www.feace.com

DESIGN PLUS

Spring 2010

PROFESSIONAL ENGINEERING SERVICES FOR *MISSION CRITICAL* INDUSTRIES

As we get closer to an energy standard for data center operation, there is a lot of information and new technologies becoming available to help you achieve a more efficient facility. In this issue of the FEA designPLUS newsletter, we discuss some of the new ways of thinking in the data center community, and what you, as the data center professional, need to be aware of. Knowing some of the consequences of using the new technologies such as economizers for 'free' cooling, high efficiency UPS options, or simply increasing the inlet temperature to your server cabinets will be investigated. We hope you will find the 2010 Spring Newsletter articles interesting and informative and wish you the best in all your mission critical endeavors.

ASHRAE Energy Standard 90.1 Regulates Data Centers

By Edward L. Gutowski, P.E., LEED AP

Significant changes are taking shape with regard to the code governing cooling systems of newly built or renovated data centers. ASHRAE 90.1 is an energy standard adopted as code across many states in the country. Data centers have been able to use an exception in the code that allows them to design their facilities without using economizers since they fall into the category of an "industrial process". Although a growing number of data center owners are currently weighing the benefits of using economizers against the costs, the proposed changes in the 2010 version of ASHRAE 90.1 may leave the owner without much choice when building or upgrading their facility. Until the dust settles on exactly what the wording of the proposed code will be, owners would do well to start the process of talking with all the interested parties about how the application of an economizer will affect them. These parties include your IT manager, supplier of servers, mechanical engineer, architect, facilities staff, and building automation provider. First, obtain copies of the "Public Review Draft, ASHRAE 90.1 addendum cy and bu" for your team to review allowing them to read first hand what the upcoming changes hold. Misinterpretation of the proposed change and misinformation is spreading virally on internet blogs which is understandable since the two addendums appear to be a patchwork of changes that need to be read side by side to get the whole story. One thing is clear however and that is data centers will soon be required to implement some form of economizer cooling, the previous exception no longer applies. The benefits of using economizers include; large reductions in annual energy consumption, lower utility bills, a smaller carbon footprint and an improved public image. The costs can include increased complexity in mechanical systems, greater construction cost, possible introduction of outside air into the computer room which may bring gaseous or particulate contaminates, increased humidification, destabilized room pressurization, risk of freezing water based cooling coils, larger HVAC equipment rooms, increased need for operator training and qualifications, large outdoor air louvers, increased building automation control, increased equipment maintenance, and increased commissioning and annual testing.

The fast growing electrical consumption of data centers hasn't gone unnoticed by regulators and government agencies that are anxious to adopt any proposed changes to reduce the nations energy consumption. Being proactive in the preparation for these changes will help make your next expansion or renovation of the data center go much smoother.

FEA

UPS Efficiencies

By Brian T. Soucy, P.E.

UPS manufacturers have been making an effort over the last several years to improve the efficiencies of their products. We have witnessed firsthand energy savings when replacing a legacy UPS with today's technology. Many UPS manufacturers are also taking advantage of sophisticated controls to introduce some rather unconventional techniques to further improve efficiencies.

At least three manufacturers offer a feature that takes advantage of advances in power and control electronic technology. This feature, sometimes called eco-mode, can improve the UPS efficiency to 97%. This selectable feature involves powering the critical load from straight utility power through the UPS's internal static bypass. The UPS inverter is in standby mode, ready to accept load and the battery is charged by the rectifier but no critical power flows through these components. At the first sense of a power anomaly (usually 4 milliseconds), the static switch will turn off and the inverter will assume the load to provide conditioned power.

A common concern is that unfiltered and unconditioned power is being provided to the critical load. Manufacturers will contend that the 4 millisecond transfer time to conditioned power from the inverter is acceptable to the critical load. This is the industry standard specification for static transfer switching times and seems reasonable but the system response to all power anomalies can, and certainly should be tested before engaging this mode of operation.

Another concern is the ability of the inverter to assume the load each and every time there is a power disturbance. If the inverter has an impending failure, it will not manifest until it is called into action at the most critical of times and the bypass source (the poor utility source) will not be available to save the load. In contrast, if the inverter always supplied the critical load as in the case of normal UPS operation, the bypass source will almost always be available if an inverter failure occurs.

Finally let's consider the case of a utility outage. Using eco-mode, four things must occur. The system must sense the outage, the static bypass needs to stop conducting, the inverter needs to assume the load step and the battery must discharge. This is considerably more complex when compared to the response of the standard mode of operation, with eco-mode off. In the standard mode, the UPS inverter is supplying the critical load, and the only change in operating state during a utility outage will be discharge of the battery. As long as the DC bus is held by the battery, the inverter will see no difference and will continue to supply the critical load; a much simpler sequence of events for a critical operation.

Recognizing reluctance of owners in turning on this feature mode, manufacturers suggest operating one of two systems in eco-mode to realize some benefit without assuming all the risk. Perhaps a self test algorithm will be available that temporarily transfers load to the inverter so issues can be discovered while a bypass source is available. Like many energy saving measures this option does not come without additional concerns. If your facility is considering this option you should be fully aware of the risks and plan on thoroughly testing the operation.

Server Inlet Temperature

By Brian T. Soucy, P.E.

There has been much discussion in the industry about higher datacom inlet temperatures after ASHRAE revised the recommended environmental envelope in 2008. A general misconception is the thought that raising the supply air temperature to the datacom equipment will save energy; however, there is no guarantee this will happen. To better understand why higher inlet temperatures are not the silver bullet lets take a closer look at the ASHRAE recommendations and reasons for widening the envelope.

With a goal to help data center operators reduce energy usage Technical Committee 9.9 set out to revise the recommended environmental envelope established in the 2004 reference ASHRAE Datacom book. TC 9.9 expanded the recommended temperature and humidity range with the upper dry bulb temperature limit of most concern for the purpose of this article. The 2004 upper dry bulb temperature of 77 deg F (25 deg C) was increased to 80.60 deg F (27 deg C).

It's interesting to note the reasoning behind the increase. According to the 2008 ASHRAE Environmental Guidelines, the "greatest justification for increasing the high side temperature is to

increase hours of economizer use per year. For non-economizer systems there may be energy benefit by increasing the supply air or chilled water temperature set points. However, the move from [77 deg F to 80.60 deg F] can have an impact on the IT equipment's power dissipation. Most IT manufacturers start to increase air moving device speed around 77 deg F to improve the cooling of the components and thereby offset the increase ambient air temperature." Put another way some datacom equipment will increase their fan speeds when ambient temperatures rise. Figure 1 shows how the power consumption of the server fan will increase with higher inlet temperature as the server tries to maintain a component temperature of 60 deg C.

Server fans can account for 10-15%, or sometimes more, of the total server power draw. So increasing the inlet temperature may lower a portion of the mechanical cooling draw but increase the UPS load. A facilities PUE may look better but it is quite possible that overall power consumption has increased without increasing useful work production as some mechanical cooling power was shifted to the less efficient IT equipment power supply.

Clearly the higher inlet temperature will help save energy in the long run if economizers are used but in cases where there is no benefit of economizer the actual savings are a bit more uncertain. All a facility can do is carefully measure total energy usage and determine if your higher UPS load is a reflection of harder working server fans or true productive work. The decision to raise the temperature is not necessary a no brainer just because AHSRAE relaxed the guideline. A facility should carefully consider all implications and make sure energy is actually being saved and a system's fault tolerance and resiliency is not compromised.

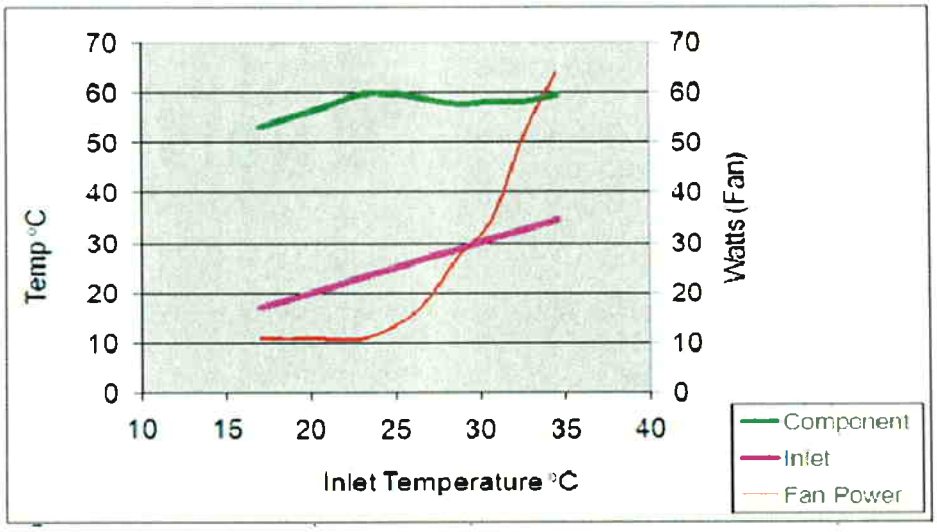

Figure 1: Courtesy 2008 ASHRAE Environmental Guidelines

References:

1. 2008 ASHRAE Environmental Guideline for Datacom Equipment – Expanding the Recommended Environmental Envelope; 2008 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.

Humidity Alarms vs. Sensor Accuracy

Data Center humidity control is heavily dependent on the accuracy of their humidity transmitters. Surprisingly, the commercially available offering of sensors is far less accurate than most people would expect. Typical published accuracy of +/- 3% can be off by as much as 5 to 10%. In an age where temperature is reported to you in fractions of a degree, you might be tempted to assume the humidity sensors are accurate on the same level; however, that is not true. Using a well know manufacturer's brand, a product with a better warranty or even a higher cost sensor is no sure indicator of performance. So what can an owner do to assure humidity is measured and controlled properly? Familiarize yourself with independent testing agencies that evaluate sensors such as the National Building Controls Information Program, calibrate your humidity transmitter annually and install redundant sensors.

Policy

designPLUS Newsletter is published to keep the readers current with the latest trends in mission critical systems.

Correspondence

FEA welcomes any letters, articles, reports and comments for publication. Please mail, fax or email written material to:

Facilities Engineering Associates, Inc.
128 Garden Street
Farmington, CT 06032
Tel. 860-677-2285
Fax. 860-676-9433
Email BSOUCY@FEACE.COM
WWW.FEACE.COM