BEST PRACTICES 2009

# Cal Poly San Luis Obispo, HVAC Demonstration Projects

**Cal Poly carried out HVAC demonstrations projects using new technological solutions in a cost effective approach, resulting in overall energy savings of 62%.**

**Award Category**

Best HVAC Retrofit

**Green Features**

Variable speed drives

Discharge Air Regulation Technique (DART)

**Annual Energy Savings**

Saves 105,000 kWh fan and cooling energy per year, a 62% reduction, and saves 14,000 therms heating energy per year, a 32% reduction

The DART project saves about $15 thousand per year and the kitchen hood retrofit saves about $10 thousand per year

**Cost**

$115 thousand total

The DART system was $60 thousand and the kitchen hood retrofit was $55 thousand

**Completion Date**

July 2008

Cal Poly, as the host of the 2008 UC/CSU/CCC Sustainability Conference, worked with CIEE's Public Interest Energy Research Program (PIER), Architectural Energy Corporation, the UC/CSU/IOU Energy Efficiency Partnership, Federspiel Controls, and Culinaire Systems, to develop several HVAC demonstration projects. This team worked together to upgrade older campus buildings, mostly those built before 1990, from constant volume air handling units to variable air volume (VAV) handling units while integrating new sensor technologies with a Siemens campus-wide Direct Digital Control (DDC) system.


*Federspiel Advanced Control System. Image: Federspiel Controls*

The team selected three buildings—the Education Building, the Student Health Center, and the Science and Mathematics Building— for conversion to VAV systems. All three buildings already included central DDC control of air handler start, stop and discharge air temperature, but did not include zone temperature sensors. (Since 1984, new construction on campus has included DDC at the air handler level but not necessarily at the zone level, while buildings after 1990 have DDC at the zone level as well as VAV.) As a result, control decisions could be based only on the entire building's average return air temperature. The team implemented a Federspiel Advanced Control System to collect zone level temperature data, a method commonly referred to as Discharge Air Regulation Technique (DART). Battery–powered wireless temperature sensors were deployed to measure zone, discharge, mixed air, and outside air temperatures. The Federspiel controller installed in the fan room is connected to the temperature sensors via a wireless mesh network. This sensor network system turned out to be relatively simple to install, as it avoids the need for wiring, and is expected to have low maintenance costs, as the battery life of the wireless sensor units is 4 to 8 years. The network is also self-monitoring, and the wireless mesh network is designed to optimize battery life and balance network traffic.

The Federspiel system functions by measuring all zone temperatures and comparing them to a pre-established allowable range for maintaining occupant comfort. If all zones are within a certain range, fans run at a minimum speed and dampers are positioned to provide outside air ventilation as per ASHRAE 62.1. When zone temperatures fall outside of the acceptable zone, fan speeds increase to provide the required heating or cooling.

### Variable speed drives, modulated by a Federspiel Advanced Control System, were installed on all supply and return fans at three campus buildings.

The variable speed drives at the three buildings were connected directly to the Siemens DDC system. The Federspiel system also calculates fan speed set points based on zone temperatures and relays this information to the Siemens system which in turn directs the drives. In order to maintain adequate pressurization, a fixed differential between the speeds of the supply and exhaust fans is maintained. The change to variable fan speed modulated by the Federspiel system in all three buildings

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**More Information**

www.federspielcontrols.com

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achieved substantial savings in terms of fan and heating energy. The science and math building had fan energy savings of 72% and heating energy savings of 24%. The education building retrofit resulted in fan energy savings of 53% and heating energy savings of 30% and the health center achieved fan energy savings of 62% and heating energy savings of 31%.

*View of Campus Dining Main Kitchen. Photo: Cal Poly*

Another aspect of the HVAC demonstration project was a retrofit of the Campus Dining Main Kitchen. The main kitchen hood had three exhaust fans typically running full speed from 6am to midnight. As cooking activities are intermittent, Cal Poly identified the potential to decrease fan running times.

### Cal Poly installed a Melink Intelli-Hood exhaust fan control system to correlate fan running times to stove use, decreasing fan energy use.

The Melink system uses temperature sensors mounted in the exhaust duct and optical sensors that detect heat, steam, and smoke from stove operations. Variable speed drives were also installed on the exhaust hoods. When the sensors detect cooking operations, fan speed is adjusted to 100% output; however the speed is decreased by 50% when no cooking is detected. The system includes a screen displaying the current speed of the fans and allows for manual override if necessary. The kitchen hood fan retrofit resulted in a decrease in fan energy of 54% and a decrease in heating energy of 34%.

## LESSONS LEARNED

The HVAC demonstration projects were a great example of the conversion of constant air volume systems to variable air volume systems in three buildings on campus. Dennis Elliot, Cal Poly Sustainability manager, states that it is imperative to always consider integration options with existing HVAC systems as opposed to immediately pursuing a complete system replacement. In the DART retrofit project, Cal Poly decided to install the Federspiel control system instead of a full DDC system, achieving approximately 80% of the energy savings at half the upfront cost. The kitchen hood retrofit project presented a unique opportunity to test a variable speed fan system, as almost all campuses currently have kitchen hoods with constant volume exhaust systems. The HVAC demonstration projects involved facilities and kitchen staff early in project development and installation, ensuring both user feedback and early training in system operation.

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