Student Sustainability Committee Proposal
Shut the Sash Model Program Development

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PROJECT DESCRIPTION

Background

Lowering the sashes on laboratory chemical fume hoods (CFHs) can result in significant energy cost savings by reducing the volume of room air that has to be heated or cooled. This project will evaluate the resources, components, and best practices required to develop a model shut the sash program and implement it campus-wide for variable air volume (VAV) CFHs.

In 2005 Harvard University (Harvard) launched a shut the sash campaign for VAV CFHs in their Medical School and Chemistry Department. Approximately 365 CFHs were identified in the target buildings, informational placards (magnets or static stickers) created for the campaign were placed on each CFH, live training was made available to lab users, and metrics were recorded to determine the success of the campaign. Metrics included tracking energy use data, tracking air volume exhausted per CFH, and average sash opening the while CFH was not in use. Metrics used were determined on a hood-by-hood or building-by-building basis based on the type of controls and monitoring equipment available. Following the initial campaign, follow-ups were conducted and notifications were placed on hood sashes that were left open overnight to remind the lab user to shut the sash while the hood is not in use. Results from the campaign indicate that the average sash opening prior to the campaign was 12 inches while the average sash opening after the campaign was 2.4 inches which translated to a total energy savings of $188,000 in the first year (average of $515 per year per CFH). Harvard has continued to expand their shut the sash campaign across their campus.

The success of the Harvard University shut the sash campaign was presented at the Lab21 conference in October 2006. Based on Harvard's success a number of universities, including Massachusetts Institute of Technology (MIT) and University of California at Berkeley (UC Berkeley), have launched their own shut the sash campaigns with similar success. MIT reported an estimated annual energy savings of $190,000 (105 hoods, $1,800 per CFH per year) and UC Berkeley reported an estimated annual energy savings of $1,000,000 (600 hoods, $1,665 per CFH per year).

Introduction

CFHs operate either on a constant air volume (CAV) or VAV system. In a CAV system, the total volume of air exhausted by a CFH remains constant regardless of sash position. The face velocity at the sash opening increases as the sash is moved down and decreases as the sash is moved up.

In a VAV system, the face velocity remains constant while the volume of air exhausted changes based on the sash opening. The air volume is controlled by means of an actuating control valve that reacts to the sash height or room pressurization.

There are approximately 1,700 CFHs on the University of Illinois Urbana-Champaign campus and cost approximately $8,500,000 annually to operate (estimated operating cost of $5,000 per CFH). Approximately 190 of these CFHs are VAV and, based on the results of shut the sash campaigns at other universities, an annual cost savings of $282,000 could be realized through a campus-wide shut the sash campaign for these CFHs.

The remaining 1,510 CFHs on campus are CAV systems and are not under consideration as part of the shut the sash program at this time.

Challenge

The current economic condition coupled with the campus initiative to become more energy efficient have prompted University administration to transfer responsibility for energy costs to Campus Units. Accordingly, some Campus Units have begun to initiate their own CFH control programs to minimize the energy costs associated with CFH operation (including shut the sash campaigns, or using local controls to lower the air volume or turn off CFHs). Some of these programs have been conducted in conjunction with facility retro-commissioning work and input from the Division of Safety and Compliance (S&C) and the Division of Research Safety (DRS) while others are being implemented independently.

The challenge of this proposal is to develop and implement a small scale shut the sash pilot program for a building with a VAV CFH system. Based on the knowledge gained during the pilot program, a model program will be developed and implemented campus-wide for the remaining VAV CFH systems.

Proposal

Phase I

S&C will design a shut the sash pilot program to be implemented at a building with a VAV CFH system. The Beckman Institute has been identified as an acceptable building to launch the pilot program and the administration at this building is in full support. The pilot program will use various methods to maximize compliance. S&C staff will work with building personnel and occupants to refine methods, training, and components needed to develop a model program. Metrics to track success are discussed below. Once the pilot program is complete, data will be evaluated and recommendations will be made for implementing the model program in other buildings.

The pilot program will last 3 months (12 weeks). In the weeks prior to initiation of the pilot program S&C will develop a pilot program plan, develop informational media, and collect baseline metrics. Once all of the baseline data has been collected, informational literature about the pilot program will be posted and distributed to affected principal investigators (PIs) and in-person informational briefings will be held.

The evening before the pilot program is to begin S&C will post "shut the sash" placards on each of the CFHs and leave informational literature in a conspicuous location within the laboratory. S&C will make weekly CFH inspections throughout the pilot program period to collect data (data collected will depend on metrics) and reinforce benefits of shutting the sash. Metrics that will be used to monitor the effectiveness of the program are detailed below.

Phase II

Phase II will take the recommendations from Phase I, and develop a shut the sash model program for VAV CFHs and implement it campus-wide.

Metrics

Energy Consumption

Each building on campus has been furnished with meters to calculate energy use. Readings of the meters have been performed in preparation for distribution of energy bills to the Campus Units. Baseline energy use has already been established and readings are currently taken on a monthly basis to determine building-by-building usage.

Energy Costs

Energy costs are currently being computed on a monthly basis based on readings from the meters described above.

Sash Opening

Based on general observations from the 2008 annual CFH survey, most CFH sashes are left open at the "approved sash location" height for safe use, typically at 18 inches. A baseline sash height for each CFH will be measured prior to initiating the pilot study with weekly measurements taken during the pilot study. The average sash height will be tracked by CFH, PI, or building to determine the average change in sash height.

Goals

- Evaluate the resources, components, and best practices required for a shut the sash program for VAV CFHs.
- Develop and implement a campus-wide shut the sash model program for VAV CFHs.
- Reduce energy use associated with CFH use on campus.
- Improve safety of VAV CFHs.

BUDGET & FUNDRAISING

Funding for Phase I and II of the pilot program is being requested at this time.

The most important resource needed to determine the true benefit of a shut the sash program is cooperation by the CFH users and support from building and departmental managers.

A detailed budget to complete the pilot program is provided below. Phase I costs are based on the pilot program being conducted at the Beckman Institute with student workers assisting in the development of the pilot program, distributing informational literature, collecting data according to the chosen metrics, collecting data from departmental programs, analyzing data, and producing a final report that details the results of the program and makes a recommendations regarding a campus-wide program. Phase II costs are based on the student workers posting CFH placards and distributing literature while the S&C Engineer will produce the model program document and work with Campus Units to implement it. Phase II also assumes that the Campus Units will assume the costs of the program following initial implementation. Student worker tasks will be monitored by S&C.

PHASE I			
Item	**Quantity**	**Unit Cost**	**Total Cost**
S&C Engineer – Program management & training	50 hours	-	-
Student Worker – Data collection & analysis	160 hours	$10/hour	$1,600
Student Worker – Literature and placard graphics	40 hours	$10/hour	$400
CFH placards	90	$4	$360
Printing - Literature	300	$0.40	$120
		Phase I Estimated Cost	$2,480
PHASE II			
Item	**Quantity**	**Unit Cost**	**Total Cost**
S&C Engineer – Program management & training	200 hours initial 40 hours/year thereafter	-	-
Student Worker – Placard hoods & literature distribution	40 hours	$10/hour	$400
Student Worker – Literature and placard graphics	40 hours	$10/hour	$400
CFH placards	200	$4	$800
Printing - Literature	700	$0.40	$280
		Phase II Estimated Cost	$1,880
		TOTAL ESTIMATED COST	$4,360

PROJECT TIMELINE

Phase I will consist of five tasks and is estimated to take approximately five months:

- Task 1 will be to develop the pilot program plan. This task is estimated to take 1 week to develop and document.
- Task 2 is to develop informational literature and in-person informational briefings, and collect baseline information. This task is estimated to take 3 weeks to complete.
- Task 3 will be to distribute informational literature, provide in-person informational briefings, and post the shut the sash placards. This task is estimated to take 2 weeks.
- Task 4 will be to initiate the pilot program and collect data on a weekly basis. This task will take 12 weeks.
- Task 5 will be to compile the data and produce a report detailing the results and recommendations. This task is estimated to take 3 weeks.

We would like the distribution of literature and in-person informational briefings to coincide with the beginning of the Fall 2009 semester, data collection will run through most of the Fall 2009 semester, and evaluation of the data should be complete before the beginning of the Spring 2010 semester.

Phase II will consist of two tasks and is estimated to take approximately 7 months.

- Task 1 will be to review the results and recommendations from Phase I and develop a model shut the sash program. This program document will contain, at a minimum, best practices, verbiage to be used on shut the sash placards, training materials, and audit information and forms. It is estimated that this task will take 3 months.
- Task 2 will be to implement the program for all VAV CFHs on campus. Based on known CFH data this will include CFHs in 6 buildings and from 15 separate departments. The program will be rolled out to these buildings over the course of 4 months, with implementation at a new building every 2-3 weeks.

ENERGY, ENVIRONMENTAL, SOCIAL, AND ECONOMIC IMPACT

Energy Impact

For the VAV CFHs at the Beckman Institute, we anticipate a reduction in the use of electric, steam and chilled water due to the reduced need to condition the building throughout the year and during all types of weather. Savings in chilled water and steam will vary based on the season. We anticipate that electricity usage will be reduced by approximately ten percent. Similar results can be expected for costs associated other VAV CFHs on campus.

Environmental Impact

Based on information from studies at other universities, we estimate that carbon dioxide emissions could be reduced by as much as 10,600 pounds per VAV CFH annually. This calculates to a total reduction of 636,000 pounds of carbon dioxide annually and 159,000 pounds of carbon dioxide during the study period for the Beckman Institute and a campus reduction of over 2 million pounds of carbon dioxide per year.

Social Impact

Closing the sashes on VAV CFHs provide a benefit to the health and safety of the user and other building occupants. Containment of chemical vapors improves with a lowered sash and the sash acts as a shield in the event of a fire or explosion within the CFH.

Economic Impact

It is estimated that the VAV CFHs will reduce energy costs by an estimated $1,500 per year per CFH. A savings of $90,000 could be realized at the Beckman Institute during one year and as much as $22,500 during the three month pilot program period. Approximately $285,000 could be saved annually with a campus-wide program.

OUTREACH AND EDUCATION

Students will perform the majority of work on this project. This project will provide the students and the CFH users in the target buildings with knowledge on safe laboratory practices and energy saving techniques in a laboratory setting.