Pneumatic VAV controllers are notoriously difficult to maintain, and their presence can be discouraging when commissioning a building and optimizing its operations and energy performance. Undaunted, LeRoy Wilke, the energy manager at the California State University San Bernardino campus, enrolled University Hall — with its classrooms, offices, and science and computer labs — in the UC/CSU/IOU Energy Efficiency Partnership's Monitoring-Based Commissioning Program. By the program's end, the campus was rewarded for their efforts when their energy bill was reduced by almost one-third.

Defining Roles and Responsibilities
From the beginning, the commissioning effort at San Bernardino was a group effort. The third-party commissioning provider Cogent Energy started off the project with a well-defined responsibility matrix that listed the roles of the project manager, building manager, building engineer, and controls specialist. “We wanted active participation with the campus. We saw it as a participatory effort between both parties,” said Tom Riley of Cogent Energy.

The commissioning process was a multi-tiered investigation that involved monitoring, verification checks, tuning up the control system, performance testing, and verification of improved performance. The provider recorded all the issues identified during each phase of the commissioning project into a master log and shared it with the campus to use as a laundry list of the things to address. The document was continually updated during the commissioning process and was submitted to the university, who reviewed it at each phase and sorted the recommended improvements — address in-house, implement by an outside contractor, defer for future implementation or decline. The findings log also included estimated costs, savings, and payback periods for many of the improvements. One of the challenges in a project like this is reliable data acquisition, relayed commissioning provider Riley. The end goal is for the facility's staff to be able to identify problems through trend analysis on an ongoing basis, and having the commissioning provider perform that initial analysis enabled the campus to get to that step.

Trending and Analysis
At University Hall, trend data was collected for a two week period, separated by system, and analyzed to validate the programmed sequences of operation. The data were
Case Study - University Hall

“‘I’m trying to instill in my people that measuring and verifying operations is the way of the future. We’re designing it into our new projects as well.’”

– LeRoy Wilke, Energy Manager

graphed on scatter plots and histograms for analysis. The commissioning provider shared the trend analysis spreadsheets with the campus and customized every sequence that was tested. With training and instructions to the staff, the campus can continue to collect new data, utilize spreadsheets, filter the data and analyze the trends as needed. “I’m trying to instill in my people that measuring and verifying operations is the way of the future,” said Wilke. “We’re designing it into our new projects as well.”

Implementation

Based on the completed monitoring and testing, a host of different operational improvements were implemented at University Hall. The facility staff addressed incorrect economizer control programming, fixed dampers that were either stuck open or stuck closed, repaired a Btu meter that was reading 40 times too high, retuned the control of the mixed air damper whose hunting was causing a temperature fluctuation of six degrees per minute, fixed a control valve that did not close, implemented new schedules, and reduced duct static pressure. The big ticket item was creating the ability to shut off air handlers to two floors that were not occupied at night, generating significant fan savings. Overall the project saved almost one-third of the whole building’s energy use.

Training

Persistence of these dramatic savings requires ongoing attention by the campus staff, so ongoing training is an important part of the project. During the commissioning process, the operations staff shadowed the commissioning provider while he validated component and system performance and collected data. This gave them hands-on training on how to spot problems. “We always appreciate that [the building operators] are setting aside their time to dedicate to the project because typically they are busy fighting fires and don’t have the time to sit down analyze this level of data,” said Riley. “We’re learning from them as well.”

After the commissioning project, the campus staff was left with the commissioning plan and responsibility matrix, the monitoring and verification plan, the functional test forms, and a CD of all the trend analysis spreadsheets. They will continue field testing and ongoing trend analysis to ensure persistence of the implemented measures and to keep energy performance on track.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Monitored Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing EMCS Points</td>
<td>4 whole building kW meters, HW and CHW BTU meters, 103 other points</td>
</tr>
<tr>
<td>Added EMCS Points</td>
<td>None</td>
</tr>
<tr>
<td>Datalogged Points</td>
<td>Light levels, discharge air temperatures</td>
</tr>
<tr>
<td>All sensors verified, calibrated, and/or repaired as necessary</td>
<td></td>
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</tbody>
</table>