

Case Study: Retro-commissioning

Silver Falls School District gets what it paid for

Have you ever bought something new and discovered it doesn't work as expected when you got it home?

Silver Falls School District administrators know that feeling - all too well. They built a beautiful new school for 309 Silverton High School freshmen in 1998 with plans to eventually replace the entire 80-year-old Silverton High building a few blocks away.

There was only one problem. The new 97,000-square-foot Pine Street campus building's heating and cooling system didn't operate as expected.



Silver Falls School District in Silverton, Oregon built this high school facility in 1998. The new Pine Street building used the latest energy efficiency measures, but didn't get the expected results. Retro-commissioning helped the district get what it paid for.

Numerous problems

There were performance issues and occupant comfort problems from the start. (See table on page 4.) Of great concern was the high-energy usage and costs that were 132 percent over target. The natural gas usage was considered "very high." The electricity usage was also well above normal. And this was in a newly constructed school that met current energy codes and used energy-efficient T8 lighting technology, vinyl-

framed thermal windows, high-efficiency gas-fired boilers, a well-insulated building envelope, and controls with energy efficiency strategies.



The new Pine Street facility was constructed with core areas (gym, cafeteria, library, administrative offices) to meet the needs of the entire high school population. Because of budget constraints, the school district only built enough classrooms for freshmen. More classroom wings can be added to the core structure when voters approve a future bond issue.

What to do?

With this disappointing situation at hand, Silver Falls administrators turned to the school's Education Service District. The Willamette Education Service District (WESD) serves as the administrative agent for SB 1149 energy efficiency funds for school districts in Marion, Polk, and Yamhill counties.



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“We bring a process to the school district,” said David McKay, project manager for WESD SB 1149 program. “And, we shepherd energy efficiency projects from inception to completion.”

McKay began to work with Silver Falls administrators and newly hired Silver Falls Maintenance Supervisor Pete Paradis. On McKay’s advice, the school district had an energy audit performed on the facility in February 2002. McKay reviewed the audit results and recommendations and approached Silver Falls Superintendent Craig Roessler and his staff with the idea of “retro-commissioning” the Pine Street facility.

Retro-commissioning

“They were unfamiliar with the term ‘retro-commissioning,’ so we gave them information,” said McKay. “And, we continued to provide information until they had enough to make an informed decision.”

Commissioning is the process of ensuring that a new building’s systems are designed, installed, tested for full functionality, and capable of being operated and maintained according to the owner’s operational needs. Retro-commissioning refers to that process being performed on an existing building, as with the Pine Street campus facility.

Once the school district decided on retro-commissioning, a commissioning agent was hired. The agent was NW Engineering, a Department of Energy-qualified commissioning agent. The agent’s investigation and tests revealed 72 discrepancies in the installation and operation of the heating and cooling systems at the Pine



The Pine Street campus of Silverton High School incorporated daylighting measures on the windows to “bounce” more natural light into the classrooms. The poles were placed in the courtyard to serve as a trellis for vines to help reduce heat during hot sunny days. However, the plant selection was not appropriate and the vines never materialized.

Street campus building. In addition, Paradis noted that the retro-commissioning agent discovered that the factory controls on HVAC equipment and the control systems for the building were not compatible and would never have worked together under any conditions.

By this time, the warranties from the general contractor, mechanical contractor, electrical contractor and numerous sub-contractors had expired. With no recourse, McKay assisted Silver Falls with developing a Request for Proposal (RFP) for a different contractor to fix the problems.

In June 2003, the selected contractor, Robert Lloyd Sheetmetal of Independence, began to work to remedy the inefficiencies, train the staff, and retest the systems. They completed the majority of the work by the start of school in September.



The 80-year-old Silverton High School houses sophomore, junior and senior students. Freshmen are in a new facility on nearby Pine Street. The school district hopes to eventually have all students housed at Pine Street.

The contractor began by removing the factory-built HVAC controls and extended the building control system into the HVAC units. From there, the contractor balanced the building controls and reviewed operations scheduling.

“They discovered that only one of boilers was coming on, but water was being pumped through both boilers,” Paradis said. “And, the domestic hot water pump was operating 24/7. A \$200 timer is helping to control the energy use there.” Occupancy sensors were added to the locker room and other areas so fans only operated when the area was occupied.

Although the savings won’t be verified until a full year after completion, it is estimated that the retro-commissioning process will save the school district \$15,000 per year in energy costs. Other savings are also expected due to reduced maintenance calls attempting to make occupants comfortable. The retro-commissioning analysis cost \$30,000 and the contractor work cost \$55,000. The full cost of the process should pay for itself in about five years.

“I use the analogy of buying a new car that hasn’t been tuned,” said McKay. “The car is new, but it’s not working. It’s only running on two of its eight cylinders. That’s what happened with this facility. It takes a third party with expertise to tune it and make certain all systems are working as it was designed to work.”

And, McKay sees great benefit in retro-commissioning. “Any building that is four or five years old and has a high energy use is a strong candidate for retro-commissioning,” he said.

Silver Falls Maintenance Supervisor Pete Paradis notes another benefit of retro-commissioning - staff training. “In a small school district, like Silver Falls, the buildings are old. We built our last school in the 1970s until the Pine Street facility,” Paradis said. “You can’t expect maintenance staff to be versed in the operations of new technology like direct digital controls.”

The retro-commissioning agent ensured that staff training was a mandatory part of the retro-commissioning process. The agent videotaped the 16 hours of training so maintenance workers have a ready resource and new workers hired by the district in the future will understand how the system should be maintained.

Silver Falls eventually hopes to add on to the Pine Street facility and completely replace Silverton High. The core areas - gym, cafeteria, administrative offices, library, parking lot - were built to accommodate the entire student body. All that is necessary is to add some more classroom wings to the structure.

“We would have been hard pressed to add on to this school when it wasn’t operating right,” said Paradis. “I am confident now that we can add on and get contractors to realistically bid knowing that the building is working as intended.”

Silver Falls School District found that retro-commissioning has been beneficial. They now have the new school building operating as they expected.



Silverton High School head custodian Helen Fetch checks the computerized system to ensure that the HVAC system is working correctly. Fetch has been at the Pine Street Campus of the school since it opened.

Problems* Found at Silverton High School Pine Street Campus by Retro-Commissioning Agent

*This is a sampling of the 72 problems listed by the retro-commissioning agent

Problems

The night low-limit sequence designed to turn on the fan and open the heating valve when the outside air temperature drops below 55 degrees F. did not work.

A cooling valve failed to open when the room temperature went above the set point.

The freeze protection heat tape was unplugged.

One of the exhaust fans was missing a belt.

One of the exhaust fans had very loose belts and the sheaves were misaligned.

The carbon dioxide override sensor did not work.

The heating water pump failed its failure test. When the pump was turned off, the boiler continued to operate.

Consequences if not corrected

The building could get too cold at night potentially causing equipment to freeze and would delay reaching a comfortable temperature until later in the day.

The room temperature could become very warm and students and teachers could be uncomfortable and less able to focus on their studies.

The heat tape is designed to heat up the chiller and prevent it from freezing if the temperature in the chiller room reaches freezing conditions. If the chiller freezes, the school district would face an expensive equipment replacement.

Air pollutants accumulate because they aren't exhausted. In addition, energy is wasted because the motor is still turning but there is no belt to turn the fan and exhaust the air from the space.

In addition to making considerable noise, this situation created excessive vibration that could result in the bearings wearing out more quickly than normal and could damage the fan. This could result in expensive repair and increased maintenance costs.

This override sensor is designed to introduce outside air into the space when the carbon dioxide levels reach a certain level. When the sensor does not work, carbon dioxide levels build and occupants will feel sleepy and lethargic.

This could potentially be a very hazardous condition. If a boiler fires and no water is flowing through it, the boiler can overheat and even potentially explode resulting in equipment an property damage and possible injury or loss of life.

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Commissioning (and retro-commissioning)

Commissioning is the process of ensuring that building systems are designed, installed, functionally tested, and capable of being operated and maintained according to the owner's operational needs. Commissioning also can restore existing buildings to high productivity through renovation, upgrade and tune-up of existing systems.

Benefits of commissioning include:

- Early detection of potential problems
- Fewer change orders
- Precise tune-up of HVAC systems and controls
- Better building documentation
- Trained building operators
- Shortened occupancy transition period
- Lower operation and maintenance cost
- Lower utility bills
- Healthy and comfortable work environment

How much commissioning costs depends on the size and complexity of the project.

“Commissioning accounts for a small portion of construction and renovation budgets,” said Greg Churchill energy analyst with the Oregon Department of Energy who works with schools. “When commissioning is done properly, the savings far outweigh the costs.”

For more information on commissioning and retro-commissioning schools, contact the Oregon Department of Energy at 1-800-221-8035 toll-free, (503) 378-4040 in Salem or visit the Web site:

www.energy.state.or.us

Silverton High School Pine Street Campus Building Energy Costs

	Annual Energy Cost	Cost per Sq. Ft./Yr.
Annual Energy Costs Before Retro-commissioning	\$95,868	\$0.988
Estimated Annual Energy Costs After Retro-commissioning	\$79,168	\$0.816
Estimated Annual Energy Savings	\$16,700	\$0.172
<i>Retro-commissioning Costs and Work:</i>	<i>\$85,000</i>	<i>Simple Payback: 5 years</i>

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