District Energy

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

FOURTH QUARTER 2012

A Century of Innovation at University of Toronto

Understanding Energy Modeling

New Piping System Debuts on Campus

Adapting LEED® for Global Markets

Danish Center Supports Industry Development

...and more

immediate aftermath of the North American electricity blackout in August 2003.

> Installation of a 6 MW cogeneration unit in 1992 has enabled the university to generate a quarter of its own electricity.

2000: Flue Gas Heat Recovery System

In 2000, the U of T installed a flue gas heat recovery system at the Central Steam Plant. Through a combination of direct and indirect contact heat exchange, heat is harvested from the hot exhaust gas that would normally be wasted. The low-grade hot water is then piped to a number of buildings including Lash Miller, Medical Sciences and the Bahen Centre. This project has resulted in annual energy savings of 73,000 GJ (69,200 MMBtu), enough to heat more than 800 Ontario homes. In 2002, when the Bahen Centre was connected to the waste heat recovery system, it became the first campus building to be 100 percent heated with energy that would otherwise have gone up the chimney.

The Way Ahead

Today the U of T heating system that got its start in 1912 serves a total of 12.45 million sq ft of space in 98 buildings. As the campus continues to grow, new buildings such as the Goldring Centre for High Performance Sport will be fed from this heating infrastructure as well. However, to ensure that campus energy services remain reliable, an ambitious program of work is under way: Underserved research buildings are being re-fed with power to meet the growing loads, improvements are being made to the boiler plant's fuel delivery system and storage facilities, "bottlenecks" in the plant that have limited the quantity of steam produced are being rectified, and the chiller plant capacities are being increased to serve new research areas.

In hindsight, those who set the University of Toronto on the course of centralized energy services at the beginning of the 20th century made the right decision – one that is still benefiting the campus in the 21st century. In this centennial year of 2012, the U of T celebrates the foresight that pioneered greener energy production in Toronto and paved the way for growth of the St. George campus to what it is today.

Andrea Shabbar is a freelance writer, visual artist and Ph.D. student at Western University in London, Ont. Shortly after completing her Master of Arts degree in communication and culture, Shabbar held the position of project coordinator in the area of sustainability at the University of Toronto. Her work on the university's sustainable efforts inspired her current doctorate research on the links between community arts, activism and the environment.

High-Temperature Hot Water District Heating: A brief history

Morris A. Pierce, Adjunct Professor of History, University of Rochester

The first high-temperature hot water district heating system was patented by the American inventor Angier March Perkins in 1831 and was widely used in Britain throughout the 19th century; some systems remained in service into the 1930s. The Perkins system used small-bore (less than 1-inch) piping that distributed hot water at 300-600 degrees Fahrenheit and 300-3,000 psig. Although none of these systems is known to have been used to heat multiple buildings, Perkins said in 1836 that he could "heat a whole parish from one fire."

After Birdsill Holly introduced commercial district steam heating in 1877, several competitors appeared including William Prall, who in 1878 patented a "superheated" water system that could deliver heat over a much longer distance than the low-pressure steam networks then in use. His National Superheated Water Co. developed systems that distributed hot water at 400 F to individual buildings, which was flashed into steam for heating and to power engines. The condensate was then metered and returned to the plant through a low-pressure condensate return line.

Small Prall systems were built in New York and Washington, D.C., before he convinced Bell Telephone founder Theodore Newton Vail to invest in a much larger system to serve the financial district in Boston, which was being rebuilt after a large fire in 1872. Vail's Boston Heating Co. began construction in 1886 and started serving 70 customers in January 1888. In November 1889 the system was shut down and went out of business due to the complete disintegration of the open return lines from atmospheric oxygen corrosion. Unlike a district steam system that can operate reasonably well without the return condensate, the Prall network was not economically viable without it. The abandoned hot water pipes were (and may still be) used as conduits for telephone wires.

German engineers in the 1920s resurrected high-temperature hot water systems, recognizing as Perkins did that a closed system was not subject to corrosion. Large high-temperature hot water systems were installed in many German industrial facilities prior to World War II, and a few were installed in American factories in the 1930s. The German systems proved to be resistant to damage from aerial bombs and could be quickly repaired, which the U.S. Air Force discovered in its survey of wartime damage. In 1947 a high-temperature hot water system operating at around 400 F was installed at the new Loring Air Force Base in Maine. Within 10 years, more than 30 similar systems were installed at other air bases, while the U.S. Navy also adopted the technology for many of its facilities. Rutgers and Brigham Young universities installed similar systems in the 1950s, with many more installed on other campuses and military bases in later years.

One notable installation was the high-temperature district heating network at the new U.S. Air Force Academy in Colorado Springs, which began service in 1957. This system operates at 454 F and 440 psia – the highest known temperature and pressure to have been used on such a system.