Medium voltage on the rise: How MV systems can cut costs and boost efficiency in data centers

The blueprints for every growing data center across the globe carry the same caption: "More Power." The increasing demand for electrical power in data centers is immense, with rack densities swelling, big data pressures pushing up storage requirements, and online social and shopping activity exploding. Existing industrial facilities are being repurposed into data centers. At the same time, existing data center administrators are simply running out of floor space, while under corporate pressures to reduce operational and capital expenses.

With the above trend of the "industrialization" of the internet in mind, data centers evolving into what amounts to data factories, operators are beginning to consider wider use of medium voltage (MV) power distribution systems in place of conventional low voltage (LV) systems as a way to significantly reduce costs and improve performance.

Medium voltage AC power systems, which manage a voltage range from 1,000 V to 38,000 V, have been employed extensively in mining and industrial plants, and many data centers have been using medium voltage to some extent. Now data center operators have connected with the idea of expanding their deployment of MV systems to meet their industrial-size demands, because they answer the data center's needs for smaller footprint, lower costs and increased reliability.

The benefits of medium voltage systems

MV power distribution is especially beneficial for data centers that rely on flexible architectures, valuing modularity and scalability. Medium voltage power distribution provides a cost-efficient way to connect modules as the facility expands, although maintaining MV-powered modules requires personnel who are specially qualified.

Considering the total power distributed per square foot, medium voltage systems are more compact than LV systems, allowing for more “white space” within the data center’s real estate to deploy IT equipment. By transforming power closer to the load, MV also helps to decrease the voltage drop inherent in the long feeder runs of low voltage systems. LV systems often use oversized feeder lines to compensate for resistance in the long runs. This can produce a substantial voltage drop from utility to data center.

Medium voltage systems carry lower current, which eliminates oversize lines and translates to smaller or fewer conductors in the power distribution system. A low voltage system may need 8 to 10 times as many cables and conduits as a medium voltage system. Where a low voltage system may require a 500-foot (150 meters) cable run, a medium voltage system in the same data center would need almost a mile less wire and conduit. That means MV can significantly reduce the high costs of copper conductors in the distribution system.

How MV equipment differs from LV

Medium voltage systems differ from LV in several other aspects, as well. One drawback for MV is that, while the MV system can be more compact than multiple LV systems, the footprint of the unit is larger for MV. While low-voltage equipment requires 3 feet of working space in front of it, medium voltage requires a minimum of 4 feet (1.2 meters) of clearance depending on the voltage level with some systems requiring rear access as well.

An important difference between the two systems that tends to favor MV is the design of their circuit breakers. LV systems use circuit breakers that contain the power switching with the basic overcurrent protection built into the device but MV separates this. The MV circuit breaker houses only the vacuum interrupter that opens or closes the circuit, while separate solid state protective relays guard against short circuits or an overcurrent.

These protective relays are highly intelligent, microprocessor based digital relays ensure safer and more efficient operation and maintenance of the circuits. These relays in conjunction with their associated circuit breakers are speedier and more accurate than traditional thermal magnetic or solid state protection found in LV circuit breakers and offer a greater range of settings.

While upgrading an existing data center to medium voltage may be difficult, MV systems can begin slashing costs for new and expanding data centers immediately. The savings on cable and conduit and more efficient power management make medium voltage systems an important consideration for data center architects, engineers and operators.

When power is distributed closer to the loads with higher voltages, resistance and current can be decreased, leading to lower costs for power consumption.

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