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SUSTAINABLE OPERATIONS

Once Is Good, Twice Is Better

KEEPING A TRADITION OF SUSTAINABILITY, A CLEAN-WATER PLANT IN LINCOLN SUPPLIES EFFLUENT TO HEAT AND COOL AN INNOVATION CAMPUS AT THE UNIVERSITY OF NEBRASKA

By Doug Day

The City of Lincoln's Theresa Street Wastewater Treatment Plant has used its effluent for heating, cooling and process water for decades. Now that effluent is being used again to heat and cool the new University of Nebraska Innovation Campus.

The Innovation Campus encourages developments in agriculture, energy, and health and food production by assisting with engineering, hardware, and product and industrial design. The office building, conference center and business accelerator building for startup companies will be joined by a wet-laboratory building, food processing pilot plant and a greenhouse complex by 2015. Eventually, plans call for 19 buildings, including a hotel, private office buildings, housing and retail space, all for up to 5,000 people collaborating on technological advancements.

RENEWABLE INNOVATION

The 164-acre site on the former Nebraska State Fair grounds is being developed by the city, the university and the TETRAD Property Group. It only made sense to look next door to the Theresa Street facility for an innovative way to heat and cool the $800 million campus.

Steve Crisler, superintendent of water pollution control facilities for Lincoln, Nebraska.

Steve Crisler, superintendent of water pollution control facilities for Lincoln, says the plant feeds effluent to the campus heat exchanger, called the Centralized Renewable Energy System (CRES). It is one of about a dozen such installations in the country and one of the largest.

"Our challenge was getting a pumping station between the UV disinfection building and our effluent discharge structure," says Crisler. "It was a very small space on our 51-acre site, so we built a 1,500-square-foot submersible pump station."

The effluent is automatically diverted to the pump station, then flows to the CRES through a 2,000-foot, 30-inch ductile iron pipe. A pipe returns the water to the plant for discharge to Salt Creek. "That eliminated a second point of discharge and another National Pollutant Discharge Elimination System [NPDES] permit process," Crisler says.

PHOTOS COURTESY OF LINCOLN NEBRASKA DEPARTMENT OF WATER POLLUTION CONTROL FACILITIES

Six pumps (Flygt) at the submersible pump station automatically divert effluent to the Centralized Renewable Energy System on the Innovation Campus through a 30-inch ductile iron pipe. The effluent is returned to the plant for discharge to Salt Creek.

A plate-and-frame heat exchanger at the CRES captures energy to heat and cool all buildings on the Innovation Campus. It took general contractor Kiewit Building Group of Lincoln about 10 months to build the system, engineered by the Lincoln office of Olsson Associates.

HISTORY OF SUSTAINABILITY

The Theresa Street Wastewater Treatment Plant began using effluent for heating and cooling long before the Nebraska Innovation Campus came along. "Thirty years ago, we used hydronic heating with effluent as the water source, and in the last 15 years we've used heat pumps for air conditioning and heating in many areas of the facilities," says Steve Crisler, superintendent of water pollution control facilities for the City of Lincoln.

As much as 1 mgd of effluent is reclaimed, about 500,000 gallons per day on average, for lawn irrigation, flushing of mechanical pump seals, belt filter press cleaning, grit removal and other purposes. The city's Northeast Wastewater Treatment Plant reuses about 125,000 gpd in the plant and up to 70 million gallons a year for cooling a nearby natural-gas-fired power plant. Together, the plants save about $576,000 a year over using potable water.

In the mid-90s, the plant began automating. In the 1980s, all pumps were converted from packing to mechanical seals, cutting energy use by up to 20 percent per pump. The plant began replacing pumps and motors with energy-efficient models 30 years ago. "I'm quite proud that we've been doing some of these things long before sustainability and green were buzzwords and standard practice," says Crisler.

The 28 mgd (design) activated sludge plant has used cogeneration since 1991. A 900 kW facility produces about 5.5 million kWh a year, sold to Lincoln Electric System to generate about $240,000 a year, about 45 percent of the plant's annual electric bill. The digesters and buildings are heated by recovered heat.

The generation system is reaching end of life, and the wastewater division and the HDR engineering firm are studying future options. "We're looking at working with the University of Nebraska to use biogas in their boilers, maybe using it for compressed gas to fuel the city's bus fleet, or maybe selling it to the natural gas industry," says Crisler. "We're looking for the best ideas that are the most attractive for sustainability and return on investment. We may stay with what we're doing, but it doesn't hurt to look."

HIGH EFFICIENCY

The CRES is more efficient than typical geothermal systems, which operate with water at temperatures from the 40s to the 90s F. "Our effluent is 57 to 75 degrees F," says Crisler. "In summer when the air is in the 90s, the CRES is more efficient than geothermal. In winter, the water temperature in a geothermal system can go down into the 40s. Our effluent typically doesn't get lower than 57 degrees. They would certainly love to heat the water more and pull more cooling out of it, but our NPDES permit limits us to a 90-degree discharge temperature. The CRES is only allowed to take the water up to 85 degrees."

The pump station is controlled by pressure demands from the CRES, which has five 110 hp, 5,000 gpm pumps, plus one backup. "As they bring more heat exchangers online, the pressure in the system drops," says Crisler. "Our pumps will speed up to maintain a set pressure. It's designed to work automatically, but we have redundant manual operation, as in any of our processes."

The pump station matches standards and equipment used in the treatment plant. It includes Flygt – a Xylem Brand CP 3306 pumps and Allen-Bradley Powerflex variable-frequency drives (Rockwell Automation). "We wanted to make sure that we had redundancy in controls and pumps and that it tied in correctly with our SCADA system," says Crisler.

Theresa Street has an enhanced SCADA system using Allen-Bradley SLC 505 PLCs and Iconics HMI software. The CRES system uses Allen-Bradley ControlLogix PLCs with FactoryTalk PanelView (Rockwell Automation) and Wonderware HMI software (Schneider Electric). The systems share control functionality and process information. "Like all pump stations, it's a critical operation," says Crisler. "We'll have to be attentive and perform good maintenance, but that's something we do every day."

The Centralized Renewable Energy System on the Innovation Campus will eventually provide heating and cooling for 1.8 million square feet of building space.

> "Our challenge was getting a pumping station between the UV disinfection building and our effluent discharge structure. It was a very small space on our 51-acre site, so we built a 1,500-square-foot submersible pump station."
> **STEVE CRISLER**

ATTRACTIVE PAYBACK

The CRES will save about 30 percent over a conventional boiler and chiller system, and the savings will pay for operations and the construction debt. After that, the energy savings will be split between the partners.

The development came at an opportune time for Crisler, who was looking for ways to use the energy inherent in effluent: "We had some conversations about how that might work and what the challenges and regulatory hurdles might be. It started very low key a couple of years ago and then kind of went away."

The Innovation Campus proposal came about a year later. "We looked a little closer, did some preliminary designs and had discussions with the Nebraska Department of Environmental Quality about compliance and permit issues," Crisler says.

The idea went on the back burner while planning continued. "Then it was, 'Hurry up, we have to get it done,' and we couldn't build it fast enough." **tpo**

What's Your Story?

***TPO* welcomes news** about environmental improvements at your facility for the Sustainable Operations column. **Send your ideas to editor@tpomag.com or call 877/953-3301.**