



## RAGINGWIRE RETROFITS COLOCATION FACILITY TO SAVE \$900,000 PER YEAR

RagingWire is a colocation facility<sup>1</sup> that provides enterprise-class, high-power density data center space to allow companies to meet mission-critical IT needs. Colocation facilities tend to face greater efficiency challenges due to the higher power density required to support the newest server, storage, and network technologies, when compared with purpose-built, single-enterprise data centers.

Despite these challenges, RagingWire's first Sacramento data center (CA1 – a 100,000 square foot, 20 MW IT load capacity data center) has always been considered energy efficient. CA1's power usage effectiveness<sup>2</sup> (PUE) was an impressive 1.65<sup>3</sup> in 2008 when the national average was 1.91.<sup>4</sup> However, RagingWire recognized that the potential existed for further improvements. For example, in 2008, CA1's data center computer room air handler (CRAH) fans, mechanical cooling pumps, and chilled water pumps all had constant-speed instead of variable-speed motors. Also, chilled water supply temperatures remained at the approximate system design level of 45 degrees Fahrenheit (F).

In 2009 and 2010, RagingWire completed a series of energy-efficiency retrofits at the CA1 facility that lead to annual savings of \$900,000. By 2011, after completion of the retrofit project, the PUE decreased from 1.65 to 1.48,<sup>5</sup> with efficiency improving by over 10%. **Due to the success of these efficiency upgrades, RagingWire's CA1 facility became one of the first colocation facilities to earn the ENERGY STAR Buildings designation.**<sup>6</sup>

### EFFICIENCY EFFORT

#### The Team

In 2008, RagingWire launched its efficiency effort at the CA1 facility. In order to create an effective strategy and a collaborative team, they brought together the following facilities and IT personnel:

- Director, Critical Facilities Engineering
- Mechanical Engineer, Critical Facilities Engineering
- Vice President, Data Center Operations
- Director, Client Services Delivery Group
- Other key Critical Facilities Department staff

In addition, RagingWire involved its equipment and service vendors in the efficiency efforts. Through this collaboration, all necessary parties were able to be involved with the decision-making process, which was essential to the project's success.

#### The Retrofit

Efficiency measures selected by the team included:

- **Wireless data center floor environmental monitoring system:** Wireless temperature sensors were placed at the top, middle, and bottom of cold aisle server and equipment racks, and at the top and middle of hot aisle racks. Wireless pressure sensors were placed under the raised floor to monitor static cooling air pressure. All of these wireless sensors were monitored using a centralized monitoring and alarm platform. Installing

<sup>1</sup> Retail co-location providers rent space to multiple tenants that are only responsible for managing their IT equipment.

<sup>2</sup> Power usage effectiveness (PUE) is the ratio of the amount of power entering a data center to the power used to run the information technology (IT) infrastructure within it. As the data center's overall efficiency improves as PUE decreases toward 1.

<sup>3</sup> With an uninterruptible power supply (UPS) output of 7.2 MW and total facility power usage of 11.9 MW.

<sup>4</sup> Based on ENERGY STAR data collected as part of the development of the ENERGY STAR Buildings designation.

<sup>5</sup> With an uninterruptible power supply (UPS) output of 7.2 MW and total facility power usage of 10.7 MW.

<sup>6</sup> Please visit <http://www.energystar.gov/datacenterenergyefficiency> for more information on the ENERGY STAR Buildings program.

this system provided a more accurate and detailed thermal map of the data floor, including a thermal picture of hot and cold aisles, from the perforated tile floor to the output of the rack's top server. Such monitoring ensured that, as the chilled water supply temperature was carefully increased, temperature and humidity would be maintained in accordance with the ASHRAE TC 9.9 standard.

- **Hot aisle containment:** RagingWire maintains a strict hot aisle/cold aisle rack configuration within all of its customer cages. During the retrofit program, RagingWire coordinated with its CA1 customers to further isolate and contain the hot aisle side of the IT network and equipment racks. Plastic curtains were placed at the end of each hot aisle, and, in some cases where equipment configurations required it, blanking panels were installed inside racks, further isolating cold and hot aisles. Extended return air ducts were installed on CRAH unit air intakes to prevent cold air from short-cycling back into the CRAH intake. The resulting increase in return air temperatures increased CRAH unit efficiency.
- **Chiller plant quick restart programming:** RagingWire implemented a chiller plant quick restart program, which returns the chilled water supply temperature to the established setpoint within two minutes following a utility power interruption. Programming changes start the chiller plant at a faster-than-normal rate, enabling the plant to return to a steady-state, lower-energy consumption status more quickly than would be possible without the improved programming.
- **Variable frequency drive (VFD) motors:** VFDs were installed on all mechanical cooling pumps, chilled water pumps, and data floor CRAH units. Consequently, fan speeds decreased

an average of 42%. With motor power use proportional to the cube of fan speed, VFDs provided substantial savings.

- **Chilled water temperature adjustment:** After completing hot aisle containment, chilled water temperatures were carefully increased from the initial plant design temperature to about 60 degrees F. Figure 1 shows the effects of increasing the chilled water supply from 50 to 60 degrees F, which resulted in significant changes in power demand from the chiller plant.

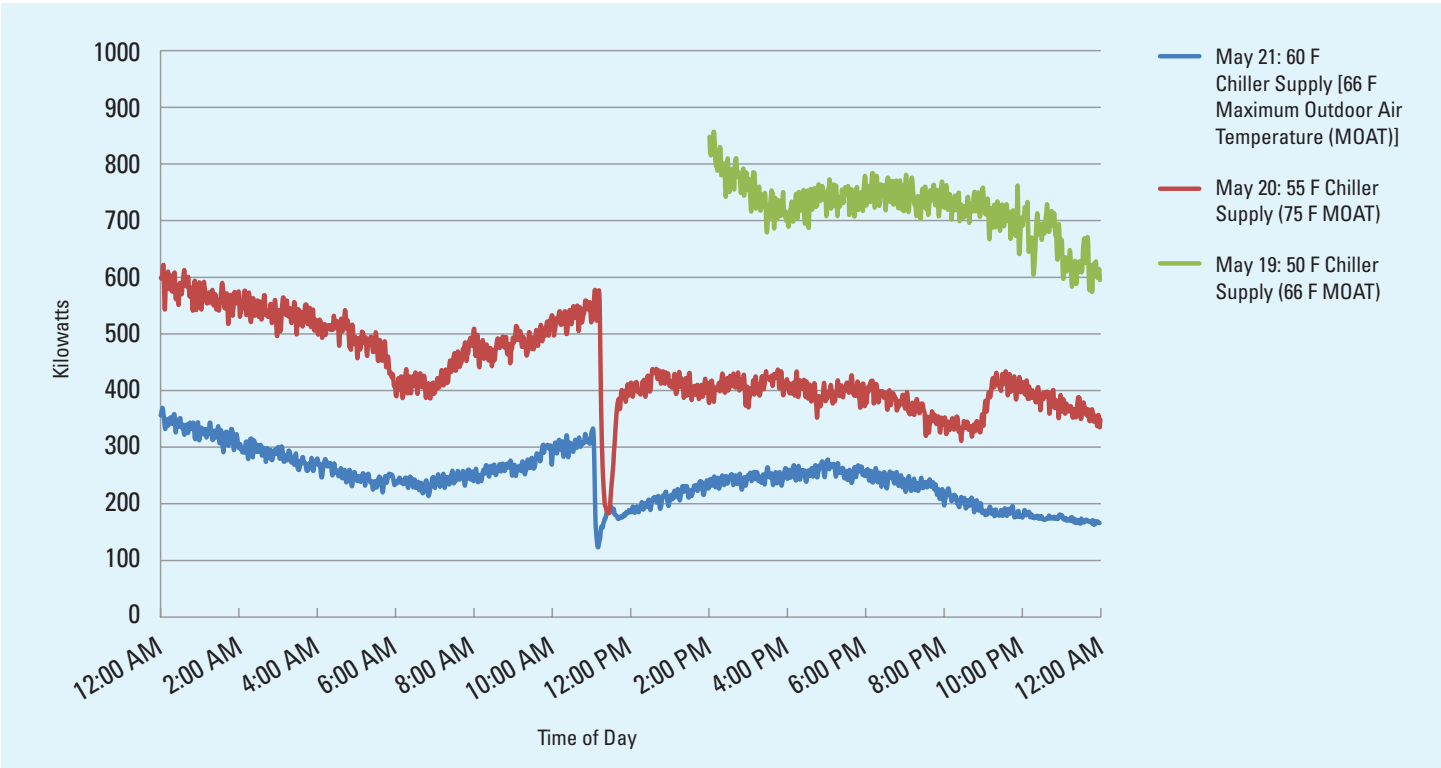
**VFDs Increase Redundancy and Lengthen Equipment Life**

In the original CRAH control system, if one machine went offline, another unit would start. With the installation of VFDs, if one unit failed, another in the vicinity can simply operate at higher speeds (rather than starting another unit). Across the facility, CRAH unit fans now operate at 42% lower speeds, resulting in greater equipment lifetime, as fans are subjected to less stress from lower static pressures.

### COST/BENEFIT ANALYSIS

As shown in Table 1, these measures saved \$900,000 annually, with the majority of savings attributed to VFD installations on pumps and fans. The measures produced an overall payback of 0.75. (Cost of equipment and labor included utility rebates of \$150,000.)<sup>7</sup>

Figure 1. Total Chilled Water Plant Consumption (kW)



<sup>7</sup> The custom incentives program paid up to 30% of project costs or \$150,000, whichever was less, on motor upgrades and related systems, including controls.

**Table 1. Payback for Raging Wire Retrofit Measures**

Measure Name	Cost of Equipment and Labor	Annual kWh Savings	Annual \$ Savings	Payback (cost/savings)
Maximize Chiller Plant Efficiency (including raising chill water supply temperature, hot aisle isolation, and control programming improvements)	\$375,655	3,500,000	\$385,000	0.98
158 CRAH Fan VFDs	\$255,498	4,300,000	\$473,000	0.54
Chiller Pump VFDs	\$44,570	385,000	\$ 42,350	1.05
Wireless Environmental Monitoring System	\$63, 167	—	—	N/A
<b>Total</b>	<b>\$ 675,723</b>	<b>8,185,000</b>	<b>\$900,350</b>	<b>0.75</b>

## CHALLENGES

RagingWire's collaborative team encountered the following challenges:

- One-hundred and fifty-eight CRAH fans with VFD motors required retrofitting, reprogramming, balancing, and testing, without interrupting customer cooling. As the facility's electrical/ mechanical infrastructure is both maintainable and fault tolerant, changing equipment configurations to ensure cooling while retrofitting units could be accomplished without client impacts, but the project's large scale required extensive coordination with clients to accomplish VFD installs.
- Implementing hot aisle containment proved challenging due to differences in every customer's rack and server configurations, thus requiring slightly different containment strategies. Some customer aisle configurations only required plastic curtains at the either end of the hot aisle, while others required blanking panels in certain rack areas. Nevertheless, the configurations shared a common goal: air entering the top of every rack at less than the 80.6 degrees F ASHRAE TC 9.9 standard. The previously described wireless environmental monitoring solution aided the process by ensuring RagingWire's cooling infrastructure adequately met customer demand.
- As an ASHRAE class A1 data center with tightly controlled environmental parameters (dew point, temperature, relative humidity, and air quality), the group worked hard to achieve IT department concurrence on data floor environmental changes to increase energy efficiency. Multiple coordination and informational meetings were held to ensure the IT department and Client Services delivery personnel understood proposed data floor environment changes, and could communicate these to customers, as required.

## KEYS TO SUCCESS

RagingWire personnel cited detail-oriented project management as key to ensuring cooling availability and IT department buy-in. Ultimately, two initiatives—wireless environmental monitoring and site-wide hot aisle containment—assured the IT department that data floor environmental changes were well within accepted standards, and posed no risks to customer equipment. Given these upgrades, efficiency opportunities such as raising chiller water supply temperatures and VFD motor installations became possible.

## WHAT'S NEXT FOR RAGINGWIRE DATA CENTERS

All energy-efficiency measures implemented at RagingWire's CA1 data center are planned for implementation at RagingWire's second Sacramento, CA, data center. Further, RagingWire's Ashburn, Virginia, data center facility will include the same types of energy-efficiency improvements, along with utilizing reclaimed water, and installing airside and waterside economizers in the chiller plant.

ENERGY STAR®, a program sponsored by the U.S. EPA and DOE, helps us all save money and protect our environment through energy efficient products and practices. Learn more. Visit [www.energystar.gov](http://www.energystar.gov).

