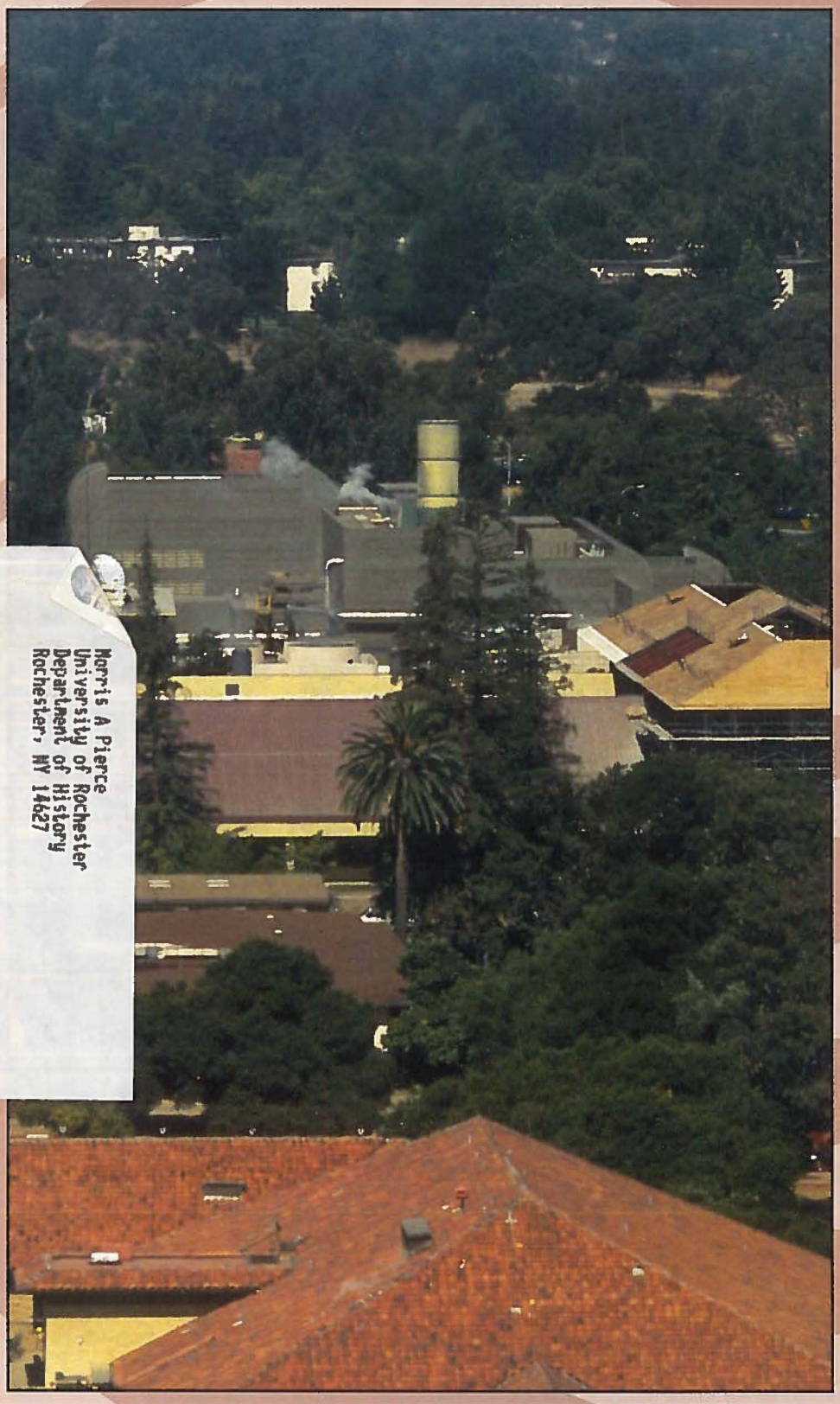
DISTRICT ENERGY

Volume 81, Number 2
Fourth Quarter 1995



Stanford University: Evolving for Tomorrow

Featuring

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

District Energy: More Than 70 Years at University of Rochester

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The University of Rochester is a private educational institution with 4,500 undergraduates and 2,500 graduate students.

The University's components include the prestigious Eastman School of Music, the Simon School of Business Administration, a School of Medicine and Dentistry and a 722-bed teaching and acute-care hospital.

The University has strong programs in optics and laser engineering, and currently operates the most powerful fusion laser in the world at its Laboratory for Laser Energetics.

The University of Rochester is nestled into the scenic banks of the Genesee River in Rochester, N.Y. Founded in 1850, the University's first campus was located near downtown Rochester, a site still home to the University's prestigious Memorial Art Gallery. The decision to build a medical school and teaching hospital led to the search for a new campus, which was subsequently built on vacant land adjacent to a golf course on the south edge of Rochester.

Several alternative boiler fuels have been considered, including coal slurry, wood and gas, but none proved economically attractive compared to coal.

Construction on the new medical center began in 1923, and shortly thereafter the University acquired the golf course for a new academic campus. A new coal-fired heating plant was located in the center of the future University complex along a railroad line which provided coal delivery for many years. In November 1924 the first boiler was lighted by University President Rush Rhees; six years later the plant was expanded to handle the new academic campus.

The campus grew slowly until the 1960s when a greatly enlarged campus was planned to meet the growing research needs of local firms such as Xerox, Kodak, and Bausch & Lomb. To accommodate the planned growth, the plant's capacity was significantly increased and a centralized chilled-water system was added. The enlarged facility was completed in 1972, but the anticipated load never developed due to energy conservation and scaling back of the overall campus plan. The plant currently supplies steam and chilled water to about 5.5 million square feet of facilities.

Changing With the Times

Saturated steam is generated at 175 psig to drive four turbine-driven centrifugal chillers; it is reduced to 80 psig for distribution to the medical center and academic campus. Condensing water for the chillers and steam turbines is obtained from the Genesee River and is also used for free cooling during the winter using two chillers modified to act as heat exchangers.

In the late 1980s the original constant-flow chilled-water system was converted to variable flow, resulting in better control and reduced energy consumption. Although there was some difficulty in

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maintaining adequate temperature difference in the building systems, educating building operating staffs has helped rectify the situation. The central plant staff maintains 448 steam, chilled-water, electric, gas and city-water meters in campus buildings. Utilities are billed monthly to appropriate departments.

A particulate baghouse was installed in the 1980s and is currently being renovated. Rochester is in an attainment area for ozone and no substantial changes are anticipated to plant operations. Several alternative boiler fuels have been considered, including coal slurry, wood and gas, but none proved economically attractive compared to coal. The University explored the installation of a 23 MW combustion turbine for cogeneration two years ago, but accepted an offer from the local electric utility to delay project implementation.

A small (±1 MW) backpressure turbine-generator project is currently being designed and will be installed by summer 1996 with an energy grant from New York State. The turbine will run in parallel with existing pressure-reducing valves that reduce steam distribution pressure from 175 psig to 80 psig. The 4160-volt generator will run in parallel with the campus service and will produce about 5 million kWh annually. Several alternatives to increase electrical output were evaluated, including a new high-pressure superheated boiler and new hot water distribution system, but they did not meet the University's financial requirement of producing a positive net present value over a ten-year period and a minimum internal rate of return of 15 percent.

Maintaining Service Campuswide

The plant staff maintains all high-voltage distribution cables and transformers on the campus. Almost all buildings have two electric feeders, allowing service to be restored quickly during interruptions. The campus itself has two electric services from the utility company, which has provided very reliable service. The chilled-water lines are direct-buried and have been relatively trouble-free except for some valve problems.

Many of the larger steam and condensate lines are in a walk-through tunnel, but several smaller distribution pipes are direct-buried. These direct-buried pipes are now insulated with the DriTherm loose-fill system, which as proven effective in providing insulation and corrosion protection, especially under road crossings that are subject to severe damage from salt.

The University of Rochester's Central Utilities Plant (upper left) serves both steam and chilled water to campus buildings.

Courtesy of University of Rochester.

University energy consumption has remained relatively stable for the past five years, even though new buildings have been constructed.

Recently, pipes were uncovered that had been protected with DriTherm 17 years ago and still looked like new.

Several buildings adjacent to the main campus have been built or acquired over the years, but are operated with separate gas boilers and electric chillers. All gas meters were aggregated into a single transportation gas contract two years ago, substantially reducing gas costs for these remote buildings. Given current gas prices this will likely continue, but the thermal distribution systems could certainly be expanded to serve them if and when it becomes economically feasible.

Two operating engineers are on duty in the plant around the clock, with a maintenance staff working during the day and supplemented by outside contractors. The plant equipment is controlled and monitored by a Bailey INFI-90 system. The large plant capacity has allowed equipment to be taken out of service for adequate maintenance. Right now, the larger chillers and boilers are thought to have at least 20 years of service-life remaining.

Evaluating Alternatives

R-12 will be removed from one of the larger 4,500-ton centrifugal chillers and the unit will be retrofitted to use R-134A. The R-12 that is removed will be adequate to supply the remaining large chillers for five to ten years, so their immediate conversion is not anticipated. The smaller 1,500-ton chiller uses R-11 and its fate is not yet clear. Various alternatives, including thermal storage and an absorption chiller that uses steam from the new backpressure turbine, are being considered, but no definite plans have been set.

The University has an engineering staff consisting of an energy management

Central Utilities Plant Characteristics	
Boilers	Two 150,000 lb/hr and one 100,000 lb/hr coal-fired; two 100,000 lb/hr No. 6 oil-fired. Maximum steam load 200,000 lb.hr.
Steam lines	Approximately 8 miles.
Chillers	Three 4,500 ton and one 1,500 ton steam turbine driven centrifugal chillers. All Carriers 17DA. Maximum chilled-water load 10,500 tons.
Chilled-water lines	Approximately 3 miles.
Cogeneration	1 MW backpressure turbine currently in design. Peak electric demand 22 MW.

University Energy Consumption and Production – 1994-1995	
Coal	43,562 tons
No. 6 Oil	290,610 gallons
Natural Gas Purchased	200,000 dekatherms
Electricity Purchased	131,686,660 kWh
Steam Production	869,971 mlb
Heating Degree Days	5,923
Chilled-Water Production	840,165 ton days
Cooling Degree Days	4,816

specialist, a mechanical engineer and an electrical engineer. These individuals work on a variety of projects, including cogeneration development, refrigerant conversion and various energy conservation measures. University energy consumption has remained relatively stable for the past five years, even though new buildings have been constructed. A new, 200,000-square-foot Ambulatory Care Facility will be opened in spring 1996, but continued conservation efforts will likely offset the added energy required for this new facility. The University operates an extensive energy management system with nearly 50,000 points connected into Landis & Gyr remote panels, which are connected by fiber-optic lines to a new Electronic Systems USA UNITY system front-end processor.

Coal remains the primary plant fuel and is currently trucked in from southwestern Pennsylvania. No. 6 fuel oil is used for backup and supplemental purposes, and a 200,000-gallon storage tank is located next to the plant. In addition to coal storage at the plant, a remote coal storage yard was maintained until the past year, when water runoff concerns and the steady coal market allowed it to be consumed in the plant.

Although thermal energy prices have remained steady for the past decade, the future cost of electricity remains uncertain. The New York electric market suffers from the seeming contradiction of high prices and excess capacity. The University's future response to these challenges may include cogeneration, retail wheeling from other utilities or producers, or even business as usual.

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