White Paper

Surge Protection for Precision Cooling Systems

ASCO Power Technologies™

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The number of data centers is growing throughout the world. With the increasing amount of information processed using the Internet, this trend is expected to continue. According to a recent Cisco study, global IT traffic will increase nearly threefold between 2017 and 2022.[1]

According to a 2018 report by Gartner, an hour of downtime on can cost more than $300,000.[2] And the Uptime Institute has reported that 80 percent of data center managers indicate that their most recent outage was preventable.[3] These costs are attributable to data loss, lost productivity, equipment damage, root-cause detection, and recovery actions. Environmental vulnerabilities, including failures related to heat density and cooling capacity, accounted for 15% of these losses.

Redundancy

Deploying redundant AC power systems reduces data center downtime. The Uptime Institute has defined four levels of redundancy. These range from Tier I systems that offer single components and single power pathways to Tier IV configurations that run dual systems concurrently to provide fault tolerance.[4] For a data center to be compliant at Tier IV, all subsystems within the facility are required to meet the industry specifications, including the heating, ventilating and air conditioning (HVAC) systems. Providing transient protection to a Tier IV power system requires that surge protective devices (SPDs) be located throughout the facility, including often-overlooked HVAC systems. And, a prudent datacenter manager at a Tier I, II or III classified facility would be wise to apply comprehensive surge protection in a similar manner.

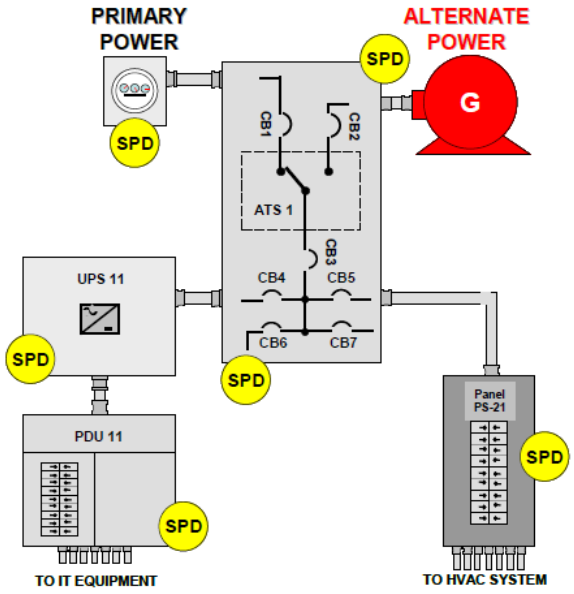

Figure 1: Power System

Precision Cooling in the Data Center

Precision Cooling systems are critical to reliable operation of IT equipment in data centers. Special Computer Room Air Conditioners (CRACs) are deployed to cool IT equipment and maintain proper humidity levels in the data center spaces. Many new CRAC units are built using sensitive electronics including circuit boards, monitors and displays, variable frequency drives (VFDs), VFD motors, and electronically commutated (EC) motor assemblies. Often these, these critical HVAC components are neglected when facilities are assessed for proper surge protection.

[1] *Cisco Visual Networking Index: Forecast and Trends, 2017-2022.* Cisco Systems, Inc. 2019. https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html, viewed March 5, 2019.
[2] A. *Learner. The Cost of Downtime. Gartner, Inc. July 16, 2014. https://blogs.gartner.com/andrew-lerner/2014/07/16/the-cost-of-downtime, viewed March 5, 2019.*
[3] R. Asciento. *Uptime Institute Global Data Survey.* Uptime Institute, LLC. 2018. Seattle, WA. https://uptimeinstitute.com/uptime_assets/f7bb01a900c060cc9abe42bb084609f63f02e448f5df1ca7ba7fdebb746cd1c4-2018-data-center-industry-survey.pdf, viewed March 6, 2019.
[4] *Data Center Site Infrastructure Tier Standard: Topology.* Uptime Institute, LLC. 2018. Seattle, WA. pp. 5-9

Precision Cooling Vulnerabilities to Surges

Rooftop condensers, dry coolers, condensing units (Figure 2), and chillers may use electronics to control fan and motor speeds. These may operate for thousands of hours during seasonal periods of low ambient temperatures, when VFDs and EC fans perform the function of controlling the speed of fan motors to reduce the power consumed by the cooling equipment.

The sensitive electronics within VFDs and EC fan motor drives, and other electronic components are especially susceptible to power quality. Properly applied surge protective devices at both the panel feeding the unit as well as the point-of-use will protect the system from power anomalies to help maintain cooling system reliability and efficiency.

Figure 2: HVAC Condensing Unit

SPD Deployment

Facilities follow industry recommended practices by installing surge protection at the incoming main service entrance switchboard. This is a good first step. However, additional protection is needed to avoid downtime caused by transient overvoltage activity. Section 8.6.4 of *IEEE 1100 - Recommended Practices for Power and Grounding* recommends that SPDs be applied to downstream electrical switchboards and panelboards.[5] Additionally, NEC Article 645.18 requires surge protection for critical operations data systems. For critical operating power systems (COPS), NEC Article 708.2 requires continuous operation for the system related to public safety, emergency management, national security or business continuity, and Article 708.20 require that surge protection devices be provided at all facility distribution voltage levels.[6] This includes panelboards that feed CRAC units.[7]

Properly sized SPDs should be applied at critical point-of-use locations, which includes outdoor HVAC equipment such as condensers and dry coolers. In Addendum Y section 9.2.2.1.2.1, ASHRAE Standard 135-2008 states, “The use of surge arrestors near each building’s cable entrance to protect all of the conductors is recommended.”[8] In addition, Section 8.6.8 of IEEE 1100 states:

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[5] *IEEE Standard 1100-2005 - IEEE Recommended Practice for Power and Grounding Electronic Equipment., Institute of Electrical and Electronics Engineers.* Piscataway, NJ. p. 302.
[6] *NEC Article 708.2 & 708.20* (2017)
[7] *NFPA 70 - National Electrical Code®*. National Fire Protection Agency. Quincy, Massachusetts. 2018. p. 70-528.
[8] *Standard 135-2008 – BACnet - A Data Communication Protocol for Building Automation and Control Networks, Addendum Y.* American Society of Heating, Refrigerating and Air-Conditioning Engineers. January 23, 2010. p 9-10.

"All exterior mechanical systems (e.g., cooling towers, fans, blowers, compressors, pumps, and motors) that are in an area not effectively protected by a lightning protection system per NFPA 780 should be considered as targets for a lightning strike. Therefore, it is recommended practice to individually provide SPD protection…".[9]

To comply with ASHRAE and IEEE guidance, precision cooling components should be protected using high-quality SPDs. Installing these devices in a cascaded approach will help ensure that critical HVAC equipment is fully protected from externally generated transients, such as lightning and utility grid switching.

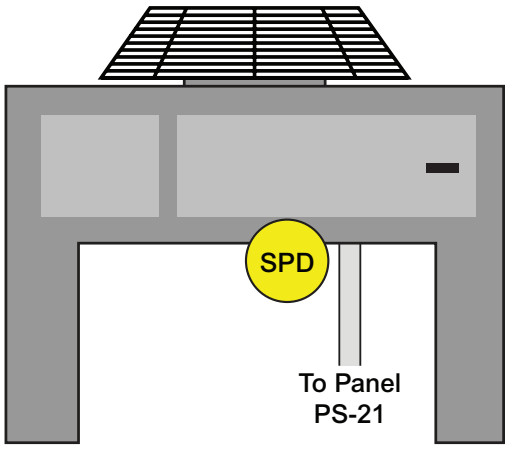

Figure 3: HVAC System

Protecting CRAC Units

To supply a basic level of protection, an effective Category C-rated SPD should always be applied at critical branch panels, including the panel board feeding precision cooling equipment. For added protection, a properly sized SPD should also be considered for installation at the CRAC unit or the disconnect feeding it. At all locations, a UL1449-Listed device with a 20kA I-Nominal should be used, with appropriate SCCR, and surge current ratings applicable to the environment for which it's installed.

Summary

To fully protect precision cooling equipment in data centers, surge protective devices should be installed on all critical branch panels and computer room air conditioners within a facility. Without these devices, transient overvoltages could damage or disable precision cooling equipment, leading to downtime, productivity and revenue losses. The losses can be easily, and cost effectively be minimized with a proper and thorough application of quality surge protective devices.

For technical assistance in selecting ASCO SPDs, contact ASCO Surge Protection Support at
(800) 237-4567

[9] *IEEE Standard 1100-2005*. p. 304.

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