CASE STUDY

ensuring environmental integrity

Energy Efficient, Low Maintenance Brigham Young University, Utah

Background

Aging laboratory facilities can pose a challenge to compliance with many of today's safety standards. As commonly happens over time, needs for increased capacity are often met by adding fume hoods within an existing laboratory or expanding into space not originally intended for use as a laboratory.

Administrators at Brigham Young University were facing this situation with the Department of Chemistry and Biochemistry spread among three separate buildings, and with the main building being over 40 years old. Motivated by a desire to provide a safer work environment and unify the department, university officials chose to construct a new, state-of-the-art research and teaching facility.

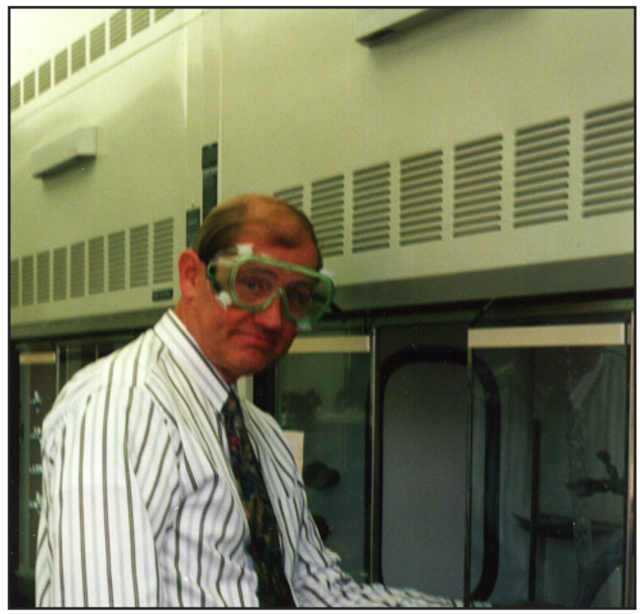
The Ezra Taft Benson Science Building encompasses 192,200 gross square feet and incorporates the latest developments in laboratory airflow control technology designed to be energy efficient and low in maintenance.

Within the large facility, researchers and students rely on 193 chemical fume hoods (including 15 walk-ins), biological safety cabinets, table-top downdraft fume hoods and snorkels to provide a safe working environment. This necessitates that capture and containment of fumes occur not only at each individual device, but that rooms are properly pressurized and the building is balanced. Integrating the airflow requirements of the various devices, while balancing the total supply and exhaust, represents a typical laboratory airflow control setting.

The Situation

Given that the system must first and foremost ensure occupant safety, there were a range of other considerations for this project. First, costs were a concern, including the ability to utilize the capacity of the existing central utilities plant for heating and cooling. Beyond first costs, and weighing heavily in the selection process, were energy, operating, and maintenance costs. The university prefers to perform its own maintenance, so it was very important that the system be easily maintained.

Aesthetically, the structure needed to blend with the rest of the campus and minimize the number and height of the exhaust stacks on the roof. A manifolded exhaust system with fewer motors and exhaust stacks on the roof would also pose fewer service issues.



Dr. Francis Nordmeyer, Chemistry DepartmentChair, in front of a laboratory fume hoodequipped with the Zone Presence Sensor®.

The Solution

To satisfy the various requirements of this project, the university selected a variable air volume approach that automatically adjusts airflow depending on sash position and the presence or absence of an operator in front of the fume hood. Detecting the presence and motion of an operator is the Zone Presence Sensor® (also known as ZPS® sensor), one component of the Usage Based Controls® solution (also known as UBC® solution).

This approach to laboratory airflow control allows designers to confidently take advantage of system diversity. Simply put, the airflow control system is based on maximum *probable* usage levels rather than maximum *possible* loads. Diversity is commonly used in the system design of non life-threatening applications (i.e., plumbing, telephone). In situations involving life safety, however, it had not been prudent to downsize until the development of the UBC solution and the measure of assurance it provides. Unobtrusive to fume hood operators, the UBC solution safely reduces airflows and efficiently directs energy usage.

To further reduce energy costs, the exhaust penthouse configuration was designed to incorporate a heat recovery system. Each of the three penthouses has two fans controlled by variable speed drives, heat recovery coils, filters, and dampers. The damper configuration permits the equipment to be serviced in a safe manner without shutting down the entire exhaust system. Operating the building on 48 degree chilled water temperature, instead of the usual 42 or 43 degree setting provides an added measure of energy savings.

In the teaching labs, each bench is fitted with a small down-draft fume hood where nontoxic activities can be performed with minimum heat gain into the room. Further, the bench top fume hoods are ganged together with a single, two-position valve for each lab to reduce airflow when the room is unoccupied.

The Result

According to Cliff Riley, Utilities Manager for BYU, "The system has required very little maintenance, and we have a lot of confidence in its performance."

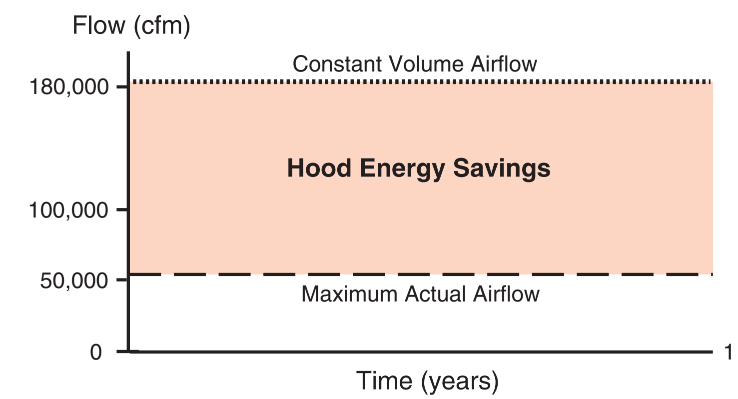
Dr. Francis Nordmeyer, the Chemistry Department Chair, stated that "It has met all our expectations and effectively controls the environment around the reactions."

The tracking of operator usage can be verified by the ability of the UBC solution to provide data to the facility management system.

Easily integrated with their campuswide BMS system, data from the UBC solution supplements traditional monitoring with detailed fume hood usage patterns. For example, BYU can monitor sash management to know if sashes are being left open.

With one full year of trending complete, the results show that the highest fume hood flows during occupied hours for all laboratories is 53,000 cfm. This is far below the 189,000 cfm that would have been required if all sashes were full open at the same time. The electrical, heating and cooling costs for the first year totaled $369,126 or $2.09 per square foot. Had a constant volume system been selected, it is estimated that the yearly operating cost would have been in excess of $520,000. Even with this conservative estimate, and accounting for the incremental cost of the motion and ZPS sensors at $100,000, the university realized a payback on the equipment in less than 8 months.

Benson Science Building



1 year of data shows peak use of 53,000 cfm - far below the system capability