BEST PRACTICES 2014

Award Category

HVAC Design/Retrofit

Green Features

Pre-retrofit survey of lab ventilation system

Continuous monitoring of contaminants provides ventilation based on need

Centralized location of equipment for service

Recording ventilation trend data

Reduced fume hood face velocity meets new ANSI Z9.5 minimums

Estimated Annual Energy and Cost Savings

549 MWh electricity

22,400 therms gas

$73,800

Size

110,000 ft²

Cost

$190,000

$50,000 PG&E and Turlock Irrigation District incentives

Completion Date

March 2014

CSU Stanislaus Naraghi Hall Lab Ventilation Improvement

CSU Stanislaus installed a contaminant measurement system in laboratory spaces in the LEED Silver-certified Naraghi Hall building. The system maintains ventilation rates that meet safety requirements as efficiently as possible, saving an average of $73,800 per year in this multi-use building.

Even in sustainably designed buildings, ongoing commissioning and occasional system upgrades are necessary to maintain energy-efficient performance. When the Naraghi Hall of Science at CSU Stanislaus was completed in 2007, it earned a LEED Silver certification, incorporating numerous energy and water conserving measures inside and outside the building. The three-story, 110,000 ft² building is a state-of-the-art facility containing 16 science project rooms, 4 classrooms, 58 faculty and department offices, 25 science and computer laboratories, and an observatory.

CSU Stanislaus Naraghi Hall Science Building. Image: CSUS.

Thirteen of these laboratory spaces on the third floor were designed with high ventilation airflow rates. The original HVAC system design provided ten air changes per hour (ACH) and operated constantly 24-hours per day, resulting in significant energy use. As with the majority of laboratories, these systems were designed based on the principle that high volumes of ventilation are needed continuously "just in case" normal lab activities produce dangerous chemical concentrations within the space. However, the amount of time that these ventilation rates are actually required is minimal, because hazardous chemicals are not always used, and the laboratories are often unoccupied at nights and other times. In order to avoid excessive energy consumption, is essential to control airflow rates based on actual ventilation needs, and this became the goal of campus facilities managers in undertaking a controls retrofit at Naraghi Hall.

The new control method relies on contaminant measurement technology to manage ventilation, so that maximum air change rates are only provided when needed.

The solution in this case was to install Aircuity's OptiNet system, which measures air quality using sensors in all laboratory spaces that report back to a central base station. The centralized nature of the system means that critical instruments for measuring contaminants are located in an equipment closet outside the laboratory spaces, and can be serviced easily without anyone needing to enter the labs. The system connects to the building management system (BMS), which then controls the HVAC system fans using variable frequency drives (VFDs) to ensure that thermal comfort, fume hood airflow, and air quality requirements are met as efficiently as possible. The system records measured contaminant levels and airflow rates on a server, allowing building operators to review historical air quality data, in order to determine which laboratories are more active than others, and to assess how often the HVAC system operates in an energy efficient mode compared to full design flow. The project team also made system changes to reduce the minimum flows through fume hoods to levels allowed by the new Z9.5 standards set by American National Standards Institute (ANSI), requiring fume hood face velocities of 100 feet per minute at all times.

These changes will reduce fan, heating, and cooling energy, and will reduce the average ventilation airflow from 22,100 CFM to 13,900

CFM, a reduction of 38 percent. The VFDs now modulate exhaust fans to an average speed of 40 Hz, down from a previous constant speed of 60 Hz. When combined, these energy efficiency measures save 549 MWh and 22,400 therms annually, which correspond to an estimated total saving of $73,800. Considering that the retrofit was applied to only the laboratory spaces (approximately 16,000 ft^2), these annual savings are very significant: close to four dollars per square foot per year. The total project cost was $190,000, and accounting for estimated utility incentives of $50,000, the project yields a simple payback of just over three years.

Fans now modulate based on the need for ventilation in laboratory spaces, reducing airflow by up to 60 percent compared to the previous constant-speed operation.

In addition to energy cost savings, additional financial benefits are expected from these changes. For example, as mechanical systems will now run at low part-load ratios, wear and tear is reduced, lowering maintenance costs and failure rates in the long term. There are also direct benefits to the occupants as well. The lower ventilation rates have reduced the number of door slamming incidents caused by fire damper malfunctions and the resulting pressure problems. Lastly, the lower fan speeds have reduced noise levels both indoors and outdoors.

LESSONS LEARNED

It is essential for project teams to engage with all people involved or affected by a retrofit as early as possible. At the very outset, the Naraghi Hall team incorporated feedback from multiple stakeholders including both internal and external campus resources. Internally, the project team reviewed door slamming and negative air pressure issues, and then worked closely with building service engineers from Facilities Services. An initial walkthrough was performed to survey the entire building, and to allow the engineers to impart their knowledge of the system to the mechanical engineer. Known issues were thoroughly documented, giving building operators a chance to voice their concerns over the operation of the system in a systematic and fair manner. The investigation team built trust among the facilities group by stressing that the investigation was not prompted by poor operation of the systems, but rather by issues inherent with the design of the building.

The Naraghi Hall retrofit reduced ventilation rates during times of low and no occupancy. Image: CSUS.

All academic departments occupying the laboratories were informed of the project in advance, which was immediately received favorably by building occupants. The work was scheduled for the winter break to ensure as little disruption as possible, and this planning resulted in minimal disturbances on normal teaching and research activities during the installation. In addition, the plans for the project were shared with the wider campus community through the University Facilities Planning Advisory Committee, to avoid unforeseen conflicts with other activities on campus.

Additional Awards

LEED-NC Silver

Contacts

Facilities Manager,
Cal State University Stanislaus:
Geng Liu, PE, CEM
GLiu@CSUStan.edu
209.664.6836

Regional Manager,
Aircuity, Inc.:
Brady Nations
BNations@Aircuity.com
916.759.4928

Project Team

CSU Stanislaus Facilities Services

Aircuity, Inc.

More Information

http://archive.csustan.edu/fs/CapitalPlanningProjects/NaraghiHallofScience.html

http://perkinswill.com/work/california-state-university-stanislaus.html

http://www.silverman-light.com/projects/category/8/59

http://www.aircuity.com/

Best Practices case studies are coordinated by the Green Building Research Center, at the University of California, Berkeley.

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