www.feace.com

Fall 2010

DESIGN PLUS

PROFESSIONAL ENGINEERING SERVICES FOR *MISSION CRITICAL* INDUSTRIES

With the Fall 2010 issue, we begin our ninth year of publishing the quarterly designPLUS Newsletter. Over the years, we have covered many areas dealing with the management, design and operation of mission critical facilities. Recently, we have published more articles that address energy saving technologies, critical air conditioning and governmental compliance.

Next year will bring a number of changes including new EPA regulations for diesel generators, adoption of the 2010 ASHRAE Standard 90.1, which now includes requirements for data centers, and as always, the requirement to continually strive to reduce energy consumption. In this issue of designPLUS, we have included a discussion of some of these items and we hope that you find them helpful in preparing for the year to come.

FEA

Better Management Through Technology

By Leo P. Soucy, Jr., P.E.

The reliance on data center assets has never been more critical to a business's success. In the past, companies have relied on data centers to run and control their business. Now, a much different approach is taken which has resulted in embracing technology to market products and keep in touch with customers. In addition to the "normal" data center functions of accounting, financial planning and payroll; companies have implemented global distribution and supply chain management systems, business-to-consumer and business-to-business commerce, content delivery systems, global communication and social networks to keep in touch with customers and employees. A company's data center is playing a much greater role in shaping its identity and determining its ability to outperform its competition.

Much to the same degree that technology has transformed business, it comes with little surprise that technology continues to transform the way we design, operate and manage the data centers that support our way of life and business. Just about every component that goes into a data center today is intelligent and networkable. Commissioning the interoperability of devices is a task best left to a network engineer in some cases. As design engineers, we find ourselves constantly making decisions as to what data is most pertinent and critical to the operation. These decisions are performance driven to:

1. Identify and respond to an emergency situation
2. Provide general situational awareness for plant operators
3. Monitor and actively manage system effectiveness and efficiency
4. Develop charge-back and cost allocation models
5. Meet regulatory and compliance requirements

As the above list shows, sophisticated control and monitoring systems including Building Automation Systems (BAS), Supervisory, Control and Data Acquisitions (SCADA) systems and power monitoring systems are mandatory for providing information to closely monitor and control today's mission critical facilities.

Emission Regulations Explained

By Brian T. Soucy, P.E.

On January 1, 2011, stricter EPA emission regulations for stationary diesel engines take affect. Based on the EPA's tiered emission-reduction plan, new non-emergency engine generators, 130kW or larger, manufactured after this date must be EPA Tier 4 Interim certified. In this article, we will explain what the new emission standard means, what manufacturers are doing to meet the new standards and take a look to the future and review the differences between Tier 4 Interim and Tier 4 Final.

EPA's existing Tier 2 and Tier 3 certifications will be in effect for engines manufactured up to December 31, 2010. In 2011, all new engines used for non-emergency standby power, regardless of kW rating, must be Tier 4 Interim certified. An important exception will exist for engines powering emergency generators, in which case they may remain at the previous tier (2 or 3 depending on kW). This exception may be subject to state or local regulations.

According to the EPA, emergency installations are those that operate only on the loss of a normal power source such as the utility or the grid. The anticipated operating scenario would be as follows:

1. Normal source power lost
2. User starts the emergency generator set to supply power to the electrical loads
3. Normal source power returns
4. User shuts down the emergency generator set and supplies the electrical loads from the normal source.

There is no restriction on the number of hours that an emergency installation may run under a true emergency condition, and the EPA regulation will allow operators to run their emergency gensets for up to 100 hours per year for maintenance and exercise purposes.

The list of genset applications that will require Tier 4 Interim are as follows:

1. Non-emergency standby units
2. Prime Power applications
3. Load management/peak shaving applications
4. Demand Response applications
5. Electric power rental and other mobile units
6. Installations which run for storm avoidance (currently under review by the EPA)

The tier classifications generally correspond to levels of Nitrogen Oxide (NOx) and particulate matter (PM) in the exhaust emissions. Some consideration is given to hydrocarbons and carbon monoxide but these are relatively small byproducts of compression ignition engines. Since 2007, all stationary non-road diesel engines were required to meet the same standards as mobile non-road engines. Compliance required factory certification and depended on rated kW. Engines 130-500kW required Tier 3 certification and engines larger than 500kW required Tier 2 certification.

Engine manufacturers have been complying with Tier 2 and 3 standards using optimized combustion techniques. Optimization can involve a combination of physical design or integrated electronics for ignition timing, valve timing, fuel delivery and injection, and air management. With stricter standards imposed, manufacturers are finding that additional measures in the form of engine exhaust after treatment will be required in order for the large horsepower engines to comply.

For the larger engines, an approach used by manufacturers is a selective catalytic reduction system or SCR. The SCR is designed to reduce current NOx emissions by up to 90% of the Tier 2 engines. The SCR consists of a packaged manifold assembly positioned at the engine exhaust and before the exhaust silencer. In the SCR, urea the reducing agent is injected and forced to mix with the engine exhaust and through chemical reaction will reduce the NOx emissions. Under the EPA regulation, engine manufacturers can only sell Tier 4 Interim certified engines for non-emergency applications, therefore the engine, SCR and controls will be certified as a package at the time of manufacturing. Manufacturers are still determining how to package this system for all applications but, at least on larger engines, the SCR will require the site to provide and maintain a source of reducing agent. In order to meet Tier 4 Interim requirements, the overall complexity, physical space and cost of ownership will increase.

In 2015, the Tier 4 Final standard will take effect at which time engines would have to further reduce NOx and particulate matter emissions. There is somewhat of a balancing act due to the fact that lower NOx emissions results in higher PM emissions and vice versa. This is attributed to the fact that lower combustion temperatures mean lower NOx but more unburned fuel or soot. So, for manufacturers to meet the lower emission limits, a particulate filter in addition to the SCR will need to be added to the exhaust system. Adding another wrinkle is the fact that a higher exhaust temperature results in better PM filter performance. This introduces some complications in meeting the standards under all load conditions since a lightly loaded or "cold" engine will run dirtier than a fully loaded engine. Manufacturers, the EPA and state and local regulators are just now grappling with these challenges in preparation for 2015. For now, plan for your next generator to be Tier 4 Interim certified, unless an emergency installation exemption applies, and expect to see more developments from manufacturers and regulators in response to the Tier 4 Final requirement over the next 4 years.

Containment Diminishes CFD Analysis

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

Last year at this time we wrote about the benefits of containment for a data center and detailed some of the advantages this new idea brought to the industry. What started out as a way to prevent hot exhaust air from spilling over to the server inlet has turned into to a significant efficiency gain through reduced fan and pump horsepower, improved PUE, and increased cooling capacity of the Computer Room Air Handlers (CRAH). It has facilitated higher densities per rack than originally thought. With each successful implementation of a contained system comes a reaffirmation of the fundamental benefits that come with the simple concept of preventing the cold supply air from mixing with the hot exhaust air. This idea is so powerful that it is becoming uncommon to see a newly proposed data center that does not employ some form of containment. More legacy facilities are seen retrofitting their high density problem areas with some form of this new technology. Once a fringe experiment, containment has become the new normal. It has changed the way we control the CRAH, configure the fire protection, build the room, position the air handlers and more. It will also have a profound effect on Computational Fluid Dynamic (CFD) modeling.

Just like containment, CFD modeling was introduced as a tool to address the problem of hot exhaust air spilling over into the rack inlet. The mixing of hot and cold air is unpredictable and complex. CFD uses the known variables like rack load, CRAH capacity and room arrangement along with complex fluid mechanics equations and heat flow equations to produce a snapshot of the air temperature within the data center at any position. However, if the hot and cold airstreams no longer mix, the value a CFD provides is greatly diminished. Every CFM of cool supply air enters the rack and there is no hot and cold mixing left to model. One of the greatest influences on the cool air stream after mixing is removed is the radiant and convective effect of hot surfaces in the cold room from ceiling tiles at the hot plenum, the hot chimneys and rear doors where chimney racks are used, and the hot return ducts of CRAH; however, these large heat exchangers don't typically factor into a CFD model. Although a CFD can still provide information about mismatched CFM to determine if a cold enclosure is under a vacuum, or flag an under floor blockage, these simple mismatches can be addressed in other ways that don't involve a CFD model.

To be clear, CFD is still a valuable tool for modeling data centers with no containment and simulating failure scenarios. CFD can also dramatically show how a containment retrofit can improve performance.

The striking and dynamic graphical models that CFDs have brought to the industry provide assurance and comfort about the performance of the data center before it gets built. It's likely that many will continue to want this type of verification that their data center is going to perform without hot spots before it is built and a CFD can continue to provide that function. But, CFS's original goal of showing hot and cold air mixing is less valuable for data centers using containment.

DESIGN PLUS

Regulations by 2010 ASHRAE Standard 90.1

The 2010 ASHRAE Energy Standard 90.1 is now available in print. This standard will be adopted as code in many states and is significant to our industry because it specifically calls out requirements for data centers that were not there before. Among the changes are minimum efficiency ratings for air conditioners and condensers serving computer rooms. The method of testing these unitary air conditioners is governed by ASHRAE Standard 127 and referenced in this standard. One of the most significant changes is the requirement for data centers to utilize some form of free cooling using economizers. Being proactive in preparation for these changes will help make your next expansion or renovation of the data center go much smoother.

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