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The DATACENTER Journal

Where IT, Facilities and Design Meet

Data Center Skills

Top 10 tips for Data Center Migration

An Adaptable Architecture for the Next Generation Data Center

A recommendation for designing the most energy efficient data center.

A recommendation for Designing the Most

Energy Efficient Data Center

It may seem like a daunting task when designing-in energy efficiency into the data center. Energy consumption, power availability and power quality are key factors for data center uptime. And, it's not just a matter of hiring an A&E firm for the electrical design and layout. You need to know how all of the power equipment works together, power requirements of servers and power hungry blades, redundancy needs, operating parameters, path for growth, what if scenarios and the list goes on. Unfortunately, a majority of data centers' electrical design plans, once put down on paper, are stored in a drawer collecting dust and quickly become outmoded. This method completely restricts you from knowing real-time energy efficiencies and performance not to mention how your power infrastructure might have changed.

THE DATA CENTER POWERING CRISIS

The digital electronics systems which shuttle our 'infobits' are located typically in buildings, which because of the high power requirements of the IT equipment, and the supporting power and cooling infrastructure, are currently up to 40 times more energy intensive than a typical office building. The data center is more like an industrial complex with respect to energy usage.

According to a recent EPA report , the power demand of the data centers in the U.S. is significant and growing.

The energy consumption of servers (including cooling and auxiliary infrastructure) in U.S. data centers has doubled in the past five years and is expected to almost double again in the next five years [2011] to more than 100 billion kilowatt-hours (kWh), costing more than $7.4 billion annually (2005 dollars). "The peak load on the power grid from these servers and data centers is currently estimated to be approximately 7 gigawatts (GW), equivalent to the output of about 15 base load power plants. If current trends continue, this demand would rise to 12 GW by 2011, which would require an additional 10 power plants."

The data center's initial design is a snap-shot. Once built, modifications are tested by trial and error. The issue is how to ensure system reliability and uptime, while managing power usage and risk of system upset cost-effectively. At a recent industry conference, the question of data center energy efficiency by design was considered with the hope that the IT industry might discover a technological breakthrough which would radically alter the design of data centers and economics of energy use. To the chagrin of the participants, no dazzling, new answers were forthcoming. Rather, the conclusion was that data center designers and owners needed to "tune up what they own," since no sea change solutions were in the offing.

It's no mystery to the data center operator that most of the energy to the servers ends up as heat. The cost to power and cool racks of installed servers is significant, and is forecasted to become greater relative to new server spending. Figure 1 graphically shows the increasing proportion of power and cooling relative to server spending worldwide. The data shows that for each dollar spent on a new server in 2005, forty-eight cents was spent on power and cooling. This is more than twice that ratio in 2000. In 2010, it is projected that this ratio will rise to $1:$0.71

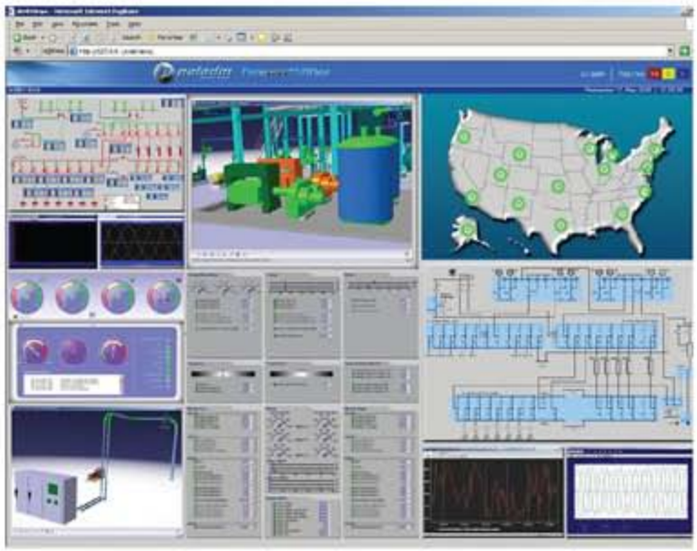
Worldwide Expense to Power and Cool Installed Server Base, 1996-2010

Figure 1

ENTER POWER ANALYTICS TO THE DATA CENTER EFFICIENCY RESCUE

Power Analytics is a design and simulation software platform that allows electrical designers, facility managers and data center managers to easily perform highly-accurate simulations of their infrastructure design – under an almost unlimited range of operating conditions. Power Analytics gives electrical engineering professionals the means to create a robust electrical "designbase" – a detailed design and knowledge base of the performance specifications of the entire electrical distribution system.

The key to an effective energy management program is accurate information regarding the consumption of energy. Based on the amount of IT equipment in racks, the power distribution and cooling equipment infrastructure, and the variations in application loading, Power Analytics can report accurate, real-time energy usage. This data can be compared to the "as-designed" energy usage calculated by the analytic system to give insight into system unbalances, capacity restraints, or overloads. The results of virtualization and other energy efficiency measures can be followed and assimilated. Intelligent Power Analytics can suggest scenarios for improved energy utilization based on its predictive diagnostics ability and by "what-if" simulation. At the current energy costs (~$o.o89 kWh), a nominal realized annual savings of ten percent for even a relatively small, lightly-loaded data center is significant – greater than $100,000.



Today's facility engineers are generally focused on the reliability and capacity of the data center's power distribution system while the data center manager is concerned with server availability and service level agreements. While they may be preoccupied with different aspects of data center operation, they both are in agreement regarding taking risks. They do not want to take them. The adage, "no pain, no gain" is simply not part of their conversation. The fact is, though, energy conservation schemes, thermal efficiency advances, capacity improvements, server loading rearrangements, new technology applications, and other energy management measures involve the risk of unintended consequences. The simulation of a system's performance in a virtual environment is the safest way to test a system modification and assess risk.

Power Analytics aptly coined "virtual electrical expert" offers a technological richness needed to analyze systems from a variety of perspectives; from static to dynamic simulations including the ability to model and embed the detailed control logic of the intelligent electronic devices responsible for controlling how power flows and how it is directed throughout the system.

In addition, a robust library allows users to perform specialized forms of analysis and optimization, including Fault Analysis, Protection Coordination, Power Flow Analysis, Power Quality Analysis and Mitigation, Dynamic Behavior Simulation, Design Optimization, and Sizing Optimization.

When installed, the power and uniqueness of the platform is derived from the complete encoding of the design specifications from the original, as-built power infrastructure. All power system electrical parameters are calculated from the stored design specifications. During the data center's normal operation, the parameters are compared with the real-time power data. The intelligence of Power Analytics can accurately corroborate as-specified power parameters, determine if there are system anomalies, and predict when and where there are potential vulnerabilities for system and equipment failure. More advanced Power Analytics systems on the market will allow users to actually capture current system state data, and run detailed "what if" simulations to verify system operations for the data center commissioning process, to investigate the effects of equipment rearrangement, configuration modifications, capacity expansion and other data room modifications that might have an impact on the live system without the risk of actually doing live testing. Simulations of maintenance and repair actions can help discover unforeseen program vulnerabilities and guide optimum cost-effective scheduling. Facilities engineers can review powering schemes for reliability and capacity. IT managers, concerned with availability and service level agreements, can explore dynamic application loading scenarios in a virtual environment without the risk of unintended downtime.

The real-time capability can intelligently predict the timing and location of potential system upsets, and, in the case of a downtime episode, can quickly apprise the right people as to the cause and solution. Since time is money, reducing overall downtime by as little as six minutes per year can mean a potential savings of about $100,000 if downtime is worth $1 million per hour. Power Analytics can formulate truly predictive diagnostics based on system design boundaries, and the implications of variable operating conditions from system aging. Intelligently scheduled system maintenance or repair based on a reliability assessment rather than a simple periodic basis can be less upsetting and costly.

WHAT IS SITE-SPECIFIC INFORMATION WORTH?

Beginning with the data center commissioning process, the "as designed" insight into a data center's electrical power infrastructure and the ability to simulate in the entire power distribution system in a virtual environment, will reduce the overall process costs by generating and maintaining a knowledge of the physical infrastructure, verification of performance, and ability to probe for potential out-of-specification system parameters.

Commissioning costs are high, but the return on the investment is significant. According to a report by Einhorn Yaffee Prescott (EYP), a global consulting engineering firm, the data center owner should plan to spend 1 to 2% of the overall data center project cost on commissioning. In most cases, the owners will see a 5-10% ROI benefit in terms of overall data center performance as a result of commissioning . With today's cost of data center construction approaching $2,500 per square foot, the commissioning of a 50,000 square foot Tier IV facility will run close to $2,500,000. Intelligent Power Analytics has the potential to save 10 to 25% of the overall commissioning process costs.

[1] Einhorn Yaffee Prescott, Data Center World, Everything You Need to Know About Commissioning, March 2006

>> BOTTOM LINE

The concern for system availability is the exclusive guiding design concern for data centers and network operations in any mission critical element from the very beginning. Power Analytics provides management easy-to-understand metrics to help simplify and demystify energy management.

The added complexity of energy management will increasingly drive system and financial decisions. Power Analytics addresses the continuum of energy management, from availability and performance to reliability and quality; a timely and powerful solution for the 21st century technological enterprise.