

District Heating & Cooling

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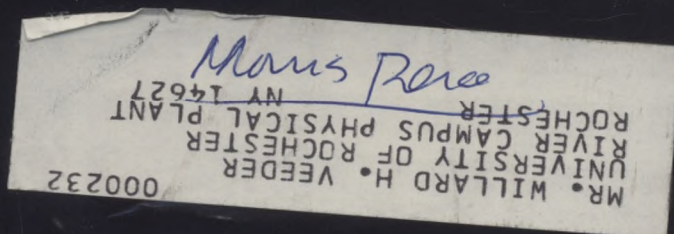
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Also in this Issue

Kansas City Steam Comeback

Nation's Largest District Heating
Company Responds to National
Energy Strategy

and more...



Kansas City Steam

From Beginning to End--and Back Again

By Thomas R. Casten
Trigen Energy Corporation

The nearly 100-year-old district steam system that had served Kansas City, Missouri, since the old trolley days was scheduled to close down on December 31, 1990. This would have left over 100 downtown customers and a large industrial plant *literally* out in the cold.

Given the uncertain status of current and future fuel supplies and Kansas City's growth potential as one of the cleanest cities in the United States, district steam had been and could continue to be an ideal solution.

But the pending demise of the Kansas City district steam system was not to be. In fact, to paraphrase Missourian Mark Twain, the reports of death were premature. There were just too many factors in favor of district steam.

For instance, consider what we know today about the proven advantages of district heating over on-site boilers. District heating saves energy, reduces pollution, lowers building costs, increases fuel flexibility and supply stability, and is more reliable and convenient. Given the uncertain status of current and future fuel supplies and Kansas City's growth poten-

tial as one of the cleanest cities in the United States, district steam had been and could continue to be an ideal solution.

In a move to continue the benefits the district steam system had to offer its customers and the community, Trigen Energy Corporation of White Plains, New York, bought the district steam system from Kansas City Power and Light (KCP&L) on March 30, 1990.

This is the story of the district steam system in Kansas City: how it faltered, how it was saved through the help of state and local officials and how Trigen intends to make it a thriving "trigeneration" system that simultaneously produces electric or mechanical energy, heat and chilled water.

A Powerful Yet Changing Resource

The Kansas City steam system began in 1905 with the construction of two downtown steam plants at Sixth and Baltimore and 1312 Baltimore. In 1917 an additional steam source at 1311 Wyandotte was constructed and was interconnected with the 1312 Baltimore plant.

In 1927, Kansas City Power and Light Company (KCP&L) bought the Grand Avenue Station power plant from the Metropolitan Street Railway Company and began extensive renovations to convert the electrical plant to a dual-purpose plant providing both electricity and steam. [See accompanying article for more on the Grand Avenue Station.] One year later, the Grand Avenue Station began supplying steam to customers in downtown Kansas City. Later that same year, a high-pressure steam transmission line was constructed from the Grand Avenue Station to the Sixth and Baltimore unit. This was the first consolidation of the steam system.

By the 1940s, Grand Avenue Station became a central relay point for a downtown electric network. During the '50s, additional new high-pressure steam transmission lines were constructed and extended, permitting the retirement of older boiler sources while increasing the importance of the Grand Avenue Station for district steam customers. By 1958, Grand Avenue was the sole source of steam for over 200 downtown Kansas City customers. *Continued*



Kansas City, Missouri, was in danger of losing its district steam system until Trigen Energy Corporation purchased the system, keeping it in operation. Courtesy Prime Time News Bureau

Although the downtown steam system's load ironically peaked at 1.2 million Mlb. in 1973 during the first energy crisis, the system, like many others, began to lose load shortly thereafter.

In the decade that followed, peak steam sales declined due to business migration from downtown, old buildings being replaced with new more energy-efficient office buildings, and aggressive efforts to market electric and gas as building energy sources—while little or no effort was made to market steam.

Because KCP&L had built adequate electrical capacity at new coal-fired plants and one nuclear plant, the Grand Avenue Station was no longer needed for electrical production, so the service was discontinued. Rather than operating the steam system as a separate for-profit business firing on coal, KCP&L elected to operate the steam system on gas to reduce its labor requirements. In 1986, KCP&L requested permission from the Missouri Public Service Commission to abandon steam service altogether since it "was not profitable" using its new method of operation.

In October 1987, the Missouri Public Service Commission advised KCP&L to make a "good-faith effort" to sell the system, rather than simply abandon it. But they also agreed that failing a sale of the system, KCP&L could stop steam service on December 31, 1990. The future looked relatively grim for the customers who relied on the district steam system. Many users had neither the space nor the capital for new on-site boilers.

"The City was concerned because of the tremendous capital expenditure it would face if the district steam plant closed," explains Joe Gentile, Kansas City's assistant manager of solid waste. "We were looking at spending over \$1 million for retrofitting the City's own buildings to use gas boilers if the steam system shut down."

But with the help of the U.S. Conference of Mayors, the Urban Consortium, the U.S. Department of Housing and Urban Development's (HUD) Energy Division, the U.S. Department of Energy (DOE) and the International District Heating and Cooling Association (IDHCA), Kansas City was able to fight for and accomplish the survival of its district steam system.

Through these various special-interest groups, Kansas City steam-system supporters studied other steam systems

that had rebounded from threatened shutdowns. "We learned how Rochester, New York, and St. Louis, Missouri, had survived impending shutdowns and had come back stronger than ever," says Gentile. "One of the first things we did was hold a workshop for steam system customers to let them know we could save the steam system if we all worked together for our common cause and strategize our rescue plan."

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Hope on the Horizon

Trigen Energy Corporation came on the scene in Kansas City with a firm belief in the inherent advantages of district steam. After careful study, Trigen felt it could reverse the trend for both steam sales and losses. This would be achieved by treating the system not as a relic and incidental to the company's main business, but by turning it into a modern, competitive alternative to on-site energy generation.

"Kansas City has a healthy economy," states Tom Casten, president of Trigen Energy Corporation. "It is a city with diversified industries that insulate it against rapidly changing conditions in any one industry. In addition, the potential economic growth we believe Kansas City will experience during coming years will be enhanced with the continued operation of the district steam system."

Through its research, Trigen developed a multi-step approach to correcting the negative trends. Some steps were preconditions of purchase; others will come in time. Their plans were outlined as follows:

1. **Obtain fair tax treatment.** The City had unintentionally hurt the steam system by imposing an effective 11.1 percent tax on gross receipts from all steam sales. Although gas and electricity sales also carried the same tax, Trigen argued that the cost of gas and electricity represents only 40 percent of the cost of generating steam (the remaining 60 percent being labor and capital costs). This meant that building owners generating their own steam using gas were paying the 11.1 percent tax on only 40 percent of their total steam costs, or a total of 4.4 percent. Steam sales, by contrast, carried an 11.1 percent gross receipts tax on total sales which included fuel, labor and capital.

The Kansas City City Council agreed and lowered the gross-receipts tax rate on steam to 40 percent of the tax on gas or electricity.

2. **Change the steam rate structure.** The steam system had virtually no downtown sales in the summer, yet sold steam for heat on a dollars-per-Mlb.-used basis. Revenues were therefore realized only in winter. Trigen redefined what was being sold, seeing themselves as providing the capacity to heat buildings (the same as what users buy if they purchase their own boilers), and only incidentally providing the service of converting fuel to steam, on demand, for user buildings.

New rates have put all of the fixed charges (capital, labor and system losses) into a base charge, payable in equal monthly installments and tied to each customer's average steam consumption in the prior three years' heating seasons. Block rates that have lower base charges per unit of capacity for larger users reflect the reality of service costs because it is cheaper to reach and serve a large user. Regardless of the base charge, all users pay a low variable cost of \$3.90 per Mlb. for steam actually used. This covers fuel costs and variable costs (water chemicals, electric energy used by the plant, etc.) In an exceptionally cold year, only the variable charge rises. The base charge will remain constant unless revised rates are approved by the Public Service Commission.

The Missouri Public Service Commission agreed, and responded to this concern by approving new rates on March 29, 1990. Everyone's billing leveled out, making it easier for customers to budget their monthly charges.

The new rates send a signal to every building in Kansas City to consider steam-driven cooling—either absorption- or steam-turbine-driven compressors. At \$3.90 per Mlb., absorption chillers are very competitive with electric-driven machines, making chilled water for two to four cents of energy cost per ton-hour.

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3. **Return to coal.** In 1989, while Trigen was still negotiating to buy the plant, it learned that there had been a gas curtailment and that coal could still be burned at the Grand Avenue Plant. The electrostatic precipitators were obviously working since the stack exhaust was completely clear.

Trigen had two good reasons to believe that coal prices would remain near present levels: (a) the tremendous buyer's market that existed, and (b) the restrictions on new coal use imposed by the Clean Air Act. Modeling was undertaken and reviewed by the state and U.S. Environmental Protection Agency officials. When it was shown that Trigen could burn coal at the Grand Avenue Plant without exceeding the ambient air quality standards, the Kansas City Health Department issued a permit for the plant to burn coal.

Coal is now used as the primary fuel. Continuous emission monitoring and other conditions ensure that Trigen's operation does not result in any ground-level pollutants in excess of federal Clean Air Act standards.

4. **Reduce steam losses.** Extensive repairs to the manholes and buried piping in the distribution system were completed during the first summer of Trigen's operations by a newly appointed team of Trigen personnel. The expert team, headed by the newly appointed president of Trigen-Kansas City, Jeff Weed, would be responsible for locating and eliminating every possible loss in the system, thus reducing fuel use, water use, chemical use and overall costs.

During that first summer, Weed's team also shut down the coal-fired boilers for one month and operated the system on a package boiler in order to do major valve and trap maintenance as well as general repair. Other changes, all of them leading to larger savings, have been designed and are being procured.

The plant will soon produce its own electrical needs. A new back-pressure steam turbine will replace the pressure-reducing station and will extract up to 5 megawatts of electricity out of the high-pressure steam while reducing it to 185-pounds-per-square-inch steam-distribution system pressure. This will supply the bulk of the plant's electric requirements at very low cost, ultimately benefitting the customer.

Since summer steam loads are presently too low for the coal burners, the plant still must burn gas until cool fall weather results in increased heating loads. Marketing efforts are initially being focused on adding customers who use steam for a steady process load so that the summer load can be increased to the level where Trigen can burn coal during summer. The



Workers at RICECO Inc.—a women's coat manufacturer and new Trigen-Kansas City customer—use steam for pressing and heating. Courtesy RICECO, Inc.

first new process user, RICECO Inc. (a manufacturer of women's coats), has already been connected.

Steam condensate, which retains 11 percent of the initial steam energy, is currently discharged to the sewers. Several options are being examined to collect and return condensate to the Grand Avenue Plant, to further reduce water and energy use.

Looking Ahead

Although stability and gradual growth of the steam system are projected, Trigen-Kansas City believes that the real future lies in cooling. Trigen believes the comfort and cost advantages inherent to district cooling will persuade new building developers to take advantage of both district cooling and steam services.

Toward that end, major development efforts are under way to start district cooling networks. Preliminary district cooling preparations are under way; the technical and economic analyses have been completed. The Grand Avenue Plant is in an excellent position to house ammonia-based cooling with its coal-fired, high-pressure steam, abundant Missouri River water for cooling, and adequate space in its nearly unused turbine hall. Trigen's cooling plans offer a greater price stability than gas- or electric-powered cooling systems because the company will use abundantly available domestic coal as a primary fuel source, and offer the inherent advantage of reduced maintenance costs. Best of all, the Trigen approach to district cooling completely eliminates chlorofluorocarbons (CFCs)—chemicals that are now believed to be damaging the ozone layer and are subject to legislative phase-out and high-use taxes. Trigen's plan also eliminates the use of hydrochlorofluorocarbons (HCFCs) which are currently under question and being evaluated regarding their effect on the environment.

Trigen is committed to making such a plant work economically, and to designing new systems that conform today to tomorrow's stringent environmental standards.

With district cooling on the horizon and district steam alive and well, it is obvious that the death reports originally issued to district energy in Kansas City was truly premature.

