Steam Solutions Require an Expert with a Systems Approach

Focusing on the proper steam solutions for the application increases efficiency and reliability while reducing steam usage and energy costs.

Located in Greenville, S.C., the Shriners Hospital for Children treats patients from the U.S. and around the world. The 50-bed orthopaedic facility provides care to children with neuromusculoskeletal conditions, burn injuries, and other special healthcare needs within a compassionate, family-centered, and collaborative care environment.

In order to provide the best health care for its patients, the hospital must ensure every system within its facility is operating at its peak. The electrical, mechanical, communications, and, of course, the steam systems must perform efficiently and reliably.

Maintaining steam systems can be challenging unless the facility has the proper tools, equipment, and knowledge in place. When the hospital began having various steam system problems, Dean Waters, the hospital’s director of engineering, turned to Ken Watkins, Spirax Sarco district manager, for help.

Initially, Watkins evaluated—and recommended a solution for—a heat exchanger issue in 2004. Since then, he has helped Waters solve other steam system issues related to condensate recovery, sterilization, operating room humidification, deaeration, and air conditioning. In addition to identifying steam system problems, Watkins also worked with Richard Hill, Maintenance Team Leader to identify steam system issues and to make their staff aware of energy opportunities they could leverage.

STEAMED OVER A LEAKING HEAT EXCHANGER

The hospital was spending a lot of time and money repeatedly replacing failed tube bundles in their heat exchanger that heats water for various general-purpose uses in the facility. In addition to not holding the water temperature at the required 140° F, the shell-and-tube type heat exchanger was leaking water onto the motor control centers (MCCs) located below the heat exchanger unit. Frequent service calls continually focused on the symptoms; none of them focused on the root of the heat exchanger problem.

The heat exchanger repeatedly leaked and couldn’t maintain the proper temperature, primarily because of system stall. “The steam in the heat exchanger was always at low pressure, and sometimes in a vacuum,” said Watkins. “If the condensate isn’t removed properly, it can cause a lot of problems.”

Watkins said that it’s not necessarily what happens at the high pressure end, but what happens at the low pressure end that causes problems. “The condensate remains in the heat exchanger and when the steam valve opens, the condensate boils, creating a much higher pressure, which ruptures the tube bundles.”
The heat exchanger was supposed to supply hot water for general hospital use at a set point of 140° F. However, the actual temperature fluctuated significantly.

A sensor monitors the water temperature as it leaves the heat exchanger. The control valve connected to the sensor modulates the flow of steam into the heat exchanger to keep the water temperature at the setpoint. “In this case, the control loop was operating properly,” Watkins said. “However, the condensate was not getting removed, causing temperature swings instead of reaching the setpoint and staying there.”

After Watkins evaluated and identified the root of the leaking heat exchanger problem, he recommended a **steam-pressure-powered pump**, with a float and thermostatic trap in a closed-loop system. The **Spirax Sarco Energy Services Group** managed the project to ensure proper system installation. Now, the heat exchangers don’t leak and the water temperature holds steady at 140° F.

**REPEATEDLY FAILING CONDENSATE PUMP**

The hospital continually had to replace its boiler room electric condensate pump. Each time the pump failed the condensate would back up, and eventually spew out of the condensate receiver vent line, which penetrates the wall. Because the vent line extends outside the building, hot water spraying from the vent posed a safety issue.

Watkins informed Waters that high condensate temperatures cause cavitation in electric pumps. According to Watkins, “As the impeller turns, hot condensate is pulled in, flashing and collapsing through the impeller. Over time, this flashing action erodes the impeller.”

To overcome the safety and maintenance obstacles, the resolution was a steam-pressure-powered pump package, a receiver, and new piping, which operates automatically to the system varying loads.

**KEEPING STERILIZERS STERILE**

Hospitals must maintain sterile conditions. However, the sterilizers at the Shriners Hospital were somehow becoming corroded. When Watkins investigated, he determined that the sterilizers were being supplied with “dirty steam.” Sterilizers must be supplied with filtered steam.

**Clean steam filters** were the obvious solution to this problem. Clean steam filters typically have sintered stainless steel elements. The sintering process produces a very fine porous structure in the stainless steel, which removes particles from the steam passing through it. In addition, a steam-pressure-powered pump and new steam and condensate piping were also installed on the sterilizing system.

**CONTROLLING HUMIDITY IN THE OPERATING ROOM**

To ensure surgical patient safety and well-being, operating room humidity must be precisely controlled. However, there were times when the operating room humidity variations exceeded specified limits.

A typical humidity control system includes a humidistat, steam
humidifier, valve controller, control valve, and a condensate removal system. According to Watkins, the existing valves didn’t control properly. “They were also having condensate issues,” he said. “Condensate was getting into the steam system because it wasn’t being removed properly.”

The Spirax Sarco solution solved the operating room humidity control issue. A new control system, an automatic pump trap, and new piping corrected the problem.

DEAERATOR TANK
The hospital was replacing the level control valve in a deaerator tank every six months. A deaerator removes oxygen and other dissolved gases from the boiler feedwater. If these dissolved gases are not removed, they will cause serious steam system corrosion damage due to oxidation.

The original level control valve wasn’t designed for the level of duty for this application. It would simply wear out after being in service for about six months. The Spirax Sarco team replaced the controller and the level control valve with units designed for this type of service. Although the new valve was more expensive than the original, it has been in place for more than five years without a failure.

KEEPING THE CAFETERIA COMFORTABLE
Hospital visitors have enough on their minds without having to deal with uncomfortable surroundings. The hospital cafeteria is no exception.

On cold days, the hospital staff couldn’t get the cafeteria temperature warm enough. In addition, the very large, very expensive heating coils for the cafeteria air handling unit were leaking. “Condensate was running out all over the floor of the air handling unit,” Watkins said. “It was eroding the floor. They had to resurface it repeatedly.”

The air handling unit takes in 100% outside air that is heated by steam coils before passing into the cafeteria. “You have to regulate the amount of steam that goes into the coil in order to put the right amount of heat into the air,” said Watkins.

Steam enters the coil through a pressure reducing station and a control valve. A sensor located in the airflow stream downstream from the coil detects the air temperature. The sensor provides input to a controller, which sends a signal to the control valve to modulate the steam to obtain the desired temperature.

The air handling unit is about the size of a tractor trailer. The coils, which are about the size of a car, are intended to heat air with steam. “In this situation,” said Watkins, “they were not getting the proper steam supply to the coil. Actually, they were heating air with condensate, which doesn’t work nearly as well. It isn’t very effective heat transfer.”

The solution to the cafeteria air handling issue was a steam-pressure-powered pump, pressure reducing station, steam control valve station, and new piping. Now the cafeteria is comfortable and, according to Waters, they don’t have to touch it. The cafeteria temperature control system takes care of itself.

CONCLUSION
Waters was impressed with the operation, efficiency, and reliability of the steam-pressure-powered pumps. He said they now get tremendous condensate return, and estimates that the hospital’s steam usage has probably dropped by about 25%, which Waters equates to between a 15% and 20% reduction in energy costs.

Waters said that when you use your steam more effectively, you use less steam.

Waters was also impressed with Watkins’ system approach. “He looked at the complete steam system,” Waters said, “now we could gain efficiency from the steam traps all the way down to the tube bundles.”

Sometimes troubleshooting steam systems can be like health care. It’s more effective to focus on the cause than merely treating the symptom.

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