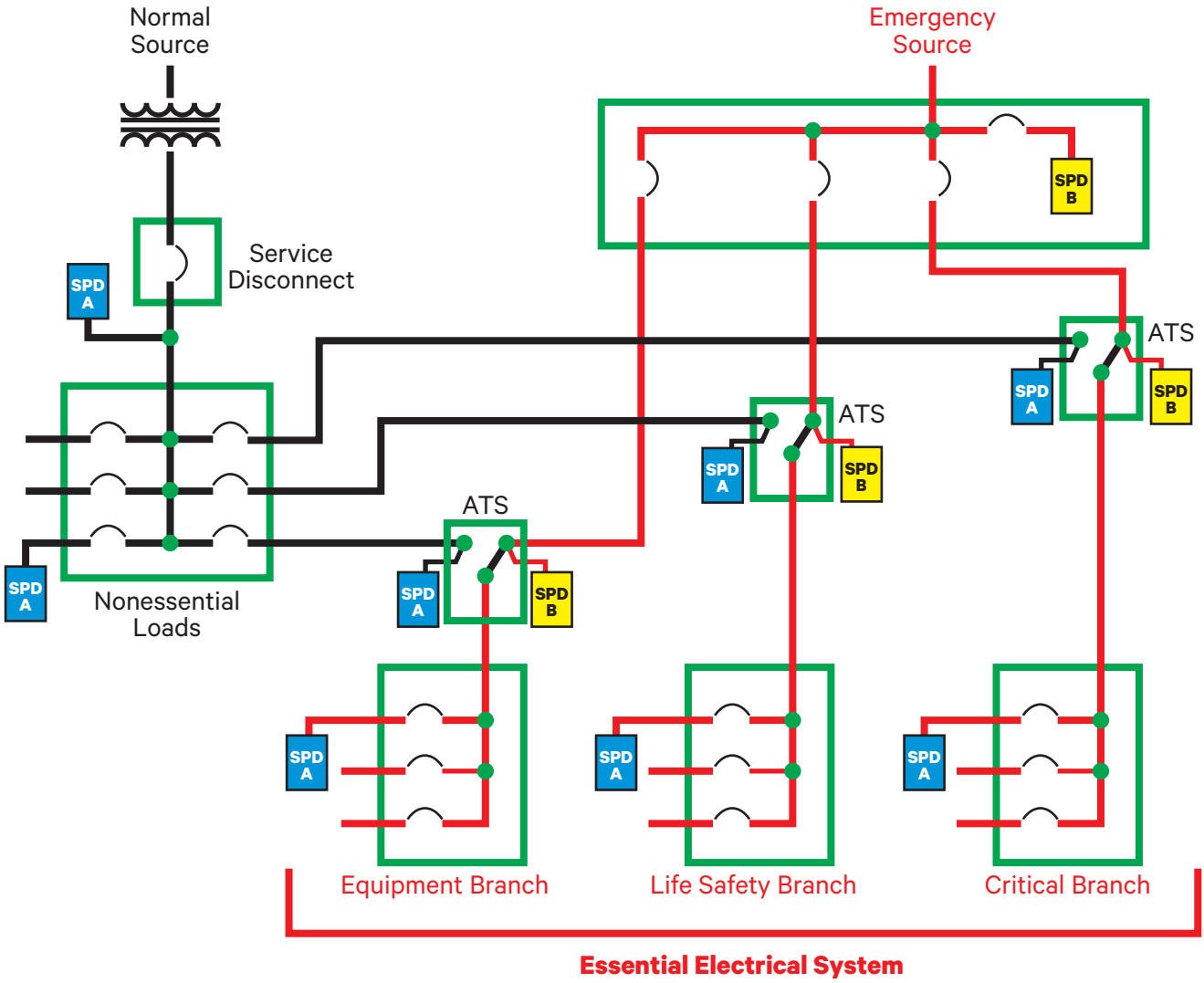

Figure 5: SPDs in a Health Care Electrical System

In most cases, the generators used to provide emergency power are located outside the health care facility itself. In those cases, it is important to apply SPDs, denoted as (B), to the terminals of the emergency power switchgear and to the emergency power terminals of each ATS in the Essential Electrical System. The SPDs installed on the terminals of the emergency power switchgear must be UL 1449 Type 1. The remaining SPDs should be Type 2.

SPDs connected at the service entrance for normal power can utilize either line-to-neutral or line-to-ground modes of protection. If no ground fault protection is provided for the emergency power, all modes of protection are required because the neutral-to-ground bond is at the normal source and not in close proximity to the applied SPD. Downstream of the normal and emergency switchgear, SPDs with all modes of protection are required to ensure that transient overvoltages do not damage equipment.

SPDs installed in a health care facility must be connected in accordance with the NEC and manufacturer recommendations. NEC Article 285 provides specific requirements for connecting surge protective devices rated 1,000 volts or less to an electrical distribution system.

Summary

In health care facilities, SPDs should be installed as follows:

- SPDs should be installed in a cascaded configuration according to IEEE 1100 recommendations, specifically at the service entrance, distribution panels, and end-use equipment.
- Individual SPDs should be installed on the non-essential electrical system and each branch of the essential electrical system.
- Type 1 SPDs should be installed at the service entrance and Type 2 SPDs should be installed at all distribution panels.
- SPDs should be installed on the normal terminals of every ATS.
- Emergency power sources installed outside of the building require an SPD, and SPDs should be installed at the emergency terminals of each ATS.
- SPDs may be installed with a dedicated upstream circuit breaker or switch to maintain selective coordination requirements and promote serviceability.
- SPDs should be installed in accordance with the National Electric Code.

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