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BY NEAL LORENZI

ECO STATION PROJECT ACHIEVES NATIONAL RECOGNITION

An innovative control system uses solar thermal to shed heat at night for radiant cooling.

Mating solar thermal collectors with radiant floor heat is always a happy marriage. Using a solar thermal heating system to shed heat at night for radiant cooling, however, is an innovative twist. SolarLogic LLC, a solar heating technology company based in Santa Fe, N.M., installed such a system at the Los Alamos County Eco Station that supplies radiant heat to floors and produces domestic hot water with both solar and high-efficiency boiler heat sources. It also cools the floors via night sky radiant cooling (NSRC), which uses the solar collectors at night to shed heat to the sky. The system, designed by Bristol Stickney, the company's chief technology officer, features a SolarLogic Integrated Controller (SLIC).

SolarLogic's innovation was recently awarded first place in two categories by the Radiant Professionals Alliance (RPA) in recognition of the solar hydronic heating and cooling system designed and installed at the Los Alamos County Eco Station earlier this year. The 2012 System Showcase Awards for "Most Innovative System" and "Best Radiant Cooling System" were presented to the company at the RPA's national conference.

"In the past, a system such as the one installed in Los Alamos would require many individual con-

Los Alamos County Eco Station achieved a LEED Silver rating for its numerous environmental features. Ten Viessmann solar collectors provide heat for space heating and hot water.

The solar collectors are mounted vertically and integrated into the building's architecture. This orientation provides more space heat in winter when the heat is needed most and minimizes the possibility of overheating in the summer.

trollers or a sophisticated, customized solution," Stickney says. "The SLIC operates the entire system by itself, and enables Los Alamos maintenance professionals to monitor and adjust operations over the Internet."

Harold Anthony Strain, construction/project manager for Los Alamos County, says, "The SLIC has proven quite remarkable. Increased efficiency, radiant night sky cooling, and remote access to 250 data points are some of its key features."

In addition to working with solar heating, the SLIC is compatible with ground-source heat pump systems, wood boilers, and other renewable energy heating and cooling sources. It requires no programming or customization.

"We are proud to be recognized by a prestigious national industry organization such as the RPA," says SolarLogic CEO Fred Milder. "The system installed at the Los Alamos County building is sophisticated, but it uses the same technology as would a typical radiant-heated home. The cooling comes practically for free."

Beginnings

The project had its genesis in 2008. "When the time came for the old Los Alamos landfill to be upgraded to a modern, solid-waste transfer and recycling center, the County took the opportunity to create the Los Alamos County Eco Station, a public showcase for energy efficiency and sustainability," Stickney explains. However, in July 2009, less than a year after it was installed, an intense hail storm damaged the radiant cooling panels in the solar thermal heating/cooling system. As a result, the NSRC system ceased to function.

Upon the recommendation of Stickney and under the leadership of Strain, Los Alamos County in 2012 decided to upgrade not only the collectors but also the solar thermal controls, which allowed them to add new capabilities, including data collection.

The 2012 installation was a retrofit. The original plastic panels, damaged in the hail storm, were replaced by unglazed metal Sun Ray Solar panels. A single SLIC replaced all the controls of the original system. SolarLogic provided the design for repairing the system and the controls upgrade. The installation was performed by Eldorado Solar, a Santa Fe contractor.

SolarLogic and Eldorado Solar met several times before the installation took place and communicated throughout. Commissioning was done jointly with the installer on-site, and SolarLogic logged into the system remotely. Installation of the mechanical equipment took four days. This included repairing the plumbing, re-

Sun Ray unglazed flat panels on the roof provide night sky radiant cooling (NSRC) to pre-cool the concrete floors in summer. On average, this provides the equivalent cooling of a 1-ton air conditioner running for four hours for just a few kWh of electricity.

moving the existing controls and relay boxes, installation of the SLIC controller, adjusting, and commissioning.

Red Fish temperature sensors were added. Some existing temperature sensors were moved into the proper locations. A total of 11 thermistors are in the system. Four thermostats were replaced with SolarLogic thermostats. A Grundfos VFS 2-40 flow meter was added on the primary loop. The one flow meter provides energy measurements for each component of the system. A Cole Parmer Instruments pH meter was also added.

Today, the Eco Station serves as a recycling center for materials such as asphalt, concrete, auto parts, and cardboard. The building was the first to be LEED-accredited in Los Alamos County. The LEED Silver rating requires that the building be 25% more energy efficient than standard buildings.

Systematic Upgrade

The upgrade was carried out systematically. The broken plastic panels were removed and new metal ones were installed with relatively minor changes to the mounting hardware.

The SolarLogic Integrated Controller (SLIC) allows complete control, monitoring, and adjustment over all hydronic heating and cooling in the building, locally and remotely.

The original temperature controls and relay boxes were replaced with a SLIC that communicates directly with every thermostat, sensor, zone valve, and circulator in the heating system. This system uses software to implement proper temperature sequences for solar heating.

New system-compatible room thermostats were installed. The photovoltaic DC circulator was replaced with an AC circulator that is monitored more precisely by the new controller for solar heat collection.

"Even the instant hot water recirculator pump was put under direct control of the SLIC," Stickney explains.

"A new flow meter," he notes, "was cut into the primary loop to allow direct energy measurement, which is compatible with the energy monitoring and continuous data recording built into the SLIC. A secure Internet connection was installed so that the SLIC can be monitored, adjusted, and displayed remotely by system administrators."

Jeff Stampfer, owner of Eldorado Solar LLC, was hired to remove the old plastic collectors from the roof. He replaced them with metal absorber plates, which would be used for floor cooling. He removed the old control system and installed the SLIC along with a flow meter, pH sensor, and numerous temperature sensors. Stampfer also replaced the existing thermostats with SolarLogic models and the existing solar pumps with AC pumps. He flushed the solar loop and filled it and the cooling loop with new propylene glycol.

It took two Eldorado Solar workers 15 hours to remove the old collectors and replace them with new ones, according to Stampfer. It took one worker 6½ hours to replumb the new collectors. Eighteen hours were required to install the SLIC with pumps, sensors, and thermostats. To replumb the primary loop with a flow meter and pH sensor took seven hours. To charge the cooling loop and solar loop took three hours.

"The exposed absorber plates were something I hadn't used before, but besides that, the project was pretty straightforward," he says. "Because of the design of the primary loop and the location of the heat exchanger, installing the flow meter was more time-consuming than I would have liked. Besides those few issues, the project went very well."

End Results

The hydronic heating system installed at the Los Alamos County Eco Station combines 26 solar collectors and an HTP Voyager 199-80R 80-gal. gas hot water heater/condensing boiler to supply four radiant heating zones with both heat and radiant cooling and provide domestic hot water. All the radiant tubing is Uponor's Wirsbo hePEX.

The SLIC is the centerpiece of the upgrade. The old control system required manual adjustment and could not be monitored remotely. The SLIC allows authorized personnel to monitor and adjust the system in real time on any network computer. This has opened up a new window into the workings of the building for everyone involved.

The new flow meter allows BTU energy measurements to be recorded continuously, so that solar heat and the NSRC contribution can be observed directly. The system temperatures, pressures, on-off status of pumps and zone valves, glycol pH, electrical consumption, and other data are recorded continuously and available remotely.

"The new cooling radiator panels provided night sky radiant cooling throughout the summer and fall of 2012," Stickney reflects. "In fact, the building was changed over from cooling mode to heating mode during October. A quick look at the cooling data shows that the peak NSRC recorded a week before the seasonal changeover was 160,000 BTUs overnight.

"The electrical data recorded that night shows that the cooling system consumed about 3.6 kWh to run the circulator pumps. That translates to an equivalent coefficient of performance (COP) of about 12.9 overnight. For every unit of energy consumed by the pumps, 12.9 units of useful cooling energy were delivered to the building."

After the building was switched to heating, "solar only" mode was chosen to allow the floors to warm up without using the backup boiler. The data shows that the peak solar heat recorded right after switching to solar heating was around 200,000 BTUs per sunny day. (This is useful heat delivered to the building, not just solar available from the collectors.) As the weather gets colder, the system will be switched to "normal" heating mode for the rest of the winter, so that the backup boiler will operate automatically when needed.

Taking Control

Whereas a combination system of this magnitude would typically require five or six differential and/or setpoint controllers in addition to pump relay boxes and zone valve controls, the SLIC controller is the only one used in the system, serving all the functions of conventional and solar controls.

It uses temperature data provided by thermistors, and makes decisions for all heating and cooling sources and loads based on demand and availability. The SLIC includes pump relays and a transformer for zone valves, enabling wiring for all system components. It also reduces installation labor, wiring complexity, and margin for error.

In concert with SolarLogic thermostats, the SLIC manages solar heat storage in the mass radiant floors and enables the system user to prioritize fuel savings, comfort or a combination of the two within each heating zone. During summer, the SLIC reduces radiant slab temperature by transferring heat from the floors through unglazed metal radiators on the roof at night.

"The SLIC is on the Internet in real time, enabling system monitoring, operation, and remote diagnostics," Stickney notes.

Use of the SLIC allows SolarLogic or county officials to remotely identify anomalies within the Eco Station solar system's operation. A few examples:

- The SLIC recorded unexpected temperature differences around the primary loop simultaneously with a drop in temperature in the DHW tank, causing the backup boiler to fire. Monitoring the boiler flue pipe verified that the boiler was firing. Logged data analysis determined that a check valve had failed.
- Anomalous temperature results indicated that sensor wiring was not sufficiently protected from the weather. (Wiring was getting wet and shorting out.)
- Logged data showed that occupants were "messing with the thermostats." When the facility manager was alerted to this, he implemented changes so that the rooms remained comfortable while the use of the solar resource was optimized.

The piping design is a dual primary loop, where every source and every load is connected to one of the primary loops with two closely spaced tees. This piping arrangement allows heat to be delivered directly from any source to any load at any time, bypassing storage tanks when appropriate.

SolarLogic also offers a web-delivered design service called SolarLogic Assisted Solar Heating Design (SLASH-D), according to Claudia Pavel, director of sales and marketing. "SLASH-D is a free web-based program accessible from our website. It enables architects, engineers, contractors, and installers to design a solar thermal system — complete with plumbing diagrams, parts list, recommendations for sizing — and provides calculations based on one's input," she explains.

By utilizing the SLASH-D service and the SLIC controller, an individual with an existing heating and/or plumbing business but no previous training in solar hydronic heating can specify, quote, and install a customized solar hydronic system, she adds.

National Recognition

The folks at SolarLogic, which was founded in 2008 by Stickney, Milder and Boaz Soifer, are proud of winning the RPA 2012 System Showcase Awards.

"SolarLogic is especially proud to have created a system that brought national recognition to the County of Los Alamos for its environmental contributions, leadership in green building and fiscal savings for taxpayers," says CEO Milder. "The demonstrable benefits are important to the client; this facility is not only a commercial building, it is a public demonstration project for Los Alamos County."

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