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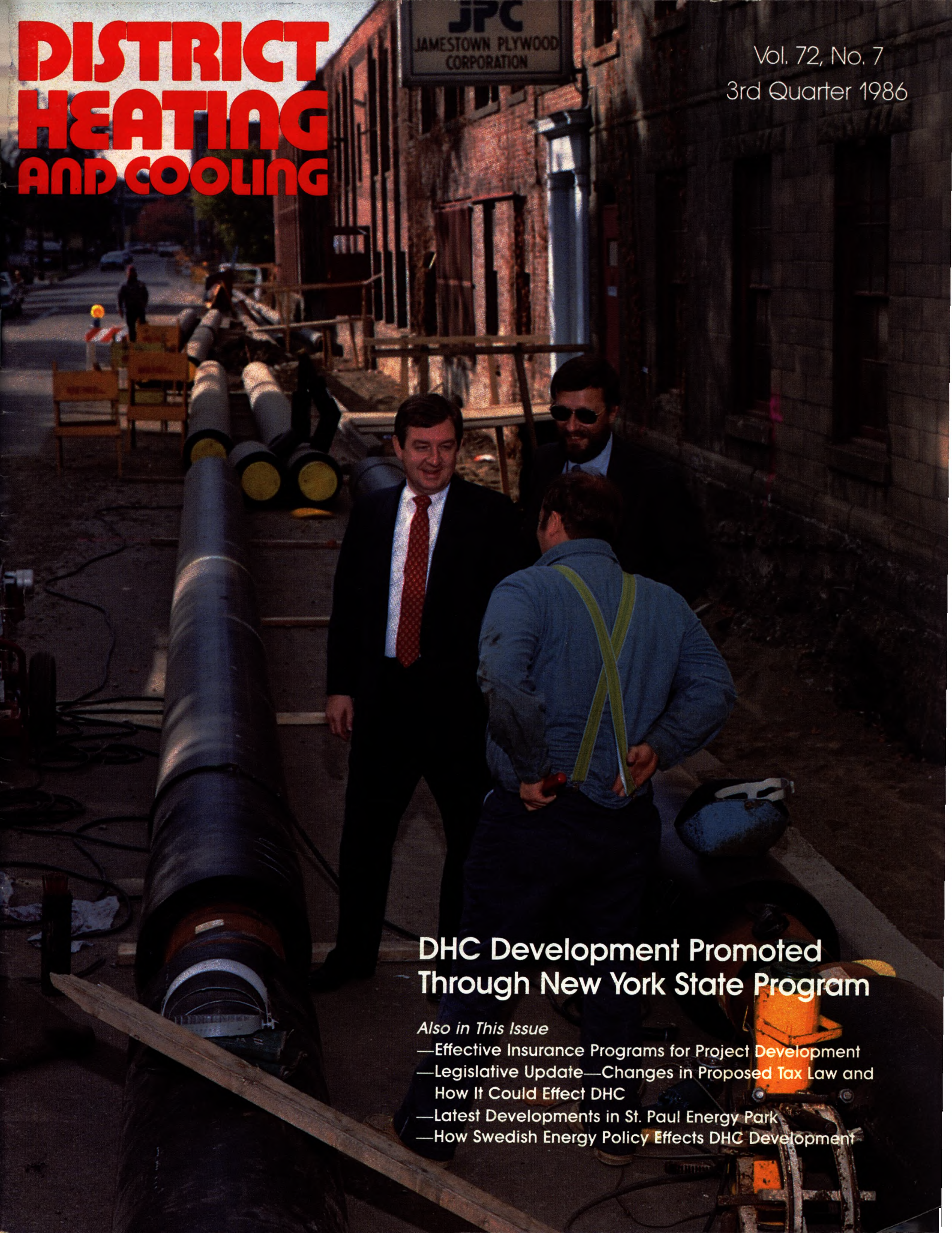

DHC Development Promoted Through New York State Program

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—Effective Insurance Programs for Project Development

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—How Swedish Energy Policy Effects DHC Development

St. Paul Energy Park and Central Heating Plant The Dream's Come True

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The St. Paul Energy Park is an American example of a DHC system being planned and built at the same time as the residential and commercial buildings which can reduce the overall cost of system installation.

What has happened to the award winning St. Paul Energy Park since it was built in 1982? Have goals been met in four years? Has the Central Energy Plant achieved its predicted performance?

Intended to be a model of an energy-efficient urban development, the St. Paul Energy Park is located midway between downtown St. Paul and downtown Minneapolis in Minnesota. It is a 218-acre development including dwelling units, recreation facilities, hotel space, commercial space, offices, research labs and a conference facility, and space for light industrial use.

Once occupied by an old coke processing plant, which contaminated the soils, and the railroad, Energy Park's site has become one of St. Paul's major industrial developments. Its purpose was to provide jobs, affordable housing, and a high-quality environment to attract and create new businesses.

The St. Paul Central Energy Plant and TKDA have received three major engineering awards for the plant's design. Its system is electric and, therefore, uses no fossil fuels and produces no air pollution. It is basically everything that TKDA engineers predicted it would be.

Central Heating Plant Systems Studied

To best meet the goal "to utilize and demonstrate the best approaches to energy efficiency and conservation in the design and operation of residential, commercial and industrial facilities," several central heating plant systems were studied. Ten systems were studied including:

1) a conventional system with an in-building gas/oil-fired boiler supplying hot water for space heating and for domestic use, and electrically driven mechanical chillers supplying chilled water for space cooling,
2) a central boiler/chiller system with a central energy facility from which hot and chilled water is distributed via a four-pipe distribution system, consisting of a hot water supply pipe, a hot water return pipe, a chilled water supply pipe and a chilled water return pipe,
3) a cogenerating plant which simultaneously generates electricity and hot water for space heating with four-pipe distribution,
4) a combined gas turbine cycle in which hot turbine exhaust enters a waste heat boiler where

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Lynn E. Englehorn, P.E., has 20 years of experience as a mechanical engineer and was TKDA's Project Manager for the design and construction of the Energy Park Central Heating and Cooling Plant for the St. Paul Port Authority. He received his Bachelor of Science in Mechanical Engineering from the South Dakota School of Mines and Technology and is a member of the International District Heating and Cooling Association, the American Society of Heating, Refrigerating and Air Conditioning Engineers, and the American Society of Mechanical Engineers.

additional fuel is added to produce low pressure steam which heats distribution water to Energy Park,

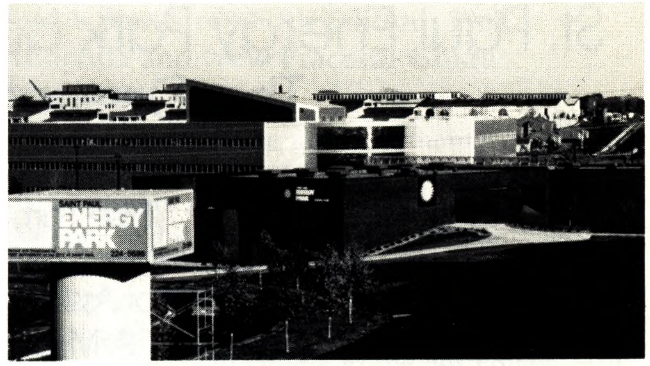
5) a system using a groundwater heat pump, topping boilers, and four-pipe distribution,
6) a system consisting of centrally located heat pumps and oil/gas-fired topping boilers supplying warmed and chilled water through independent distribution systems to buildings throughout the park,
7) a distributed heat pump system with a heat pump or a number of heat pumps in each building,
8) a system generating hot and chilled water at a central site, distributed through two-pipe distribution systems to individual buildings and consisting of hot/cold aquifer storage,
9) a cogeneration system consisting of diesel engines, engine generators, waste heat boilers, chillers and a three-pipe distribution, and
10) a system consisting of distributed heat pumps, central heat pumps, a central boiler, aquifer well and two-pipe distribution.

St. Paul Energy Plant District Heating & Cooling System

The best suited alternative indicated from the studies was the $8 million District Heating and Cooling System which features a central energy plant which uses six heat pumps to extract energy from 50° groundwater to heat distribution water to a temperature of 92° to 118°. In the cooling mode the system removes heat from the distribution water and rejects it to the well water. This system was predicted to be the best investment due to its relatively low construction cost and anticipated low fuel costs.

The facility is operated by a monitoring and control system which provides central control of the Energy Plant, monitoring and metering of tenant energy usage, automated monthly billing for energy usage, available

Site of the St. Paul Energy Park DHC Plant.



The finished plant for the St. Paul Energy Park.

monitoring and control of tenant HVAC systems, supervision of tenant fire and life safety systems, and tenant building security monitoring.

A Thermal Distribution System, consisting of approximately 7,400 feet of ductile iron pipe, runs from the Central Energy Plant to more than 20 planned commercial/industrial buildings and 950 planned residential units. Use of the ductile iron pipe, which is preinsulated with urethane foam and surrounded by a waterproof outer jacket, resulted in an initial construction savings of 30% to 50% over conventional welded steel piping.

Growth Pattern

After four years of operation, Energy Park has experienced a slower growth pattern than was predicted. Builders were originally very optimistic about filling residential and commercial space. For example, planned housing units total 950, some being owner-occupied, some being rental. Currently, 356 rental, condominium and townhouse units are now completed with an additional 415 units to be completed in 1986. This slow growth pattern is a direct result of the unpredicted amount of time needed for Energy Park to be noticed. Due to this slow growth, predicted population density and type changed as new clientele were attracted to the park. New offices and community related facilities have moved into the park and rental units now out number condominiums and townhouses. Despite the slow beginning, St. Paul Energy Park has grown and currently uses the installed capacity of the Central Energy Plant.

The largest new development at the park is a 115,000 square foot supercomputer manufacturing facility. Other developments include the final phase of the housing plan, the Energy Park Plaza (a condominium and rental light manufacturing/office facility), a $1 million parking ramp, and an office and distribution center. Initial vacant buildings now occupied include a printing plant, headquarters for an electronics firm, and an office complex in one of the restored, historic railroad buildings left behind by the railroad.

As the park's energy load increases, plant equipment is installed to meet the park's needs. As planned, eight heat pumps will eventually be installed in the plant. Originally, five 400-ton, variable speed heat pumps, one being standby, were installed. In a second installation phase an additional facility was built to accommodate three heat pumps, one chiller, and two boilers. One gas-fired boiler was installed to meet peak heating needs in the winter months. Using a boiler is cost effective due to its lower installation cost, compared to that of a heat pump, together with its relatively small amount of use on each given day. Most recently, two 900-ton, two speed heat pumps were added to the original five heat pumps at the plant.

Predicted Plant Performance Achieved

The theme of the Central Energy Plant during design was "to provide an alternative energy which will reduce the consumption of conventional fuels at a competitive price." This has been achieved as predicted. The plant provides hot-water heat in the winter and chilled water cooling in the summer to all the buildings in the park at a price competitive to conventional methods. Not only has the plant achieved its predicted performance, but an unexpected winter cooling load is now piped to computer centers to provide cooling at a very low cost. Prior to the construction of computer centers, the well water was disgarded after passing through the evaporator. It is now piped directly to the computer centers to cool their facilities and then is disgarded to the sewer. This use of waste product is an efficient improvement of the already available system.

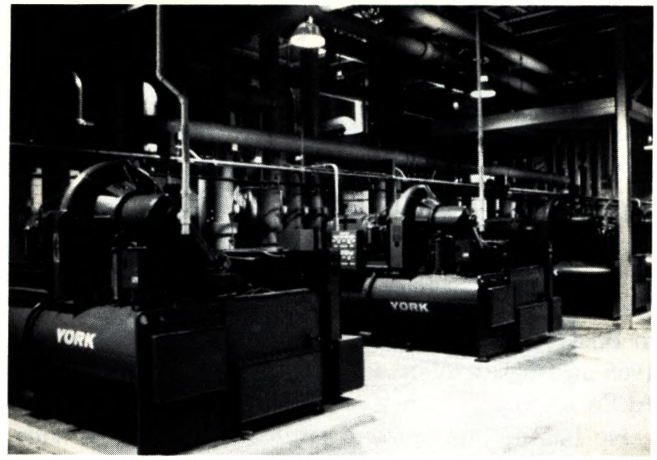
Operating Efficiencies

	KW/T	C.O.P.	$/10.6 BTU's
Machine			
Heat	0.8	4.39	—
Cool	0.4	8.78	—
Plant			
Heat	1.38	2.55	9.31
Cool	0.96	3.68	9.72
	Winter Cooling		5.37

Based on these efficiencies and costs it can be seen that heat pumps can be competitive, depending on electric costs and competitive fuel costs. TKDA's experience at the Energy Park has also demonstrated ways to lower both the operating costs and capital costs if a new plant were to be built today.

A Dream-Come-True

The Energy Park site has come a long way in four years. The St. Paul Port Authority began with one of the largest parcels of undeveloped property in the Twin Cities and after waving its wand for integrating a land development, users, energy technology, and financing has produced a most successful energy efficient development. Most of this 218-acre site is filled with approximately 30 acres still available. After four years, St. Paul Energy Park, although not adhering to all proposed plans, is right where it expected to be.



Heat pumps used to generate hot and chilled water for the St. Paul Energy Park.