FACILITY CORNER

The Shift to 380V DC in the Data Center

BY JEFF HUDGINS

As the demands on data centers increase, creating higher costs and power usage, the industry is looking for ways to increase efficiency and decrease operating costs. One potential area of increased efficiency lies in the power distribution configuration within the data center and its IT equipment.

In a conventional data center, power is supplied from the grid as alternating-current (AC) power and is distributed throughout the data center infrastructure as AC power. However, most of the electrical equipment within the data center, as well as the batteries storing the backup power in the UPS system, require direct-current (DC) power. As a result, the AC power must go through multiple conversions, resulting in power loss and wasted energy.

To eliminate these unnecessary conversion steps and substantially reduce power wastage, data centers should consider DC power distribution – specifically, 380 volt DC. By leveraging 380V DC power distribution, organizations can achieve numerous benefits over a traditional alternating current design, including greater energy efficiency, higher reliability, a smaller footprint, lower installation and maintenance costs, more scalability, and easier integration of renewable energy.

BENEFITS OF HIGH-VOLTAGE DC POWER

While it has been talked about for many years, DC power is finally making the transition from concept to practical use. The key reasons why more data center managers are seriously considering adopting high-voltage DC architecture include:

Fewer conversions

In a typical data center scenario, 15kV AC must be stepped-down in a transformer, sent through an uninterruptible power supply (UPS), passed through a power distribution unit (PDU), and then delivered as AC input to a server where it is finally converted to DC voltage to power microprocessors, memory and drives. All of these efforts to store and convert the signal produce heat and reduce efficiency. Using a DC architecture, the 15kV AC power line voltage is immediately converted to high-voltage DC. This reduces heat and improves efficiency.

Less heat = less cooling

Because less heat is generated, less cooling is necessary. HVAC is the second biggest power user after servers in data centers. Reducing power conversions means more power goes directly to the servers, but, more importantly, it means the cooling systems have less work to do.

Smaller footprint

With less equipment installed for power conversions, less space is needed for these secondary systems. This means greater computing equipment density, enabling organizations to achieve greater capacity without increasing space.

Greater reliability

It is a fundamental design principal: fewer parts lead to fewer breakdowns. With traditional AC architecture, each power conversion introduces one more component which can fail, leading to downtime. DC architecture with its two- or three-step conversion process reduces the risk of downtime due to power component failure.

ALIGNING AROUND THE 380V DC STANDARD

Support for the 380V DC standard is increasing worldwide, with Japan initially leading the way. DC is already the resident power used by data center subsystems, primarily at the microchip and board level, and virtually all active and passive semiconductor integrated circuits operate from low-level DC voltages. High-speed processors, memory and storage devices, and I/O circuitry all consume DC power, which is readily regulated and distributed in x86-based servers. Lower and lower DC voltages are also being used to power microcircuits, and data processing performance has become increasingly efficient with every successive generation of processors.

In terms of adopting 380V DC power in the data center, the servers and data center appliances themselves

are no longer the conversion break point. Equipment manufacturers are developing technology products that support the 380V DC standard.

However, for 380V DC to become the mainstream power standard in data centers, three forces must be in alignment:

- Data center managers must embrace the concept, and be willing to make the investment to upgrade their infrastructures;
- Equipment manufacturers must provide the necessary equipment, such as rack power distribution products and servers, to support high-voltage DC power, and;
- Regional utility providers must offer incentives compelling enough for data centers to make the switch.

There is no question that 380V DC power is gaining traction among managers of greenfield data centers. For example, ABB's investment earlier this year in Validus DC Systems, a leading provider of DC power infrastructure equipment for data centers, signals that global power company's intent to drive the market by expanding the availability of DC power solutions for new data centers. But even managers of existing data centers are finding it increasingly hard to resist the considerable benefits of converting to a 380V DC infrastructure.

Regional utility companies are a critical piece of the overall puzzle. They wield enormous influence that can be used to help drive the evolution to DC power by data centers. In Europe, where demand for power is rapidly outstripping supply, utility companies are actively working with their customers to increase their data centers' efficiency so that they can ensure they will be able to provide enough power to them in the years to come. In the U.S., utility companies must follow their European counterparts' lead, and create incentive programs for data centers that make it practical for them to convert to DC power.

Duke Energy is an example of a regional utility company that is putting its weight behind 380V DC. Last year, the company conducted a data center experiment on the use of 380V DC power, which found that a DC power system uses 15% less electricity than the existing AC power system. For the project, the data center's 480vAC was converted to 380V DC and delivered to the equipment racks via a 380V DC bus. The researchers believe that the 15% energy savings achieved in the project is a good benchmark for the industry because the 480V AC system configuration is typical for data centers across the United States.

According to Curt Watkins of Duke Energy's Technology Development Group, "While this is significant news for any company running a data center today, [it] could be especially critical for the more than 2.5 million smaller data centers across the United States that rely upon inexpensive yet viable ways to reduce costs. If this DC technology was implemented in all those data centers the impact could be significant."

SUMMARY

After years of talk, we are finally starting to see 380V DC in the data center transform from future vision to practical reality. Momentum is building among the three key constituencies that need to be behind it – the data center managers, equipment manufacturers, and regional utility companies – and countries like Japan are showing how to move ahead with implementations. Now is the time to focus on bringing the necessary technologies and services to market that will help accelerate 380V DC adoption and reward the early adopters. ■

About the Author: Jeff Hudgins is the Vice President of Marketing, NEI