

Data Centers – Meeting Today’s Demand

Computer servers have become smaller and more powerful, but that doesn’t mean businesses are devoting fewer square feet to them. In fact, data center construction is one of the biggest bright spots in today’s commercial construction market.

While today’s machines are far more efficient than earlier models, the dramatic increase in their numbers is pushing the electricity demand from groups of these machines to new highs. As a result, energy use is a critical consideration of data center design and construction.

While electrical equipment performance is vital to any facility, electrical systems are especially crucial to data center operation. Often categorized as “mission-critical,” data centers are complex structures. Unique demands and requirements include:

- ◆ Extraordinary electricity consumption – up to 2,000 watts per square foot, according to some calculations;
- ◆ Zero tolerance for electrical downtime – round-the-clock operations can be essential if a company is going to meet its business goals;
- ◆ Dependence on uninterruptible power supply (UPS) equipment and backup power systems to protect against damage from surges, brownouts and other electrical disruptions; and
- ◆ Cable designs that protect data-transfer operations against electromagnetic interference.

All of this, and more, is well within the capabilities and competence of a qualified and experienced electrical contractor with a trained and well-managed workforce.

Demand shows no signs of slowing

Common sense might suggest the need for new data centers would be slowing. After all, mainframes and conventional servers are being replaced with space-saving, blade-design models. However, as web-based services and operations become more important and businesses’ recordkeeping needs increase, our demand for data – and new data centers – continues to skyrocket. North American data center demand rose 14.67% in the year to May 2007, according to market researchers at Tier 1 Research.

Further, Digital Realty Trust (a real-estate investment trust specializing in data center properties) predicts that just between 2008 and 2010 businesses will need up to 5 million square feet of additional data center space.



Plus, as servers shrink, designers can fit more of them in a given facility. As a result, data center electricity demand is skyrocketing. Although new blade servers use a third less electricity than older models, the sheer number of new servers means electricity demand can be as high as 20 kW or more per server cabinet. The facts are stunning:

- ◆ Between 2000 and 2005, data center electricity use increased at an annual rate of 14% (Lawrence Berkeley National Laboratory).
- ◆ For 2006, the electricity demand of the web's five top search engines – taken as a group – reportedly equaled the entire city of Las Vegas.
- ◆ Companies spent 50 cents on energy use in 2006 for every dollar spent on data center computer hardware (IDC research). This will change, researchers say...the energy component will increase.

Data centers consume up to 2,000 watts per square foot.

Beyond powering the servers themselves, facility operators must keep these machines cool. That adds to data center operating budgets; this problem, too, will increase. "Insufficient cooling" was cited as the top problem at primary data centers by attendees at the 2006 Data Center Conference (Gartner Interactive).

Strategies for cutting costs

Data center power requirements could increase by 40% by 2010, say Lawrence Berkeley Laboratory scientists. This potential growth – on top of today's already high demand – is attracting the attention of corporate and government officials. Company managers are looking at a range of strategies for managing costs, while regulators are considering more-stringent efficiency targets.

Power requirements for data centers could increase 40% by 2010.

Energy issues are a prime factor in corporate-decision making, starting with the locations of new data centers. Electricity concerns include the reliability of supply and, of course, the cost. Utility requirements can be vital, as data centers often require dual, redundant power connections to ensure operations continue even if one feeder fails.

Thus, many larger operations are moving to the hydropower-rich Pacific Northwest, where costs are a fraction of those elsewhere. But simply relocating the present way of doing business to a less-expensive locale probably isn't a good long-term solution.

Proposed solutions

Recognizing the growing problem, manufacturers of everything from processors to power-distribution units seek ways to improve efficiency and reduce cooling needs. A new organization – The Green Grid – is bringing together equipment makers, data center service providers, equipment manufacturers, and major data center operators to develop new guidelines for improving facility efficiency. Efficiency-improving strategies that The Green Grid champions include:

Planning improvements. How a data center is laid out can have a big impact on cooling costs. A hot aisle/cold aisle configuration arranges server racks facing front-to-front and back-to-back.

The GC for the DC

With electrical equipment comprising 30% to 50% of a typical data center's construction costs (excepting server purchases), electrical contractors can play a significantly larger role in designing and constructing these facilities.

Recognizing this increased importance, some clients are selecting their electrical contractors first, giving these professionals project-management responsibilities. Typical electrical contractor data center responsibilities can include:

- ◆ Power-protection – design, specify, and install equipment, including uninterruptible power supplies and backup generators, along with the switchgear required for smooth transition to and from the local utility's electrical grid and to ensure all necessary redundant power connections.
- ◆ Engineering design – design services for the facility's voice and data cabling infrastructure, design and layout of network components, and elevation drawings of server rooms and the racks they will house.
- ◆ Cable management – design and document cable-management systems, which can be key to future maintenance and upgrades.
- ◆ Fire and security – design and install access controls, closed-circuit television and fire/smoke alarm and protection controls and wiring.
- ◆ Power monitoring – install the systems that can give managers important electricity-use information, down to the individual-circuit level.
- ◆ Alternative energy systems – help companies evaluate and capitalize on opportunities for reducing peak-demand expenses.
- ◆ Lighting – design and install lighting systems, along with the control systems that can play a key role in reducing energy costs in what are often lightly staffed facilities.

Cool air is supplied via floor vents to the front-facing servers and is drawn through the racks to the back-facing hot aisle to hot-air return vents. This arrangement prevents unwanted cross-flow of hot air into cooled areas and raises cooling efficiency.

Operational improvements. “Virtualization” makes use of partitioning and other techniques to enable a single server to perform multiple tasks. It allows managers to cut the total number of servers operating within a given facility. Some utilities, including California's Pacific Gas & Electric, are beginning to offer incentives to encourage virtualization programs. Consolidating server operations (which thus far can be fairly described as “haphazard”) can reduce an organization's overall server count.

Cooling-system improvements. Bringing cold air directly to where it's needed most – through close-coupled cooling arrangements – can result in shorter air paths and reduced fan-power requirements. In more conventional raised-floor arrangements, keeping under-floor plenums free of flow-disrupting obstructions and being strategic about the location of perforated floor tiles (through which cool air is supplied) can boost performance.

Energy supply alternatives

Data center owners are beginning to explore alternative energy sources as a solution. For example, data centers often include expansive, flat rooftops – the perfect setting for a photovoltaic installation. Solar PV panels now cover rooftops and parking structures throughout Google’s corporate complex in sunny Silicon Valley – enough to generate 1.6 MW of electricity. (Note: Even this large array doesn’t come close to covering the 30 MW required by just one of Google’s major data centers.)

One idea is to pair a solar PV system with battery storage. That could help reduce a facility’s peak-period usage, when both cooling demand and electricity rates are at their highest. Utility “tariffs” (their rate arrangements) can lead to significant savings with the shaving of peak demand.

For cleaner-burning backup protection, fuel cells designed specifically for use within standard data center racks are now being demonstrated. The units are intended to replace traditional diesel backup generators. Current models are expensive, but they offer the advantage of in-house backup power in dense urban settings, where standard diesel generators might have trouble coming in beneath emission limits.

New efficiency opportunities within sight

Although the phrase “energy-efficient data center” might now be an oxymoron, there is hope. The U.S. Environmental Protection Agency expects to expand its Energy Star program to include servers and other data center equipment. The agency also is working on a tool, similar to its Energy Star building-performance methodology, for evaluating a data facility’s energy efficiency.

Additionally, several large data center developers have made the move to build new facilities to the Leadership in Energy and Environmental Design (LEED) standards overseen by the U.S. Green Building Council. LEED certification is a points-based system addressing a range of design and construction practices – including indoor air quality and construction-material recycling – which go beyond reducing energy use. Though LEED may be more appropriate to commercial office buildings than data centers, the program can provide insights into the integrated-design strategies that are key to overall energy use, regardless of building type.

Conclusion

Data center technology seems to move at the speed of light, with the trend (thus far) always toward increasing energy concentration and demand. As of the latter half of the 2000s, electrical efficiency has come to the fore as a primary consideration in data center design and construction.



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