As Seen In: The DATACENTER Journal
Where IT, Facilities and Design Meet

GAINING AWARENESS INTO DATA CENTER ENERGY ISSUES *by Linda Morrow*

It's often been said that the world is becoming a smaller place, and this is certainly true with the increased demand for data mobility and connectivity. Our collective need to stay in touch has led to an unprecedented reliance on mobile devices. It is significant to point out that these trends are not exclusive to the business world. Twenty years ago, the noise level of shrieking adolescents on the average school bus was deafening. Now, that bus is one of the quietest places anywhere, with every child on board staring intently at the micro-screen in their hands, desperate to keep up with the local version of the Kardashians on Facebook or texting incessantly with their BFF sitting exactly one bench behind them on the same bus. Furthermore, it is not uncommon in today's culture to see that even a toddler's most constant companion is made of plastic and processors rather than skin and bones.

Record Increases in Data Traffic

According to CISCO, data traffic on smartphones, tablets, and other mobile devices increased 69% in 2014 over the previous year. Nearly half a billion mobile device connections were added in 2014 alone. In addition, hundreds of new mobile apps are created on a daily basis.

The significant uptick in mobile traffic led Google to change its algorithms to give mobile–friendly websites a higher ranking in searches earlier this year – proof positive that a more mobile world is surely on the rise. Add to this an ever-rising dependence on streaming entertainment, online retail transactions, GPS applications, and digitization of historic records in just about any industry – all of which have driven the need for data storage exponentially.

Cloud-Based Enterprises

More evidence of a shrinking world lies in the growth of enterprise activities that are cloud-based. More and more companies are pushing an increasing share of their transactions skyward, leading many to scale back their own IT physical square footage. This shift in data processing load from enterprise-based facilities to off-site data centers and colos has led to more servers being packed into the latter. Blade servers have been developed in response to the need for more computing power in less space. The downside is that these servers gobble up more power per square foot of available real estate than their predecessors and racks are becoming increasingly denser. As a result, energy consumption, and therefore, operating costs are on the rise.

More circuits packed into tighter areas leads to an increased need for cooling capacity and heat dissipation. Add to this the fact that mission critical applications often demand uptime in the "five nines," making redundancy often a requirement in data center design. Together, a high degree of redundancy coupled with high density translates into higher demand for power. The resulting higher energy costs understandably get the attention of the data center owner/operator and likely make energy efficiency his top priority in an effort to reduce the electric bill for his data center.

The UPS Factor

As one of the core components of mission critical infrastructure in a data center, UPS systems are often viewed as one of the biggest culprits regarding energy loss in power distribution. The larger loads commonly found in data centers make it necessary to install larger UPS systems to support those loads. It is no wonder, then, that there has been increased interest in utilizing the most efficient UPS system available. In the past, UPS systems were most efficient at peak loads. Since loads in various data centers can swing wildly based on fluctuating clientele needs, recent design efforts have resulted in the introduction of a UPS with a relatively flat efficiency curve. This new generation of UPSs means they will be highly efficient regardless of the load, providing data center owners an attractive option for trimming operating costs.

AC vs. DC Power in Data Centers

The ever present challenge to meet the power hungry needs of a technologically dependent society is becoming an increasing burden on the nation's existing power grid. This situation is getting the attention of organizations with green initiatives, such as the Environmental Protection Agency (EPA) and other like-minded groups. In an effort to emphasize the need to improve data center efficiencies and minimize power consumption, the EPA initiated an Energy Star Program in 2010 specifically for data centers.

Another area of interest expressed by these organizations concerns the use of high voltage DC power to energize data centers. Since the bulk of the electrical infrastructure (servers, storage devices, battery backup for UPS systems, and other IT related equipment) requires DC power, it stands to reason that this idea has merit. Indeed, several studies have been conducted exploring the viability of this as an option. One important consideration is that of safety, as it may expose data center staff to voltages with which they are not experienced. However, there are other systems present in a data center such as lighting, security systems, and cooling that rely on an AC power source. This, coupled with the fact that data centers are now almost exclusively fueled by the existing AC power grid, make high voltage DC power a longshot at this point in time.

Keeping Cool

Because of the higher power densities now commonplace in data centers and the fact that cooling needs are one of the largest drains on power, special emphasis has been placed on developing new cooling strategies to effectively combat the increased heat generation. Previously, CRAC (Computer Room Air Conditioning) units were positioned around the perimeter of a data center and blew air indiscriminately at a constant rate into an open room.

Recent years have seen efforts to “contain” and isolate hot and cold air flows. Proper air management guides cold air across and through heated circuit boards and then exports it directly into the intake of the CRAC units. A carefully positioned artificial ceiling and plastic sheets that form doors have been frequently used to confine the spaces further. Using variable speed (as opposed to fixed speed) CRAC units can help in operating the units at the lowest level necessary to achieve the desired temperature, as overcooling translates to overspending. Alternative designs for air handling systems, such as thermal wheels, have also been utilized to effect a more efficient cooling model. In addition to air-based cooling systems, water and other liquid-based cooling systems have made their way to the marketplace.

ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) announced its temperature recommendations for maximizing energy efficiencies in data centers most recently in November 2014. (See Figure 1).

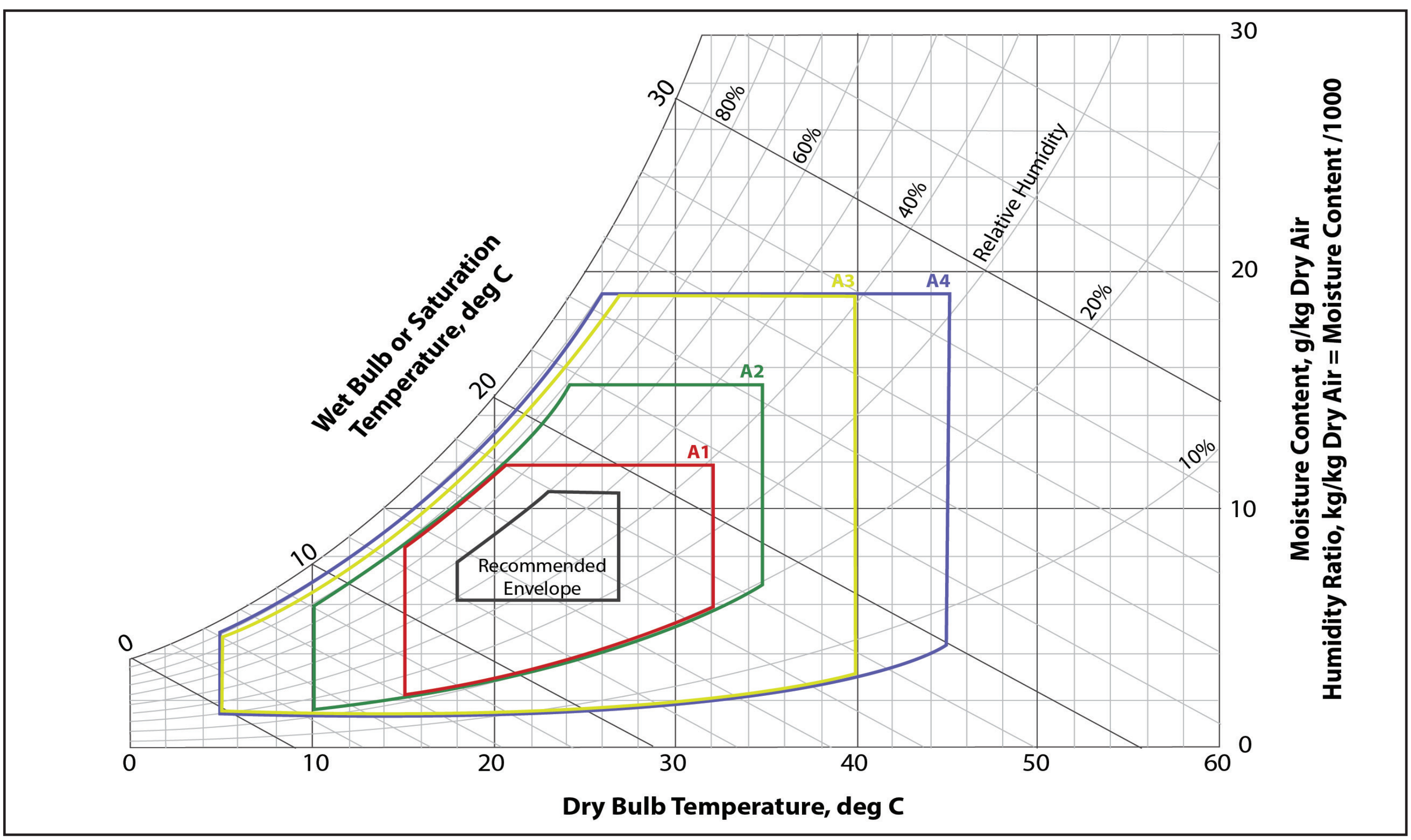

Figure 1: ASHRAE Temperature & Relative Humidity Recommendations for Data Centers

Back in 2011, ASHRAE had developed a classification system for data centers based on need and risk and categorized them A1 (most stringent) through A4 (most lenient). According to its committee 9.9, which concerns itself specifically with mission critical facilities, a class A1 (highest standards) data center can safely tolerate temperatures between 59 and 89.6 degrees Fahrenheit (15 and 32 degrees Celsius) and a relative humidity in the 20% to 80% range. The combination of a higher temperature and a lower relative humidity in the acceptable ranges mentioned above will maximize the energy efficiency of the data center as it will minimize energy needs at both the cooling coil as well as the humidifier. Data center operators would therefore be well advised to adopt ASHRAE's recommended temperature and humidity ranges as operational yardsticks.

The Case for DCIM

For those operators who have the time and resources available, installing monitoring hardware and software known collectively as Data Center Infrastructure Management, or DCIM, may be of interest. The installation of thermal sensors and constant monitoring will reveal hot spots and potential vulnerabilities of equipment currently in place as well as gain insights into the overall efficiency of the data center's operation.

Summary

This article provides merely a cursory view of data center energy issues. There are a myriad of other dynamics that can play into the overall efficiency and operating costs of a data center, such as the price of electricity and localized incentives. Some facilities may have been re-purposed and not originally intended or built as a data center. This situation may present its own list of unique challenges, such as inadequate floor loading capacities and less than desirable room dimensions. As no two data centers are exactly the same, no one solution to improve efficiency is going to be universally advantageous for all. New strategies involving the latest ideas, equipment, and/or software are emerging all the time, and our incredible shrinking world is seemingly accelerating the speed of change.

As published in print and online by
Data Center Journal, February 2016

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