Building Description

The Coroner and Crime Laboratory located at 4800 Broadway, Sacramento, California is a two-story northerly-faced rectangular building that was completed and occupied in 1997. The facility, totaling 94,000 ft² of conditioned floor area, serves as a combination of offices, morgue and crime laboratory. The Coroners facility is typically occupied 24 hours per day, seven days per week, and the Crime Lab from about 7:00 am until 6:00 pm five days per week. However, lab operations are often extended past normal working hours.

The HVAC system is comprised of a central plant housing two-265 ton centrifugal chillers tied to two cooling towers with centrifugal fans. The chilled water pumping system utilizes a primary/secondary piping arrangement. Heating is provided by two 4,000 MBtu hot water gas boilers with hot water distribution also having primary/secondary piping arrangement. Variable speed drives control the pumping rate on the secondary loops of each of the chilled and hot water distribution systems with two-way valves used at the coils. The air distribution system is comprised of five primary air handlers, three of which use 100% outside air (for the morgue, shooting range and the laboratories). All fans are equipped with variable speed drives. The dust system utilizes full direct digital control (DDC) terminal boxes. The building automation system (BAS), which controls HVAC operation, is a Barber Coleman 8000 with excellent control and monitoring capabilities. There is also refrigeration equipment handling morgue coolers. The lighting was originally set up with lighting sweep controls.
Building Energy Utilization

The Coroner Laboratory uses electricity and natural gas to meet its energy needs. The facility consumed approximately 3,078,100 kWh of electricity at a peak load of 696 kW ($199,340) and 179,660 therms of natural gas ($39,550) in 1999, the year of the retrocommissioning study. This level of energy use corresponded to an EUI of 303 kBtu/ft²/yr. This is a highly specialized building that does not have a class of buildings to compare with in the US DOE Commercial Building Energy Consumption Survey (CBECS), 1995. The closest it might compare with are health care facilities (inpatient) with a national average of 240.5 kBtu/ft²/yr.

The final report of the retrocommissioning study containing recommendations for energy efficiency improvements was submitted and reviewed with the facility management and staff around March of 2000 and implementation of low cost measures started soon after. Other more capital-intensive measures took longer to implement, as discussed later. Energy savings at the meter started appearing soon after and continued to increase as more measures were implemented, as seen in Table 4 summarizing annual energy use in the years following the study.

Savings in electrical energy use amounted to 453,900 kWh and 48 kW in year 2000, which represented some 14.7% and 6.9% savings respectively relative to 1999. Natural gas savings of 53,580 therms, or 29.8%, were also achieved in 2000. The savings continued into 2001 bringing the total for the two years to 852,900 kWh and 182 kW, which represent a 27.7% and 26.1% savings respectively relative to 1999. Natural gas savings also increased to 79,060 therms or 44% relative to 1999. Some of these savings might rightfully be attributed to cutbacks in energy use in response to the state energy crisis and the California Governor’s mandate to conserve energy, particularly in government facilities. It is interesting to note that conservation activities practiced in 2001 persisted through 2002 as seen in Table 4. The only change of significance was the rise in the peak electrical load to 624 kW. This rise could have been caused by a momentary occurrence in the absence of an effective load control strategy and should not contribute much to the total energy use. The present energy use level corresponds to an EUI of 189 kBtu/ft²/yr, some 38% reduction from usage prior to retrocommissioning. The usage now compares very favorably with the national average for buildings of similar use.

<table>
<thead>
<tr>
<th>Table 4: Summary of Annual Energy Use 1998 – 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Use Data</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Electrical Energy - kWh</td>
</tr>
<tr>
<td>Peak Electrical Load - kW</td>
</tr>
<tr>
<td>Natural Gas - Therms</td>
</tr>
</tbody>
</table>
Retrocommissioning Results Summary

Twenty-seven separate findings were identified during the retrocommissioning process. Energy savings and implementation cost calculations were performed on eight measures. Four of these eight measures were considered “low-cost O&M measures” as they were fairly simple in nature, low in cost and could likely be implemented by the facility staff. If implemented, these four measures were estimated to result in gross savings of 629,350 kWh and 68,000 therms. This corresponded to $60,800 in annual utility cost savings. These savings numbers included a 20% reduction to account for interactive effects.

Significant Measures and Implementation Status

A list of recommended measures and their implementation status is provided in Table 5. These were grouped as low cost and capital intensive measures along with other findings of significance. The other findings are of general interest with varying energy savings potential though the extent of savings is not readily determinable. Due to space and size limitations for this publication, the measures are listed as line items. More information on each measure can be obtained by contacting the authors.

Table 5: Recommended Measures and Implementation Status

Low Cost O&M Measures with Savings and Costs

<table>
<thead>
<tr>
<th>Finding #</th>
<th>Energy Conservation Project Title</th>
<th>Electric Energy Saved (kWh/yr)</th>
<th>Nat. Gas Saved (Therm/yr)</th>
<th>Implementation Status</th>
<th>Implementation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-01</td>
<td>By-Pass Timers for AHU-1&amp;2</td>
<td>454,497</td>
<td>72,619</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>B-01</td>
<td>By-Pass Timers for AHU-5</td>
<td>124,427</td>
<td>11,141</td>
<td>Yes</td>
<td>$ 200.00</td>
</tr>
<tr>
<td>C-04</td>
<td>Raise supply air temperature setpoint</td>
<td>65,056</td>
<td>3,884</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>H-01</td>
<td>Reprogram lighting Sweep Controls</td>
<td>142,705</td>
<td>-2,651</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>786,685</td>
<td>84,993</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Less 20% Interactive Effects 629,348 67,994

Note: 1.) Findings C-02 and J-02 are associated with finding A-01.
2.) Additional findings have potential savings, but project budget limitations prevented their full analysis.

Capital Intensive Measures & Implementation Status

<table>
<thead>
<tr>
<th>Finding #</th>
<th>Energy Conservation Project Title</th>
<th>Electric Energy Saved (kWh/yr)</th>
<th>Nat. Gas Saved (Therm/yr)</th>
<th>Implementation Status</th>
<th>Implementation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-03</td>
<td>Displace Fan Coil Cooling Loads</td>
<td>171,907</td>
<td>0</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>F-01</td>
<td>Trim Impellers on Condenser Water Pumps 1 &amp; 2</td>
<td>34,737</td>
<td>0</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>I-01</td>
<td>Monitor and Control Building Energy Usage with BAS</td>
<td>0</td>
<td>0</td>
<td>Yes</td>
<td>$ 500.00</td>
</tr>
<tr>
<td>J-01</td>
<td>Occupancy Based Fume Hood Control</td>
<td>283,481</td>
<td>28,463</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>490,125</td>
<td>28,463</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Less 20% Interactive Effects 392,100 22,770

Note: Findings D-9,D-16,1-4,C-5, and C-10 are associated with C-03; finding B-02 with B-03; and I-6 with B-1
Other Findings of Significance

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G-01</td>
<td>There is excessive use of hot water, even when hot outside.</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>I-07</td>
<td>Reduce head pressure on refrigeration system</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Repaired</td>
<td></td>
</tr>
<tr>
<td>I-04</td>
<td>Sequence of operation for HVAC not being used</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-03</td>
<td>Check weather stripping on exterior doors</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>$300.00</td>
<td></td>
</tr>
<tr>
<td>I-02</td>
<td>Check and calibrate BAS</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>C-02</td>
<td>Check and make sure filters being used are correct</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>A-04</td>
<td>AHU-1 cooling coil valve opens when not needed because of faulty damper sequence/sensor.</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Repaired</td>
<td></td>
</tr>
<tr>
<td>A-05</td>
<td>Heating coil valve opens when not needed because of air damper malfunction/sensor.</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Repaired</td>
<td></td>
</tr>
<tr>
<td>C-04</td>
<td>The cooling coil valve of AHU-3 is hunting</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>C-05</td>
<td>Supply air temperature sensor on AHU-3 and AHU-4 seem to be out of calibration.</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>A-02</td>
<td>Exhaust, return and outside dampers were open the same time on AHU-1 &amp; 2</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>A-03</td>
<td>The dust static pressure of AHU-2 (AH2.SAPR) bounces between two values</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-01</td>
<td>Freeze stats on the air handlers are manual reset</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-05</td>
<td>Documentation for the system is not accurate.</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>J-02</td>
<td>Fume hood fans will shut off when air handlers shut off</td>
<td>-</td>
<td>-</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-01</td>
<td>Check into chilled water reset based on damper position on all VAV and CAV boxes</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>F-02</td>
<td>Cooling tower fans cycling on approximately every two minutes</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

* BAS Control System Modifications

**Overall Assessment and Conclusions**

Because of the retrocommissioning process, significant information was provided to county staff related to the operation, maintenance and repair of the Sacramento County Coroner/Crime Lab. Design deficiencies, which should have been identified at start up, identification of operational problems, equipment schedules and equipment sequencing and timing control issues have been documented and corrected. The Sacramento County Coroner/Crime Lab is one of the most sophisticated crime labs on the west coast. The more complex building systems become, the greater the need for formal building commissioning. As a result of the retrocommissioning process completed by SMUD, Sacramento County has now embedded a formal commissioning element into its new building programs.