Just like people, some buildings work overtime. Such was the case at California State University's Fullerton Campus, where the central plant was operating excessively to compensate for buildings that were not well-tuned. The UC/CSU/IOU Energy Efficiency Partnership’s Monitoring-Based Commissioning (MBCx) Program helped facility staff take a critical look at their central plant and building operations to reduce those unnecessary loads, allowing the entire campus to become more energy efficient.

**Inefficiencies at the Central Plant**

The central plant at Fullerton provides space cooling, space heating, and domestic hot water heating for the entire campus. The 12-year-old plant had never been commissioned. It had been keeping up with changing demands at the facility (including the addition of new buildings, the increase of off-hour electricity demands, and the addition of new instrumentation) only because it was originally built with excess capacity. However, it had not been functioning efficiently. This central plant provides heat for the campus from the heat rejected from the chillers, and both chilled water and hot water are stored in thermal energy storage systems. The particularly complex configuration provided opportunity for automated controls and significant energy savings, but the campus was not taking advantage of it. Instead, it had essentially been manually controlled by the engineer, who determined whether it should be in heating or cooling mode, adjusted the blending valves to alter the differential temperatures to the tanks, and set the temperatures for charging or discharging the thermal storage.

The MBCx Program set out to commission the plant, make operations more efficient, and maintain the proper heating and cooling for the buildings it serves. In Fullerton’s case, the commissioning effort was focused on the central system as a whole, not on its equipment. In this way, monitoring was used for detecting and diagnosing system-level problems, tracking performance, and as a way to achieve lasting improvements.

**Optimizing Plant Performance**

To optimize the plant’s performance, the commissioning lead and campus staff brainstormed possible alternative sequences of operation. Then the in-house staff wrote and programmed the revised control software and

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**QUICK FACTS:**

**Facility Type:** Central heating and cooling plant with thermal storage

**Project Date:** 2005

**Summary:** Used central plant monitoring and testing to optimize central system operation and identify individual building deficiencies.

**Benefits:**

- Energy Cost Savings (at representative rates): $477,000/year
- Energy Saved: 16 million kBtu/year
- Percent Energy Savings: 43%
- Non-Energy: Identified additional performance improvement opportunities and developed tools to continually optimize building and central systems

**Costs:**

- In-House: $6,250
- Commissioning Providers: $125,000

**Simple Payback Period:** 4 months

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**Monitoring-Based Commissioning:**

California’s public university systems and investor-owned utilities have partnered to provide the MBCx Program, which provides funding to campuses to commission their central or building systems by installing metering and executing functional tests, improving their ongoing performance, and reducing operating costs.
Case Study - Central Plant

“How this project enabled us to clearly see the problems we had been ignoring.”

– Craig Newton, Utilities Manager

conducted the performance tests of these new modes. To facilitate both the testing and the ongoing selection of optimal operating modes for several distinct circumstances, the building operators have a “software switch” that allowed them to easily switch from one set of operating sequences to another. The testing identified several recommendations, like changing the sequences of operations of the distribution pumps, implementing a differential pressure reset schedule based on time of day and environmental conditions, fully opening triple duty valves and lowering the chiller’s discharge temperature setpoint. All of the optimization efforts were described in the systems manual so that the campus staff could ensure their persistence. As these fixes and other changes are made over time, campus staff will continually optimize the central plant to account for the changed system, using monitoring techniques to maintain the system and to detect when the central plant is no longer running optimally.

Hidden Problems Revealed
After the new sequences of operation and setpoints were initiated, it became clear that the poorly optimized central system had been masking other problems in individual campus buildings. For example, when the central plant stopped providing excess chilled water to buildings when the outside air temperature was below 60 degrees, problems like ineffective economizers began revealing themselves. The broken economizers weren’t meeting the cooling load, and the staff began to receive comfort complaints. As a solution, the commissioning lead recommended a number of measures, including repairing ineffective economizers. The campus operators are now correcting these problems as a part of their deferred maintenance plan.

After the commissioning efforts, the baseline energy use was compared to the new post-commissioning performance and the improvements were obvious. The central plant optimization generated immediate savings by reducing excess cooling provided to some of the buildings. The optimization yielded an average daily savings of 13,000 kWh. “As we continually optimize the system, our energy use after the project will become our new baseline,” said Utilities Manager Craig Newton.

Although this facility has a unique central plant, the techniques and approaches can be applied to any central plant optimization. After the project, Newton noted, “we were able to clearly see the problems we had been ignoring.” With that new awareness, the facility operators are well on their way to having a properly functioning and energy efficient facility.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Monitored Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing EMCS Points</td>
<td>All existing points; replaced central plant flow and electric meters</td>
</tr>
<tr>
<td>Added EMCS Points</td>
<td>Cooling tower fan and pump kW</td>
</tr>
<tr>
<td>Datalogged Points</td>
<td>None</td>
</tr>
<tr>
<td>All sensors verified, calibrated, and/or repaired as necessary</td>
<td></td>
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</tbody>
</table>

MBCx Team

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