IEEE Emerald Book Series – Staged Approach for SPDs in Data Center Applications

White Paper – September 26, 2007

IEEE Standard 1100-2006 (Emerald Book), Section 8.6.3 (p. 300) *"Facilities housing electronic load equipment of any type should have service entrance equipped with effective lightning protection in the form of a listed Category C SPDs..."* **Section 8.6.4 (p. 301)** *"In addition to SPDs installed in the service entrance equipment, it is recommended that additional SPDs...be applied to downstream electrical switchboards and panelboards, and panelboards on the secondary of separately derived systems...* **Section 8.6.8 (P. 304)** *"All exterior mechanical systems (e.g. cooling towers, fans, blowers, compressors, pumps, and motors) that are in an area not effectively protected by lightning protection per NFPA 780 should be considered as targets for a lightning strike. Therefore, it is recommended to practice to individually provide SPD protection...to all such equipment."*

INTRODUCTION

For today's communications, banking, and financial sectors, the reliance of data centers to obtain, store, retrieve, communicate, and utilize data is vital. Data centers range in size from large to small. Large data centers can be a stand alone structure or specified rooms or floors within a facility. Data centers categorized as small range from a single room to stand alone equipment racks.

In addition to the varying sizes of data centers, rapid changes in information technology (IT) equipment is also taking place. The demand for new IT equipment is coming from the requirement to process more data for the organization. New IT equipment is smaller, more adaptable, and more powerful than its predecessors. The newer IT equipment is also more susceptible to power fluctuations and transient conditions.

FIGURE 1
DATA CENTER

REDUNDANCY

To account for the increased needs for IT equipment, redundancy has become a critical topic addressed by the engineering community. The deployment of redundant AC power systems should reduce the amount of time systems are be without power.

The Uptime Institute has qualified this by denoting four levels of redundancy and their anticipated availability for the AC power system. These levels are denoted as Tier 1, Tier 2, Tier 3, and Tier 4 [1]. Each level is based on specific redundancies for the systems used to operate a data center.

For a system to be compliant to a specific level, all subsystems are required to meet the specifications for that particular tier [1]. This includes the power system, the heating ventilating and air condition (HVAC) system, and the fire alarm system. For simplicity sake the Tier 1 Power System will be the focal point of this article.

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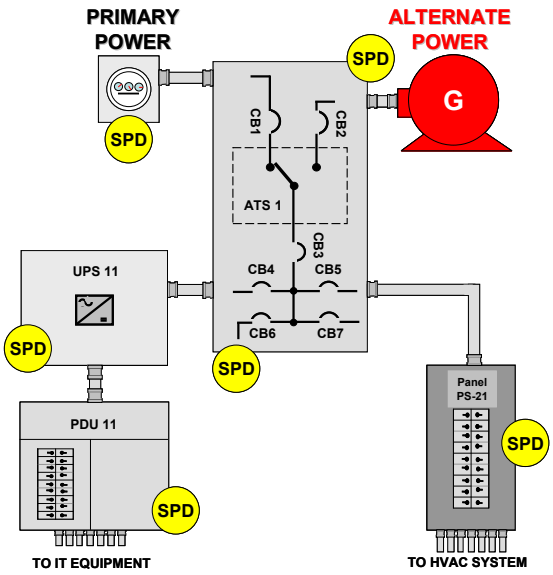
TIER 1 POWER SYSTEM

The Tier 1 power system (Figure 2) is composed of two power sources: primary and alternate, an uninterruptible power supply (UPS), a power distribution unit (PDU), a switchgear for the incoming power, and a distribution switchgear for the HVAC system. In Figure 2, the primary source is derived from the local utility and the alternate power source is derived from an engine generator. Non-standard sources of AC power (e.g. wind turbines) can also be used to provide primary power with the utility providing the alternate power source. In addition, a separate utility feed can also be used for alternate power. When a utility service is used for both the primary and the alternate AC power, it is up to the authorities having jurisdiction (AHJ) to determine its applicability [3].

FIGURE 2
TIER 1 POWER SYSTEM



In Figure 2, AC power is conditioned by UPS11 and PDU11 and supplied to the IT equipment. While the term "conditioned power" has different meanings to some, it generally implies that the AC power is free from transients, noise, is at a constant voltage, and is at a constant frequency. AC power for the HVAC system is provided through the distribution switchgear PS21.

To provide transient protection to a Tier 1 system, surge protective devices (SPDs) are required at all levels within the electrical distribution [2], (Figure 2). The levels within the facility include the service entrance, the distribution panels, and the point of use equipment [4]. In Figure 2, the service entrance location is the input to the switchgear where primary AC power is supplied from the utility service, and alternate AC power is supplied from the generator. The branch panel location is identified as the input and output locations of the UPS11, and PDU11 for conditioned power to the IT equipment. For the HVAC system, branch panel location is PS21.

Application Notes from Emerson Network Power providing guidance on the proper application of SPD's in various locations of a data center's ac power system are:

- *IEEE Emerald Book Series – Using SPDs in Applications with Primary & Alternate Power Systems*
- *IEEE Emerald Book Series – Using SPDs in Applications with Uninterruptible Power Systems (UPSs).*
- *IEEE Emerald Book Series – Integrating SPDs Into Power Distribution Equipment.*

CONCLUSION

Data centers provide critical support to a variety of business functions. To ensure that the ac power system has high levels of availability to meet the demands of the business, specific levels of redundancy have been established by the Uptime Institute. The basic level of redundancy is denoted as a Tier 1 system. For a facility to be classified as a Tier 1 facility, all systems (e.g. ac power, HVAC, fire alarm, etc.) must comply with the requirements designated for Tier 1 systems.
Providing transient protection to a Tier 1 power system requires that SPDs be located throughout the facility. The IEEE recommends that SPDs be installed at:

- Each service entrance location
- Each distribution level switchgear, UPS, or PDU
- All point of use locations (specific IT and HVAC equipment)
- Any system (HVAC, fire alarm, security) that requires components to be located external to the structure of the facility

The IEEE also recommends that ac power that is supplied from external locations (utility) or ac power that feeds external components (HVAC, fire alarm, security) be capable of protecting these systems from Category C type transient conditions. Additionally, one should consider that Category C transient conditions can occur many times over the life span of the equipment and the facility.SPDs perform an important function by reducing trans- ient conditions so that processes can operate as designed. Using scientific processes, best engineering practices, and various codes and standards will create safer, more efficient, and more profitable processes and installations.

REFERENCES

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Headquarters
Surge Protection
328 Water Street
Binghamton, NY 13901
P (607) 724 2484
P (800) 288 6169
F (607) 722 8713
E surgeprotection@emersonnetworkpower.com

1805 NE 19th Avenue
Ocala, FL 34470
P (352) 732 3029
P (800) 648 4076
F (352) 867 1237

WP-30014 Rev. 1 - 9/08