# DISTRICT CHILLED WATER: An Idea Whose Time Has Come

WILLIAM J. BAILEY

ALMOST overnight, as such things armeasured, a new business has burst upon the scene the business of selling refrigerated water for air conditning. The companies in this business are as varied as thc customers, but all use gas as their main energy source.

Gas utilities in particular are intrigul by the district plant concept in which a single chilled ater production and distribution plant can serve a variety f structures in a given district.

At first, it was one way to fill in th valleys of their sales curves. Steam or hot water could be old in winter for heating, and used in summer to power lae water chilling machines. With a district plant, they uld use gas to produce steam all year, and sell wateror heating and cooling much as gas or electricity is sold.

Seven years ago one company enterethis business. In 1967 there were four. Now there are 10, eh selling chilled water for cooling and steam or hot ter for heating building complexes ranging from private omes to office buildings to medical centers to a world's ir to the Queen Mary.

There are the gas utilities: Connectut Natural Gas Corp, Houston Natural Gas Corp, Oklahna Natural Gas Co, and Washington (D.C.) Gas Light CoPacific Lighting Corp of California has two non-utility bsidiaries: Uni-Plant Corp and Central Plants Inc. The is a pipeline distributor: Northern Natural Gas Co, id a municipal water utility: the City Water Board of S Antonio. Two firms were founded expressly to sell heang and cooling: Central Energy Corp and Ohio Energy Systns.

These companies have already investe a total of over $60 million in plants, equipment and ping. Obviously, this is big business in every sense. And it is just begun to grow. There are central plants now in th planning stage which could easily double the total investmt figure.

Although the business is new, the idc is not. It was born at the time of the New York Worlo Fair in 1940 when Dr. Willis H. Carrier predicted that vithin 25 years public utilities would be piping chilled ter under city streets to air condition buildings. Dr. Carrr, the "Father of Air Conditioning" and a founder of the company that bears his name, dreamed of entire cities air conditioned from a few central plants.

It was a dream based on common sense. New York City's Consolidated Edison has sold steam to Manhattan skyscrapers through "district heating" systems since 1882. The sale of chilled water – or "district cooling" – is a logical progression.

District cooling offers many advantages to its users. The customer is saved the initial expense of purchasing his own water cooling and heating equipment. Consolidation of all this equipment in one place naturally removes it from individual buildings, thereby centralizing maintenance, freeing space for other purposes, and moving cooling towers to areas where noise and water spray are not objectionable. A few large chillers cost less to purchase and operate than many smaller chillers. And a central plant provides increased operating efficiency and flexibility in planning.

Although utilities did not begin to sell chilled water until 1962, three years short of Dr. Carrier's goal, the first seed of the district plant concept was actually sowed the same year of the prediction. In 1940, Southern Methodist University in Dallas began operating the world's first true central plant. Other universities in the United States and Canada own or are building or considering a central plant.

Following universities in the acceptance of central plant air conditioning were multi-building complexes such as New York's John F. Kennedy International Airport. The Port of New York Authority, a non-profit governmental organization, installed a large central plant in 1957 to serve the airline terminal complex. The airlines are billed only to recover the costs of equipment and operation. The Authority began operating a similar system for LaGuardia Airport in 1964.

There have been other ventures into district cooling by non-profit organizations. The first central plant to heat and cool individual private homes was started at River Park Cooperative Homes in Washington, D.C. The plant, like the 134 townhouses and 385-unit apartment house, is owned by the residents.

One of the unique district cooling systems was turned

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on in mid-1965 at Reston, Va., the nation's most widely publicized "new town." The system supplies chilled water from a 1200-ton capacity central plant to Lake Anne Village, first of seven village centers planned for the city of Reston. (See ASHRAE JOURNAL, April 1967, p. 58, Central Utility for a New City by Alan H. Smith.)

This was the world's first "community" air-conditioning system, serving townhouses, apartments, stores and offices. The all-electric plant is operated by a privately owned public utility set up by Reston's builders under Virginia law.

Because such innovations as district cooling require time, careful engineering and customers, public utilities did not get into the cooling business until 1962. The pioneer, Connecticut Natural Gas Corp (then The Hartford Gas Co) constructed a heating-cooling plant on the edge of downtown Hartford to serve an urban renewal project and several large existing buildings.

They say nothing is as powerful as an idea whose time has come, and this was one of those ideas. With the Hartford installation leading the way, district cooling took off. These utilities are now discovering that a profit can be made on selling chilled water alone. It is no longer just a matter of selling gas. This is proven by the fact that companies other than the local gas utility have entered the business. Following is a brief summary of all 10 companies, some of them competitors:

**Connecticut Natural Gas Corp**, formerly The Hartford Gas Co, was the first public utility to enter the district cooling business. The firm still owns and operates the largest single plant of its type (Fig. 1).

William T. Jebb, then the chairman of Hartford Gas, began planning this plant in the late 1950's, spurred by announcement of an urban renewal project in downtown Hartford known as Constitution Plaza. With these buildings as the key cooling load, the company designed a central plant to be constructed on the outer fringe of the downtown area.

The plant was opened in 1962, supplying chilled water and steam through pipes buried under 3600 ft of Hartford streets. The original 6500 tons of cooling capacity grew to 11,000 tons in 1963, and by 1965 there were 15,000 tons serving 14 major customers.

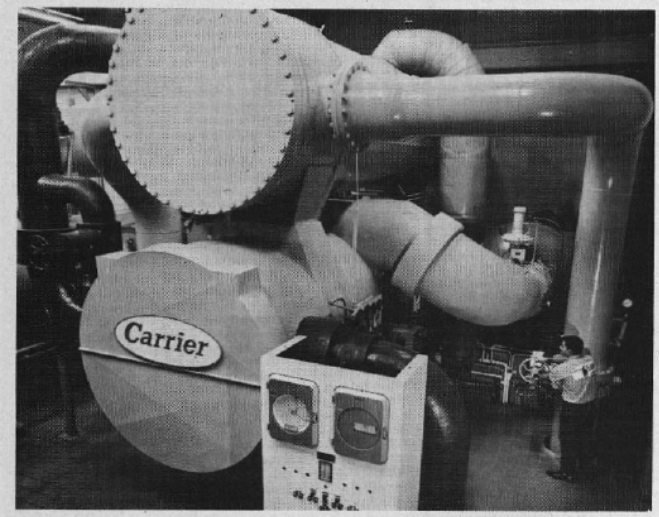


*Fig. 1 One of two 4500-ton centrifugal water chillers installed in the world's first utility-operated district cooling/heating plant in Hartford, Conn. The 15,000-ton system, owned and operated by the Connecticut Natural Gas Corp, provides chilled water and steam to 14 major customers in downtown Hartford*

Both expansions were accomplished by installation of what were then the world's largest chilling machines, two turbine-powered Carrier centrifugals of 4500 tons cooling capacity each. This further fulfilled Dr. Carrier's prediction that this business would create a demand for machines of then unheard of capacities.

Robert H. Willis, president and chief executive officer of Connecticut Natural, said his company presently has over $6 million invested in a plant that accounts for nearly $2 million in annual gross revenue. The company is planning expansions which may double plant capacity.

**Houston Natural Gas Corp** is another pioneer in the sale of chilled water. This firm began operating its first central plant in 1964 and today is building what may become the world's largest heating and cooling plant.

The first of this company's district plants serves Nassau Bay, a commercial-residential project near Houston (Fig. 2). The $100 million complex, adjacent to the National Aeronautics & Space Administration (NASA) Manned Spacecraft Center, provides office space for companies serving NASA, and living space for some of those working there.

When opened, the Houston Natural plant supplied 2000 tons of cooling capacity through a 3-mile distribution system. Today the plant has 5200 tons and nearly 10 miles of underground piping for chilled and hot water.

The system serves 10 office buildings (including one housing a back-up computer for NASA's mission control center, and another for space flight news conferences), two motels, two apartment complexes, several clusters of townhouses, a large shopping center, three churches and a warehouse.

William E. Long, vice president of Houston Natural Gas, said his company has invested about $2,750,000 in the Nassau Bay plant. The annual gross revenue is about $350,000, with additional customers to be added.

The company recently began operating a plant with a projected cooling capacity of 50,000 tons – exceeding any plant now planned – at the Texas Medical Center in Houston (Fig. 3). Initial phase of the project is a plant of 10,000 tons capacity, and an additional 5000-ton chiller has just been ordered. This first phase serves four hospitals with chilled water for cooling and steam for heating and other hospital requirements.

The plant will expand as other hospitals on the site build new additions, and as their existing cooling and heating plants require expansion or replacement.

Houston Natural's new 28-story headquarters building in Houston is equipped with the country's largest single-structure total energy system which supplies all electrical energy for the building as well as heating and cooling. The system, owned and operated by Houston Natural, is designed for expansion to provide heating and cooling for neighboring buildings in the future.

**Washington Gas Light Co.** Watergate, a $66 million luxury apartment community in Washington, D.C., is being cooled and heated from a 3000-ton central plant furnished and operated by Washington Gas Light.

Three of five planned high-rise buildings are now occupied and the fourth is under construction. When completed, Watergate will contain about 1000 cooperative apartments ranging from $17,600 to over $200,000, all cooled and heated from the district plant. The plant will utimately be equipped with 4000 tons of cooling, using 1000-ton Carrier absorption machines.

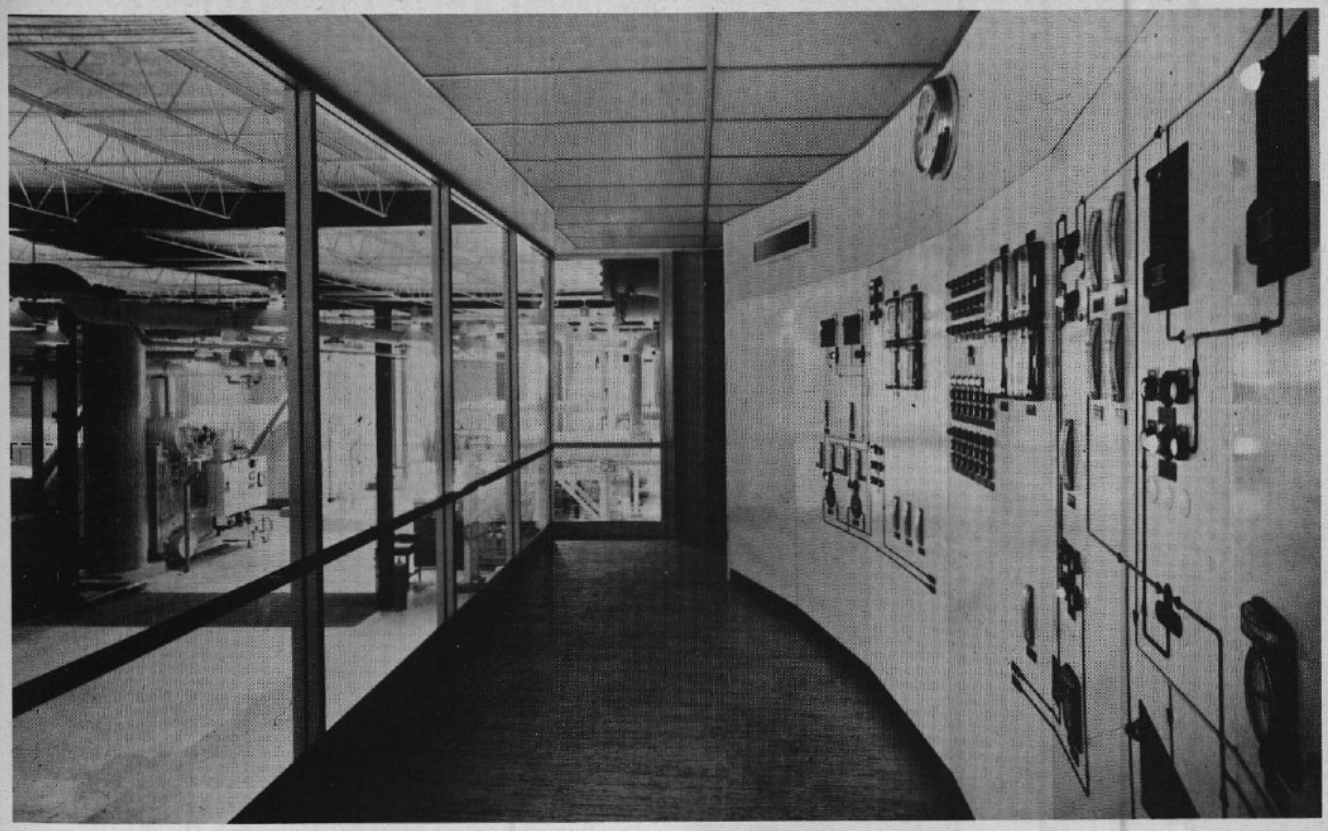

*Fig. 2 Control panel of the district plant owned and oerated by Houston Natural Gas Co at Nassau Bay, a commercial-residential project near Houston. The plant has 5200 tons of coolin capacity and nearly 10 miles of underground piping for chilled and hot water*

Richard C. Vierbuchen, vice president for mareting of Washington Gas Light, estimates the annual gross revenue from the completed plant will be about $00,000. "Washington is the richest metropolitan area in the country, and growing fast," he said. "One of these days there'll be other developers with plans like Watergæ. When they come along we'll be ready for them."

**Oklahoma Natural Gas Co** is the latest gas tility to enter the district cooling business, through a whol-owned subsidiary known as Thermal Systems Inc. Howver, the company now has two plants underway.

Under construction is a district cooling/heatin plant in the company's home city of Tulsa. The facility ill serve both new and existing buildings in the city's cental core, according to Max L. Knotts, Tulsa district vice president for Oklahoma Natural.

The $6 million first phase will include two 000-ton turbine-driven centrifugal water chillers and two 10,000-lb steam boilers, 7000 ft of distribution piping uder city streets, and a public frozen food warehouse adjacat to the central plant building. This phase will primaty serve existing buildings and will begin operating early in 970.

Knotts said the Tulsa plant will ultimatey reach 25,000 tons at an investment of $11 million. Latr phases will serve new buildings in two urban renewal projcts.

Thermal Systems' second district cooling/heang plant will be built in Oklahoma City's downtown core ea. First customers of the $3.7 million, 10,000-ton plant will be a new $22.9 million convention center built by the ity, and the 35-story Liberty Tower. The plant will be exandable to 20,000 tons cooling capacity as customers are aded.

In addition, Thermal Systems has announce interest in another 20,000-ton plant that would serve the klahoma Health Center campus, a major hospital-medic school complex planned for another section of Oklahoma City.

"The challenge of establishing these large central heating and cooling plants has been a very real one, and it has been met successfully," Knotts said. "The interest of both the general public and businessmen has increased since the announcement of our plans."

**Uni-Plant Corp:** Early in 1963 the Pacific Lighting Corp of California formed two non-utility subsidiaries to build, operate and maintain district heating and cooling plants in the southern California distribution area already served by the corporation's distributing utility subsidiaries – Southern California and Southern Counties Gas Companies.

Uni-Plant Corp was designed to serve single customers, and Central Plants Inc to serve multiple customers.

The first Uni-Plant customer was the McDonnell-Douglas Space Systems Center at Huntington Beach, Calif. (Fig. 4). Opened in 1963, the central plant was equipped with 2500 tons of cooling capacity. Early in 1966 the plant was expanded to 4700 tons, and capacity was recently increased to 8000 tons. The two-mile-long distribution system serves 15 major buildings at the 308-acre center.

Douglas, which pays only for the cooling and heating it uses, said when the plant was opened that the resultant savings in capital investment enabled the company to add one more building immediately to the research complex – a building which would have otherwise been deferred.

Uni-Plant has invested about $5 million in the Douglas plant, and has another $1.5 million in smaller projects.

**Central Plants Inc:** The second of Pacific Lighting Corp's two non-utility subsidiaries operating in this field is Central Plants Inc, established to serve multiple customers.

Central Plants currently has five projects, with a total investment of $13 million. These include a central cooling

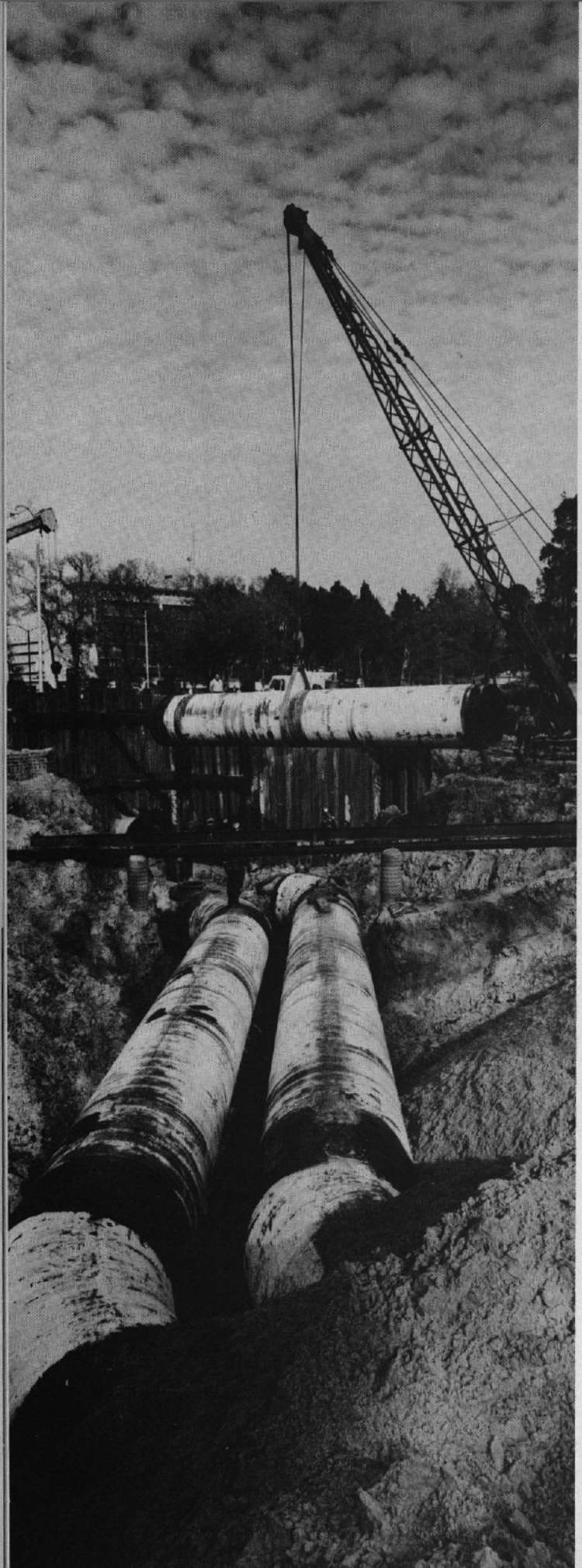

*Fig. 3 Distribution piping for chilled water to supply the Texas Medical Center from a plant operated by Houston Natural Gas Corp*

and heating plant serving Century City, a 180-acre residential-commercial project in Los Angeles. The plant presently serves a 3900-ton connected load. Another plant, with 3000 tons installed, serves the Bunker Hill Urban Renewal Project in downtown Los Angeles. A plant with 1000 tons of installed capacity serves a bus terminal-office building complex in that city.

A unique Central Plants project introduces a totally new concept in energy supply. Instead of chilled water, Central Plants is supplying −40 F ammonia, +20 F ammonia, hot gas for defrosting, steam and compressed air to a complex of food freezing and processing plants at Santa Fe Springs, Calif.

The plant, built at a cost of $4 million and equipped with four gas engine-driven centrifugal refrigerating machines totaling 5600 hp, provides all the major energy services necessary to the food industry by underground pipelines laid in 8760 ft of trench.

**Northern Natural Gas Co**, whose major business is piping, is another logical entrant in the district plant business. Northern Natural, one of the largest gas transmission companies in the country, has laid 22,000 miles of pipe from Texas and Oklahoma gas fields to cities and towns in Nebraska, Iowa, Minnesota, South Dakota, North Dakota, Illinois, Wisconsin and Michigan.

Northern Natural is now operating its first district heating and cooling plant in downtown Omaha, its headquarters city. The plant is operated by its Energy Systems Div and is equipped with an initial 12,000 tons of cooling capacity. Gas to power the plant is purchased from the local utility, and all power required in the plant is generated by gas-driven generators.

The plant and distribution system, built at a cost of about $6 million, serves a variety of new and existing buildings on a 1 1/2-mile loop around downtown Omaha, according to Leo F. Dippel, manager of the Energy Systems Div. Largest buildings on the initial phase are the 29-story Woodmen of the World Insurance Co tower and the Northwestern Bell Telephone complex which is presently being expanded.

Construction plans now under way or being discussed will eventually bring system capacity to 35,000 tons, Dippel said. Northern Natural is also actively studying other cities, some outside their distribution system, as possible sites for district plants.

**City Water Board, San Antonio, Tex.** From plain water to refrigerated water is the story of this unique, municipally owned central plant. Sparked by San Antonio's HemisFair '68 and by the desire to further encourage the city's urban renewal efforts, the City Water Board was asked by the city to construct and operate a central heating-cooling system to serve HemisFair.

The 10,000-ton plant and distribution system, costing approximately $5 million initially, yielded a gross revenue of some $1.3 million during 1968. Water Board officials foresee a gross revenue of about $700,000 annually for a 10-yr period following the fair, when another $1 million will be invested in plant and piping.

This plant is an exception to the rule of gas-powered cooling for utility-type operations. Steam is supplied by gas-fired boilers, but the five 2000-ton centrifugals are driven by electric motors.

In addition to the many permanent buildings which

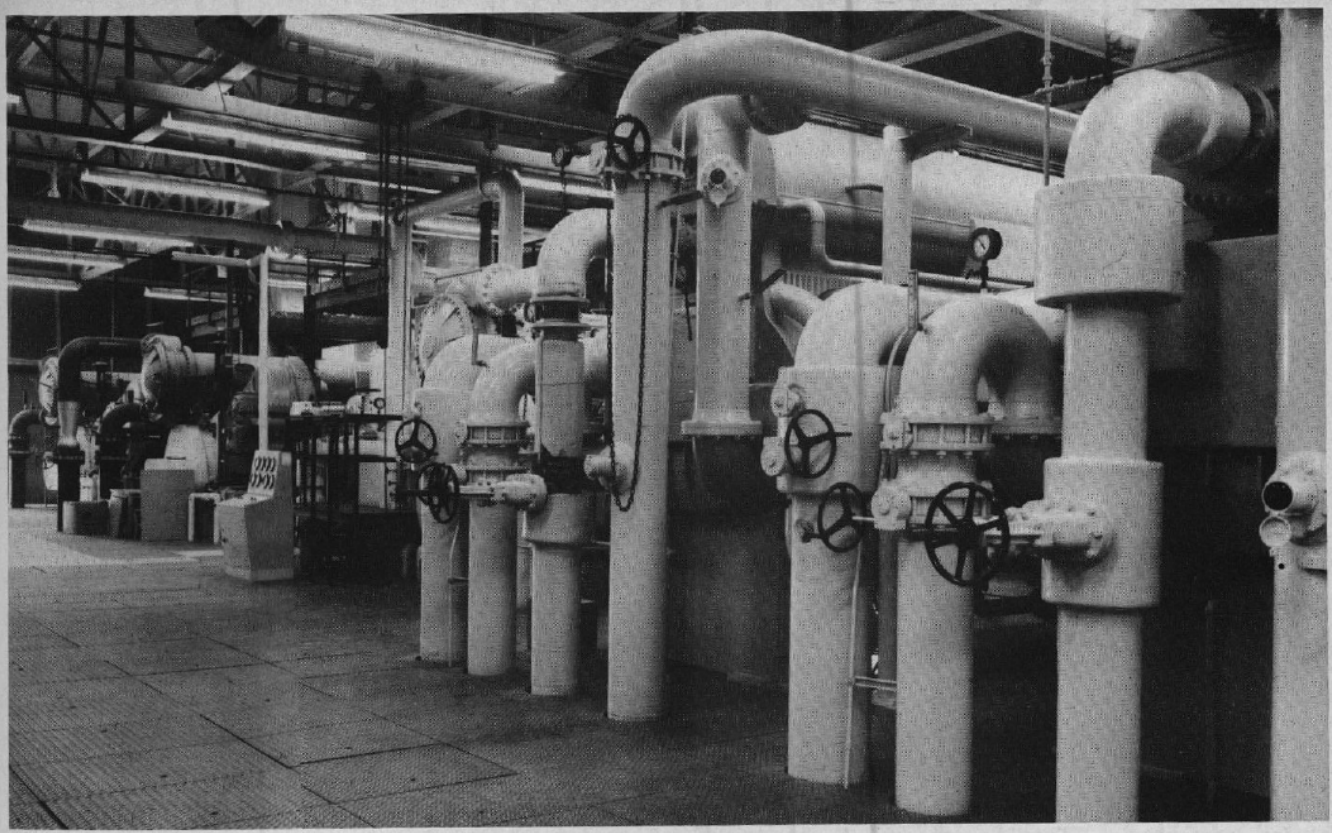

*Fig. 4 Uni-plant Corp, a nontility subsidiary of Pacific Lighting Corp, owns and operates this 8000-ton district plant for the McDonnell-Douglas Space Systas Center at Huntington Beach, Calif. The plant serves 15 major buildings on the 308-acre complex*

remain on the HemisFair si as post-fair customers, Water Board officials expect that dditional new public buildings will be constructed on the te in the future. Great interest in this new utility service also being shown by building and business owners in thedowntown area adjoining the exposition grounds.

"This new concept is rticularly well suited to major civic, commercial and busins developments," according to Robert P. Van Dyke, gener manager of the Water Board. "Customers get reliability oservice at a predictable annual cost without the problemsand costs of installing, maintaining and operating indivigal units. We feel this will be a commonplace utility operatin in many communities in the fairly near future."

**Central Energy Corp**, hose only business is district cooling, was established in 967 by two mechanical contracting firms in Dallas. Th company has obtained contracts to build, own and operate district plants for multi-building complexes in San Antonio, El Paso, Dallas and Galveston.

Central Energy, headqartered in Houston, is not limited to Texas. John Gray company president, has both national and international plas for his firm.

"The keynote of the central system is simplicity," he said. "The basis of the overa design is reliability, and the prime purpose is to furnish he quantities and qualities of thermal energy required by he customer on a continuous and reliable basis for as long a the requirements exist. Such a service can be used anywhere."

Central Energy is currenty operating a district plant at the South Texas Medical Center in San Antonio. This complex of hospitals is served by a 6000-ton plant costing over $2 million. Gray says evertual size may be 30,000 tons.

A second plant serves the University of Texas at El Paso. This 9000-student campus is initially equipped with 2000 tons of cooling at an investment of $1.5 million for Central Energy. Plant size is projected to be 7000 tons within 10 yrs.

The third contract is to provide thermal energy for the University of Texas Medical Center at Dallas. Initial size will be approximately 3000 tons at an initial capitalization of about $1.5 million. Expected expansions may raise plant capacity to 12,000 tons or more.

The company recently received a 25-yr contract to operate a district plant at the University of Texas Medical Branch at Galveston. The company purchased the existing 4000-ton plant, and will add 4500 tons more.

**Ohio Energy Systems Inc**, founded in 1967 expressly to design, build and operate district cooling/heating and total energy plants, recently received a 26-yr contract to serve the most unusual customer the young district cooling industry has to date – the Queen Mary.

The former Cunard luxury liner was purchased by the city of Long Beach, Calif. as the hub of a massive redevelopment project. It will re-open later this year as a permanently docked convention center, 400-room hotel and museum of the sea.

Ohio Energy Systems is building a land-based plant which will supply steam and chilled water to the ship through a quarter-mile-long piping system. The central plant will contain three centrifugal chillers of 2400 tons total cooling capacity, powered by natural gas engines.

Steam will be supplied by two boilers plus a recovery system which will reclaim heat from the gas engine mufflers. Engine generator sets will provide electric power to operate pumps and lights within the central plant building.

Ohio Energy Systems is headquartered in Columbus and has a branch office in Long Beach. The company has energy plants operating across the country in a variety of applications.