Engineering Clean Air

E-Newsletter Brought to You by Purafil Technical Services

August 2011

Purafil's scientists and researchers publish this bi-monthly e-newsletter specifically for the engineering community. This exclusive newsletter will include information and explanations on the latest gas-phase technology changes, regulations, standards, solutions, research findings and other information of value to consulting and specifying engineers.

Please feel free to forward to your engineering colleagues and have them join the Engineering Clean Air e-newsletter community by clicking the link to the right.

Sincerely,
Technical Services Department
Purafil, Inc.

In This Issue

Data Center Contamination Control: A Case Study

Companion Paper: Data Center Woes: Reliability Issues Plague RoHS-Compliant Electronics

Related Links/ Information/ Events

Contaminant of the Month

Purafil Solutions

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About Purafil, Inc.

For more than 40 years, Purafil has been a world leader in the development of gas-phase air filtration media and systems designed to eliminate and control gaseous contaminants. We were the first to propose standards for industrial facilities using electronic process controls. Today, these standards are used worldwide.

Purafil offers the widest variety of gas-phase air filtration media and award-winning systems for the control of any Indoor Air Quality (IAQ) challenge. Purafil provides engineered, clean air solutions in an array of markets including commercial, industrial, water wastewater, museums and cleanrooms. Purafil's dry-chemical air cleaning media removes specific gases and contaminants from high-volume facilities in order to control corrosion, improve process reliability and IAQ, as well as save money.

Purafil's state-of-the-art laboratory and research facility offers valuable customer services, such as media life analysis, air quality assessment, and circuit board failure evaluation. In addition to those valued process, Purafil also offers a variety of technical services to ensure clean air and customer satisfaction. Purafil's ongoing commitment to quality, customer satisfaction and safety are exemplified by earning the latest ISO 9001:2008 certification, numerous industry awards and an obligation to the research and development of new clean air technologies.

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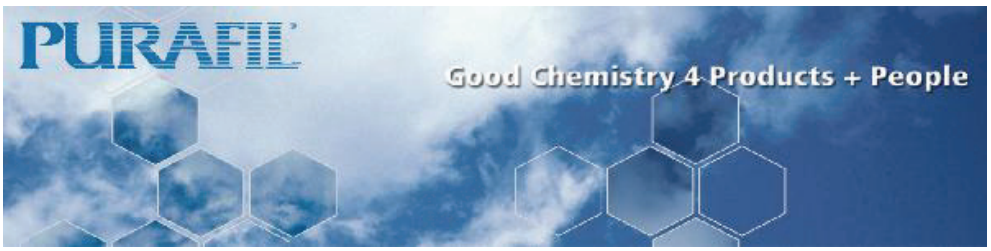


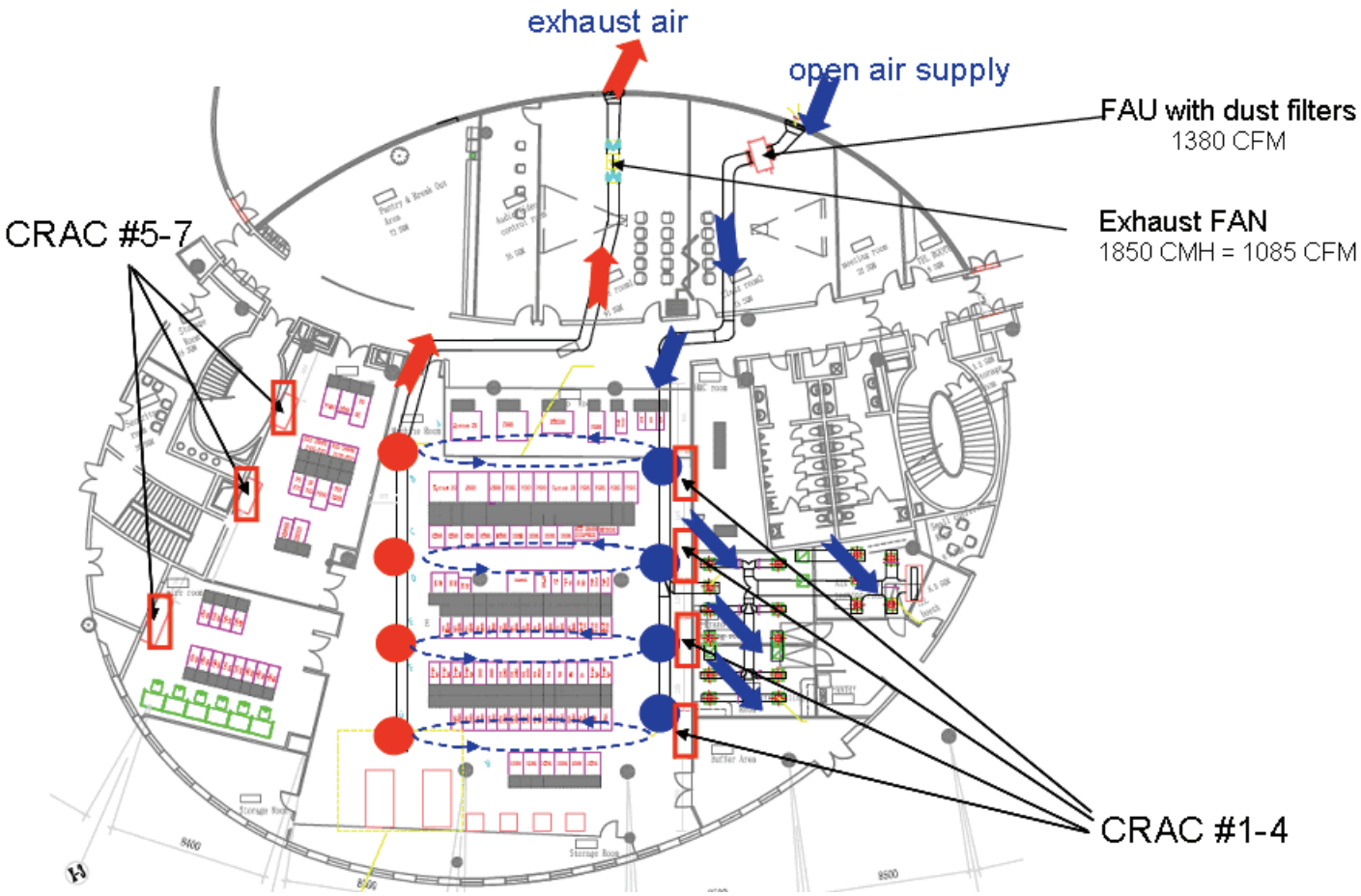
Data Center Contamination Control: A Case Study

In order to continue to deliver relevant and timely information, we polled a number of those receiving this newsletter as to what topics they would most like to see. The overwhelming majority came back with requests for more case studies and applications. Therefore, this month's newsletter will be the first of several cases studies we will present over the coming months. And as always, we welcome your input on topics for future newsletters.

A data center in China began experiencing failures due to corrosion in RoHS-compliant electronic equipment and the owners wanted to improve the indoor environment to prevent future failures. Previous reactivity (corrosion) monitoring using Purafil's Corrosion Classification Coupons (CCCs) had indicated high levels of sulfur contamination in the outdoor ventilation air (see pictures above) and in the data center itself. The copper severity level as determined using the International Society for Automation's (ISA) Standard 71.04-1985 was generally ***G1 – Mild*** (<300Å / 30 days); however, the corresponding silver severity levels was a high ***G2 – Moderate/Harsh*** (300-999 angstroms [Å] / 30days). The average silver corrosion rate was almost 4½ times higher than that of the copper and the owners wanted to reduce both the copper and silver corrosions rates to (at least) a severity level of ***G1 – Mild*** (<300Å / 30 days) and preferably reduce these corrosion rates to their own internal specification of <100Å / 30 days for both the copper and silver corrosion rates.

Outdoor air was supplied to the data center through a Fresh Air Unit (FAU) that delivered air through ceiling diffusers above four Computer Room Air Conditioners (CRACs) located along one side of the data center. The CRAC units delivered tempered air underneath a raised floor through

perforated floor tiles to create individual cold aisles. An exhaust fan removed air from the data center (primarily for temperature control) through ductwork on the side of the room opposite the CRAC units (see diagram below for the data center layout).



Upon review of the data center design specifications and a visit to the site, recommendations were made for improvements to the data center envelope which included (among other things) sealing and pressurizing the room **and** adding Purafil air cleaning systems.

An engineering review estimated that a minimum of 4,500 cfm (7,650 cmh) of recirculation air would be required for complete distribution of clean air in the data center including the spaces below the raised floor and above the drop ceiling. It was proposed to use nine Purafil Corrosive Air (CA) Systems, each rated for a total airflow of 500 cfm (CA-500, 850 cmh). The customer indicated that they were not able to dedicate that much of the data center floor space to the air cleaning systems and the proposal was revised to include three CA-1000s (1,000 cfm, 1,700 cmh) and one CA-2000 (2,000 cfm, 3,400 cmh). Each CA system had two passes of PK-12 MediaPAK™ modules with Puracarb® and SP Blend media.

Additionally, it was proposed that the existing FAU be turned off and a Purafil Side Access System (PSA 202) be installed in a buffer room used for staging equipment into and out of the data center. The PSA would provide clean outdoor air to be used for ventilation and pressurization. This unit along with the four CA systems inside the data center would provide the air cleaning required to meet the customer's air quality specifications and to provide distribution of this clean air throughout the data center. To monitor the equipment effectiveness and to view real-time corrosion levels, an OnGuard® 3000 monitor was also purchased and installed.

These systems were installed in late 2009 and started up in January 2010. There was a dramatic and immediate improvement in air quality corresponding to ISA Class G1 with the largest decrease (>75%) being shown in the silver corrosion rates which indicated the sulfur contamination was being removed. Further improvements to the data center envelope were completed in April of 2010 resulted in even lower corrosion rates approaching the customer-specified corrosion rates of <100Å / 30 days.

A management decision was made to turn off the PSA in early June 2010 to determine if this additional air cleaning was required to maintain the specified corrosion levels in the data center. As a result, immediate and significant increases were observed in both the copper and silver corrosion rates which led to the PSA being turned back on in July 2010. Corrosion rates once again began to decline but it was determined soon afterwards by media life analysis that chemical filtration media in the PSA and each of the CA systems were nearly spent and all MediaPAK modules were replaced in August 2010. At the same time Purafilters (PSPB-500/30 combination particulate and chemical filters) were added to the CRAC units and corrosion rates again decreased (see below).

Data Center Reactivity Monitoring Results

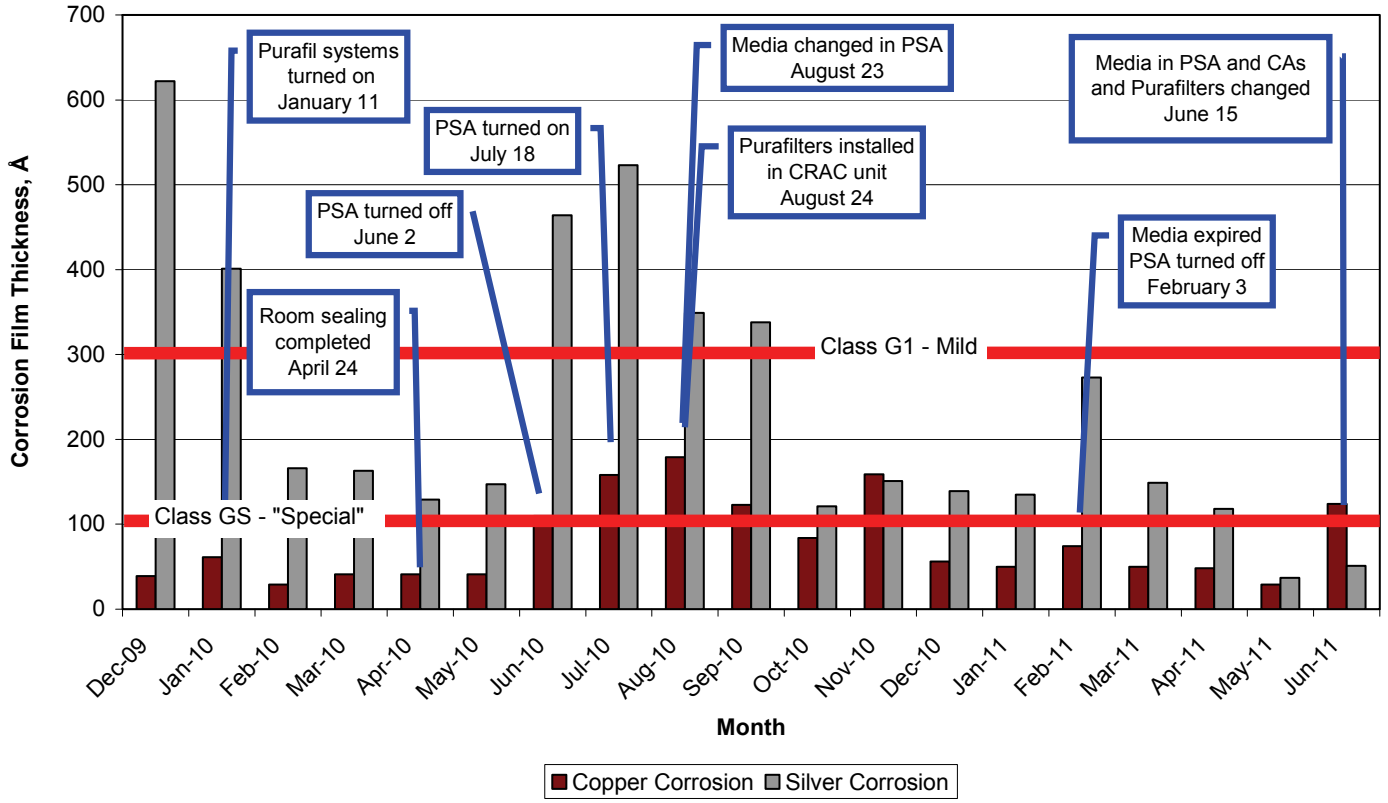
Monitoring Period		Reactivity Monitoring Results (average)	
		Copper	Silver
2009	Dec	39	622
2010	Jan	61	401
	Feb	29	166
	Mar	41	163
	Apr	41	129
	May	41	147
	Jun	110	464
	Jul	158	523
	Aug	179	349
	Sep	123	338
	Oct	84	121
	Nov	159	151
	Dec	56	139
2011	Jan	50	135
	Feb	74	273
	Mar	50	149
	Apr	48	118
	May	29	37
	Jun	124	51

The average monthly total corrosion and the 30-day incremental corrosion rates are presented graphically in the two charts below showing how the copper and silver corrosion rates were reduced by the addition of Purafil's gas-phase air filtration systems and the improvements made to the data center envelope.

It's important to note that temperature, and particularly the humidity control provided by the CRAC units can in some cases be enough to bring the copper corrosion rates into specification. However, because silver corrosion is not affected by humidity, the corrosion measured on these coupons / sensors is a primary indicator of the contamination levels in the space.

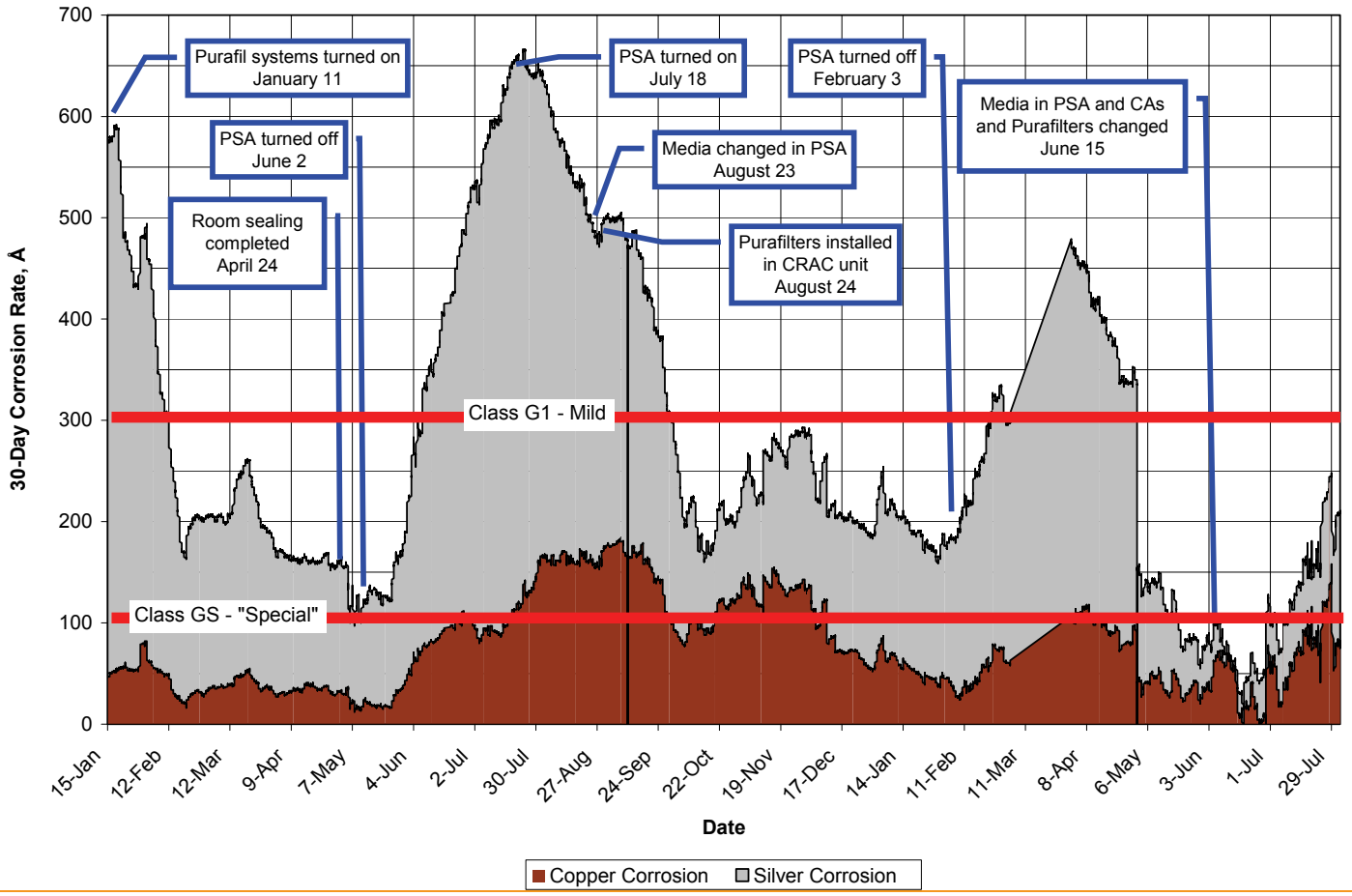
Data Center OnGuard 3000 Data

30-Day Average Corrosion Rates



Data Center OnGuard 3000 Data

30-Day Incremental Corrosion Rates



The Senior IT Specialist overseeing operation of the HVAC and air cleaning systems at this location reports that: "***It is a fact that the hardware failure rate has decreased after implementing the air filtration project in the computer room. My company produces and uses the latest computer technologies and we rely on the Purafil gas-phase air filtration in the data center to assure that the systems working in a safe environment. The air quality is much better now than before.***"

With the increasing pressure to reduce energy consumption in data centers and the increasing use of air-side economizers, data centers located in regions with poor ambient air quality will struggle to maintain efficient operations without the application of enhanced air cleaning. This means increasing particulate filter efficiencies to at least ASHRAE 85% (MERV 13) and the addition of gas-phase air filtration designed to control specific contaminants of concern.

The issue and potential problem of corrosion in data centers has been presented. The problem needs to be addressed by monitoring the environment and removing contaminants where needed.

Purafil is in a unique position to address contamination challenges in mission critical facilities such as data centers. This includes working with manufacturers to quantify the damaging potential of the environment, providing engineered solutions for contamination control, and ongoing monitoring of the critical environment to assure compliance with standards and specifications. For more information on Purafil enhanced air cleaning solutions contact us at 1-800-222-6367 (U.S.), 1-770-662-8545 (all others), send us an e-mail at technicalservices@purafil.com, or visit our website at www.purafil.com.

Contaminant of the Month

Sulfur Dioxide (SO_2, molecular weight 64.06) belongs to a group of gases collectively referred to as sulfur oxides (SOx). Sulfur is prevalent in many raw materials, including crude oil, coal, and ores that contain common metals like aluminum, copper, zinc, lead, and iron. Sulfur oxides are formed when fuel containing sulfur, such as coal and oil, is burned, when gasoline is extracted from oil or metals are extracted from ore. Volcanoes produce more sulfur dioxide than any other single natural source.

Sulfur dioxide, the primary product of the combustion of sulfur-containing fossil fuels, plays an important role in atmospheric corrosion for urban and industrial environments. It is adsorbed on metal surfaces, has a high solubility in water and tends to form sulfuric acid (H_2SO_4) in the presence of moisture. Sulfate ions are formed in the surface moisture layer by the oxidation of sulfur dioxide and their formation is considered to be the main corrosion accelerating effect from sulfur dioxide. The acidification of the electrolyte could arguably also lead to accelerated corrosion attack but this effect is likely to be of secondary importance due to buffering effects of hydroxide corrosion products.

Low parts per billion levels of sulfur oxides can reduce the reactivity of metals and thus slow down corrosion. At higher levels, however, they will attack certain types of metals. The reaction with metals normally occurs when these gases dissolve in water to form sulfurous (H_2SO_3) and sulfuric acid. Sulfur dioxide can also interact with other gases and particles in the air to form sulfates and other products that can be harmful to people, materials, and the environment.

Sulfur oxides, and particularly sulfur dioxide, have been implicated as one of the primary causes of creep corrosion and higher failure rates in electronic equipment since the implementation of the RoHS regulations.

The control of sulfur dioxide and other sulfur oxides can be achieved using Purafil's dry-scrubbing media products including Puracarb® and Purafil® SP. Visit the Purafil website for more information on the control of sulfur dioxide and many other corrosive gaseous contaminants.

Purafil Solutions

Corrosive Air (CA) System – The Purafil Corrosive Air System is a self-contained air purification system designed to recirculate and clean air within controlled environments containing sensitive computer or electronic equipment. Designed to stand alone, it can also be used in conjunction with Purafil's Positive Pressurization Unit. The CA system is designed to filter room air to maintain low corrosive gas levels in mission critical applications such as data centers, server rooms, telecommunications, and many other applications using IT / datacom equipment. CA systems are also effective industrial environments such as pulp and paper mills, petrochemical plants, refineries, steel mills, and smelting plants as well as other process industries.

Purafil's CA system supplies corrosion-free air to a controlled environment. The level of air cleanliness meets or exceeds established industry standards, such as the International Society of Automation's Standard 71.04-1985. This level of protection conforms to the warranty requirements of most computer and instrument manufacturers.

The CA system is a self-contained air purification system designed to recirculate and clean indoor air inside a protected space. The CA system contains four stages of contamination control, and offers optional gauge units to read particulate filter pressure differentials to determine optimum change out intervals. Supplied air designs for Purafil pressurization systems are available for the CA system.

The CA system is configured with two separate banks of media. This allows one to choose the appropriate dry-scrubbing filtration media for targeted contaminant gas removal. Purafil manufactures these media products, each of which are uniquely effective against specific gases or groups of gases.

The CA system is available in four horizontal and four vertical configurations, ranging from 500 cfm (850 cmh) to 4,000 cfm (6,800 cmh). The flexibility of the CA system design allows for a solution to be tailored to meet particular air filtration needs and requirements.

Related Links/Information/Events

Purafil, Inc. will be attending meetings and/or presenting papers on data center and mission critical facility contamination control and monitoring in a number of venues:

SMTA China South Conference 2011 – August 29 -September 1, 2011, Shenzhen Convention & Exhibition Center, Shenzhen, China (http://www.smta.org/china/).

Data Center World Fall 2011 – September 11-14, 2011, Orlando World Center Marriott Resort & Convention Center, Orlando, Florida (http://www.datacenterworld.com/).

ASHRAE 2012 Winter Conference (Technical Committee 9.9: Mission Critical Facilities, Technology Spaces and Electronic Equipment) – January 21-25, 2012, Chicago, Illinois (http://ashrae.org/events/2012-winter-conference)

Companion Paper

Data Center Woes: Reliability Issues Plague RoHS-Compliant Electronics