

DISTRICT HEATING

TOUCH ALL
THE
BASES
IN
COOPERSTOWN



THE ROCHESTER STEAM STORY

by **Robert F. Botsford**, Superintendent of Fossil, Hydro and Steam Production, Rochester Gas & Electric Corporation

For man to exist comfortably for long on the colder parts of the earth, he must have protection from the elements. Such defenses usually consist of heat, shelter, and clothing. Over the years, history has given credit to many people involved with the development of inventions and systems designed to aid in the comfort of mankind in the colder climates. An individual whose name is not easily found in any history book is one by the name of Birdsill Holly. Mr. Birdsill Holly began his experiments in 1876-77 and deserves all the credit as the first, but hopefully, not the last, to put district heating on a successful commercial basis.

Born in 1820 in nearby Auburn, New York, he became a noted hydraulic engineer and the inventor of over 150 items.

Mr. Holly eventually relocated to Lockport, New York to gain enlarged manufacturing facilities. At the time, he was producing sewing machines, flat irons, boxes, sinks, and cistern pumps. Not being an individual easily contented, he looked toward the concept of heating several dwellings from a central source.



Birdsill Holly, the inventor of district heating.

To carry out his experiments, a boiler was built in the cellar of his home at 31 Chestnut Street. The grate was made of steel sheet with holes drilled in it. Pipe coils containing water were used for heat col-

lection, and the steam was sent to a distributor in the attic of his home. From the distributor, the steam was sent to the various rooms with the condensate returning back to the basement. This system operated at approximately 10 psi pressure.

Mr. Holly then decided to learn if steam could be transported for greater distances underground. He buried 500 feet of one inch line in his and adjacent lawns. He successfully began furnishing heat to nearby homes. The iron pipe was wrapped with asbestos, felt, and manila paper and tied with twine. It was buried approximately 3½ feet deep in a wooden box 10" x 12", filled with sawdust.

This experiment being a success, Mr. Holly decided to start a heating utility in Lockport. He raised \$25,000 and organized the Holly Steam Combination Company. A franchise was secured and steam service began in October, 1877, when 14 customers were connected on a 30 psi system.

Information spread rapidly of district heating developments in Lockport.

In nearby Rochester, steam for heating buildings and other uses began in 1889 when this community became the third in the nation to have this service. The steam system began as a cogeneration approach—years after the start of the electric operations in Rochester.

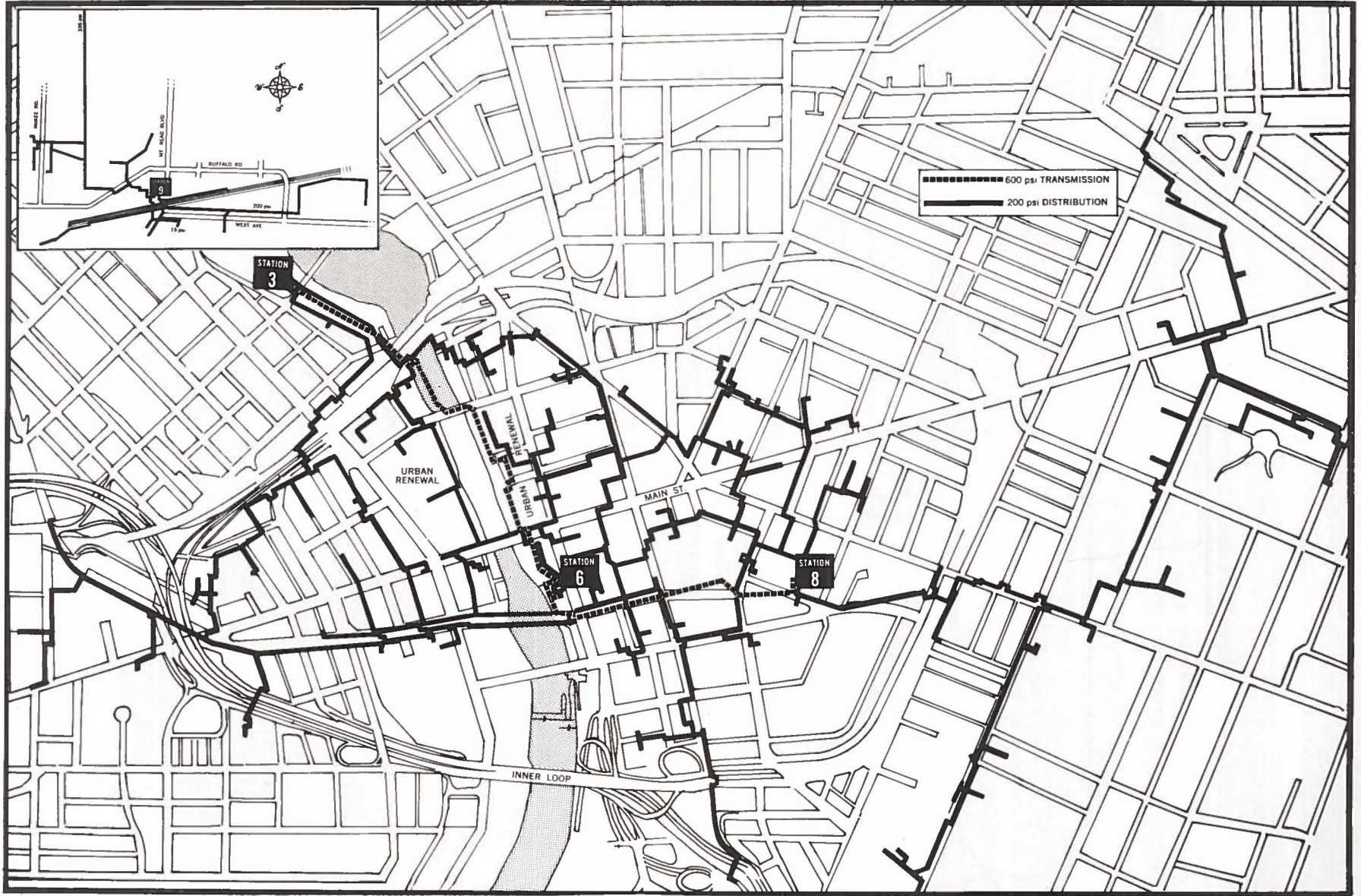
Steam from the old Edison plant near the Erie Canal at Exchange Street was being sold to nearby buildings, stores, and taverns. This early service was augmented by the erection of Station #2 at the base of the upper falls. However, the procupine boilers of Station #2 have long given way to the boilers at Stations #3, #8, and #9.

The construction of Stations #8 and #9 in the mid 20's was the beginning of the growth years for the Rochester system. Various private steam plants were also purchased and became known as Stations #11 and #35. These last two stations have long been abandoned with their systems being connected back to the downtown district.

Coal was the fuel used up to the 1970's at the three steam stations. At this point in time, governmental concern and regulation in regard to the effluents from stack emissions would necessitate that R.G.&E. spend considerable sums to upgrade the pollution control equipment at the stations.

An economic choice was made at this time, rather than to spend additional dollars on air pollution control equipment and perhaps other structural changes, it was decided to convert the coal-fired boilers at Station #3 and #9 to No. 6 oil, while converting the boilers at Station #8 to gas.

It can be remembered that the very reason R.G.&E. grew as it did in the past, was the fact that they were



ROCHESTER STEAM SYSTEM

able to eliminate many individual sources of pollution. With the Steam Department on one hand taking credit for a cleaner downtown, on the other hand, they now have to accept a new governmental charge that the new air pollution standards of the day were now being violated. Hence, the conversions at Stations #3, #8, and #9 occurred.

Presently, all boilers at Station #3 that can supply steam to the steam system burn No. 6 oil. The three boilers at Station #8 burn natural gas at present and at Station #9, two boilers are on No. 6 oil and the remaining three are natural gas fired.

What are some of the problems seen in the plants today? The number one problem and concern is the "State of the Art" existing today to burn No. 6 oil in boilers located at plants which are surrounded by literally acres of parking lots. Basically, it sounds like burning oil should be easy. It is done in homes without R.G.&E.'s location problems and certainly, it seems that it has to be easier than burning coal. It is easier, but, the No. 6 oil that is used at Stations #3 and #9 is far different than the No. 2 oil that is used in a small basement oil burner. Primarily, it is the sulfur in the oil, that when burned with the necessary excess air, can eventually form SO₃. The SO₃ can further combine with water vapor and ash to produce a substance known as "acid smut."

The formation of this acid has caused many problems internally in the boiler air heaters, breechings, and stacks. However, the biggest problem occurs when this acid clings to the ash particle and settles on someone's automobile. This has caused great concern and additional work for management, public relations, the Claim Department, and all personnel in station operation and maintenance.

Are there any other problems at the plants? From an equipment point of view, perhaps the fact that boilers installed in the 1920's at Station #8 and #9 are still in seasonal operation. Boilers installed at Station #3 during the 1930's and 40's are in daily operation. These boilers are still reliable and can operate for years into the future. However, it must be recognized that they do not have an indefinite life. There is also concern about the fuel that is being used today. Should R.G.&E. be using oil, gas, or convert back to coal, or burn R.D.F.? Many variables are involved, and it is not clear what direction should be taken at this time.

With this question left in mind, let's leave the production of steam behind and look at the transmission and distribution system beyond the boiler room walls. The distribution system is referenced to, as either belonging to the Station #3 district, the Station #8 district, or the Station #9 district. It goes without too much imagination, that the steam district was so identified as to indicate the source of its steam.

Station #9 and its steam district was formed in the mid 20's with the construction of the station. The

system was designed to provide an ample supply of steam to be used in an area on the west side of Rochester, soon to be industrialized. The customers presently served are situated in two areas of development. They are located along West Avenue and range from Taylor Instrument Co. to the Pflauser Corp. Also served is a concentrated area bounded by Mt. Read Boulevard and McKee Road with a high pressure line spanning Route 490 West supplying the Delco Division of General Motors.

Steam is distributed from Station #9 at one of the three pressures; either 335, 180, or 15 psi. The 15 psi low pressure steam, which feeds only G.R.S. and the Eastman Kodak Company is supplied from the topping turbine. 6,897 MWH of electric energy was generated in 1980, and such by-product or co-generation efforts are very much in accord with the current discussion of the day.

Presently, there are only 21 customers in this district, which is approximately 8 percent of the 271 total in our R.G.&E. system. Yet, for the year 1980, this 8 percent of the customers accounted for 39 percent of total company steam sales.

The Station #3 district in 1930 was known as the factory district, and today, still continues to serve many large customers in the area. Steam for distribution to the existing 29 customers is supplied from exhaust of its topping turbines. Generation from these turbines in 1980 totaled 41,470 MWH.

Some of the customers served presently include the Genesee Brewery, Case Hoyt, Bausch and Lomb, Eastman Kodak office, and the Peter's Shoe Store. Incidentally, the Peter's Shoe Store recorded a consumption of 65.7 M lbs. in 1980 and provided revenue of \$1,053 and probably is the smallest customer on our total system. In contrast, the Genesee Brewery purchased 326,631 M lbs. in 1980 and contributed \$3,044,890 to our revenue.

From the factory district, we turn to the Station #8 business or downtown district. This is where it all began, and perhaps someday, where it all might end!

This district generally enjoyed steady growth from the 20's through the mid-60's. The distribution lines presently supply as far west as Litchfield Street, which was in the former Station #35 area, and as far east as Goodman Street at College Avenue. This was the former Station #11 area acquired around 1929.

A 15 psi low pressure system blanketed much of the downtown area, and through the 1940's provided an appreciable amount to the electric generation base. This low pressure system extended as far east as the Medical Arts Building, which was added as a new customer in 1930. However, because of the construction of the Inner Loop at East Avenue, a high to low reducing station now meets their steam requirements. The low pressure has generally disappeared with changes, due to redevelopment in the downtown area. What was to remain, and change—and shift, with development would be the present 200 psi high pressure system.

Noted changes and additions were made after World War II. Most notably, with steam sales increasing, the additional demand placed on Station #8 was somewhat straining the facility. In 1946, construction began on a high pressure transmission line from Station #3 supplementing the Station #8 downtown system and connecting at Station #6 on Water Street. An additional line was installed in 1950, via Allen Street, which continued to provide for steam generated at Station #3 to be supplied to the Station #8 system.

As the lines steadily reached out from Station #3 and gradually assumed the responsibilities of a growing dynamic system, customer numbers steadily increased, peaking out to a number well over 600. In January, 1963, an all time one hour sendout peak of 1,331,000 lbs. of steam was experienced. It appeared as though there was no end in sight.

And then, something happened—gradual at first, but a change which was felt to be good for the city and could only have a positive effect on the Steam Department. This change was called, "Urban Renewal," that well meaning, grandiose dream to restore and revitalize America's decaying urban centers. The idea was well meant, but like many government programs—not always too well thought out.

It is an undisputed fact that district heating is an efficient method of heating in high density area. Urban Renewal destroyed this important high density factor, creating large areas of open space, and thereby creating the conditions that have led to the gradual decline of this form of energy in almost every city that was fortunate enough to have such a system to begin with.

In the development years of this country, even as today, power was one of the most important ingredients for the growth of commerce and trade. In the early days, it was water power, and the fastest growth and the largest cities blossomed and flourished where water power was available.

This means, of course, that the oldest areas of a city were to be found along the banks of the rivers which attracted them.

In Rochester, Urban Renewal began in a two square block area, one block on each bank of the Genesee River in the heart of the city.

This two block area contained 52 steam customers. What was to be the start of the rebuilding of Urban Rochester was also the start of the decline of our steam system.

On the east bank of the river, a section of the 650 psi transmission line and a major 8" distribution line in the area between Andrews Street and Main Street had to be relocated. This was completed to accommodate the Crossroads Park and the Holiday Inn at a cost in excess of \$200,000.

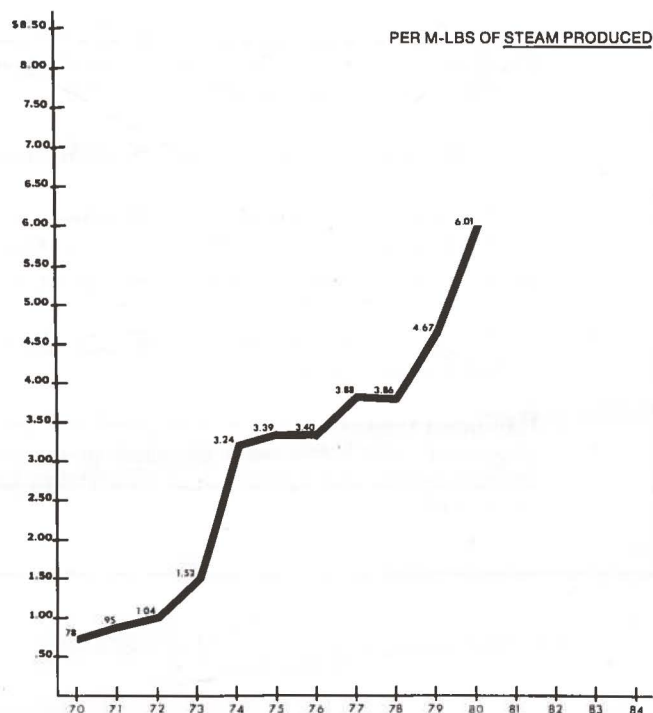
Five years ago, when Water Street was reconstructed from Main Street south to Ely Street, another section of these lines had to be encased in

concrete at an additional expense. Not one penny of these expenses added any overall increased sales nor improved service to R.G.&E. customers. In fact, customers were lost in the process. All that these expenses succeeded in doing was to add to the capital base, which eventually is reflected in increased rates to the customers.

Before Urban Renewal, Rochester's steam system served 621 customers and was growing steadily. It was the fourth largest system in sales in the United States. Eighteen years after Urban Renewal entered the picture, the system now serves 271 customers and is steadily declining. R.G.&E.'s system is now the sixth largest in the country and the sendout peak this past winter was approximately 58 percent of the all time peak experienced in 1963. The fact that R.G.&E. has lost over 55 percent of its customers and yet have slipped only two places in relationship to other cities, indicates that the decline of this important source of energy has not been restricted to Rochester. It has been the general, and regrettable, trend of the entire industry.

With the battle of Urban Renewal behind them, it might appear that perhaps, so too, were R.G.&E.'s troubles. This is definitely not the case! They have continued to experience a decline in customers because of conversions to alternate fuels. Shortly after the stations converted to No. 6 oil from coal, the foreign suppliers tested the waters and found that they had a commodity which appeared to be unrealistically underpriced. Oil prices increased from the \$4 to \$5 range per barrel to its present high of approximately \$35, and overall fuel cost of production has changed from \$.80 per Mlbs. produced to approximately \$6 in 1980.

FUEL EXPENSE



Percentage-wise, the fuel component in a pound of steam has increased dramatically and has been the determining factor in customer decline and sales. Another area that has also had an affect, similar to the effect felt in the gas and electric divisions, is just plain energy conservation. With the price of steam increasing, customers have increased maintenance efforts to reduce steam losses and have allowed the thermostats to be set lower.

Similar situations are being encountered in cities such as New York, Philadelphia, Detroit, Boston, and Cleveland. Oblivious to all of this is Indianapolis, the fifth largest steam company and steadily growing. Indianapolis never converted from coal and experience fuel costs of a third of R.G.&E.'s cost. They are in an envied position as a steam company and are content to watch from the sidelines.

THE FUTURE

What's going to happen to Rochester in the future? You can bet that it will be the same thing that happens in the other major cities that were mentioned. The previous problems discussed are *not* unique to Rochester, and as the district heating industry enjoyed the good years, so must the answers to the current dilemma and joint problems be found. Basically, we are faced with an energy crisis that is

not going to disappear very soon. Aside from finding new sources of energy, a task which is long-term at best, everyone agrees that we have to stop wasting what we have. It is believed that given the right set of circumstances, district heating can provide a significant amount of fuel conservation. Unfortunately, because of district heating industry's small size, regulatory constraint, people's indifference, and a tendency for us in the industry to have spent the last few years mostly talking to ourselves, the concept has failed to assume an appropriate role in our national energy scheme. National attention has now somewhat focused on the needs and potential for district heating. Today, our national energy agencies and numerous national research laboratories, such as Oak Ridge and Brookhaven, are involved in studies to combine electric power production with district heating on a scale never before contemplated. Agencies are debating the use of hot water rather than steam in the distribution facilities.

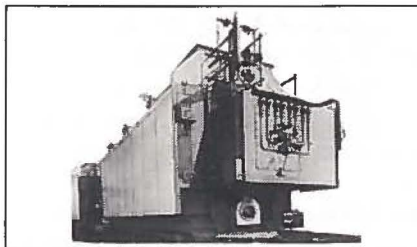
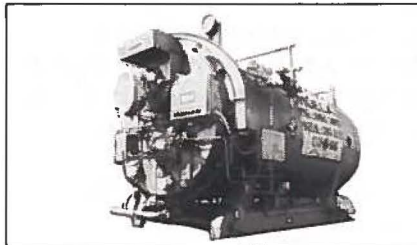
We in the industry, might be quick to say, "Oh, that will never work, because of the costly system and pumping costs." Perhaps, we haven't opened our minds to fairly access the value of various concepts for different situations. One thing that we know will work, and not to be overlooked for too long, is the potential for using the energy derived

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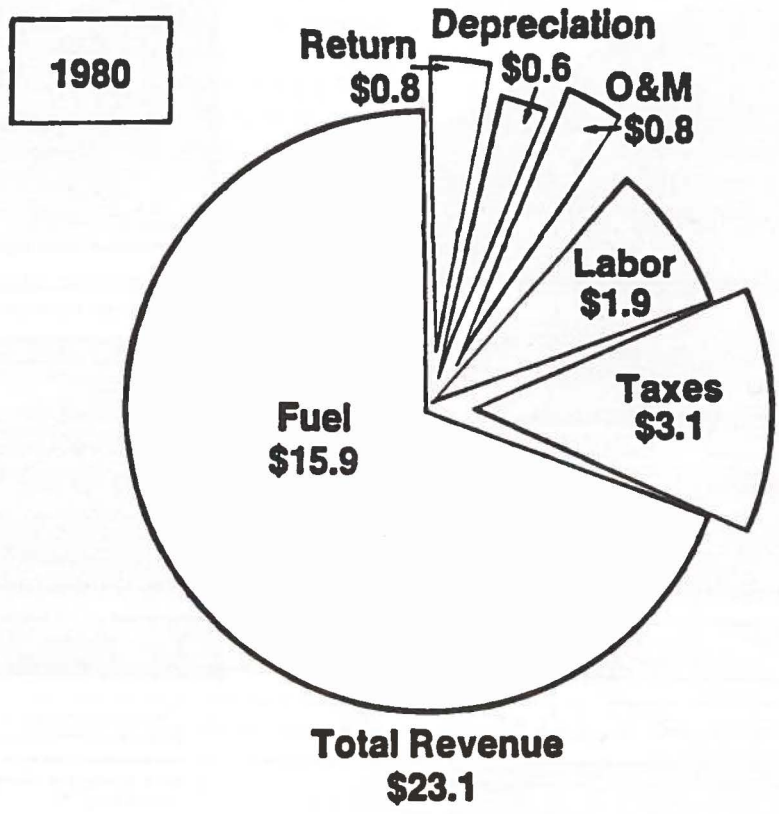


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Looking at the RG&E Steam Department revenue dollar*



*Dollar figures given are for millions of dollars.

	<u>1972</u>	<u>Estimated 1980</u>
Fuel	\$4.5	\$15.9
Taxes	1.3	3.1
Labor	1.1	1.9
O&M	1.4	0.8
Depreciation	0.5	0.6
Return	0.4	0.8
Total Revenue	9.2	23.1

from burning trash and refuse derived fuel (R.D.F.). At R.G.&E., R.D.F. will be used at Russell Station for supplemental firing in the boilers generating steam for electric production. In the future, R.D.F. will be part of the answer to undercut the fuel costs involved with district heating in the United States. This is not to say that there are not problems with burning R.D.F. There are probably more problems that we can easily visualize; and reluctance to meet these head on, has in general caused the slow development of this concept on an actual operating basis. The future is wide open for improved energy utilization in this area.

Yes, the road ahead is indeed difficult. Rising fuel costs, financial burdens, customer concerns and hostility loom ahead of us; but, such is the case for all utility and energy operators. There are no easy answers. District heating and the Rochester steam system was born out of need and concern for man's economic and physical comfort. Which direction and how successful Rochester is depends on many factors not in the control of the company. Whatever happens in the future, whatever direction, will be the result of R.G.&E.'s total awareness and concern for man and for his efficient use of his resources making for a better environment.

OAK RIDGE NATIONAL LABORATORY ROCHESTER STEAM SYSTEM

Preliminary findings of this review suggest, among other things, that refuse-derived fuel or RDF be used as a lower cost fuel for generating steam. Federal grants called Urban Development Action Grants (UDAG) do exist for such an undertaking, but only for 20 percent of the capital cost of such a project. It is R.G.&E.'s feeling that such a capital project could be practical only if a grant to cover the total cost of the project could be obtained.

The study also recommended that R.G.&E. study in more detail a method for obtaining steam from a coal-fired electric generating unit at the Beebe Station. The problem with that recommendation is that the electric generating capacity of the unit would be reduced and again would require considerable investment. However, R.G.&E. is seriously investigating this suggestion.

Another suggestion was to consider the creation of hot water islands in downtown Rochester for space heating. These islands could ultimately be connected to R.G.&E.'s system, after converting it from a steam system to hot water system. In an expanding system, the concept of heat islands makes sense. But in an area that is just trying to "hang in," it's difficult to see any potential for the concept.

The economic realities on the long term prospects for the steam system don't give much cause for optimism. But R.G.&E. does intend to provide steam service as long as it has enough customers to justify continuing operations and hope that time will provide for a restabilization of the R.G.&E. system.

R.G.&E. STEAM DEPARTMENT REVENUE DOLLAR 1972 - 1980

Fuel expenses have nearly tripled, up to \$14.3 million from \$4.5 million in 1972 due to a large extent to the need to convert from coal to oil in 1973.

Taxes have gone up about 2½ times.

Labor costs have increased moderately when balanced against the inflation of this period. One way this has been possible is due to a reduction in staff employed in our steam operation. R.G.&E. has reduced its staff 25 percent in the Steam Department.

Operation and maintenance expenses have been reduced sharply because of many changes we have made to improve our operations. There is no real potential for additional large savings in this area.

Depreciation expense and cost of money are minor expenses.

While the customers are having to pay more for steam, all investors see is a sharply reduced return.

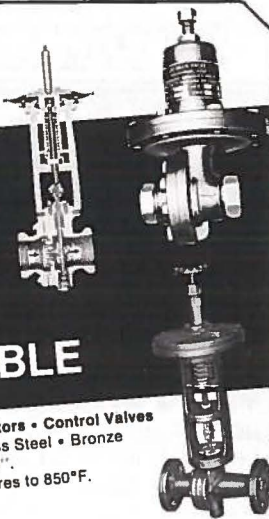
ROCHESTER STEAM SYSTEM

Remains committed to:

- 1) retaining the benefits of a Rochester steam system as long as it can be economically viable;
- 2) a strong concern for the well-being of steam customers and the impact of rising costs on those users.


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