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DISTRICT HEATING FEASIBILITY STUDY FOR JAMESTOWN, NEW YORK, PHASE TWO

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DISTRICT HEATING FEASIBILITY STUDY FOR
JAMESTOWN, NEW YORK

PHASE TWO

FINAL REPORT

Prepared for

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ABSTRACT

This document presents the results of the second phase District Heating Feasibility Study for Jamestown, N.Y. The study takes an in-depth look at a hot water district heating system using the Jamestown municipal electric plant as the heat source and the downtown area as the primary load. The study considers phased expansion to outlying areas. This second phase study was performed in light of the findings of a first phase district heating study which determined that district heating was technically and economically feasible in Jamestown.

The objective of this second phase study is to perform a detailed assessment of district heating and present the findings to the City in sufficient detail to serve as a basis for deciding whether or not to proceed with final design and construction of a district heating system. The study assesses the technical, financial and institutional feasibility of the system, recommends system ownership and financing strategies, develops a phased implementation plan, identifies prospective users and analyzes potential user performance from both a technical and economic point of view

The study concludes that a municipal district heating system financed with municipal bonds could be developed in Jamestown to economically supply heat to the downtown area and the industrial corridor. The study shows that district heating could successfully compete with alternate fuels, allowing most customers to recover their district heating retrofit costs in three to four years.

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The study was conducted by the Power Technology Division of Burns and Roe under the supervision of Dr. Ishai Olikier. The following members of Burns and Roe's staff contributed substantially to the performance of the study: W. Buffa, A. Farmer, W. Major, B. Shaikh and F. Silaghy.

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SUMMARY

The results of the second phase feasibility study for district heating in Jamestown, New York conclude that a district heating system can be constructed that will be self supporting. The system will deliver thermal energy at a rate that will allow most customers to recover their conversion costs in four years or less. The study presents a phased development for the system as well as a pilot project. It is recommended that the City of Jamestown, through the Board of Public Utilities, implement the construction of the first phase of development in 1985. Hot water district heating is an economic energy alternative that the City of Jamestown should commit to.

HEAT LOAD ASSESSMENT

The study develops the district heating system in phases. The heat load assessment results have been presented by development phase. The heat load assessment identifies the entire load that is retrofittable to district heating. Since it is likely that a portion of the identified load for each phase will decline to convert to district heating, capacity factors have been applied to the heat load for the purpose of performing economic analyses and projecting actual system performance. The heat loads for the different implementation phases are presented below. Capacity factors have been used in determining these loads.

Phase I	-	Core Area	-	12.96 MWt
Phase II	-	Saturated Core Area	-	16.50 MWt
Phase III	-	Saturated Core + Ind. Corr.	-	30.7 MWt
Phase IV	-	Saturated Core + Ind. Corr.		
		+ Outlying Areas	-	76.20 MWt

HEAT SOURCE ANALYSIS

Several power plant retrofit alternatives have been investigated, and a heat source development plan has been designed to support the phased development of the system. The heat source development plan has been designed to involve minimal changes to the existing electric plant and to result in no permanent loss in electrical generation capacity.

The first-phase retrofit will involve the installation of a new district heating condenser in series with the existing Unit 6 auxiliary heat exchanger. The new condenser will be base loaded, supplying the district heating load from 0 to approximately 7 megawatts thermal. The new condenser will operate on steam from the up-to-now blanked off 11th stage turbine extraction. The auxiliary heat exchanger will supply the load from 7.0 MWt to the peak load of 12.96 MWt. The auxiliary heat exchanger will operate with steam directly from the boilers. The plant retrofit will also required the installation of four district heating circulating water pumps, steam piping, water piping, control valves and a combined head/expansion tank. The completed first phase retrofit will have a rated capacity of approximately 26.0 MWt. This results from the large capacity of the auxiliary heater. However, this is limited by a pumping capacity of approximately 19 MWt.

The second phase of heat source development builds on the first by incorporating the Unit 5 auxiliary heater into the district heating cycle in parallel with the Unit 6 auxiliary heater. This addition does not increase the rated capacity of the heat source but does increase the operating flexibility of the plant. The second phase development also involves the installation of additional pumping capacity that allows the full heat generation capacity of 26 MWt to be utilized if required. The first phase pumping capacity is limited to approximately 15 MWt.

The third phase of heat source development involves the installation of a new cogeneration steam turbine cycle to the Steele Street Plant. This development phase is based on the assumption that the utility will be installing new electric capacity at the plant. The new thermal capacity associated with the cogeneration cycle could have a thermal capacity as high as 80 MW. This new capacity would be used to supply the heat load of the industrial corridor and other outlying districts. The new cycle would be run a partial load in parallel with the initial heat source retrofits or at full load in place of the initial heat source retrofits. The heat source development phases are summarized in Table S-1.

PIPING SYSTEM ANALYSIS

The piping system developed to deliver hot water to the Jamestown district heating customers is a two-pipe closed system. The system will be installed below sidewalks wherever possible. The system will have a peak load supply temperature of 250°F and a peak load return temperature of 160°F. The design operating pressure of the system will be 200 psi. The pipe design used will be that of a prefabricated insulated conduit. The conduit will consist of a carbon steel carrier pipe, polyurethane insulation, a polyethylene casing and a leak detection system. The initial phase of development are designed with excess capacity to facilitate expansion. The piping system development is summarized in Table S-2.

FINANCING ANALYSIS

In light of the recommendation to pursue municipal ownership of the system, municipal tax exempt financing is recommended. Under present interest rates, savings on Floating Fixed-Rate Bonds or "lower floater" type instruments compared to fixed-rate long-term bonds could be as significant as 400 basis points. However, the requirement for a letter of credit during the floating period of the bond reduces such savings by a least 100-150 basis points. The approach of a floating fixed-rate bond should be considered during the initial financial planning for the district heating project. This approach will result in a bond rate of approximately 7 percent.

ECONOMIC ANALYSIS

An economic analysis of the system has been performed to determine the cash flow for the district heating system and the cost of district heat. The results of the analysis for municipal system ownership and a floating fixed-rate bond at 7 percent are presented in Table S-3.

PILOT PROJECT

A pilot project has been designed for the Jamestown district heating system. The objective of the pilot project is to develop a limited district heating system by implementing a small portion of the full-scale plans incurring minimal expense. The pilot project will demonstrate the district heating concept in Jamestown, provide a learning tool for the utility and generate public enthusiasm all at minimal risk.

Table S-1
HEAT SOURCE DEVELOPMENT

	<u>Phase I</u>	<u>Phase II</u>	<u>Phase III</u>
Rated Thermal Capacity, Mwt	19.0	26.0	80.0
Estimated Installed (1984 Dollars x 10 ³)	633	157	2,473

Table S-2
PIPING SYSTEM DEVELOPMENT

	<u>Phase I</u>	<u>Phase III</u>	<u>Phase III</u>	<u>Phase IV</u>
Transmission Piping (Mi)	3.34	0.21	2.18	5.63
Distribution Piping (Mi)	0.96	0.94	0.12	4.08
Total Piping (Mi)	4.30	1.15	2.30	9.71
Installed Costs (1984 Dollars)	2,558,000	394,000	1,789,000	5,330,000

The pilot system design incorporates a portion of the first phase plant retrofit as the heat source by using the Unit 6 auxiliary heater for heat generation. The heat load is of a small group of representative customers close to the power plant consisting of Jamestown General Hospital, Jamestown Plywood Corporation, the Board of Public Utilities Warehouse and the Department of Public Works Garage. The transmission system consists of approximately 1200 feet of 12-inch pipe (size has been determined by fully developed system) and approximately 1000 feet of distribution piping ranging from 1 1/2 to 3 inches.

Approximately four months are required to implement the pilot project.

Table S-3
ECONOMIC ANALYSIS RESULTS
Bond Rate 7%

	<u>Phase 1</u>	<u>Phase 2</u>	<u>Phase 3</u>	<u>Phase 4</u>
Implementation	1985	1986	1989	1991
Peak Load (MWt)	12.96	16.50	30.70	76.20
Annual Sales (MBtu)	117,309	144,929	253,614	508,917
Investments (1984 Dollars)				
Power Plant	\$ 633,000	157,000	2,473,000	0
Piping	<u>2,558,000</u>	<u>394,000</u>	<u>1,789,000</u>	<u>5,330,000</u>
Total	\$3,191,000	551,000	4,262,000	5,330,000

UNIT COST OF HEAT
(\$/MBtu)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1. Fixed Expenses	\$3.15	\$2.96	\$2.89	\$2.83	\$4.08	\$3.99	\$3.71	\$3.63	\$3.54	\$3.46
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$1.44	\$1.55	\$1.82	\$1.96	\$2.10	\$2.26
3. Operating Expenses	\$1.27	\$1.39	\$1.48	\$1.57	\$1.24	\$1.33	\$1.19	\$1.28	\$1.38	\$1.48
4. Gross Receipts Tax	\$0.59	\$0.57	\$0.56	\$0.57	\$0.71	\$0.70	\$0.67	\$0.67	\$0.66	\$0.66
5. Reinvestment Fund	\$0.73	\$0.72	\$0.74	\$0.76	\$0.83	\$0.84	\$0.82	\$0.84	\$0.85	\$0.87
	<u>\$7.33</u>	<u>\$7.22</u>	<u>\$7.37</u>	<u>\$7.60</u>	<u>\$8.30</u>	<u>\$8.42</u>	<u>\$8.21</u>	<u>\$8.37</u>	<u>\$8.54</u>	<u>\$8.73</u>

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. Fixed Expenses	\$3.38	\$3.29	\$3.21	\$3.13	\$3.04	\$2.96	\$2.88	\$2.79	\$2.71	\$2.63
2. Replacement Electricity	\$2.43	\$2.61	\$2.81	\$3.02	\$3.25	\$3.49	\$3.75	\$4.03	\$4.34	\$4.66
3. Operating Expenses	\$1.59	\$1.71	\$1.84	\$1.98	\$2.12	\$2.28	\$2.45	\$2.64	\$2.84	\$3.05
4. Gross Receipts Tax	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.67	\$0.68	\$0.69	\$0.70
5. Reinvestment Fund	\$0.89	\$0.92	\$0.94	\$0.97	\$1.01	\$1.04	\$1.08	\$1.13	\$1.17	\$1.22
	<u>\$8.95</u>	<u>\$9.19</u>	<u>\$9.46</u>	<u>\$9.75</u>	<u>\$10.08</u>	<u>\$10.44</u>	<u>\$10.83</u>	<u>\$11.27</u>	<u>\$11.74</u>	<u>\$12.26</u>

Section 1

INTRODUCTION

The Jamestown district heating project began in October 1981 as a preliminary feasibility study financed by the New York State Energy Research and Development Authority. The goal of the study was to determine if a hot water district heating system could be designed to economically supply the downtown area of Jamestown with thermal energy from the municipal electric plant. The results of the study were that district heating was technically feasible and economically attractive in Jamestown. In light of the favorable results, a comprehensive second phase study was contracted to bring the City to the final decision point as to whether or not to proceed with final design, financing and construction of the system. This report presents the results of the second phase study.

The objectives of this second phase study were to: Perform an engineering reference design to serve as the basis for financial analysis, marketing, final design, engineering and bid specification; market district heating to potential customers; prepare the basis for the financial instruments for project financing; and develop a project implementation plan. The work completed in developing the engineering reference design includes the identification and assessment of the core area heat load, design of a power plant retrofit, design of the piping system required to connect the heat source with the heat load, development of individual building retrofits to accept district heat and development of cost estimates for the power plant retrofit, piping system and customer retrofits.

Based on the favorable results of the second phase study, a pilot project has been developed and is presented in Section 11.

Section 2

HEAT LOAD ASSESSMENT

INTRODUCTION

This section presents the results of the heat load assessment performed to complete the feasibility study for district heating in the City of Jamestown. Peak and annual potential district heating loads have been determined for the core area, saturated core area, and outlying districts.

Stage 1 of the Phase II feasibility study effort identified 19 buildings in the core area for which heat loads, conceptual retrofit designs, and conversion cost estimates were developed. Seventeen of these buildings provided the basis for the recommended Stage 1 distribution network in the core area, the design of which allowed for expansion within the core area and to outlying districts.

Additional buildings to be studied as prospective district heating customers were chosen on the basis of annual energy consumption, adaptability to hot water district heating, and location with respect to the recommended Stage 1 distribution network and expansion alternatives thereof.

Quantifying the district heat demand for satisfying prospective customers' comfort, process, and domestic hot water heating loads was primarily based on the analysis of fuel consumption records in conjunction with site specific parameters and energy use characteristics. Natural gas is the fuel type used by most facilities.

APPROACH AND METHODOLOGY

In order to determine the heat load of prospective customers and, in turn, prepare conceptual designs of the necessary conversion work and associated cost estimates, a survey of building heating, process, and domestic hot water systems was conducted. Copies of engineering drawings and equipment specifications were obtained where available. Where drawings/specifications were unavailable, sketches were made and equipment/systems data collected as necessary to provide a sufficient basis for accessing the loads adaptable to district heating and to develop retrofit designs and conversion cost estimates. Fuel consumption records of the buildings were obtained for the purposes of the heat load assessment.

Quantifying the heating demand for each building was primarily based on the methodology outlined in the Phase I study report. This methodology analyzes fuel consumption data in conjunction with site-specific parameters in lieu of the less accurate method requiring detailed information on construction types, U-values, wall and roof areas, fenestration, etc. Based on fuel consumption records for a consecutive 12-month period, both average annual and peak hourly district heating loads were determined for comfort heating and internal uses such as domestic hot water and process systems.

Methodology used for determining building heat loads is highly dependent on the accuracy of fuel-records analyses.

- o TI1 - indoor design temperature setting during normal hours
- o TI2 - indoor design temperature setting during setback hours
- o TR1 - indoor temperature gain due to internal heat sources (lighting, people, equipment, etc.)
- o TR2 - indoor design temperature gain due to internal heat sources during setback hours
- o HR1 - average number of normal hours per week
- o HR2 - average number of setback hours per week

A tabulation of this data for each of the buildings evaluated is presented in Table 2-1 for the core area and in Table 2-2 for the additional buildings comprising the saturated core area.

The comfort heating loads determined for all buildings are based on a 3°F outdoor design temperature as defined by ASHRAE for Jamestown. Estimated heat usage rates for purposes other than comfort heating (i.e., domestic hot water, process) were assumed constant throughout the year and for the most part occur during normal hours only. This internal heat-use rate was determined based on fuel consumption in summer months judged to reflect non-comfort heating use throughout the year. Peak heat loads for comfort heating were determined based on knowing the heating degree days (HDD) for the heating season in which fuel records have been obtained and adjusting the HDD to account for the site-specific parameters noted above.

TABLE 2-1
INITIAL CORE AREA BUILDINGS SITE-SPECIFIC PARAMETERS

BUILDING	Indoor Temp. Normal TI1 (°F)	Indoor Temp. Setback TI2 (°F)	Internal Gain Normal TR1 (°F)	Internal Gain Setback TR2 (°F)	Normal Hours HR1 (hrs/wk)	Setback Hours HR2 (hrs/wk)
Federal Building (Post Office)	68	55	0	0	152	16
Mail Processing Areas	68	55	0	0	54	114
Administration/Offices Areas						
Unigard Insurance						
Occupied Areas	72	55	5	0	60	108
Non-Occupied Areas	-	55	-	0	-	168
Jamestown Plywood Corp.	65	50	10	0	60	108
YWCA	68	55	5	0	63	105
YMCA	68	-	5	-	168	-
City Hall	72	-	5	-	168	-
Chautauqua Hardware Corp.	70	70	10	0	50	118
Jamestown Boys Club	72	65	5	0	91	77
Jamestown General Hospital	72	-	5	-	168	-
WCA Hospital	72	-	5	-	168	-
Senior High School	65	55	5	0	35	133
BPU Warehouse	65	50	10	0	50	118
Telephone Company	70	-	5	-	168	-
First Covenant Church						
New Building	68	68	5	0	84	84
Old Building	68	55	5	0	10	158
First Presbyterian Church	65	55	5	0	44	124
Marine Midland Bank	70	63	5	0	40	128
Hotel Jamestown	72	-	5	-	168	-
James Prendergast Library	68	68	5	0	70	98
The Post Journal	70	-	5	-	168	-

TABLE 2-2
ADDITIONAL CORE AREA BUILDING SITE-SPECIFIC PARAMETERS

BUILDING	Indoor Temp. Normal T11 (°F)	Indoor Temp. Setback T12 (°F)	Internal Gain Normal TR1 (°F)	Internal Gain Setback TR2 (°F)	Normal Hours HR1 (hrs/wk)	Setback Hours HR2 (hrs/wk)
AAA	70	65	5	0	45	123
AVM Precision Tops	72	55	5	0	55	113
Bigelows	70	60	5	0	60	108
Cameo Apartments	70	65	5	0	112	56
Carnahans Dept. Store	70	65	5	0	60	108
Chamber of Commerce	68	-	5	-	168	-
Credit Bureau of Jamestown	68	-	5	-	168	-
DPW Garage	65	50	10	0	50	118
Empire State Building	68	60	5	0	50	118
Grant Building	68	60	5	0	50	118
Herbert's Shoes	70	60	5	0	60	108
Jamestown Cycle Shop	72	62	5	0	69	99
Little Theater	70	60	5	0	60	108
Lucies	68	62	5	0	42	126
Monitor Furniture	70	60	5	0	60	108
Nelson Bros. Lumber	70	65	5	0	60	108
Palace Civic Theater	70	60	5	0	40	128
Pearl City Paint and Glass	70	55	5	0	60	108
Scottish Rite	70	65	5	0	80	88
Towne Barbers	70	55	5	0	60	108
Wilcox Apartments	70	65	5	0	112	56

The heat load assessment methodology outlined in the Phase I study report has been utilized with minor modifications to account for varying daily operating modes of ventilation systems where applicable and for system operating parameters (indoor temperatures, normal and setback hours) which may differ in individual building or building areas comprising a facility.

RESULTS

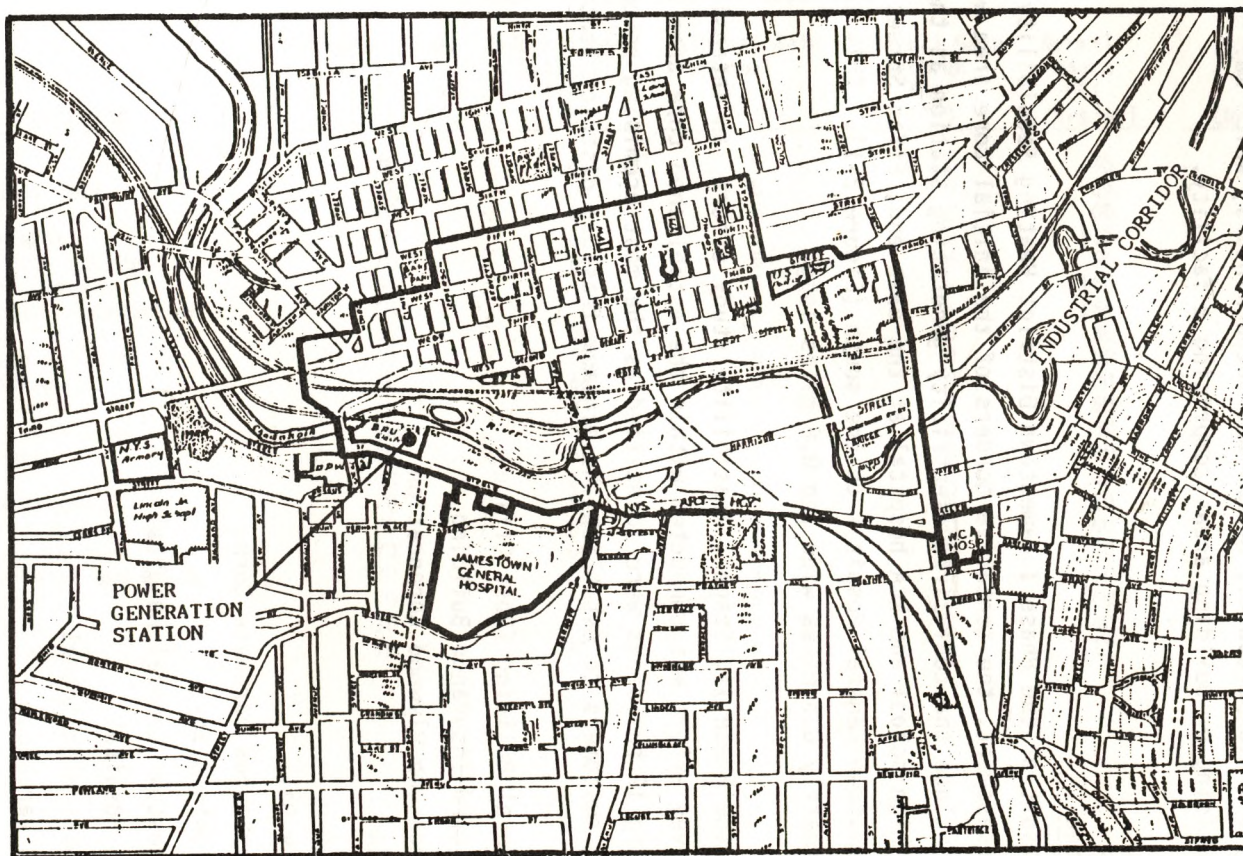
Core Area

As a result of the Phase I Jamestown District Heating Feasibility Study heat load assessment, the tentative borders of the initial core area were defined so as to include the coal-fired electricity generating station at the west end, the senior high school and WCA hospital at the east end, Fifth Street on the north, and Jamestown General Hospital on the south (Figure 2-1). This is an area approximately 0.5 miles wide and 0.8 miles long.

During the Phase II, Stage I feasibility study effort, an intensive marketing and survey effort was conducted within the established core area and the following 19 buildings were identified as the most promising potential district heating customers to establish the minimum feasible district heating system:

1. Federal Building (Post Office)
2. Unigard Insurance Building
3. Jamestown Plywood Corporation
4. YWCA
5. YMCA
6. City Hall
7. Chautauqua Hardware Corp.
8. Jamestown Boys Club
9. Jamestown General Hospital
10. WCA Hospital
11. Senior High School
12. BPU Warehouse
13. Telephone Company
14. First Covenant Church
15. First Presbyterian Church
16. Marine Midland Bank
17. Hotel Jamestown

Figure 2-1
INITIAL PHASE I CORE AREA BOUNDARIES



18. James Prendergast Library

19. The Post Journal

On the basis of the buildings identified above and the Stage 1 recommended distribution network, the core area is now considered to be bounded by Washington Street on the west end, north of the Chadakoin River.

The results of the initial core area heat load assessment are presented in Table 2-3 which lists the following for each of the above buildings:

QPF - present average annual fuel consumption

ADH - percent of present annual usage adaptable to district heating

Q₁ - comfort heating peak hourly load

Q₂ - internal heat use average hourly load

Q₃ - comfort heating average annual load

Q₁ - comfort heating average annual load

Q₂ - total average annual load

Q₃ - total average annual load

The total peak load for these 19 buildings is 11.975 Mwt. However, as indicated in the Phase II, Stage 1 report, the recommended distribution network established for the minimum feasible district heating system excludes connection of the Marine Midland Bank and the Post Journal. Accordingly, the base load for the minimum core area system is 11.537 Mwt. Since the Phase II, Stage 1 report was released, additional investigation was made into the core area. Because there is such a positive feeling toward district heating and because of the very favorable ratio of additional revenue to additional investment, it was decided to include additional buildings into the initial phase of development.

Listed below are the additional buildings surveyed in the core area for which heat load assessments have been performed to establish the heat load for the core area. Buildings denoted with an asterisk (*) can be interconnected to the Stage 1 recommended distribution network. All others require modification and/or addition to this network.

1. AAA*

2. AVM Precision Tops

TABLE 2-3

CORE AREA BUILDING HEAT LOAD ASSESSMENT SUMMARY

BUILDING	Annual Total Fuel QPF (MMBTU/YR)	Percent to DH ADH (%)	Comfort Load Q ₁ (MMBTU/HR) ⁽¹⁾	Internal Use Load Q ₂ (MMBTU/HR)	Total Peak DH Load Q ₃ (MMBTU/HR)	KW	Annual Comfort Load Q ₁ (MMBTU/YR)	Annual Internal Load Q ₂ (MMBTU/YR)	Total Annual Load to DH Q ₃ (MMBTU/YR)
Federal Building (Post Office)	4113	100	.955	.014(3)	.969	284	1908	70	1978
Unigard Insurance	3917	100	.910	.098(3)	1.008	295	2102	206	2308
Jamestown Plywood Corp.	15744	80.4	3.227	-	3.227	946	5947	-	5947
YWCA	2197	100	.365	.142(3)	.507	149	729	467	1196
YMCA	7170	87.5	1.161	.470(4)	1.631	478	1164	2052	3216
City Hall	7065	100	1.179	.155(3)	1.334	391	3233	1359	4592
Chautauqua Hardware Corp.	58900	56	5.481	-	5.481	1606	15502	-	15502
Jamestown Boys Club	4237	100	.792	.184(4)	.976	286	1835	484	2319
Jamestown General Hospital	28400	76	1.891	1.734	3.625	1062	5184	4853	10037
WCA Hospital	44803	94	4.214	1.873(3)	6.087	1783	12219	16419	28638
Senior High School	31500	100	6.267	1.040(4)	7.307	2141	12455	2980	15435
BPU Warehouse (2)	1506	100	.722	-	.722	212	1310	-	1310
Telephone Company	5037	100	1.042	.030(3)	1.072	314	2580	130	2710
First Covenant Church	1370	90	.342	-	.342	100	740	-	740
First Presbyterian Church	3058	100	.839	.052(3)	.891	261	1318	153	1471
Marine Midland Bank	1195	95.7	.254	-	.254	74	537	-	537
Hotel Jamestown	16700	100	1.809	1.600(3)	3.409	999	5034	3600	8634
James Prendergast Library	3900	88	.784	-	.784	230	2059	-	2059
The Post Journal	6772	98.5	1.243	-	1.243	364	3334	-	3334

- Notes: 1- 1MMBTU = 1,000,000 BTU
 2- BPU warehouse heating system utilizes steam delivered from power plant
 3- Domestic hot water
 4- Domestic hot water and pool heating

3. Bigelows Department Store
4. Cameo Apartments*
5. Carnahans Department Store
6. Chamber of Commerce*
7. Credit Bureau of Jamestown
8. DPW Garage*
9. Empire State Building*
10. Grant Building
11. Holiday Inn*
12. Herbert's Shoes
13. Jamestown Cycle Shop*
14. Little Theater
15. Lucies*
16. Monitor Furniture*
17. Nelson Brothers Lumber*
18. Palace Civic Theater
19. Pearl City Paint and Glass
20. Scottish Rite Temple*
21. Towne Barbers*
22. Wilcox Apartments

The results of the heat load assessment for each of these buildings are presented in Table 2-4. The total additional peak load is 3.278 Mwt representing a potential core area district heating peak load of 15.253 for all specific buildings identified including the Marine Midland Bank and the Post Journal.

SATURATED CORE AREA

In addition to the potential district heating loads for the additional buildings in the core area listed above, an estimate of the remaining potential load in the core area was performed. Table 2-5 presents the results of this assessment for the downtown core area and Table 2-6 for the core area south of the Erie Railroad. The additional potential peak district heating load is 8.426 Mwt, and accordingly, the total potential saturated core area load is estimated to be 23.499 Mwt.

Figure 2-9 presents a load map for the downtown core area and Figure 2-10 for the core area south of the Erie Railroad.

TABLE 2-4
 ADDITIONAL CORE AREA BUILDING HEAT LOAD ASSESSMENT SUMMARY

BUILDING	Annual Total Fuel QPF (MMBTU/YR)	Percent to DH ADH (%)	Comfort Load Q ₁ (MMBTU/HR)	Internal Use Load Q ₂ (MMBTU/HR)	Total Peak DH Load Q ₃ (MMBTU/HR)	KW	Annual Comfort Load Q ₁ (MMBTU/YR)	Internal Load Q ₂ (MMBTU/YR)	Annual Load to DH Q ₃ (MMBTU/YR)
AAA	265.1	85	.058	-	.058	17	157.8	-	157.8
AVM Precision Tops	3296.5	95.6	1.151	-	1.151	337	1891.0	-	1891.0
Bigelows	3024.4	100	.735	.020 ⁽³⁾	.755	221	1751.9	62.8	1814.7
Cameo Apartments	2009.0	100	.306	.063 ⁽³⁾	.369	108	834.0	371.0	1205.0
Carnahans Dept. Store	1525.4	100	.342	.025 ⁽³⁾	.367	108	842.4	72.8	915.2
Chamber of Commerce	180.9	85	.036	-	.036	11	91.8	-	91.8
Credit Bureau of Jamestown	262.1	87	.053	-	.053	16	136.6	-	136.6
DPW Garage	4703.0	100	1.330	-	1.330	390	4091.0	-	4091.0
Empire State Building	1746.8	100	.411	.025 ⁽³⁾	.436	128	971.8	76.2	1047.0
Grant Building	666.0	100	.163	-	.163	48	399.0	-	815.0
Holiday Inn	1030.0 ⁽⁴⁾	100 ⁽⁴⁾	-	.761 ⁽³⁾	.761	223	-	670.0	670.0
Herbert's Shoes	1358.3	100	.342	-	.342	100	815.0	-	815.0
Jamestown Cycle Shop	486.8	94	.126	-	.126	37	320.7	-	320.7
Little Theater	3869.5	100	.915	.047 ⁽³⁾	.962	282	2183.0	138.6	2321.6
Lucies	352.8	85	.071	-	.071	21	179.4	-	179.4
Monitor Furniture	7289.2	78.2	1.361	.050	1.411	413	3224.7	233.8	3478.5
Nelson Bros. Lumber	1623.2	97	.625	-	.625	183	1104.8	-	1104.8
Palace Civic Theater	2964.8	100	.736	.037 ⁽³⁾	.773	226	1676.2	102.7	1778.9
Pearl City Paint and Glass	1611.8	97	.461	-	.461	135	942.6	-	942.6
Scottish Rite	1402.4	100	.278	.025 ⁽³⁾	.303	89	757.2	75.8	833.0
Towne Barbers	517.5	100	.118	.030 ⁽³⁾	.148	43	241.9	120.4	362.3
Wilcox Apartments	2486.0	100	.420	.063 ⁽³⁾	.483	142	1144.0	347.0	1491.0

For Notes See Figure 2-5

TABLE 2-5
DOWNTOWN CORE AREA
POTENTIAL DISTRICT HEATING LOADS¹

<u>BLOCK NO.²</u>	<u>ADDITIONAL POTENTIAL LOAD</u>	
	<u>PEAK (Mwt)⁴</u>	<u>ANNUAL (MMBTU)</u>
270	.030	251.1
271	.168	1406.5
273	.226	1891.9
274	.091	761.8
275	.187	1565.4
276	.016	133.9
277	.151	1264.1
278	.541	4528.9
279	.120	1004.5
280	0.0	0.0
282	.439	3675.0
283	.030	251.1
286	.150	1255.7
287	.139	1163.6
288 and 292	1.017	8513.7
290	0.0	0.0
291	.199	1665.9
293 and 294	0.0	0.0
324	0.0	0.0
329	0.0	0.0
341	0.0	0.0
342 ³	-	-
343	.010	83.5
344	.125	1046.4
345	.076	636.0
346	0.0	0.0
347 ³	-	-

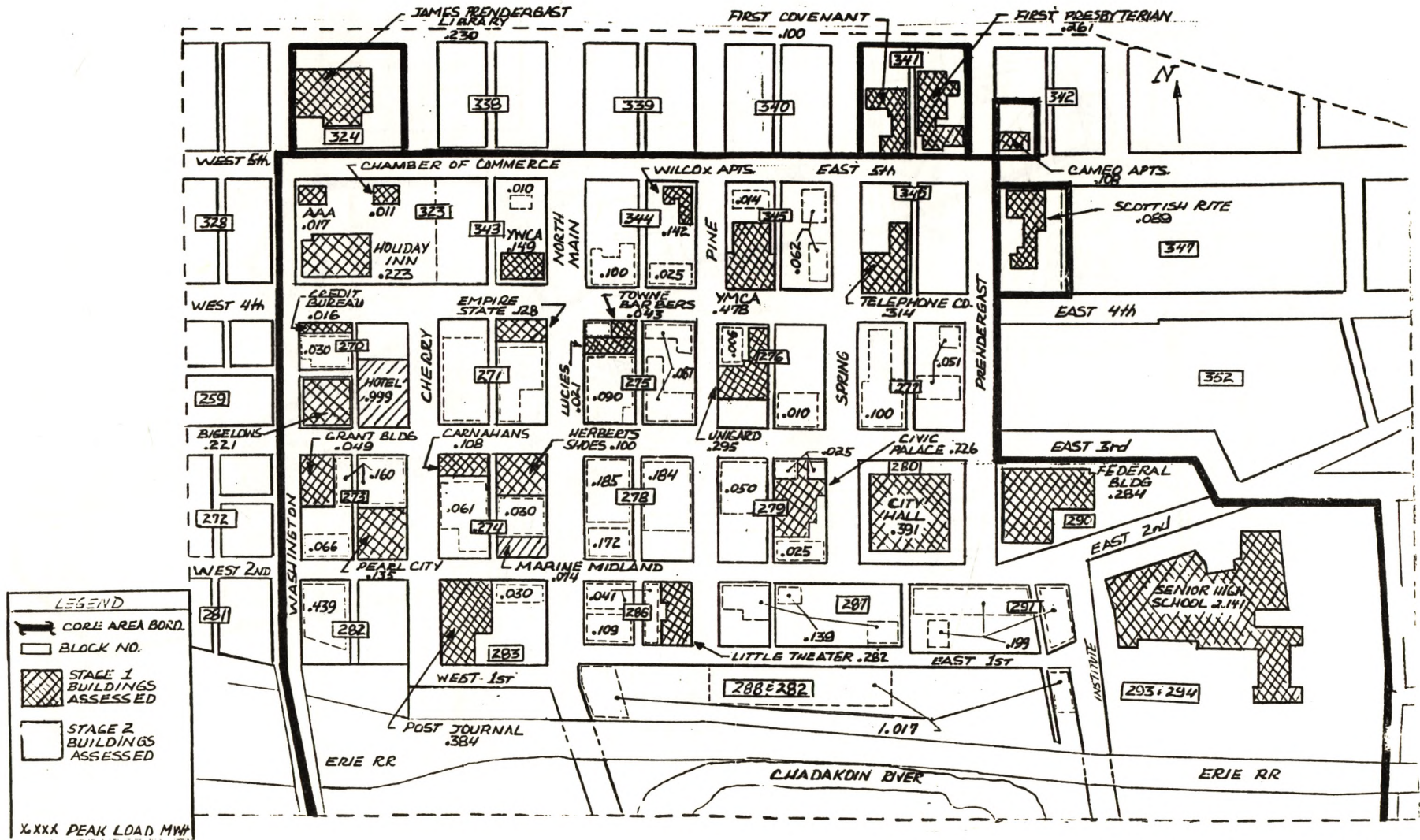
- 1- Estimated for remaining buildings not individually assessed
- 2- See Figure 2-9
- 3- Balance of block considered outside of core area
- 4- Includes internal use loads such as domestic hot water adaptable to district heating

TABLE 2-6
CORE AREA SOUTH OF CORE RAILROAD
POTENTIAL DISTRICT HEATING LOADS¹

<u>BLOCK NO.</u> ²	<u>ADDITIONAL POTENTIAL LOAD</u>	
	<u>PEAK (Mwt)</u> ⁴	<u>ANNUAL (MMBTU)</u>
123 ³	-	-
267 ³	-	-
265	.170	1423.1
299	3.400	28462.8
514 and 515	0.0	0.0
520	0.0	0.0
522 and 523	.117	979.5
524 and 289	0.0	0.0
527	.326	2729.1
529, 530 and 531	.378	3164.4
534 and 535	.140	1172.0
537	0.0	0.0
542	0.0	0.0
554 ³	-	-

- 1- Estimated for remaining buildings not individually assessed
- 2- See Figure 2-10
- 3- Balance of block considered outside of core area
- 4- Includes internal use loads adaptable to district heating such as domestic hot water

Figure 2-2
DOWNTOWN CORE AREA LOAD MAP



CORE AREA LOAD MAP
SOUTH OF ERIE RAILROAD



Outlying Districts

In the previous sections the heat load assessment for the core and saturated core area resulted in a potential district heating load of 23.499 MWt. As the City of Jamestown does not foresee any major new construction in the core area in the near future, the most likely increase in district heating demand will come from the industrial corridor east of the core area and residential/commercial neighborhoods surrounding the core area. This section provides a discussion and heat load assessment for those outlying districts.

Industrial Corridor

East of the core area along the Chadakoin River is the industrial corridor consisting of a variety of manufacturing/industrial facilities. Several of the industries could not only be customers of the district heating system but also contributors. Opportunities exist for heat recovery from high-temperature process systems and utilization of excess heat when available from industries which burn waste wood.

Specific facilities which provided fuel records and for which a heat load assessment was performed are listed in Table 2-7 along with their respective potential loads which total 19.387 MWt.

Residential/Commercial

Surrounding the core area and industrial corridor, the remainder of the City of Jamestown consists primarily of residential and small commercial neighborhoods. While the Phase I study assessed the potential district heating load for the entire city, any foreseeable expansion into outlying districts in the near future is considered to be constrained by the practical heat source limits of the Steele Street power plant. This limit is 80 MWt based on the installation of a 55 MWe cogeneration district heating turbine-generator at the power plant. (Note: A feasibility study performed by General Electric Company determined that the largest single-purpose turbine-generator that could be installed at the plant was 55 MWe.) Accordingly, with the previously established potential district heating loads of 23.499 MWt for the saturated core area and 19.387 MWt for the industrial corridor, further expansion is considered limited to 37 MWt for the single heat source.

Accordingly, the residential/commercial area for which the heat load assessment was performed is indicated on Figure 2-4. This area, bordered by the core area

TABLE 2-7

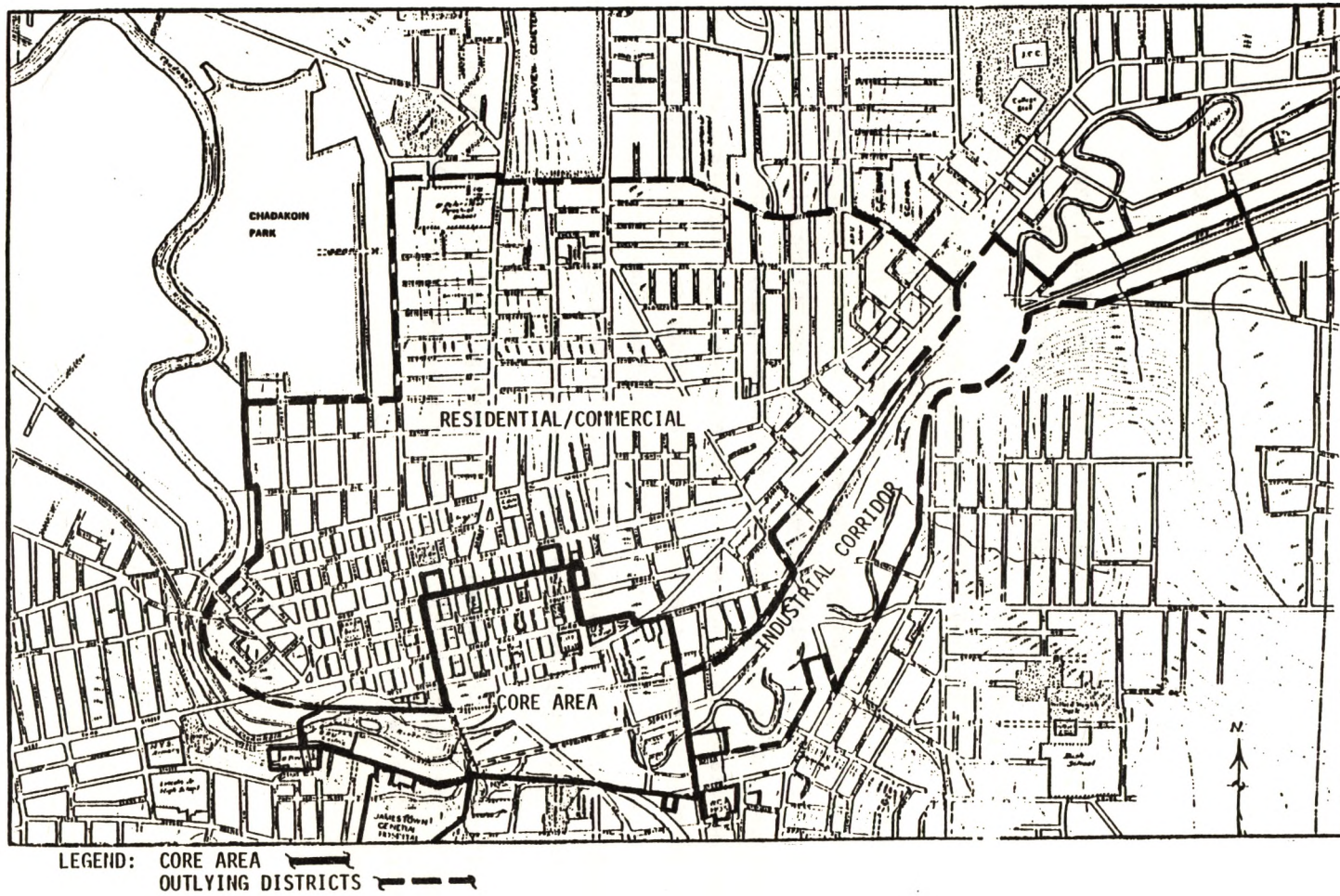
POTENTIAL DISTRICT HEATING LOADS
INDUSTRIAL CORRIDOR

FACILITY	Peak DH Load (Mwt)		Annual DH Load (MMBTU)	
	Comfort	Internal ²	Comfort	Internal
Crescent Tool Company	1.283	.111	10,741	791
Watson Industries	1.499	.130	12,549	926
Mason Carvings ¹	.070	.003	586	23
Jamestown Electro Plating	.347	.314	2,905	2,237
TRW Bearing Division	1.972	.378	15,000	2,688
VanStee Corporation	.232	.121	1,942	863
Jamestown Royal, Incorporated	.167	.024	1,398	171
Dawson Metal Company	.319	.036	2,670	259
Weber-Knapp Company	1.310	.765	10,966	12,568
Dahlstrom	3.912	.175	32,752	8,367
Jamestown Metal Manufacturing	.420	.118	3,520	838
Crawford Furniture	.176	.019	1,472	136
Jamestown Metal Products	3.257	.229	27,266	1,631

1- Burn waste wood and supplemented by gas boiler

2- Domestic hot water and process uses adaptable to district heating

Figure 2-4
CORE AREA AND OUTLYING DISTRICTS



and industrial corridor on the south and east, the Chadakoin River and Park on the west, and Buffalo Street on the north, was chosen based on the following considerations:

- o Review of this area indicated a higher density of residential and commercial units than areas south of the core area and industrial corridor.
- o Expansion into this area can be accomplished from both the downtown core area and the industrial corridor, as well as directly from the power plant thus offering greater flexibility in the development of the distribution network.

The heat load assessment for this area was performed on a block-by-block basis in a similar manner as was done for the saturated core area buildings not individually assessed. Sanborn maps provided an estimated count of residential and commercial units on each block. For housing units, the average heated floor space was taken as 1,500 sq. ft. with a peak heat loss rate of 50,000 Btu/hr. For commercial units the average heated floor space was taken as 5,000 sq. ft. with a peak heat loss rate of 80,000 Btu/hr. Domestic hot water loads were not considered, as the conversion to district heating was not found to be cost effective for such expected small usage rates.

An estimate for the annual district heating load of the residential units was made utilizing the ASHRAE modified degree-day method (1980 SYSTEMS HANDBOOK) indicated below:

$$Q_c = \frac{Q_c \times HDD \times 24}{\Delta T \times EFF} \times C_D$$

Where: Q_c = Annual comfort load (Btu)

Q_c = Peak heat loss rate (Btu/hr)

HDD = Heating degree days (7062)

ΔT = Indoor-outdoor design temperature difference
(72°F - 3°F)

EFF = Combustion efficiency (100% for hot water
district heating)

C_D = Heating effect vs. degree days (.63 at 7062 HDD
for residential units).

With the above stated parameters, the ratio of Q_c to Q_c , or the average annual equivalent peak load hours, is 1548 which represents an annual capacity factor of .177 (i.e., $1548 \div 8760$) for residential units. For commercial units, the data base established by the specific commercial building assessed in the downtown area resulted in an average capacity factor of .28 or 2543 annual equivalent peak load hours which was used to estimate the commercial units annual potential district heating loads. The results of the heat load assessment for the residential/commercial outlying district are presented below.

	No. of <u>Units</u>	Potential Peak DH Load <u>(MWt)</u>	Potential Annual DH Load <u>(MM Btu)</u>
Residential	5555	81.380	429,957
Commercial	411	<u>9.634</u>	<u>80,648</u>
Total		91,014	510,605

SUMMARY

Table 2-8 presents a summary of the results of the heat load assessment for core area, saturated core area, and outlying districts established in the previous sections. It is recognized that these potential loads represent the maximum for the areas evaluated and cannot be expected to represent the actual load which could be connected to a district heating system. Particularly in the

outlying districts, adaptability of existing heating systems, cost effectiveness of the retrofits, and other system and site-specific constraints will reduce the potential load. Realistic expectations may be on the order of 50 percent for the outlying districts (55.2 MWt), 70 percent for the saturated core area (16.5 MWt) and 85 percent for the core area (12.96 MWt).

Table 2-8
HEAT LOAD ASSESSMENT SUMMARY

	Peak DH Load (Mwt)			Annual DH Load (MMBTU)		
	Comfort	Internal	Total	Comfort	Internal	Total
STAGE 1 - Core Area						
Initial 19 Bldgs	9.809	2,166	11.975	79,190	32,773	111,963
Additional 22 Bldgs	<u>2.941</u>	<u>.337</u>	<u>3.278</u>	<u>23,777</u>	<u>2,271</u>	<u>26,048</u>
Subtotal	12.750	2.503	15.253	102,967	35,044	138,011
STAGE 2 - Saturated Core Area						
Additional Load	<u>7.429</u>	<u>.817</u>	<u>8.246</u>	<u>63,274</u>	<u>5,756</u>	<u>69,030</u>
Subtotal	20.179	3.320	23.499	166,241	40,800	207,041
STAGE 3 - Industrial Corridor						
Additional Load	<u>14.964</u>	<u>4.423</u>	<u>19.387</u>	<u>123,767</u>	<u>31,498</u>	<u>155,265</u>
Subtotal	35.143	7.743	42.886	290,008	72,298	362,306
STAGE 4 - Outlying Districts						
Additional Load (Residential/Commercial)	91.014	-	91.014	510,605	-	510,605
TOTAL	126.157	7.743	133.900	800,613	72,298	872,911

Section 3

HEAT SOURCE ANALYSIS

INTRODUCTION

This section develops in conceptual form the power plant retrofit alternatives necessary to adapt the City of Jamestown, Board of Public Utilities' Steele Street Station for district heat supply. The district heat would be supplied with hot water as a transport medium.

When designing the power plant retrofit to supply district heat, the objective would be to increase the thermal efficiency of the plant while keeping the loss in electrical generation and capital costs to a minimum. In order to achieve this objective the approach used is to develop district heat supply from the plant in stages that coincide with the development of the heat load. The study considers several alternatives for adapting the Steele Street Plant to district heat, starting with relatively simple modifications to the steam turbine cycles at the plant and concluding with the addition of a new cogeneration steam turbine cycle at the plant. New cogeneration capacity installed at a remote location from the plant is also considered in this study and is expected to be considered in greater detail in future studies.

Based on the conceptual design of the most promising alternatives, budgetary cost estimates are developed. This includes the cost of additional equipment and modifications to existing piping. Additional equipment includes district heating condensers, district heating water circulating pumps, an expansion tank, piping, valves and controls. The cost of hot water piping outside of the plant boundary is not included in this section of the study.

DESCRIPTION OF EXISTING STEELE STREET PLANT

The Steele Street Power Station consists of two operational units, it burns coal, and it uses cooling towers for cooling its circulating water. The cooling towers are connected to ponds which receive water from and discharge water to the river.

Both operational turbines were manufactured by General Electric Company. The units are non-reheat units. Unit 5 was erected in 1951 and Unit 6 was erected in 1968.

Unit 5 is a 25,000 kw, 3600 RPM, 19-stage condensing unit designed to operate at 850 psig steam pressure and 900°F temperature at 1.5 inches Hg. condenser pressure. It is a single-flow unit. Unit 5 has recently been redesigned by General Electric and has been uprated to 28,750 kw. The throttle steam flow is 275,146 lb/hr at 1.5 inches Hg. condenser pressure. Extraction steam for regenerative feedwater heating is taken from the 4th, 8th, 12th and 16th stages. Makeup to the cycle is from an evaporator. The feedwater heating cycle consists of four closed feedwater heaters and one open feedwater heater.

Unit 6 is a 25,000 kw, 2600 RPM, 15-stage condensing unit designed to operate at 850 psig steam pressure and 900°F temperature at 3.5 inches Hg. condenser pressure. It is a single-flow unit with a rated throttle flow of 238,072 lbs/hr. Extraction steam for regenerative feedwater heating is taken from four extraction points. The turbine has one blanked-off extraction point at the 11th stage. The feedwater heating cycle consists of four closed feedwater heaters and one open feedwater heater. Makeup to the cycle is through the condenser hotwell.

HEAT SUPPLY ALTERNATIVES CONSIDERED

In view of the characteristics of the proposed service area, the proposed power plant retrofits are designed to coincide with phased implementation of district heating in Jamestown. The development of the system will begin with a plant retrofit designed to supply the first stage of load development, the core area anchor customers with a load of approximately 15 mwt. The second stage plant retrofit will build on this first stage retrofit and will be designed to supply the saturated core area with a load of approximately 24 Mwt. The third and subsequent stages of development would be designed to supply district heat to the industrial corridor and other subsequent stages of load development.

Several different modification alternatives have been investigated. These alternatives determined that the first two phases of development could be handled by modifications to the existing steam turbine cycles and that the industrial corridor and subsequent phases of development would be served best by the addition of new capacity at the plant or possibly at a site remote from the plant. A limited portion of the industrial corridor load may be served with modifications to the existing steam turbine cycles and the existing boiler capacity.

Modification Alternatives for Existing Thermal Cycles

The following alternatives have been considered for conversion of the existing steam turbine cycles at the Steele Street Plant to cogeneration district heating supply:

1. The first alternative examined was bypassing the low-pressure feedwater heaters. In this case, heater number 1 and heater number 3 are removed from the feedwater cycle and used for district heating. Extraction steam to the deaerator is supplied from the up-to-now unused extraction port at stage 11.
2. The second alternative examined was the installation of a single district heating condenser that would operate with steam supplied from the 11th stage extraction.
3. The third alternative is to add a second district heating condenser in series with the alternative two district heating condenser. The additional district heating condenser would be connected to the 9th stage turbine extraction. All existing feedwater heaters would remain in place and operational.
4. Alternative four is to install a single new district heating condenser that would operate with extraction steam from stage 9. The deaerator would be supplied with steam from stage 11.
5. The fifth alternative is to install a new district heating condenser that would operate on steam from the 11th stage turbine extraction and operate the existing Unit 6 auxiliary heat exchanger in series with the new district heating condenser depending on load. The auxiliary heat exchanger would only be used when the system load exceeds the capabilities of the new district heating condenser.

Preliminary investigation determined that the heat obtainable from Unit 5, after its recent uprating, is small compared to that from Unit 6 and, therefore, Unit 5 is not considered for heat supply.

The above alternatives were compared to an alternate selection criteria which included the following:

- o Lowest Cost. The selected alternative should provide the maximum thermal efficiency at the lowest capital and operating costs.
- o Reliability. The cogeneration system should reliably supply both electricity and heat.
- o Operating Flexibility. The ability to vary the unit heat load and electrical output independently should be considered. The ability to satisfy heat and electric demands by using various unit combinations increases overall reliability and lowers operating cost and must also be considered.
- o Thermodynamic Constraints. These constraints include the maximum heat load that can be extracted, blade loading as a result of extraction, extraction line limitations, steam flow and pressure changes in turbine elements, backpressure increase in turbine exhaust, and windage losses in LP elements.
- o Mechanical Constraints. These include the number and type of casing designs, thrust considerations and physical arrangements.
- o Space Availability.
- o Structural Design Limits.
- o Other Considerations. Such as arrangements and availability of other equipment, considerations for construction phase, etc.

The customer retrofit analyses performed determined that the district heat water return temperature associated with the maximum system heat load would be 160°F rather than the 140°F return temperature used in the Phase I study. Therefore, the district heating system will be designed for a maximum effluent temperature of 250°F and a maximum return temperature of 160°F.

Based on the above design criteria, the following are the findings for the alternatives considered:

An analysis of alternative one determined that a maximum thermal load of about 15.5 MW could be produced with a maximum district heating water supply temperature of 228°F. The corresponding district heating water flow rate would be 600,000 lb/hr. This alternative results in an increase in extraction steam flow to heater 4 of 87% and an increase in extraction steam flow to heater 3 of 144%. Extraction steam flow to the deaerator is increased by 102%. This alternative does not require modification to the turbine itself, however, due to the increased extraction flows, modification to the extraction and drain piping, heaters 3 and 4 and the deaerator steam inlet would be required. This causes a significant reduction in final feedwater temperature and more than 2 MW loss in electrical output. This alternative is not recommended because of the thermodynamic stresses it imposes on the feedwater cycle.

An analysis of alternative two determined that no modifications would be required to the turbine or the existing feedwater heaters. The thermal output of this alternative is approximately 7 MW and, therefore, cannot be used alone.

Alternative three requires the purchase of a new heat exchanger and only results in a thermal load of about 9 MW. This alternative would result in a higher cost than alternative 2.

Alternative four would be incapable of providing a thermal load equal to that of alternative 2, and would be more costly to implement, therefore, it is rejected from further consideration.

Alternative five will provide a thermal load of up to 26 MW with a minimum investment by taking advantage of the existing auxiliary heat exchanger. This alternative does not require modifications of the turbine or existing extraction piping. The presently blanked-off extraction at stage 11 will be used to supply steam to the new district heating condenser. Alternative 5 is the recommended alternative. The alternative was investigated in detail by Burns and Roe. Calculations have been performed to estimate the effects of this retrofit.

Once the heat load of the Jamestown district heating system reaches a level of 26 MWt or greater, new thermal generation capacity should be considered. Modification of the existing Steele Street Plant to provide more than 26 MWt would be significantly more expensive and difficult. Further modification of

the plant would require internal modifications to the steam turbines and would result in higher losses in electrical generation.

The following alternatives have been considered for providing new thermal generation capacity for the Jamestown district heating system:

Installation of New Cogeneration Capacity at the Steele Street Station

A feasibility study performed by General Electric Company for the Board of Public Utilities, City of Jamestown, determined that the largest single-purpose turbine-generator that could be installed in the Steele Street Station without major structural changes was a 55 MWe capacity machine. It was assumed in the General Electric study that the new turbine would not run at full load in parallel with the existing units.

The new district heating turbine alternative is based on installing a 55 MWe dual-purpose district heating machine in place of the single purpose machine. The dual-purpose machine would have a full-load electric only capacity of 55 MW and a full-load heating capacity of 80 MWt. The 80 MWt load would be supplied to two district heating condensers. The load would be split equally between these two condensers which would heat district heating water from 160°F to 250°F. The coincident electrical load at the maximum heating capacity of 80 MWt would be approximately 40 MWe.

The new turbine would be capable of running at reduced load in parallel with the existing turbines to satisfy the heat loads associated with expansion into the industrial corridor and other outlying districts. At the full load of 80 MWt it would be capable of supplying the full heat load of the system.

Installation of New Thermal Capacity Remote From the Steele Street Plant

Once the core area heat load is fully developed the major area of development will be in the industrial corridor, which is estimated to have a thermal load of 20 MW. One alternative for supplying this load is to develop a heat source local to the industrial load. Based on fuel availability in Jamestown the logical fuel source for an independent facility would be coal or natural gas.

If coal were used as the fuel, the approach would be to develop a coal-fired boiler plant capable of providing process steam as well as space heating

requirements. To enhance the economics of energy production from this plant and to improve the overall efficiency of the plant, the addition of a steam turbine to cogenerate electricity would be considered.

If natural gas was used as the fuel, the approach would be to install a cogeneration gas turbine facility. The facility would incorporate a waste heat boiler to extract heat from the turbine exhaust. The facility would provide electricity as well as hot water for space heating.

The installation of new thermal capacity remote from the Steele Street Plant to serve the industrial corridor will be addressed in detail in an independent study that is expected to be commissioned in early 1985. For the purpose of this study, it is assumed that new thermal capacity will be installed at the Steele Street Plant and will be fueled with coal.

RECOMMENDED HEAT SOURCE DEVELOPMENT PLAN

The heat source development plan developed for the Jamestown district heating system develops the heat source in phases coincident with the development of the heat load.

Phase I

The first phase heat source development is based on modification alternative five for the existing steam turbine cycle. The heat supply from this alternative closely matches the first stage of heat load development with adequate backup and minimum capital investment.

This alternative extracts steam from the blanked off 11th stage of the Unit 6 turbine for loads up to 7 MWt. For loads above 7 MWt, additional steam is taken from the auxiliary steam header and used in the existing Unit 6 auxiliary heat exchanger arranged in series with the new district heating condenser. The auxiliary heater brings the peak output from this alternative to approximately 26 MWt. With this alternative, the Unit 6 auxiliary heater can be used alone to supply loads up to 19 MWt.

The heat load for the first stage of development is approximately 15 MWt.

Phase II

The second phase heat source development builds on the first phase by incorporating the auxiliary heater from Unit 5 in parallel with the Unit 6 auxiliary heater. With this arrangement, the Unit 6 Auxiliary heater is used in series with the new district heating condenser installed in the first phase to supply thermal loads up to 26 MWt. The Unit 5 auxiliary heater is used to provide backup capacity for the first two stages of load development. The second stage of load development saturates the core area and brings the total load to approximately 24 MWt.

The capital investment associated with the second phase heat load development is minimal. The new equipment required will be limited to additional pumping capacity and piping and valves necessary to connect the pumps and the Unit 5 auxiliary heater. All other required equipment and facilities will have been installed during the first retrofit phase.

Phase III

The third phase heat source development will be to install new cogeneration capacity at the Steele Street Plant. A new 55 MWe cogeneration turbine will be installed at the plant. This turbine will have a maximum thermal capacity for district heating of 80 MW. The new turbine will be capable of supplying the full system load consisting of the first two phases of development as well as the industrial corridor and other outlying districts. When the new unit is run at its full capacity, the first two phases of heat source development will serve as backup capacity. If the new unit is operated in parallel with existing Units 5 or 6, then it will run at a reduced load supplying only the thermal load that cannot be satisfied by the other units. In this case, the spare capacity of the new unit will serve as backup.

The capital investment associated with the third phase of development will consist of all the capital costs associated with the district heating equipment plus the differential cost for installing a district heating turbine in place of a pure electric turbine.

Phase IV

The fourth phase of development and subsequent phases will involve the installation of new capacity remote from the Steele Street Plant.

This development is most likely to occur local to the industrial corridor. Analyses and costs for this development are not present in this report since it is expected that new capacity would be provided at the Steele Street Plant which will be capable of providing sufficient heat to supply the core area development and several outlying districts.

ANALYSIS OF DEVELOPMENT ALTERNATIVES

Phase I

The first phase of heat source development involves extracting steam from the blanked-off 11th stage of the Unit 6 turbine for use in a new district heating condenser for loads up to 7 MWt. For loads above 7 MWt, additional steam is taken from the auxiliary steam header and used in the existing Unit 6 auxiliary heat exchanger that will be arranged in series with the new district heating condenser. The auxiliary heat exchanger will operate when the system load is between 7 MWt and the peak load.

During peak heat load operation, the return water temperature will be 160°F and the district heating water supply temperature will be 250°F. The district heating water flow rate corresponding to peak load is 498,000 lb/hr. The maximum extraction flow available from the 11th stage extraction will allow the heating of 379,000 lb/hr of district circulating water to a temperature of 223°F. At the maximum heat load conditions, 119,000 lbs/hr of district heating water bypasses the new district heating condenser and the auxiliary heat exchanger. The 379,000 lb/hr of 223°F effluent water from the new district heating condenser is passed through the auxiliary heat exchanger where it is increased in temperature above the design temperature of 250°F such that when mixed with the bypassed water the final temperature is 250°F.

The new heat exchanger will operate during the entire year providing both space heating and domestic hot water needs. The auxiliary heat exchanger will be in operation approximately one third of the year. The maximum operating pressure of the new district heating condenser will be approximately 20 psia. The maximum operating pressure of the auxiliary heat exchanger will be approximately 60 psia

during district heating operation. The maximum steam flow for the auxiliary heat exchanger during district heating operation is 18,900 lb/hr.

When the heat load is equal to or less than 7 MW, the auxiliary heat exchanger is out of service, and the maximum extraction steam flow to the new district heating condenser is 23,813 lb/hr at an extraction stage pressure of 21.8 psia. The maximum electrical load reduction from the Unit 6 turbine-generator is about 1.24 MWe during district heating operation. Drains from the new heat exchanger are cascaded to the condenser through an internal drain cooler.

Modifications to the turbine are not required since the redistribution of extraction flows are relatively minimal. All existing feedwater heaters remain in service without modification.

Figure 3-1 shows the operation of Unit 6 during district heating operation. Figure 3-2 shows the district heating system arrangement for Phase I.

Equipment and Piping Selection for Phase I

The new equipment for the proposed retrofit alternative includes a new heat exchanger used only for district heating, district heating water circulating pumps and motors, an expansion tank, piping, valves, water treatment equipment and instrumentation and controls for the extraction, district circulating water, and heater drain systems.

The new heat exchanger is sized to handle the maximum heat load allowed by the turbine extraction. It has a total surface area of 1589 sq. ft with approximate dimensions of 33 inches in diameter and 20 ft. in length. This heat exchanger will be a vertical heater installed channel down near the turbine and condenser. This will minimize extraction and drain piping to and from the heater. The extraction pipe from the 11th stage extraction opening to the control valve in the extraction pipe is 10 inches in diameter and 12 inches from the control valve to the heater steam inlet nozzle. A positive closing non-return valve will be installed in this line to prevent turbine water induction. The drain line from this new heat exchanger to the condenser will be 3 inches in diameter upstream and 4 inches in diameter downstream of the heater level control valve.

The district heating system will incorporate four - 33-1/3% capacity horizontal split casing circulating pumps. The pumps will be sized for 375 GPM each with a

STEELE STREET GENERATING STATION
UNIT 6 - DISTRICT HEATING OPERATION

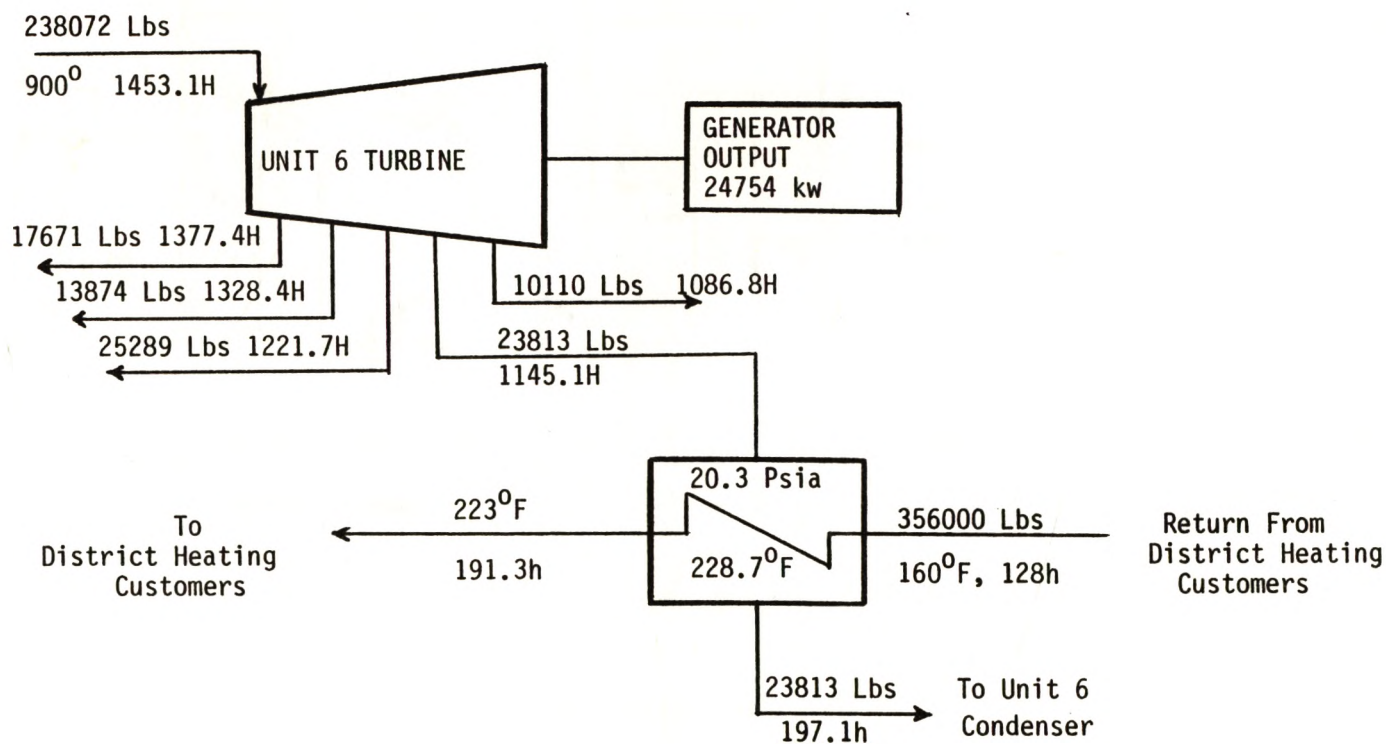


FIGURE 3-1.

STEELE STREET PLANT DISTRICT HEATING RETROFIT

System Arrangement Phase I

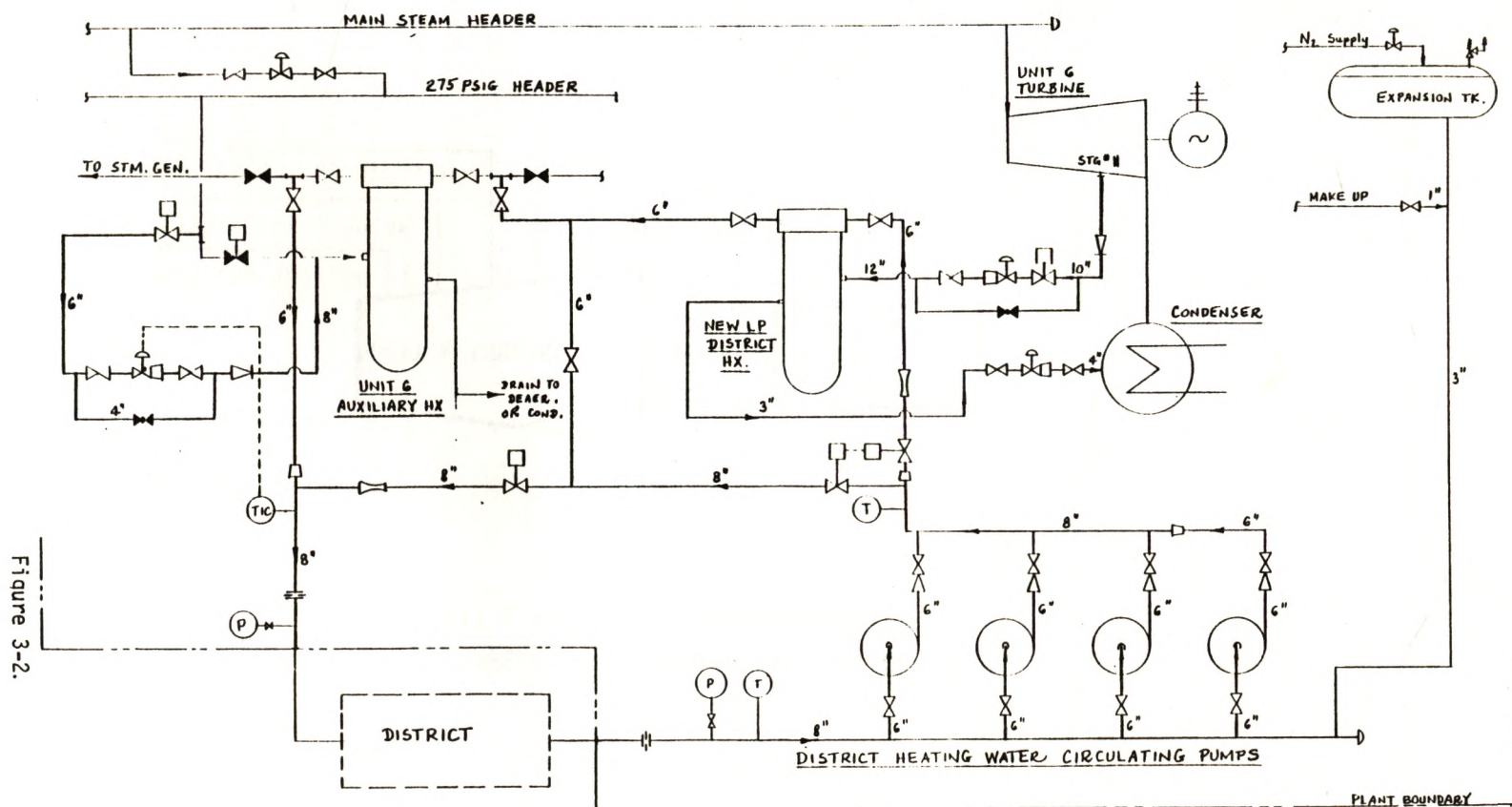


Figure 3-2.

total dynamic head of 360 ft. They will be driven by 50-horsepower motors and located on the ground floor. Two smaller capacity pumps will be provided to supply the summer load which consists only of domestic hot water requirements. Two summer pumps will be installed. Each summer pump will be sized for 300 GPM at a total dynamic head of 100 ft.

The main supply and return headers will be 8 inches in diameter. The branch lines to and from the new heat exchanger and the auxiliary heat exchangers will be sized for a flow rate of 379,000 lb/hr and will have a 6-inch diameter. The inlet pipe to the new heat exchanger will be provided with a flow regulating valve to protect the turbine from excessive extraction flow. The control signal to this flow regulating valve will be obtained from the district heating system return water temperature. The bypass lines for both heat exchangers will be sized to carry the total maximum flow rate of 498,000 lb/hr. The bypass line of the auxiliary heat exchanger must be 8 inches to be able to carry full flow during heat loads of less than 7.03 Mwt when operation of the auxiliary heat exchanger is not required. The 8-inch diameter is also required for initial heat up recirculation of the system or when the auxiliary heat exchanger is used for backup in case of the unavailability of the new heat exchanger. Isolation valves must be installed in the piping serving the auxiliary heat exchanger to allow it to be easily switched from district heating operation to non-district heating operation. The maximum district heating flow rate of 379,000 lb/hr through this heat exchanger is less than the non-district heating design flow rate through the auxiliary heat exchanger.

The existing drain piping from the auxiliary heat exchanger is adequate to handle the drains resulting from steam condensation during district heating. However, heater pressures are lower than during the operation for which the heater was originally designed. Therefore, during partial heat load operation the drains must be routed to the condenser when cascading is no longer possible to the deaerator.

The expansion tank for the district heating system will be sized for differential expansion of the district heating system from initial cold water fill temperature to the average system design temperature. It will be a cylindrical tank with approximate dimensions of a 6-foot diameter and an 18-foot length. This tank will be pressurized by nitrogen to pressures ranging from 40 psig to

80 psig depending on supply temperature pressures and it will be located at an elevation of 65 feet in the plant.

The expansion tank will be connected to the pump suction header by a 3-inch line. A 1-inch line will provide makeup to the system when necessary during normal system operation. Makeup to the cycle will be provided from the municipal water system through water treatment facilities.

Phase II

The second phase heat source development operates in essentially the same manner as the first phase retrofit, except that the auxiliary heater is used to supply heat from thermal loads of 7 MW up to approximately 24 MW instead of 15 MW.

The operation of the new district heating condenser will remain unchanged. At peak load conditions, the district circulating water flow will increase to approximately 905,105 lbs/hr, corresponding to the 24 MWt heat load. A flow of 379,000 lb/hr will be passed through the new district heating condenser and raised to a temperature of 223°F. A flow of 526,105 lbs/hr will be bypassed and 21,000 lb/hr of the bypassed flow will be mixed with the 223°F effluent from the new district heating condenser to form a total flow stream of 400,000 lbs/hr that will pass through the auxiliary heater. A flow stream of 400,000 lbs/hr is the maximum allowable flow in the auxiliary heater. The auxiliary heater will raise the water to a temperature of 360°F so that when mixed with the bypassed water the final system supply temperature will be 250°F.

The new district heating condenser will operate during the entire year as in Phase I. The auxiliary heat exchanger will be in operation approximately one-third of the year. The maximum operating pressure of the new district heating condenser will be approximately 20 psia. The maximum operating pressure of the auxiliary heat exchanger will increase to approximately 153 psia during district heating operation.

During normal operation at loads equal to or less than 7 MWt, the system operation will be identical to that for the first phase of development.

The second phase of heat source development involves incorporating the Unit 5 auxiliary heater into the district heating system to operate in parallel with

the Unit 6 auxiliary heater. With this arrangement, the Unit 5 auxiliary heater could be used in place of the Unit 6 auxiliary heater providing backup to the Unit 6 auxiliary heater, or it could be used in parallel with the Unit 6 auxiliary, providing backup for the new district heating condenser operating off the Unit 5 steam turbine.

As in the case of the Unit 6 auxiliary heater, the Unit 5 auxiliary heater would be capable of heating district water from 160°F to 250°F when operating in a parallel mode, with the Unit 6 heater providing backup for the new district heating condenser. It would be capable of heating district water from 228°F to a temperature above 250°F when operating in series, with the new district heating condenser providing backup for the Unit 6 auxiliary heater. Figure 3-3 shows the district heating system arrangement for Phase II.

Equipment and Piping Selection for Phase II

The new equipment for the second phase retrofit alternative includes additional district heating circulating water pumps and the piping and valves necessary to incorporate the Unit 5 auxiliary heater into the district heating system.

The additional pumps will have the same rating as the original pumps and will be added in parallel with the original pumps. It is recommended that four additional pumps be added, bringing the total to 8 16-2/3% capacity pumps. The piping installed in the first phase was designed with excess capacity to handle the second phase. The only new piping required for the pump installation will be that required to connect the pumps to the main supply and return headers.

The only other equipment required is the piping and valving necessary to incorporate the Unit 5 auxiliary heater into the cycle. This will be essentially the same as that required for the Unit 6 auxiliary heater in Phase I.

All other equipment installed during Phase I will have the necessary excess capacity to operate satisfactorily in Phase II.

STEELE STREET PLANT DISTRICT HEATING RETROFIT

System Arrangement Phase II

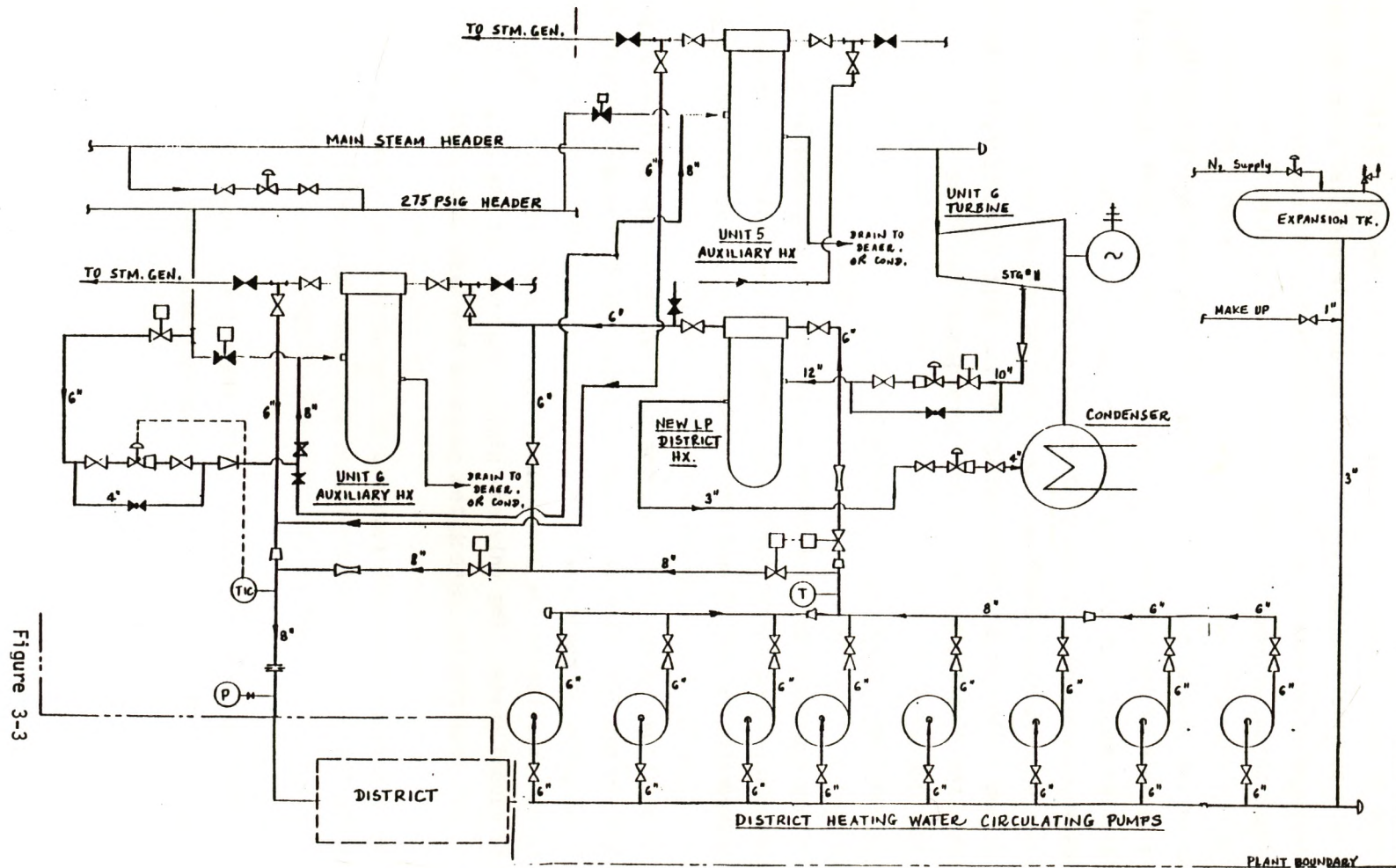


Figure 3-3

Phase III

This phase of development involves the installation of a new 55 MW turbine at the Steele Street Station. A feasibility study performed by General Electric Company for the Board of Public Utilities, City of Jamestown, determined that the largest single purpose turbine-generator that could be installed in the Steele Street Station without major structural changes was a 55 MWe-capacity machine. The new district heating turbine alternative is based on installing a 55 MWe dual-purpose district heating machine in place of the single-purpose machine. The dual -purpose machine would have a full load electric-only capacity of 55 MW and a full load heating-only capacity of 80 MWt. The 80 MWt load would be supplied to two district heating condensers. The load is split equally between these two condensers and serves to heat district water from 140°F to 250°F. The coincident electrical load at the maximum heating capacity of 80 MWt would be approximately 50 MWe. If the turbine was installed for a peak load of 80 MWt, it would run at an average load of approximately 36 MWt based on the load duration curve for Jamestown. This would correspond to an electric load of approximately 46 MWe.

The district heating turbine would be installed in the same location proposed for the 55 MWe single-purpose machine, in the 1929 turbine room extension. The district heating turbine would require all the turbine-generator accessories and related steam cycle equipment required by the single-purpose machine plus the necessary district heating additions. The district heating additions include the extraction steam system for the district heating condensers, the drain system for the district heating condensers, the district circulating water system and the district heating water makeup and treatment system.

Equipment and Piping Selection for Phase III

The new district heating turbine alternative requires the selection and installation of a new cogeneration district heating turbine rated for 55 MW electric output and 80 MW thermal output. The turbine will be designed to operate with throttle conditions of 1000 PSIG, 900°F and a full load flow of 534,450 lbs/hr. The turbine will incorporate two district heating extractions. One district heating extraction will supply the high pressure district heating condenser which will operate at 42 psi. The second district heating extraction will supply the low-pressure district heating condenser which will operate at 15 psi. The high-pressure district heating extraction will have a shell pressure

of approximately 240 psi and an enthalpy of approximately 1300 btu/lbm. The extraction line to the high-pressure district heating condenser will be 8 inches in diameter and will carry superheated steam at a full load rate of 129,000 lbs/hr. The low-pressure district heating extraction will have a shell pressure of approximately 46 psia and an enthalpy of approximately 1175 btu/lbm. The extraction line to the low-pressure district heating condenser will be 18 inches in diameter and will carry saturated steam at a full load rate of 138,000 lbs/hr.

The two district heating condensers are shell and tube-type heaters, each having two passes. The heat load is split equally between the two condensers, thus each district heating condenser has a design load of 40 MWt. The district heating condensers each contain approximately 4,580 square feet of heat transfer area. They measure approximately 5 feet in diameter and are 28 feet long. The design is based on 1-inch diameter, 90-10 CuNi tubes.

At 100 percent heat load, the maximum high-pressure and low-pressure district heating condenser drain flow is 267,000 lbs/hr. The drains from the high-pressure condenser are normally cascaded to the low-pressure condenser, and all drains are then pumped forward to the deaerator. Two 50% capacity, 275 gpm vertical can-type pumps are used. The pumps have a design head of 72 feet. If the low-pressure condenser is not in service, the high-pressure drains are cascaded to the main condenser.

The district water system uses three 50-percent capacity, 2600 gpm circulating pumps. The pumps have horizontally split casings. The pumps are rated for a system pressure of 150 psi. They are driven by 300-horsepower electric motors.

The expansion head tank has a capacity of 77 cu. ft. The tank is 3.5 ft. in diameter and 8 ft. long.

The makeup system components are sized to produce treated water at 26 gpm to compensate for system losses corresponding to about one-half percent of the district heating water flow rate. There are two 100-percent capacity soft water pumps, one 38,000-gallon soft water storage tank, one 26-gpm vacuum degasifier, two 100-percent capacity vacuum degasifier pumps and two 100-percent capacity zeolite softeners. The soft water storage tank dimensions are 18 ft. in diameter by 20 ft. high.

The district water piping is 14-inch nominal size with 10-inch individual pump suction and discharge lines. The lines were sized not to exceed a maximum velocity of 12 ft. per second.

HEAT SOURCE COST ESTIMATE

Table 3-1 presents the estimated cost for developing the heat sources for the different phases of district heating development. All figures represent installed costs. A 15 percent increase has been included for contingency, and a 16 percent increase has been included for engineering and construction management.

The costs presented are based on manufacturers quotes, and piping lengths and equipment locations are determined from plant drawings.

TABLE 3-1
HEAT SOURCE COSTS
(1984 DOLLARS)

<u>ITEM</u>	<u>PHASE I</u>	<u>PHASE II</u>	<u>PHASE III</u>
1. Turbine Generator Modifications	---	---	1,200,000
2. District Heating Condensers	60,000	---	380,000
3. District Heating Circulating Pumps	41,000	41,000	50,000
4. Piping and Valves	334,000	74,000	199,000
5. Makeup and Expansion System	33,000	---	25,000
6. Removal/Relocation of Existing Equipment	7,000	2,000	---
Subtotal	475,000	117,000	1,854,000
Contingency @15%	71,000	18,000	278,000
Engineering & Construction Management @16%	87,000	22,000	341,000
TOTAL	633,000	157,000	2,473,000

Section 4

TRANSMISSION SYSTEM

INTRODUCTION

The objective of this task is to develop a piping system design, routing and installation technique that will enable the delivery and return of hot water from the Steele Street plant to district heating customers in Jamestown. The system shall be designed to serve facilities, that have presently been targeted as district heating customers, in the most economical manner, while providing excess capacity in the lines for future development of the system.

The development and installation of the transmission system will be the largest task in developing Jamestown's district heating system. The transmission system represents approximately 75 percent of the cost of the system and will require the longest time period to complete. This section of the report will present an overview of the work effort required to build the transmission system.

PIPING SYSTEM DESIGN

The piping system is designed as a two-pipe closed system with all pumps, water treatment facilities and the expansion head tank located at the Steele Street plant. The system will have a design pressure of approximately 240 psi with the pumps sized for a total dynamic head of 140 psi. The piping is designed for a maximum velocity of 8 ft. per second based on a peak load supply temperature of 250°F and a peak load return temperature of 160°F.

The pipe design used will be that of a prefabricated insulated conduit. The conduit system will consist of a carbon steel carrier pipe, polyurethane insulation, polyethylene casing and a leak detection system. For the carbon steel carrier pipe, schedule 20 wall thickness is being recommended. Schedule 20 wall thickness will meet the pressure and temperature requirements of the piping system.

The effects of accelerated corrosion of carbon steel piping in the 200°F range require that the supply piping be physically protected against outside water

contact. Equally important, the pipe insulation must be protected from moisture penetration that would increase the thermal conductivity of the insulation. The insulation must also be protected against mechanical abuse, ultraviolet degradation, erosion and other environmental hazards. The polyurethane foam insulation must be protected against mechanical damage from weathering, handling abuse, field bending, casing pressures, water pressure, saddle-bearing forces, ground movement and damage in storage. The most economic and reliable method for providing the piping system with protection against the above problems is to use a shop-fabricated conduit design with a polyethylene casing.

The polyethylene casing is the preferred casing material because it will not corrode in the underground environment, has excellent water-resisting properties, is easy and cost-effective to install, and is lightweight and easy to repair if physically damaged.

A shop-fabricated conduit system can be fully shop tested, is less expensive to install, is faster to install (causing less disruption of the district heating site) and can be manufactured with a high degree of quality control, resulting in a product of high reliability.

The polyurethane foam is preferred because of its low thermal conductivity ($0.18 \text{ Btu/in/ft}^2/\text{°F}$) which provides excellent thermal efficiency of the conduit system. The foam is easily installed during manufacture of the conduit. The foam is poured between the carrier pipe and the casing in a liquid form and expands to fully occupy the space between the carrier pipe and the casing. The foam bonds itself to the pipe and casing walls, providing a structurally stable insulation that will not shift, settle or shrink with time to create inefficient voids. The conduit requires no special hardware for fastening the insulation in place.

The prefabricated conduit is installed by butt-welding the carrier pipe sections together. After the carrier pipes are welded together, the alarm wires from the two pipe sections are connected, forming a continuous circuit. The casing joint is then made, and polyurethane foam is injected into the conduit between the

carrier pipe and the casing to insulate the joint. There are two common methods for making the casing joint.

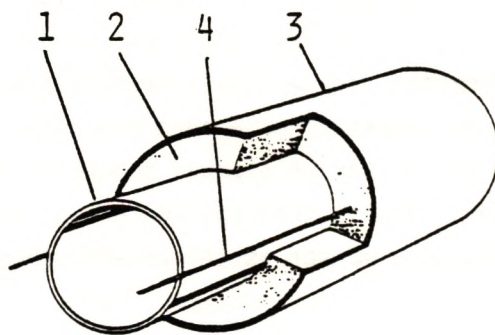
One method is to slide a polyethylene sleeve over the pipe casing before the carrier pipes are welded, then slide the sleeve over the joint and apply foam for insulating through holes drilled in the casing. The sleeve is then bonded to the pipe casing using a plastic shrink sleeve or by welding the sleeve to the casing. Experience has shown that, over a several-year period, shrink sleeves tend to loosen and shift on the pipe. As a result, the latest practice is to apply a mastic to the inside surface of the sleeve to increase adhesion.

The other method used for making casing joints is to place a steel fitting coated with a thick layer of polyethylene around the joint. The fitting consists of two halves which are bolted or clamped together, securing the fitting to the pipe casing. Polyurethane is then poured through holes in the fitting, insulating the joint in the same manner as the pre-manufactured conduit.

The conduit will be manufactured and shipped to the field in lengths of 20 feet or more. All fittings and valves are also pre-insulated and shipped to the field in the form of a finished conduit section. Figure 4-1 shows the conduit design.

The smaller customer branches will be designed with a conduit using a flexible copper carrier pipe. The copper pipe conduit will be delivered in coils of long lengths rather than straight sections. The copper pipe conduit has the advantage of being flexible and requiring fewer joints.

To protect the system and facilitate service of the system, a combined alarm and fault locator system is built into the conduit during manufacture. The alarm system consists of two copper wires that are molded into the foam insulation during manufacturing of the conduit. As the conduit sections are installed, the wires are connected forming a continuous circuit through the piping system. The copper wires are connected to alarm/control boxes at either central or remote locations. The wires carry a low voltage current. When moisture enters the



1. CARBON STEEL CARRIER PIPE
2. POLYURETHANE INSULATION
3. POLYETHYLENE CASING
4. ALARM WIRES

FIGURE 4-1. DISTRICT HEATING CONDUIT

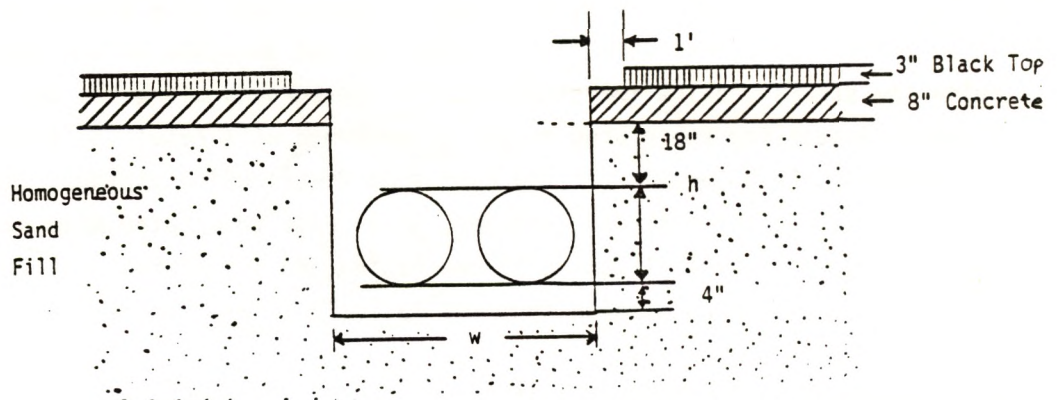
piping system, it completes the circuit between the wires and the carrier pipe, triggering the alarm. The alarm system not only detects the leak but, by measuring resistance, can tell the system operators exactly where the leak is located. This system allows maintenance personnel to repair a leak in the system with minimal expense and with minimal excavation. This system also gives immediate detection of a problem, allowing it to be corrected before substantial damage is done.

The installation technique for the Jamestown district heating piping will be to install both the supply and return piping side-by-side in a single trench. Three different schemes were investigated for the location of the conduit: below the streets, below the sidewalks and aboveground along the railroad right-of-way. Installing the piping along the railroad will result in a cost savings of approximately 6 percent for the core area distribution piping. Installing the piping along the railroad, however, will leave the piping more susceptible to vandalism and physical damage to the casing and insulation. It would also be necessary to obtain permission from the railroad to use the right-of-way.

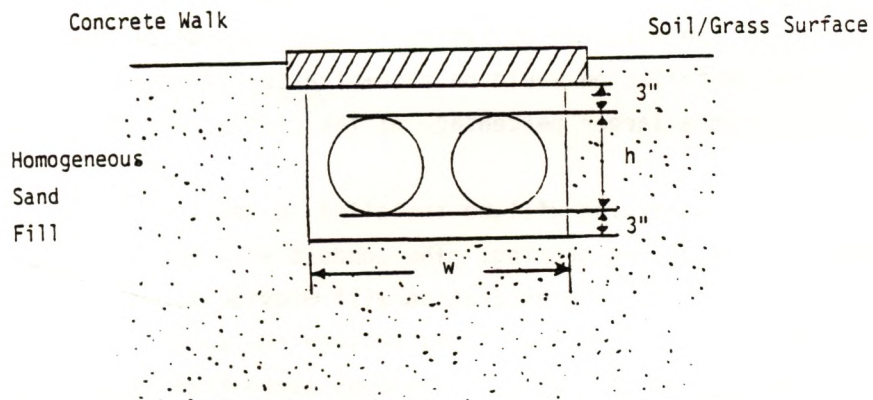
When comparing the installation of piping beneath the streets to piping beneath the sidewalk, the sidewalk installation is generally more cost-effective. Installing the conduit below the sidewalks requires shallow excavation, involves less expensive surface removal and replacement, encounters fewer interferences with other utilities and causes less disruption of vehicular traffic. Investigation of the existing utilities in Jamestown determined that the most cost-effective installation would be a combination of street and sidewalk installation, with a larger percentage of the piping beneath the sidewalks.

The district heating piping will be installed in shallow trenches requiring minimum excavation and no shoring. The conduit will be laid directly in the trenches on a sand bed. The excavation will provide for a clearance of six inches between conduits and six inches between the conduit and the trench walls. The conduit is then covered with homogeneous stone-free sand. The surface pavement will be installed directly over the sand layer. Figure 4-2 shows the trench configuration and conduit installation for the street and sidewalk

A. Street Installation



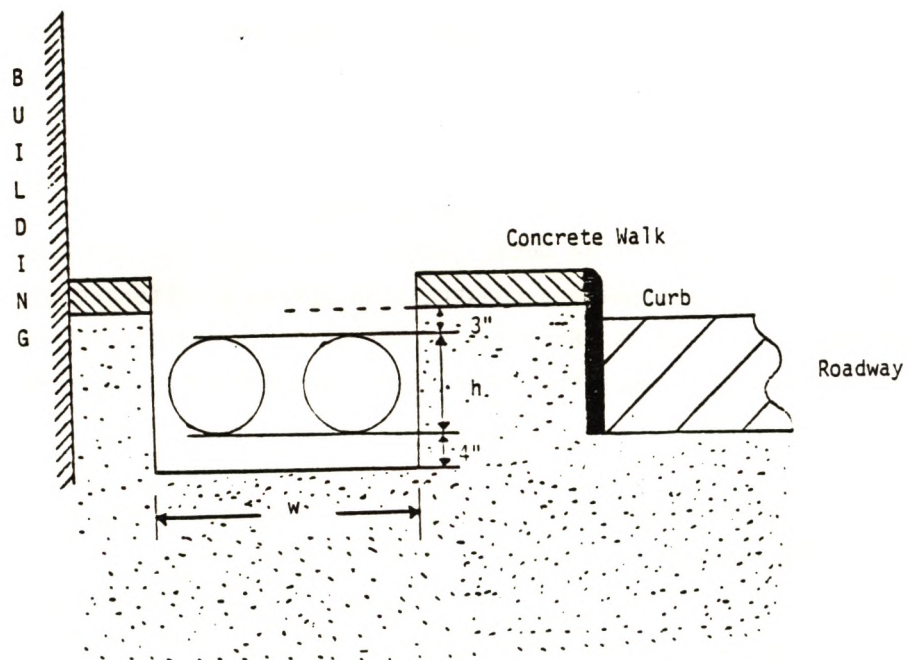
B. Sidewalk Installation, Type 1



Note: Walk is broken, removed and new walk installed

Figure 4-2. District Heating Conduit Installations

C. Sidewalk Installation, Type 2



Note: Walk is cut, removed and repaired

Figure 4-2(Continued) District Heating Conduit Installations

installations required in Jamestown. Table 4-1 shows the conduit diameter and required trench size for different size carrier pipes. Proper backfilling of the conduit is very important.

The district heating system is designed to operate at a peak load supply temperature of 250°F and a peak load return temperature of 160°F. The system temperature will vary downward from these design temperatures based on system load; however, the temperature will always be significantly higher than the ambient temperature at which the piping was installed. As a result, the piping will experience thermal expansion and will have to be protected against over-stressing. The conventional method of protecting piping systems against excessive movement and thermal stresses is to design the system with expansion loops and bends or expansion joints. Expansion joints can be a source of maintenance problems and are often avoided. Expansion bends and loops require extra pipe and fittings and can add substantial cost to the project.

The conduit piping design used in the Jamestown district heating system is a fully-bonded construction with the outer jacket, insulation and carrier pipe forming a single unit. This unitary construction allows an alternative installation technique known as "Friction Anchoring." In this technique, the frictional forces acting between the outer jacket and the surrounding ground restrain the pipe from moving.

The piping experiences increased stresses caused by the restraining of the thermal expansion. The stresses experienced by the pipe must be within the allowable stress limits of the piping. As a result, there is a limited temperature range for which this technique can be used. The temperature at which the pipes are restrained (i.e., backfilled) will become the neutral or unstressed temperature of the system. For temperatures below this point the system will experience tensile stresses, and for temperatures above this point the system will experience compressive stresses.

In order to minimize stresses over the operating temperature range of the system, the neutral point is set at the middle temperature between the peak

TABLE 4-1

CONDUIT INSTALLATION DIMENSIONS

Pipe Size Inches	Conduit Diameter Inches	Installation Envelope (wxh) Inches
3/4	4	24 x 4
1	4	24 x 4
1-1/4	5	26 x 5
1-1/2	5	28 x 5
2	6	30 x 6
2-1/2	6	30 x 6
3	7	32 x 7
4	9	36 x 9
5	10	38 x 10
6	11	40 x 11
8	14	46 x 14
10	8	54 x 18

operating temperature that could be experienced and the non-operating ambient condition. To accomplish this, the piping system is preheated to the middle temperature after being laid in the trench. During preheating, the pipe will expand freely without stresses. The piping will then be held at the middle temperature during backfilling and compaction. This installation technique has the following advantages:

- o The majority of the piping system does not experience expansion movement.
- o There is little axial expansion movement at expansion joints.
- o No expansion joints, compensators or expansion loops are required.
- o No concrete anchor blocks are required to control movement.
- o Variations in depth of cover are unimportant.
- o A minimum of piping material is required in the system.

A disadvantage of this installation technique is that the trenches cannot be backfilled until the pipe is preheated. This could be a problem when installing pipe in congested city areas.

It is recommended that the "Friction Anchoring" technique be used for the Jamestown system. There will be sections of the piping system where the routing has sufficient flexibility such that preheating will not be necessary. This will generally occur in the downtown area, where location of customers requires that the distribution system make several changes in direction and where bends and loops are required to avoid interferences with other utilities.

PIPE ROUTING

For each phase of expansion, several piping alternatives were studied to determine the optimal layout. The overriding criterion was the ability of a particular layout to pick up the greatest number of customers, and more importantly, the greatest annual load for the least investment. To keep the capital cost low, the pipe was run under sidewalks and grassy areas to the greatest extent possible in lieu of the more costly and inconvenient street installation. This also had the added benefit of minimizing interferences with other utilities as they were found to be mostly under the street.

In addition to optimizing the capital cost, the layouts were made with an eye toward future expansion of the system. This meant that large headers were placed in convenient locations for future phases to tie into, and that in general, the pipe sizes were kept large enough and were laid out in such a fashion that all possible existing and future customers within a given district would be allowed access to the system with minimal incremental cost.

Taking the above criteria into consideration optimal piping layouts were determined for each phase and are presented here in Figures 4-3 through 4-6, showing the physical layout, and Tables 4-2 through 4-5, showing the lengths and sizes of piping for each.

The pipe routing for the core area has a total of 17,637 feet of transmission piping, and 5,050 feet of distribution piping and has the capability of reaching the majority of the customers within the core area boundaries. Saturation of the core area requires only an additional 1,125 feet of transmission piping but entails 4,950 feet of small diameter distribution piping. The third phase of piping implementation will bring on the industrial corridor and will total 11,500 feet of transmission piping and, for a 70% penetration of this district, 650 feet of distribution piping. The remaining expansion into the residential and commercial district will have 29,700 feet of transmission piping and, for a 50% penetration of these districts 21,550 feet of distribution piping when fully completed.

Table 4-2
CORE AREA PIPING

<u>Transmission</u>		<u>DIAM (in)</u>	<u>LENGTH (ft)</u>	<u>INSTALLATION</u>
<u>NODE</u>	<u>TO NODE</u>			
1	2	12	410	Street
		12	3240	Sidewalk (1)
2	3	5	75	Street
		5	1225	Sidewalk (1)
3	4	3	50	Street
		3	290	Sidewalk (1)
2	5	8	75	Street
		8	675	Sidewalk (1)
5	6	6	300	Street
		6	90	Sidewalk (1)
6	7	4	90	Street
		4	290	Sidewalk (1)
7	8	3	160	Street
		3	640	Sidewalk (1)
8	9	1.5	50	Street
		1.5	275	Sidewalk (1)
6	10	5	175	Street
		5	500	Sidewalk (1)
10	16	2	100	Sidewalk (1)
16	17	1.5	65	Street
		1.5	585	Sidewalk (1)
10	11	5	60	Street
		5	140	Sidewalk (1)
11	12	4	175	Street
		4	6852	
12	13	3	60	Street
		3	390	Sidewalk (1)
13	14	2	175	Sidewalk (1)
14	15	1.25	25	Street
		1.25	400	Sidewalk (1)
Total			17,637	

<u>Distribution</u>	
<u>DIAM (in)</u>	<u>LENGTH (FT)</u>
0.75	1125
1	335
1.25	1540
1.5	85
2	110
2.5	700
3	1080
4	75
5	0
Total	5050

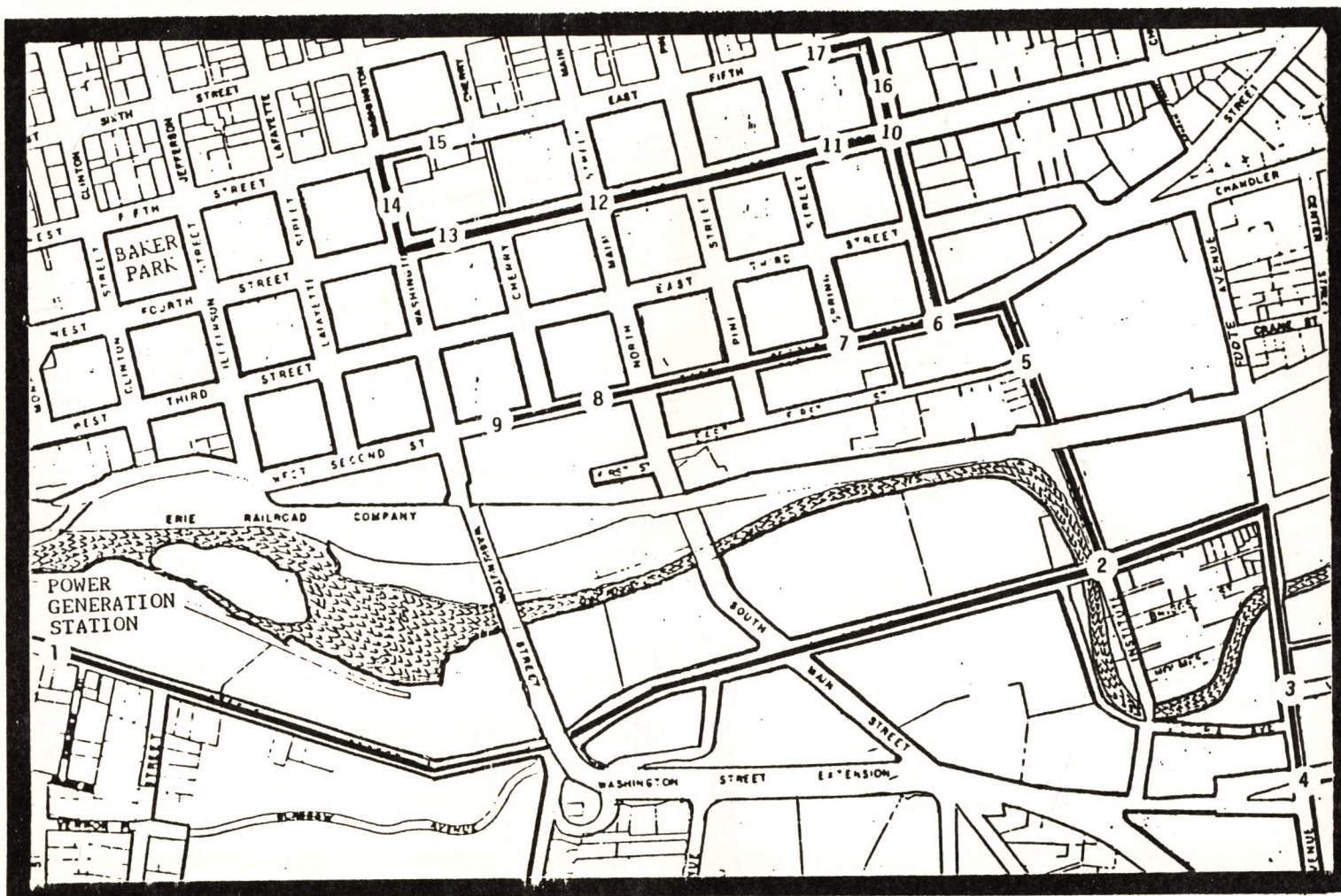


Figure 4-3
Core Area Piping

Table 4-3

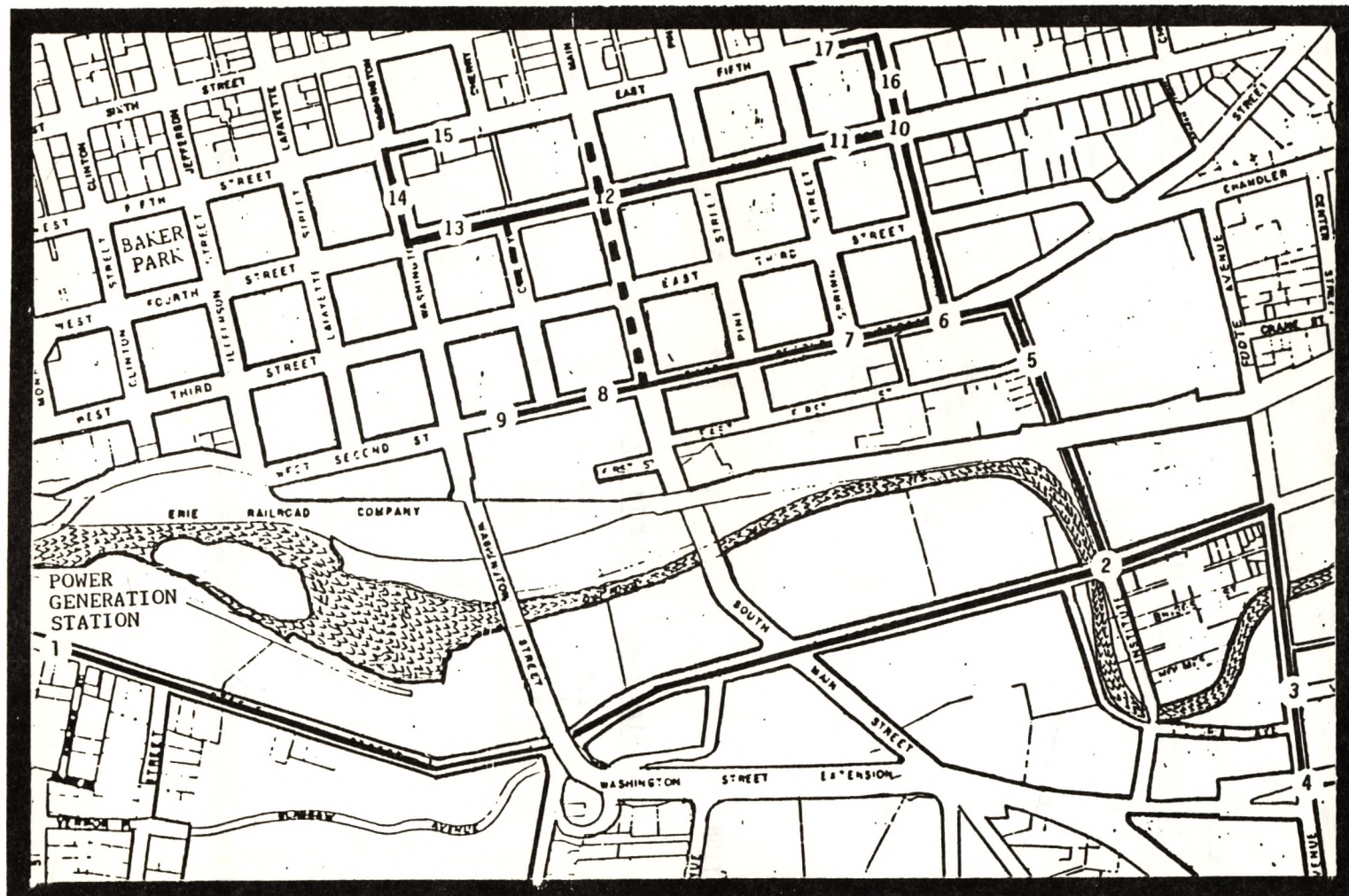
SATURATED CORE AREA ADDITIONAL PIPING

TRANSMISSION PIPING

<u>DIAM (in)</u>	<u>LENGTH (ft)</u>	<u>INSTALLATION</u>
1.5	75	Street
1.5	150	Sidewalk (1)
2	225	Street
2	<u>675</u>	Sidewalk (1)
Total	1125	

DISTRIBUTION PIPING

<u>DIAM (in)</u>	<u>LENGTH (ft)</u>
0.75	3850
1	600
1.25	325
1.5	75
2	<u>100</u>
Total	4950



- Core Area Piping
- - - Additional Piping to Saturate Core Area

Figure 4-4
Core Area with Additional Piping
to Saturate Core Area

Table 4-4
INDUSTRIAL CORRIDOR PIPING

TRANSMISSION

<u>NODE</u>	<u>TO NODE</u>	<u>DIAM (in)</u>	<u>LENGTH (ft)</u>	<u>INSTALLATION</u>
1	2	8	250	Street
		8	4550	Grass
2	3	6	50	Street
		6	2750	Grass
3	4	4	2800	Grass
5	6	2	50	Street
		2	1050	Sidewalk (1)
TOTAL			11,500	

DISTRIBUTION

<u>DIAM (in)</u>	<u>LENGTH (ft)</u>
1.5	400
2	150
3	100
TOTAL	650

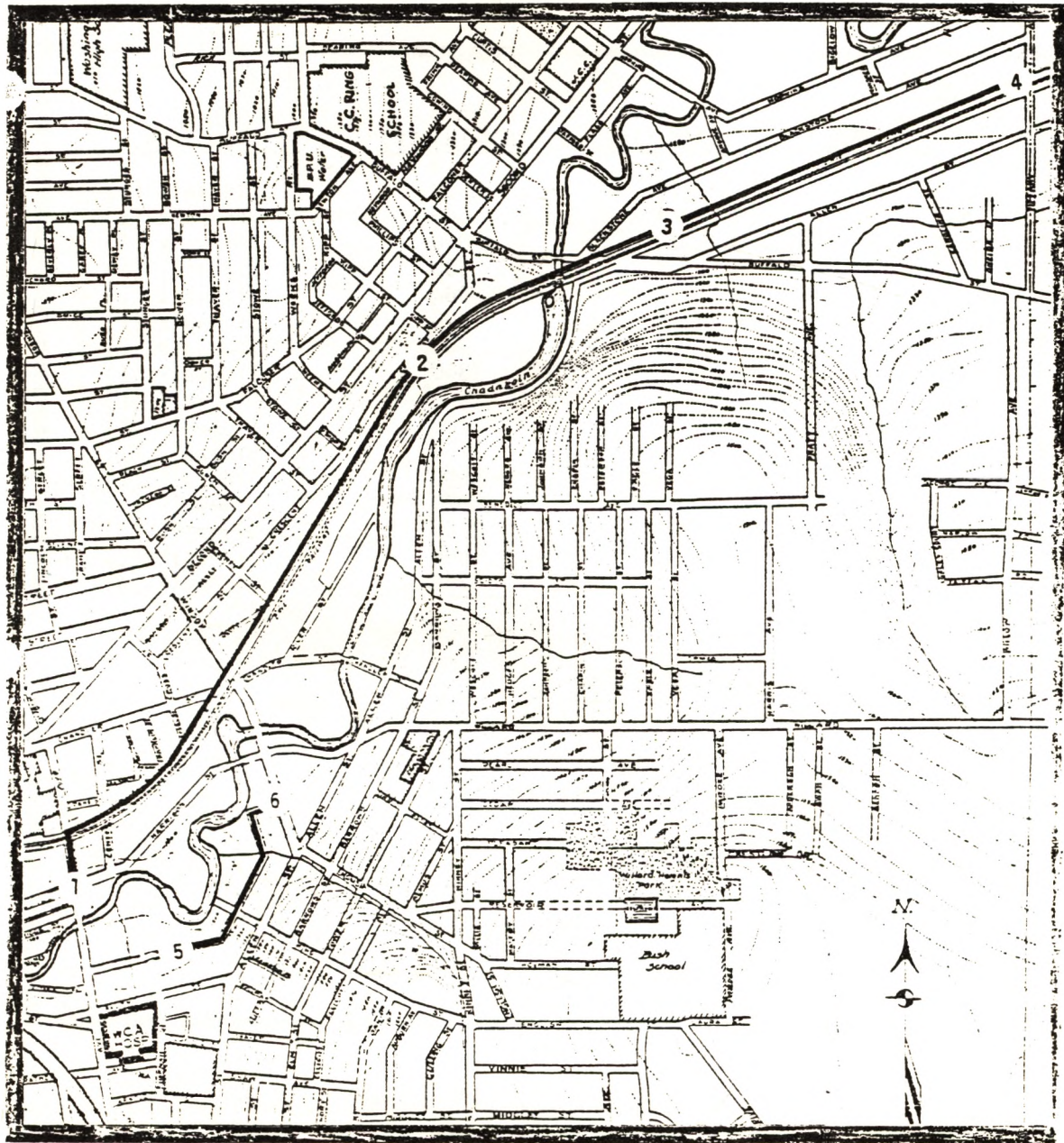


Figure 4-5
Industrial Corridor Piping

Table 4-5
RESIDENTIAL AND COMMERCIAL DISTRICTS PIPING

TRANSMISSION

<u>NODE</u>	<u>TO NODE</u>	<u>DIAM (in)</u>	<u>LENGTH (ft)</u>	<u>INSTALLATION</u>
1	2	12	2500	Sidewalk (1)
2	3	4	600	Sidewalk (1)
2	4	10	600	Sidewalk (1)
4	5	2	500	Sidewalk (1)
4	6	10	1000	Sidewalk (1)
6	7	8	600	Sidewalk (1)
7	8	3	300	Sidewalk (1)
8	9	2	1300	Sidewalk (1)
8	10	3	600	Sidewalk (1)
10	11	2	1400	Sidewalk (1)
10	12	2	2150	Sidewalk (1)
7	13	6	600	Sidewalk (1)
13	14	3	3000	Sidewalk (1)
13	15	4	2700	Sidewalk (1)
15	16	2	1600	Sidewalk (1)
15	6	3	<u>10250</u>	Sidewalk (1)
TOTAL			29,700	

DISTRIBUTION

<u>DIAM (in)</u>	<u>LENGTH (ft)</u>
0.75	15000
1	5000
1.5	1250
2	<u>300</u>
TOTAL	21,550

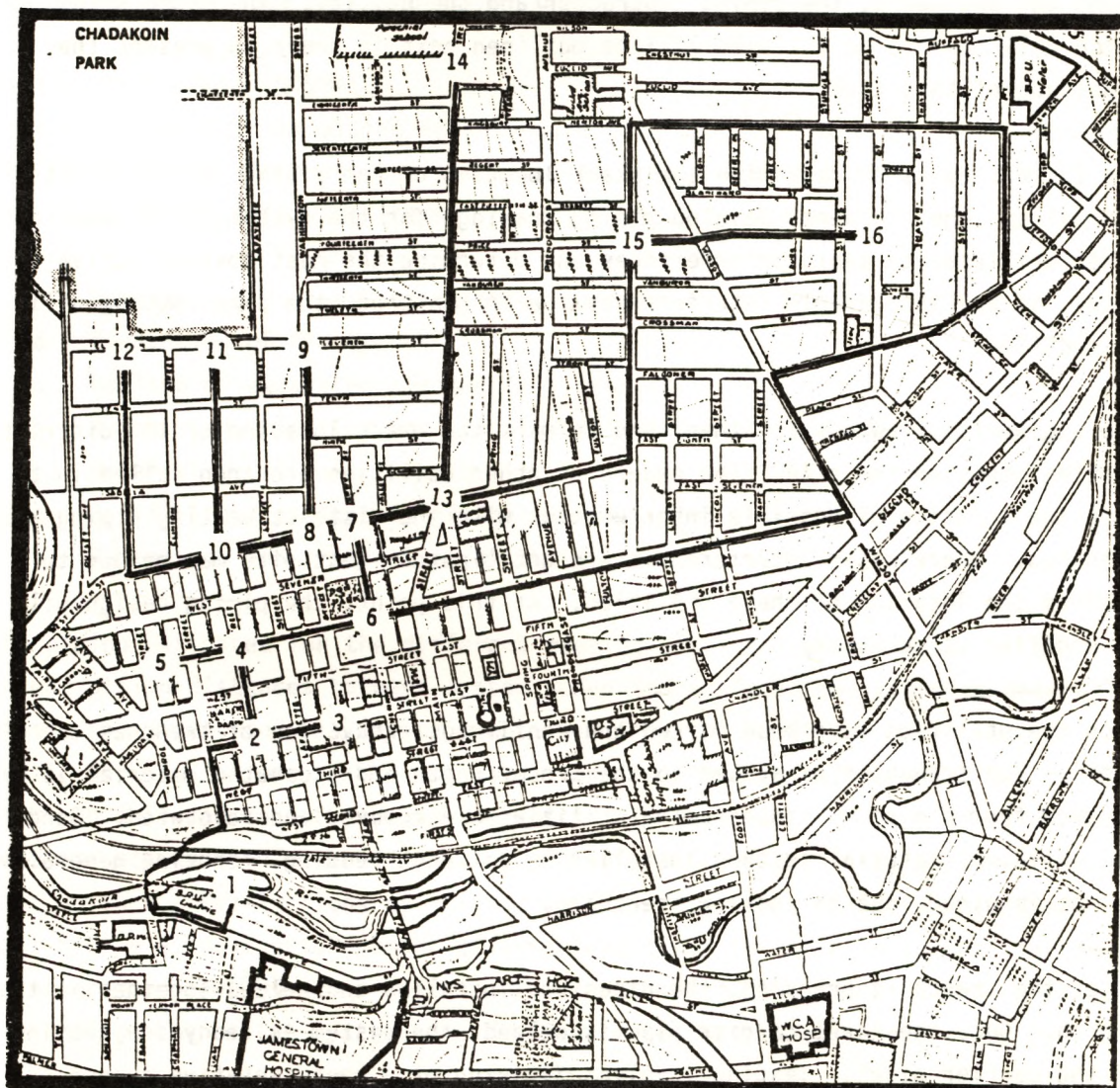


Figure 4-6
Residential and Commercial
Districts Piping

PIPING SYSTEM INSTALLATION

Once the piping system design has been chosen and the general pipe routing has been determined, there is still a substantial design and work effort required during the actual construction period. This effort requires close cooperation among the engineers, the piping contractor and the utility. The basic steps which will have to be followed will be outlined next in order to present the magnitude of this task.

The first step is to determine the exact location of the piping in the streets and walks. The engineers develop piping drawings for the system, using maps of other utilities to avoid interferences and determine the most cost-effective path. If any intolerable interferences are encountered, the pipe routing will be modified.

The engineers' drawings are then used to mark the exact location of the district heating pipes on the site. The owners of other utilities are then called in to mark the location of possible interferences with the district heating piping and trenches. Where major interferences are anticipated, test pits may be dug to confirm the location of these utilities. At this point, the piping design will be modified as necessary.

Once the utilities have been marked and confirmed, excavation of trenches can begin. The trench is excavated to the proper depth and excavated material is removed from the site. Interfering utilities are removed and relocated. Sand or equivalent material is then installed as a trench bedding. Shoring generally is not required, due to shallow trenching.

After the trench is prepared, the pipes are installed and welded together in the trench. Once the steel carrier pipe is welded, the system is ready for testing of the carrier pipes. Testing involves X-raying of a representative number of welds and hydro-testing of completed sections.

After hydro-testing is completed, the leak detection system wires are connected and tested for continuity. This is followed by completion of the casing joints and insulating of the joints.

The conduit system is completely sealed at this point and can be preheated as required and backfilled. Backfilling should be done in layers with clean fill; each layer is compacted. Street and sidewalk surfaces are then replaced, restoring the surface to its original condition.

PIPING SYSTEM COST ESTIMATES

Cost estimates for the piping systems were developed by individually estimating the cost of each component and installation step. The cost estimates are comprised of the following items:

- o Removal and disposal of existing surface
- o Excavation of the trench
- o Hauling of excavated and backfill material
- o Purchasing, handling and installation of conduit and other mechanical material
- o Backfill and compaction of the trench
- o Repavement and restoration of the surface.

The piping estimates for the different routing alternatives are based on the actual piping distances between system nodes and surface conditions as determined from street and utility maps obtained from the Jamestown Department of Public Works. The base price estimates represent the installation of the pipe in clean soil and do not include the costs associated with solving interference problems between the district heating piping and other utilities and underground obstructions. Examinations of utility maps for Jamestown indicate that there will not be a substantial number of interferences. In order to account for the interferences that do occur and to allow for funds for engineering and construction management of the system, the base estimates have been increased by 25%.

The cost estimates for the different piping alternatives are shown in Table 4-6.

Table 4-6

DISTRICT HEATING PIPING SYSTEM COST ESTIMATE1984 DOLLARS x 10³

	Phase I (Core Area)	Phase II (Saturated Core Area)	Phase III (Industrial Corridor)	Phase IV (Outlying Residential and Commercial Districts)	Total
Transmission Piping	1,720	84	1,405	3,237	6,446
Customer Connections	<u>326</u>	<u>231</u>	<u>26</u>	<u>1,027</u>	<u>1,610</u>
Subtotal	2,046	315	1,431	4,264	8,056
Engineering Construction Management Contingency	<u>512</u>	<u>79</u>	<u>358</u>	<u>1,066</u>	<u>2,015</u>
Total	2,558	394	1,789	5,330	10,071

Section 5

BUILDING RETROFIT ANALYSIS

INTRODUCTION

This section presents the results of the retrofit analysis performed for the varying types of existing heating systems encountered in Jamestown industrial, commercial, and residential buildings and facilities. While the project scope did not allow a detailed analysis for all buildings, the data base, provided by the numerous specific buildings for which an in-person survey was conducted, permitted the development of conceptual retrofit designs and associated conversion cost estimates applicable to all types of buildings presently heated by fuel-burning equipment. Buildings with primarily electric resistance heating were not considered due to the high costs associated with converting to hot water heating.

GENERAL

The design philosophy for the building retrofit analysis can be summarized as follows:

- o Due to the high temperatures and pressures in the district heating system distribution network, plate-type heat exchanger(s) are utilized in each building to transfer heat from the district heating water supply to the building distribution system for comfort heating and internal uses (domestic hot water, process, etc.).
- o The district heating water supply temperature varies according to outdoor temperature from a maximum of 250°F on the design day (3°F outdoor temperature) to approximately 160°F during the summer months. Consequently, the building heating system distribution temperature must also be reset from the outdoor temperature to satisfy the heating load as it varies with outdoor temperature.
- o Building systems operating temperatures were selected to optimize size of system components while providing for the lowest possible

district heating water-return temperatures and maximum differential temperatures.

- o Since achieving a low return temperature in the district heating system is important to the overall system economics, where buildings require multiple heat exchangers for comfort heating, domestic hot water, and process system loads, the heat exchangers in most cases are arranged in series so as to extract heat at the lowest possible temperatures. Typically, district heating water first passes through the comfort heating heat exchangers (due to their higher secondary side temperature requirements) prior to entering the domestic hot water and process units.
- o Existing central and terminal comfort heating equipment are evaluated for performance and adaptability when being changed from steam to hot water service.
- o Existing control methods are evaluated for all building systems to determine appropriateness to the hot water district heating system. Controls are revised when necessary to optimize system temperatures and to adapt to the hot water district heating operating characteristics.
- o The adaptability of each building's internal process and domestic hot water systems to hot water district heating is evaluated. These systems remain in their present configuration in cases such as when minimal hot water demands do not justify associated retrofit costs (i.e., heat exchanger, extensive piping runs), or when process system requirements cannot be met due to high temperature or extensive retrofit requirements.

The majority of building heating systems encountered were typically one of the following, utilizing primarily gas-fired boilers or furnaces:

- o Two-pipe steam heating (Figure 5-1)
- o Hot water (Figure 5-2)
- o Combined steam and hot water (Figure 5-3)
- o Forced air (Figure 5-4)

Two-pipe steam heating systems were the most frequently installed heating system in all types of buildings. Conversion to hot water district heating is depicted in Figure 5-5. A plate-type heat exchanger is installed to replace the existing boiler to transfer heat from the district heating water to the building heating system. Existing steam piping and condensate piping (if large enough to handle the flow rates associated with hot water) are utilized to establish a closed-loop hot water circulating system with the installation of circulating pumps, expansion tank, and air removal system. All steam traps are removed and air vents are installed at system high points.

Existing steam heating terminal units, including cast iron radiators, finned tube radiators, cabinet and unit air heaters, in most cases may be converted to hot water service. While these units provide less heat when hot water is used because of the lower media temperature, units are often oversized particularly in older systems as found in Jamestown. Oversizing, as a result of conservative heat load estimates, safety factors, and disregard of energy conservation in the past due to low fuel costs, permits existing equipment to be used with hot water and still provide adequate performance. Steam coils in air handling units and ductwork may also be retrofitted to hot water service provided they are capable of withstanding higher pressures associated with hot water service, have sufficient capacity with hot water, and by configuration are adaptable.

Figures 5-6 through 5-10 depict typical retrofits of steam heating terminal units to hot water service. Cast iron and fin-tube radiators require removal of steam traps and the installation of a balancing valve and air vent. Existing steam supply valves need not be replaced with hot water valves if positive shutoff can be achieved. Cabinet and unit heaters require removal of the steam trap and installation of a balancing valve, air vent, and an automatic shutoff valve where not previously installed. The automatic shutoff valve prevents

FIGURE 5-1
TWO-PIPE STEAM HEATING SYSTEM

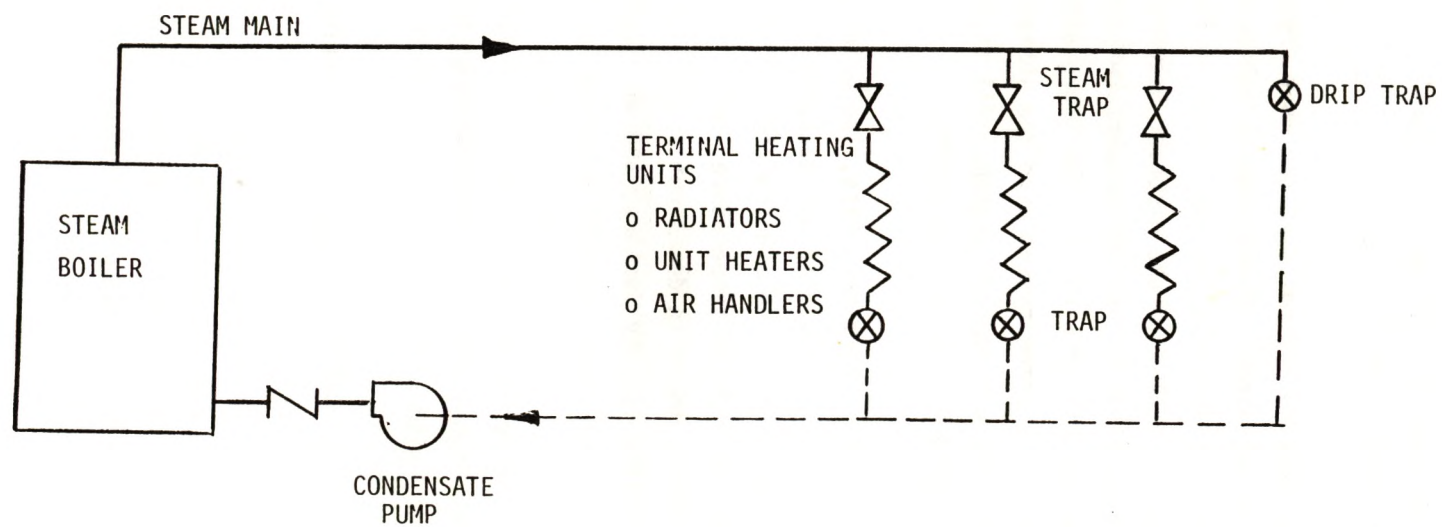


FIGURE 5-2
HOT WATER HEATING SYSTEM

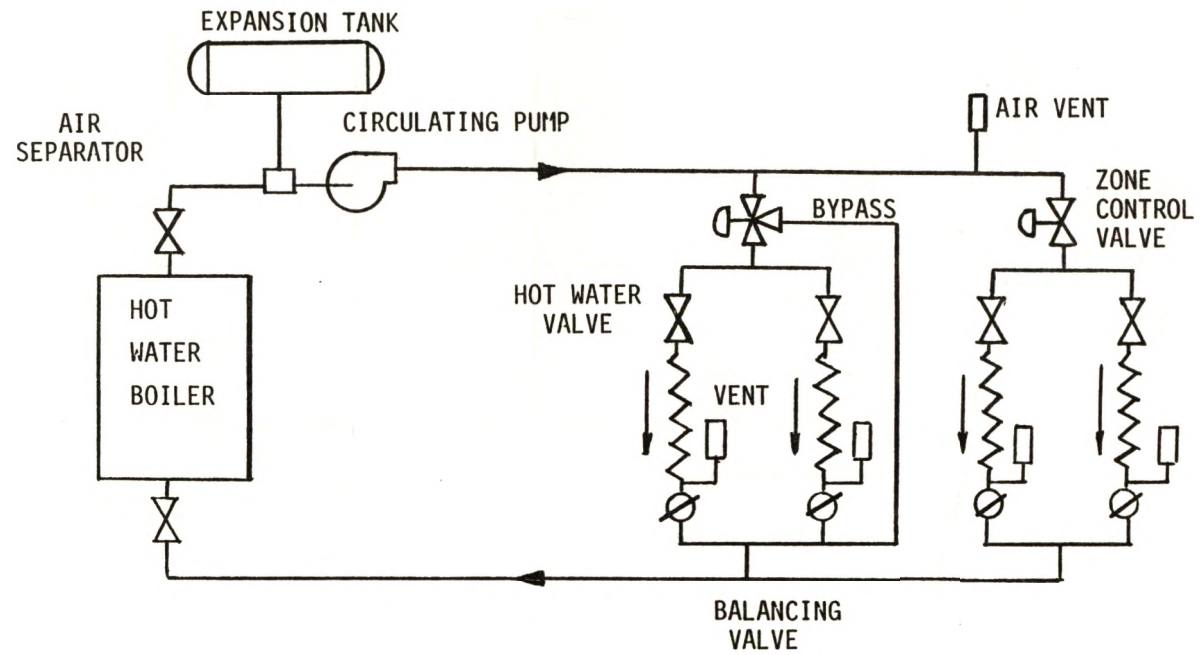


FIGURE 5-3
COMBINED STEAM/HOT WATER HEATING SYSTEM

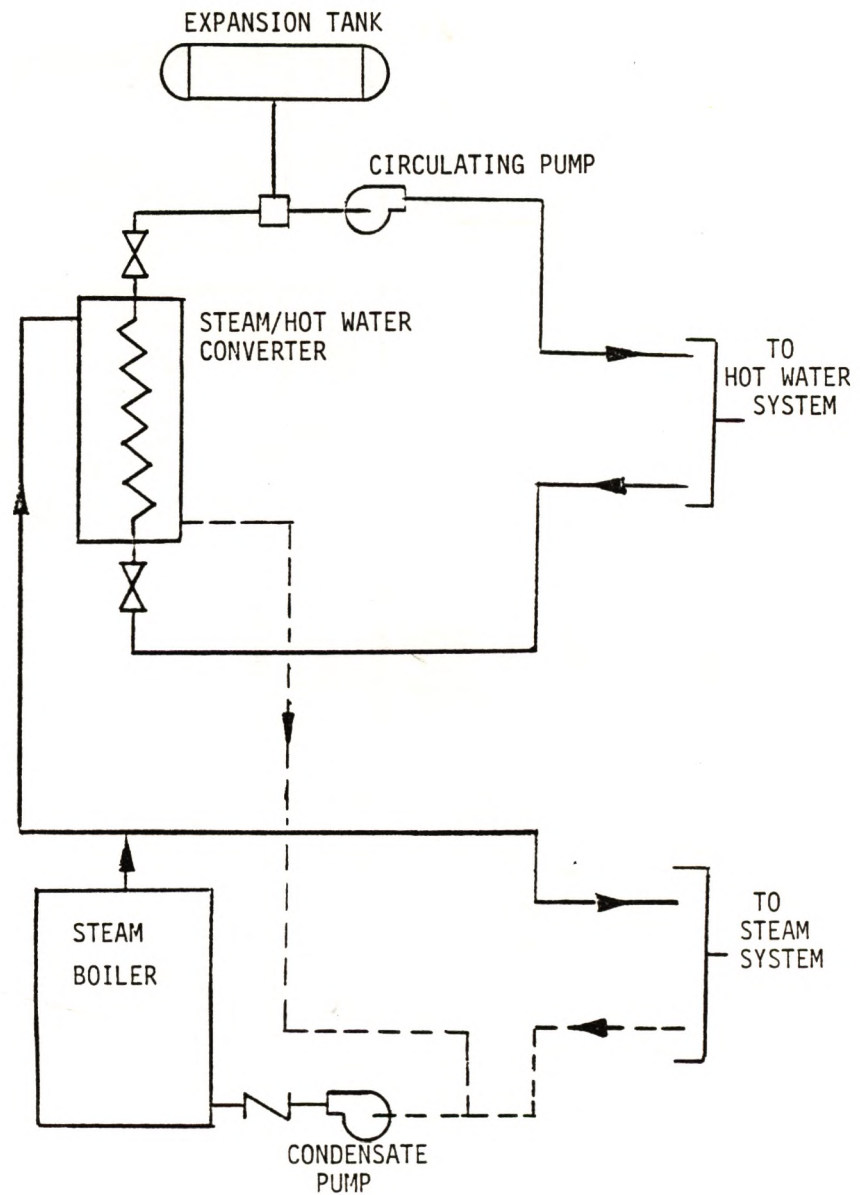
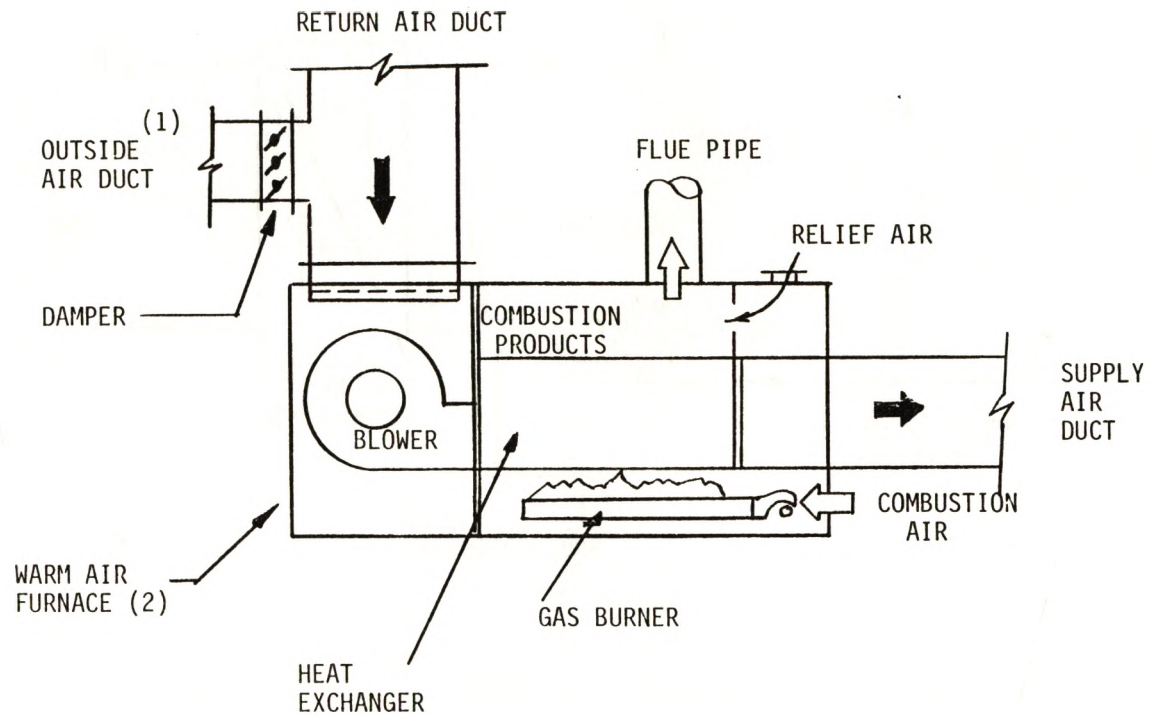


FIGURE 5-4

TYPICAL GAS-FIRED FORCED AIR HEATING SYSTEM



- 1 - GENERALLY FOR LARGE COMMERCIAL UNITS WHEN VENTILATION IS REQUIRED YEAR ROUND
- 2 - COMMON UNITS ALSO INCLUDE AIR CONDITIONERS

FIGURE 5-5
CONVERTED TWO-PIPE STEAM HEATING SYSTEM

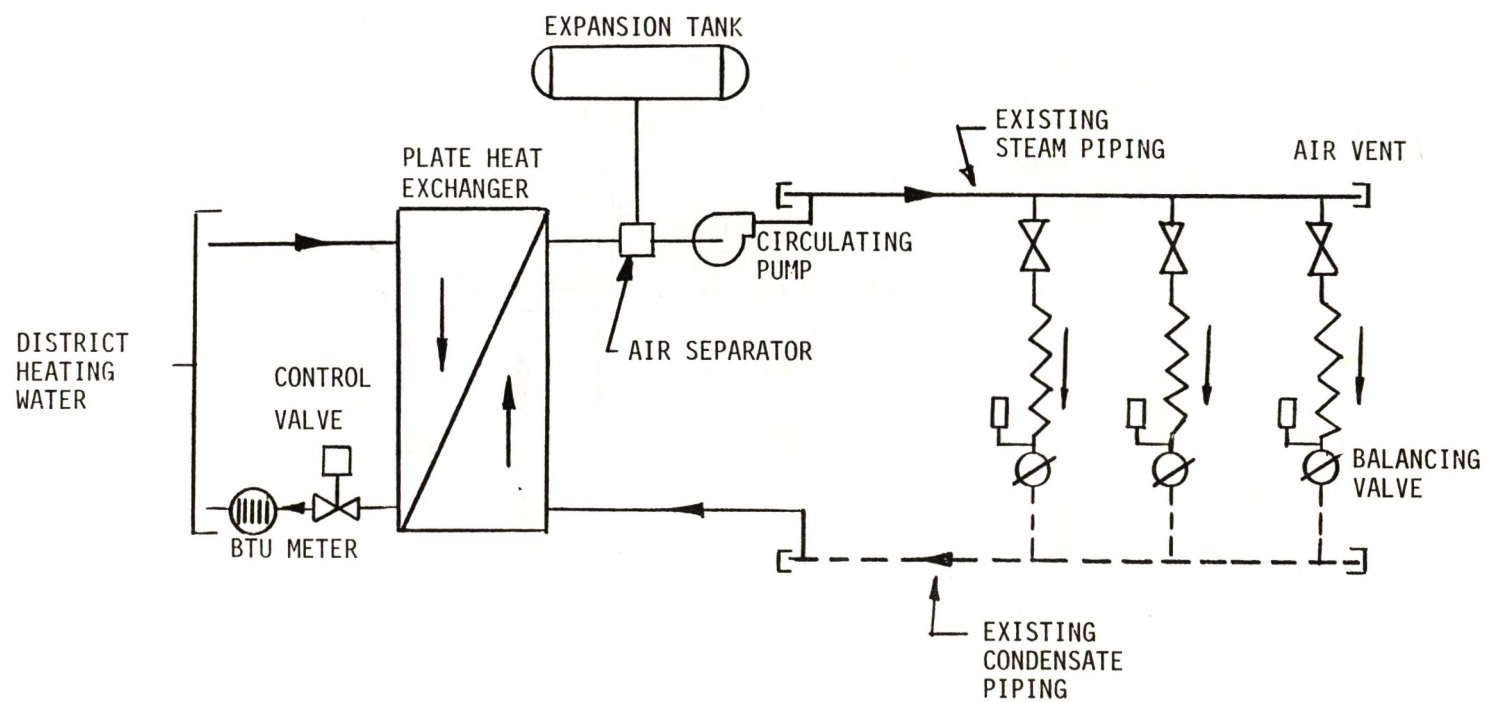
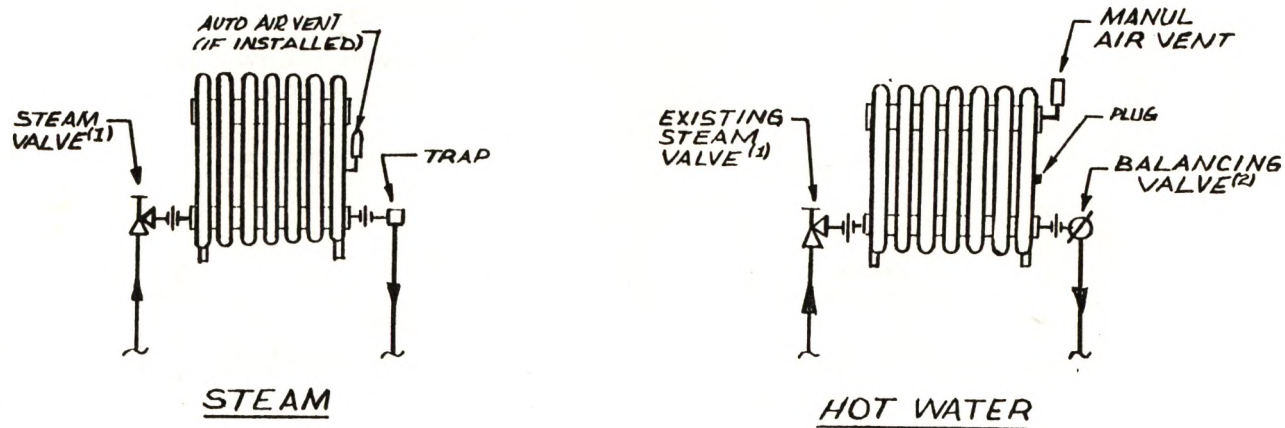


FIGURE 5-6

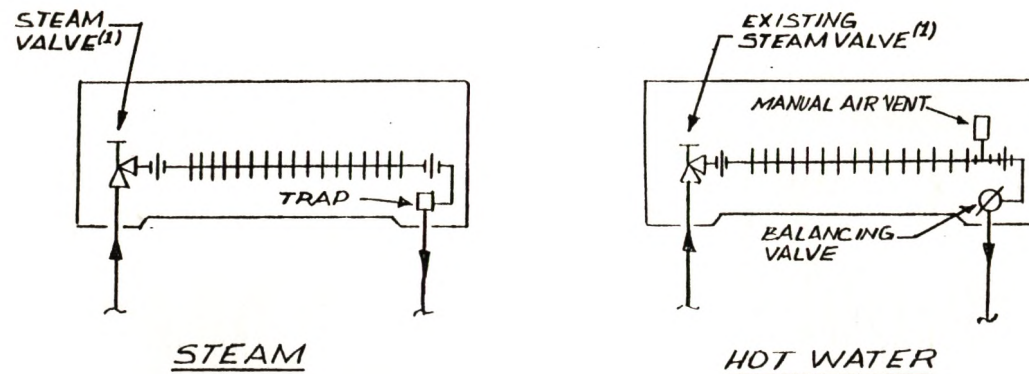
TYPICAL RADIATOR CONVERSION



- (1) EXISTING STEAM VALVE MAY BE MANUAL OR THERMOSTATICALLY CONTROLLED AND NEED NOT BE REPLACED WITH NEW HOT WATER VALVE IF POSITIVE SHUTOFF CAN BE ACHIEVED BY IT OR A NEW SERVICE VALVE INSTALLED IN THE SUPPLY LINE SERVING MULTIPLE UNITS.
- (2) BALANCING VALVE INSTALLED SHOULD BE POSITIVE SHUTOFF; STRAIGHT OR ANGLE PATTERN TO SUIT.

FIGURE 5-7

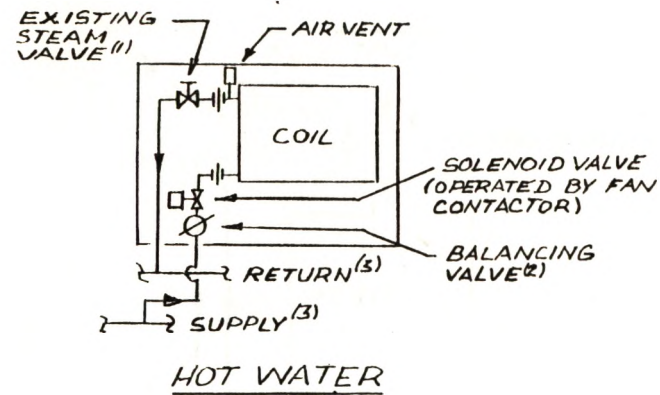
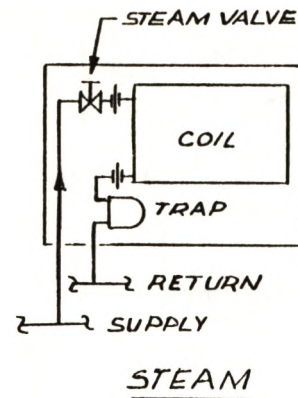
TYPICAL FINNED CONVECTOR CONVERSION



- (1) EXISTING STEAM VALVE MAY BE MANUAL OR THERMOSTATICALLY CONTROLLED AND NEED NOT BE REPLACED WITH NEW HOT WATER VALVE IF POSITIVE SHUTOFF CAN BE ACHIEVED BY IT OR A NEW SERVICE VALVE INSTALLED IN THE SUPPLY LINE SERVING MULTIPLE UNITS.
- (2) BALANCING VALVE INSTALLED SHOULD BE POSITIVE SHUTOFF; STRAIGHT OR ANGLE PATTERN TO SUIT.

FIGURE 5-8

TYPICAL CABINET AIR HEATER CONVERSION



- (1) EXISTING STEAM VALVE MAY BE MANUAL OR THERMOSTATICALLY CONTROLLED AND NEED NOT BE REPLACED WITH NEW HOT WATER VALVE IF POSITIVE SHUTOFF CAN BE ACHIEVED BY IT OR A NEW SERVICE VALVE INSTALLED IN THE SUPPLY LINE SERVING MULTIPLE UNITS.
- (2) BALANCING VALVE INSTALLED SHOULD BE POSITIVE SHUTOFF; STRAIGHT OR ANGLE PATTERN TO SUIT.
- (3) NOTE SUPPLY AND RETURN CONNECTIONS REVERSED

FIGURE 5-9

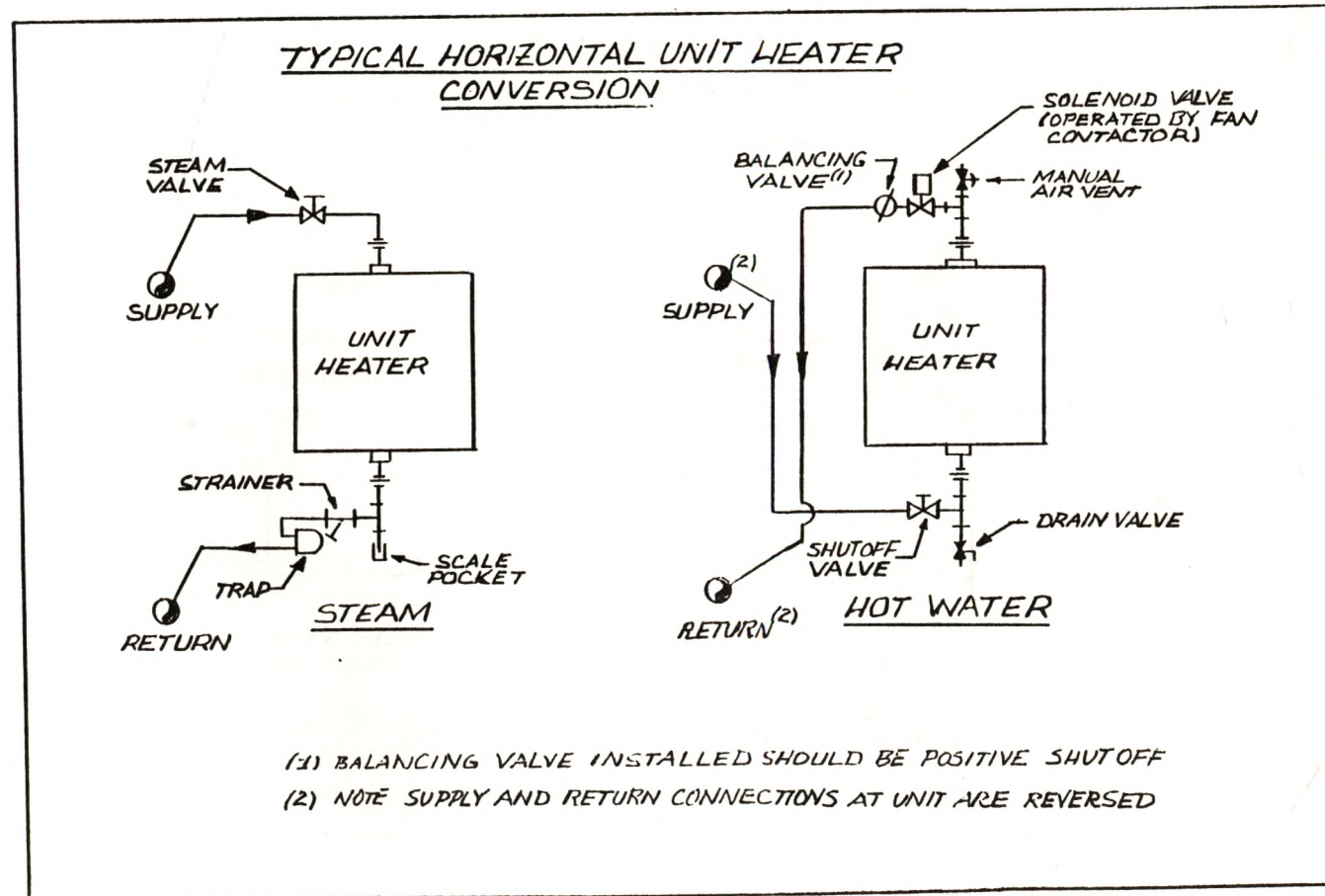
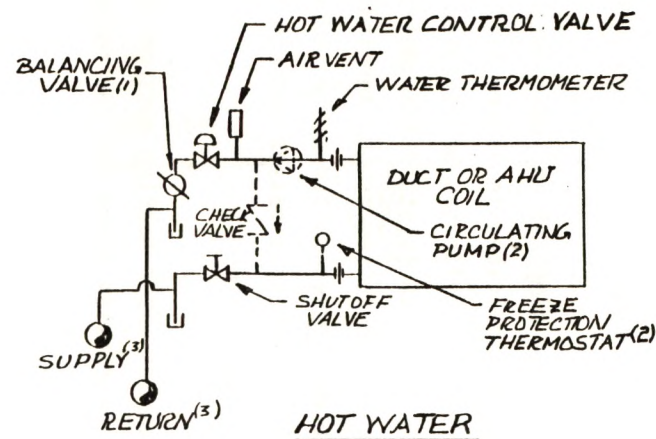
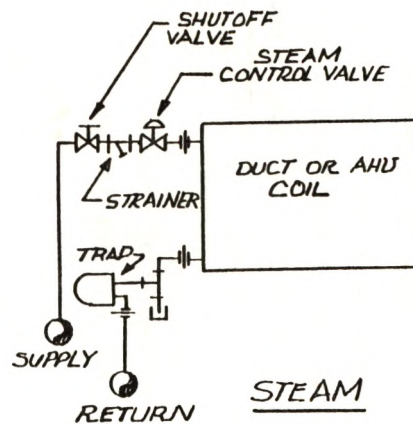


FIGURE 5-10

TYPICAL AIR HEATING COIL CONVERSION



- (1) BALANCING VALVE INSTALLED SHOULD BE POSITIVE SHUTOFF
- (2) CIRCULATING PUMP, THERMOSTAT, AND CHECK VALVE INSTALLED WHEN FREEZE PROTECTION IS REQUIRED. PUMP OPERATES AT PRESET OUTDOOR TEMPERATURE.

circulation through the unit when it is shut off either manually or in response to a room thermostat. Air handling units with steam coils require removal of steam traps and installation of an air vent and balancing valve. Existing steam shut-off and control valves should be replaced with valves designed for hot water service. In addition, if the coil is subject to outside air, freeze protection may be required, installing a circulation pump and/or using a glycol solution in the circulation water. If the coil is not serpentine then the performance with hot water will probably not be adequate and coil replacement is necessary.

Hot water heating systems are the simplest and most cost-effective retrofit to hot water district heating. As indicated in Figure 5-11, a plate heat exchanger is installed to replace the boiler which can be isolated and utilized for backup service. Existing terminal units, circulators and controls in most cases remain in their present configuration. Bypasses around terminal heating equipment, as frequently installed in hot water systems for space temperature control, should be eliminated to ensure all hot water is passed through the terminal units to minimize the return water temperatures.

Conversion of combined steam/hot water heating systems is depicted in Figure 5-12, and accordingly, the discussion above for the retrofit of both steam and hot water systems applies.

Conversion of gas-fired air systems is indicated in Figure 5-13. A new hot water heating coil is installed in the return air duct along with an associated plate-type heat exchanger and closed loop hot water circulating system. The existing gas furnace can be used for backup service. In instances where a significant portion of outside air is required, it may be necessary to install a pre-heater hot water coil in the outside air supply duct to avoid freeze-up and uneven air temperature distribution over the primary heating coil.

Where the adaptability and/or demand of internal uses such as industrial processes, domestic hot water, and pool heating enables or justifies conversion to hot water district heating, a plate heat exchanger may also be used to satisfy these needs. Figure 5-14 presents a typical heat exchanger arrangement providing both space heating and domestic hot water.

FIGURE 5-11

CONVERTED HOT WATER HEATING SYSTEM

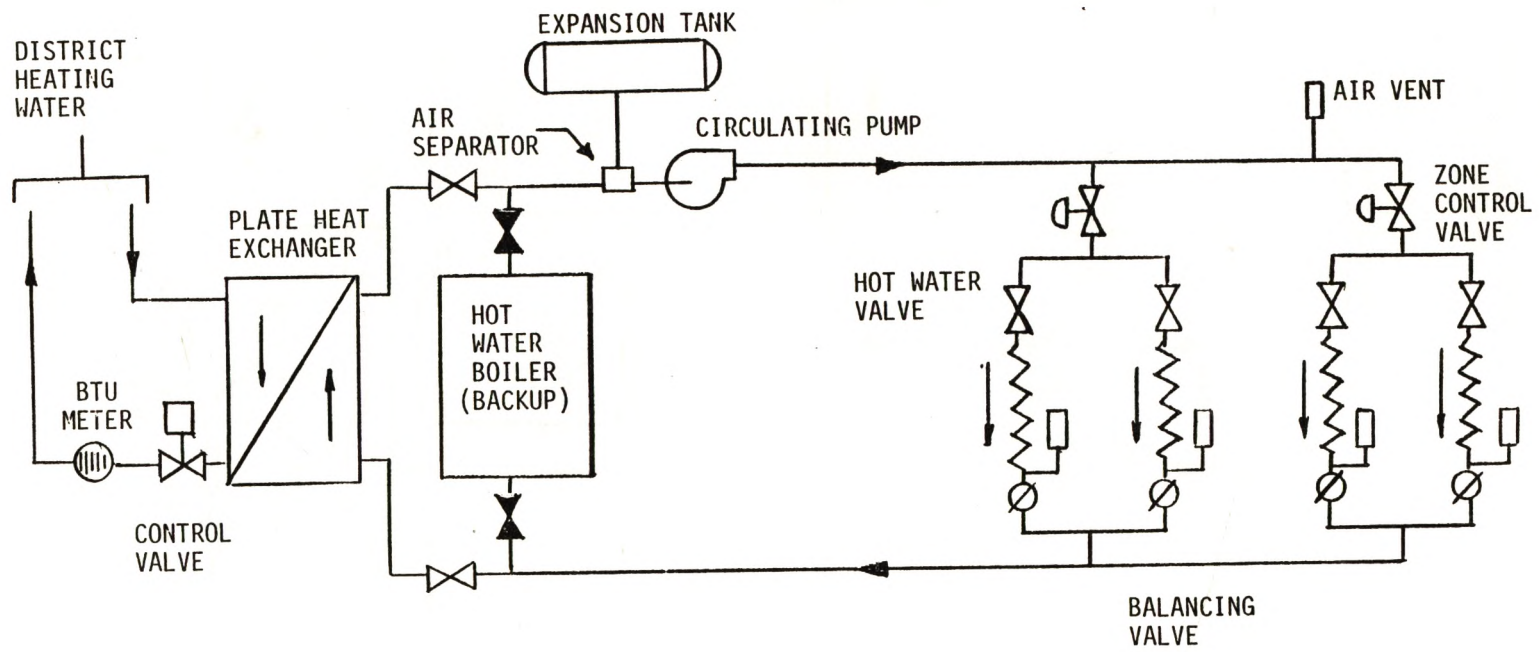


FIGURE 5-12
 CONVERTED COMBINED STEAM/HOT WATER
 HEATING SYSTEM

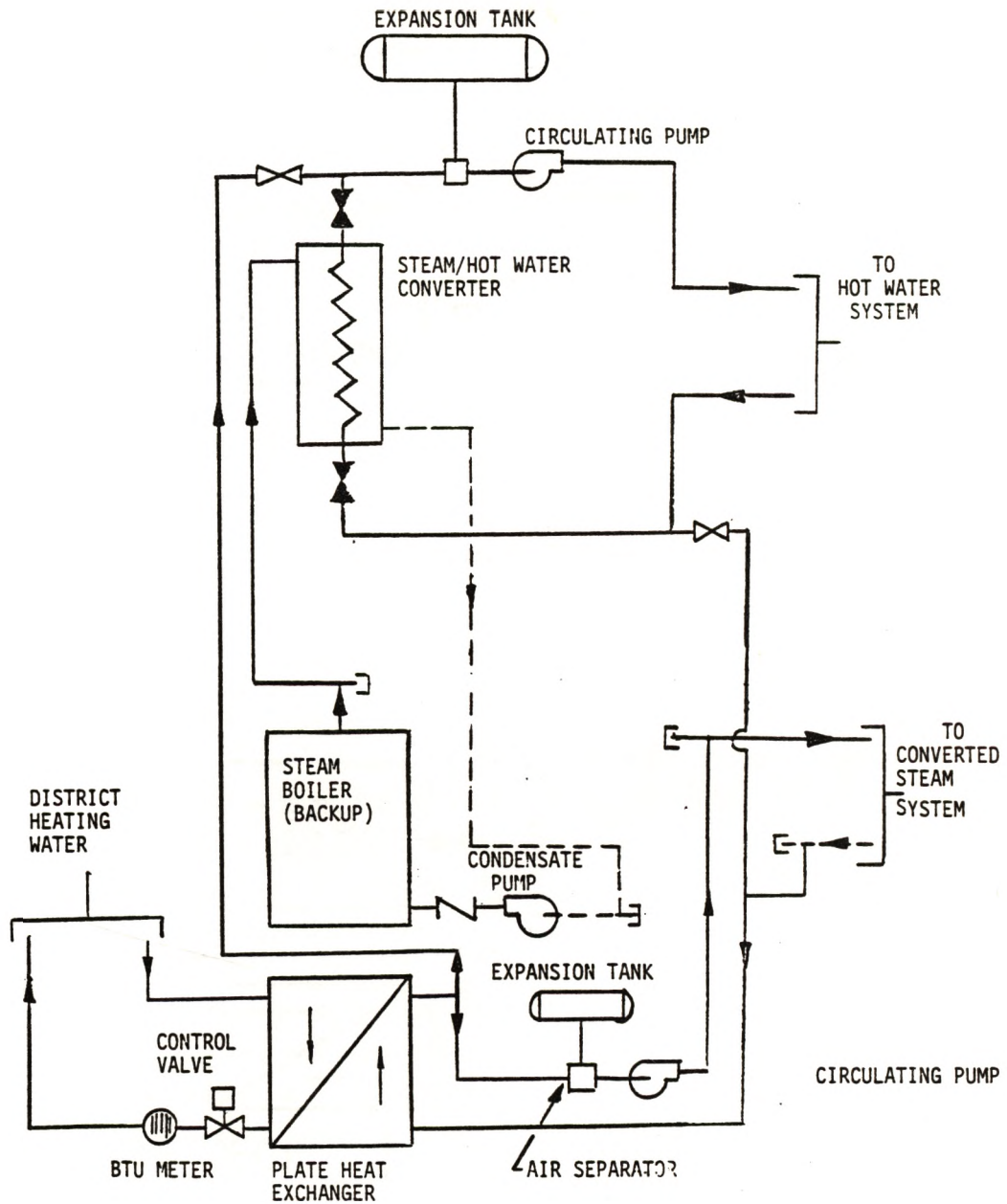


FIGURE 5-13

CONVERTED GAS-FIRED FORCED-AIR HEATING SYSTEM

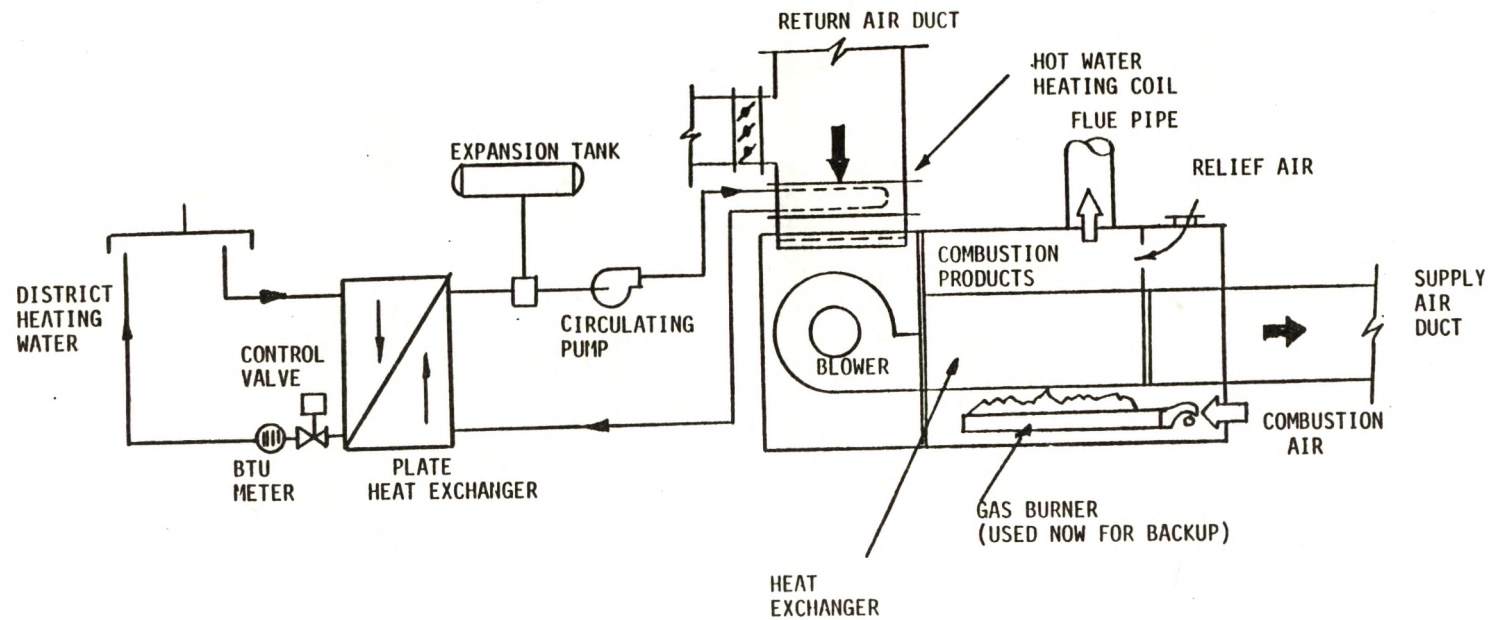
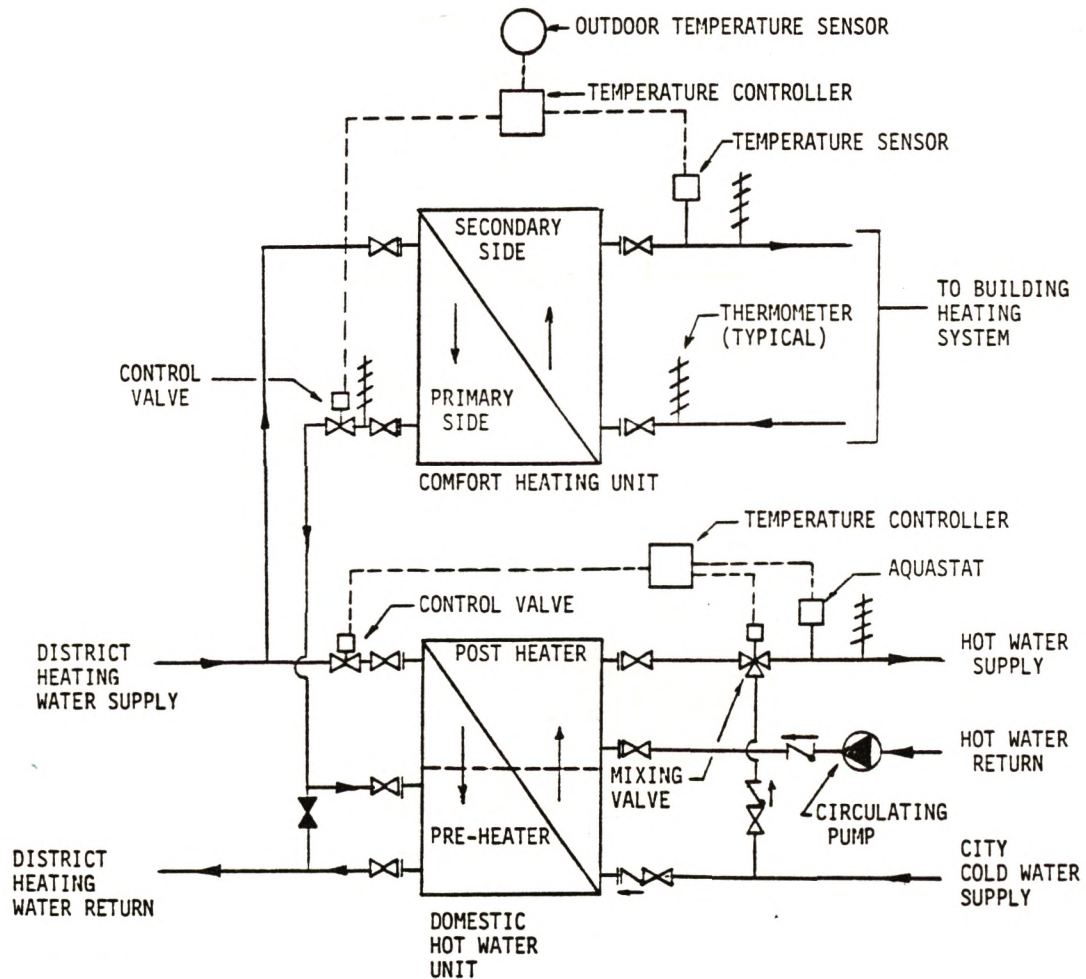


FIGURE 5-14
TYPICAL PLATE HEAT EXCHANGER ARRANGEMENT



NOTE: DURING WINTER MONTHS PRE-HEATER SECTION OF DOMESTIC UNIT UTILIZES PRIMARY RETURN WATER FROM THE COMFORT HEATING UNIT TO SATISFY HOT WATER DEMANDS AND MINIMIZE DISTRICT HEATING WATER RETURN TEMPERATURES.

CORE AREA

Appendix C presents the conceptual retrofit design as well as a description of the present systems for a representative sampling of prospective customers in the core area. Retrofit designs were developed in sufficient detail for a reliable conversion cost estimate. Table 5-1 presents the cost estimates for the work required in each building to convert to hot water district heating. Costs include:

- o Direct cost for all material, equipment and labor necessary for the conversion, excluding the Btu meter and associated instruments (provided by system owner)
- o Contractor's overhead and profit
- o Engineering fee
- o Contingency

Based on the detailed retrofit analyses performed during Stage 1 and subsequent in-person surveys of the additional buildings in the core area, conceptual retrofit designs were developed and conversion costs estimated for each of the specific additional prospective customers identified during Stage 2. Table 5-2 summarizes the existing heating systems and presents the estimated conversion costs for each of these buildings. The conversion costs are indicated both with and without a heat exchanger package. As many of these customers are small, consideration should be given to capitalizing the cost of the heat exchanger package (including associated instruments and controls) with the district heating system to provide a more cost-effective retrofit for the owner.

OUTLYING DISTRICTS

While it has been found that hot water conversions for industrial and commercial users vary considerably depending on type of existing system, facility size, and operating characteristics, some generalization can be made.

TABLE 5-1

INITIAL CORE AREA BUILDING RETROFIT COST ESTIMATES

<u>Building</u>	Total Estimated Cost
	<u>1984 Dollars</u>
Federal Building (Post Office)	\$ 35,700
Unigard Insurance	19,500
Jamestown Plywood Corp.	44,200
YWCA	15,800
YMCA	37,700
City Hall	19,750
Chautauqua Hardware Corp.	73,100
Jamestown Boys Club	25,300
Jamestown General Hospital	132,500
WCA Hospital	89,600
Senior High School	183,100
BPU Warehouse	10,400
Telephone Company	35,900
First Covenant Church	7,800
First Presbyterian Church	19,500
Marine Midland Bank	6,500
Hotel Jamestown	145,100
James Prendergast Library	16,700
The Post Journal	35,900

Table 5-2 ADDITIONAL CORE AREA BUILDING RETROFITS

BUILDING	PEAK LOAD (MMBTU/HR)		PRESENT HEATING SYSTEM	TERMINAL UNIT RETROFIT REQUIRED ⁽¹⁾	CONVERSION COSTS 1984 DOLLARS	
	COMFORT	DOMESTIC HW			WITH HX	WITHOUT HX ⁽²⁾
AAA	.058	-	Hot Water	-	3,800	1,750
AVM Precision Tops	1.151	-	Two-Pipe Steam	1,2,3	16,350	12,200
Bigelows Dept. Store	.735	.020	One-Pipe Steam	1,2	17,800	13,750
Cameo Apartments	.306	.063	One-Pipe Steam	1,2,3,4	17,700	14,100
Carnahans Dept. Store	.342	.025	Two-Pipe Steam	1	11,950	8,500
Chamber of Commerce	.036	-	Gas Forced Air	4(3)	7,600	5,450
Credit Bureau of Jamestown	.053	-	Hot Water	-	3,800	1,750
DPW Garage	1.330	-	Two-Pipe Steam (From Power Plant)	1,3	12,100	-
Empire State Building	.411	.025	Two-Pipe Steam	1	13,800	10,250
Grant Building	.163	-	Two-Pipe Steam	1,3,4	15,100	12,200
Herbert Shoes	.342	-	Two-Pipe Steam	-	14,450	11,850
Holiday Inn ⁽⁴⁾	-	.761	Steam/Water Converter (For Domestic HW)	1	5,400	2,100
Jamestown Cycle Shop	.126	-	Gas Forced Air	4(3)	12,800	10,650
Little Theater	.915	.074	Two-Pipe Steam and Hot Water	1,3,4	16,850	12,200
Lucies	.071	-	Two-Pipe Steam	4	9,450	7,300
Monitor Furniture	1.361	.050	Two-Pipe Steam and Hot Water	1,3	21,200	15,600
Nelson Bros. Lumber	.625	-	Hot Water and Gas-Fired Roof Units	4(3)	9,700	6,450
Palace Civic Theater	.736	.037	Hot Water and Two-Pipe Steam	1	13,200	9,100
Peal City Paint and Glass	.461	-	One-Pipe Steam	1	17,200	14,400
Scottish Rite	.278	.025	Two-Pipe Steam	1,2	12,100	8,800
Towne Barbers	.118	.030	Hot Water and Forced Air	4(3)	8,900	5,900
Wilcox Apartments	.420	.063	One-Pipe Steam	1	18,800	14,950

(1) 1-Cast Iron Radiators, 2-Finned Tube Radiation, 3-Cabinet or Unit Heaters, 4-Duct or Air Handling Unit Coils

(2) Capital cost to Owner if heat exchanger (HX) packages are capitalized as part of the district heating system.

(3) New hot water coils to be installed in ductwork or gas-fired unit

(4) Space heating system is electric heat pumps

- o Most of the existing heating systems for the industrial facilities in the industrial corridor are two-pipe steam which can be converted to hot water service as previously discussed. These building systems are typified by terminal units such as wall-hung radiators, finned-tube convectors and unit heaters which are significantly larger than those encountered in smaller buildings (i.e., number of individual units per square foot of heated floor space is less). Accordingly, with a large portion of conversion costs attributable to terminal unit retrofit, the conversion costs per unit load are less. Typically, they are in the range of \$45/KW to \$55/KW.
- o Outside the core area there are no large commercial buildings which can be considered as target customers for expansion into outlying districts. Typical conversion costs (1984 dollars) for an average 80,000 Btu/hr, 5000 square foot unit are as follows:

Conversion Cost

<u>System</u>	<u>Total \$</u>	<u>\$/KW</u>
One-pipe steam	5250	225
Two-pipe steam	3750	160
Hot Water	2450	105
Forced Air	4250	181.

Conversion requirements for private residences vary and are typically dependent on the type of existing system. For purposes of an average 1500-sq.-ft. unit evaluation, conversion of an existing steam heating system would be the most costly retrofit, particularly of one-pipe systems. However, certain costs such as plate heat exchangers, district heating interconnecting piping, controls and instrumentation are relatively fixed for the ranges expected in heating requirements (30,000 to 150,000 Btu/hr) and are applicable to existing forced-air and hot-water systems as well as steam. A typical 1500-sq.-ft. private residence conversion cost (1984 dollars from two-pipe steam to hot water) is presented

below. To be cost-effective (and attractive) for an owner, consideration should be given to some or all of these costs to be capitalized with the district heating system and capital costs built into the heat rate structure.

Heat Exchanger Package (50,000 Btu/hr includes instruments and controls)	\$1,200
District Heating and Building System Interconnecting Piping, Valves, and Fittings	<u>500</u>
Subtotal (minimum cost all systems)	\$1,700
Circulating Pump, Expansion Tank, and Specialty Items	750
Terminal Unit Retrofits	<u>500</u>
Total Estimated Steam System Conversion	\$2,950 (\$201/KW)

Section 6

SYSTEM IMPLEMENTATION

This section of the report combines the findings of the heat load assessment, the thermal source assessment and the piping analysis to form a recommended plan for implementing district heating in the City of Jamestown. The objective is to develop the system in stages spreading the capital expenditures out in incremental investments over the development period, allowing the system to generate revenues to offset the capital investments. The strategy in developing the system is to begin with a relatively inexpensive retrofit to supply a load in a high-density area close to the heat source. This will minimize the initial cash outlay required and the time from initial cash outlay to revenue production.

The first implementation stage has a thermal load of approximately 15MW. The load consists of those buildings that have been identified as comprising the core area. The heat for the first stage of development should be obtained by performing the first phase plant retrofit described in Section 3. This retrofit involves modifying the existing Unit 6 steam turbine cycle to produce hot water. The hot water will be produced using a combination of extraction steam and auxiliary steam in a new district heating heat exchanger and the existing Unit 6 auxiliary heater. The first stage of development will require the installation of approximately 4.3 miles of piping. It is planned that the first stage of development will be operational for the 1985-1986 heating season. The annual district heat sales for the first implementation stage are estimated to be 138,000 MM Btu.

The second implementation stage will increase the thermal load by approximately 9 MW, bringing the system load to a level of approximately 24 MWt. The load at this point corresponds to what has been described as the saturated core area. The heat source development for this development stage builds on the first stage of development by incorporating the Unit 5 auxiliary heater into the system in parallel with the Unit 6 auxiliary heater. Additional pumps are added to supply the increased load. The second stage of development requires the installation of approximately 1.2 miles of piping. It is planned that the second stage of development will be operational for the 1986-1987 heating season. The annual district heat sales for the second implementation stage are estimated to be 69,000 MM Btu.

The third implementation stage will begin to develop outlying districts. The first outlying district to be developed is the industrial corridor east of the plant. The heat load associated with this third stage of development is estimated to be 20 MWt. At this stage of district heating development, new thermal capacity is added to the system. The third stage heat source development is to bring new cogeneration district heating capacity on line. A new steam turbine cycle will be added to the plant that will have a peak district heating capacity of 80 MWt. The third stage of development requires the installation of approximately 2.3 miles of piping. It is planned that the third stage of development will be operational for the 1988-1989 heating season. The additional annual district heat sales for the third implementation stage are estimated to be 155,000 MM Btu.

The fourth and subsequent implementation stages would be to bring other outlying districts onto the system. These districts would be supplied with heat generated through the steam turbine cycle installed in the third implementation stage. The most likely area for expansion is the area to the north of the core area. The total available heat load for the outlying residential and commercial areas has been estimated to be 91 MWt. It is estimated that 9.7 miles of piping would be required to connect this load.

The development of the system can be terminated or altered at any point. The success of the system does not rely on future expansion, although expansion is likely to improve the economics for all system users.

Table 6-1 summarizes the implementation plan. Capacity factors have been applied to the total available load to determine the expected connected load. Capacity factors are discussed further in Section 7, ECONOMIC ANALYSIS.

TABLE 6-1
DISTRICT HEATING SYSTEM IMPLEMENTATION

	<u>Phase One</u>	<u>Phase Two</u>	<u>Phase Three</u>	<u>Phase Four</u>
Proposed Date On Line	1985	1986	1989	1991
Rated System Capacity (MWt)	26.0	26.0	80.0	80.0
Cumulative Connected Peak Load (MWt)	12.96	16.50	30.70	76.20
Cumulative Annual Heat Sales (MWt)	34,371	42,464	74,308	149,111

Note: 1 Thermal capacity is 26 MW, however the installed pumping capacity limits the output to 14 MWt.

Section 7

ECONOMIC ANALYSIS

The economic analysis of hot water district heating in Jamestown was performed from the viewpoint of ownership by the City of Jamestown. The analysis determined the annual carrying charges for the system, the unit cost of district heat and the payback period for each of the core area anchor customers.

The analysis uses the required revenue approach to determine the necessary charges for district heating. The annual carrying charges for the district heating investment are calculated based on 100% debt financing with bond rates of 7% and 9.75%. The method used was to develop the total system costs and compare these costs with the total quantity of heat sold to determine the minimum required charges for district heat. The total system costs are comprised of fixed expenses, operating expenses, replacement electricity and gross receipt taxes. Included in the analysis is a reinvestment fund based on retaining 10% of the gross revenues to fund future expansion.

The capital costs were derived in 1984 dollars and then escalated to the year of expenditure at a rate of 6.5%. The capital costs include all direct and indirect costs associated with the power plant retrofit and the piping systems.

The annual carrying charges were based on the assumption that the entire system would be owned by the city and that the project would be financed using municipal bonds. The income tax rate for the utility is 0%, the property tax rate is 0% and the insurance rate is 0.5%. The analysis is conducted for a 30-year book life.

The operating expenses for the district heating system are comprised of replacement electricity costs, pumping costs, operating and maintenance manpower, operating and maintenance materials and steam costs. The replacement electricity costs are charged against the district heating systems to compensate for the reduction in electrical output caused by the district heating retrofit. The

replacement electricity costs are \$30.00/MWh in 1984 dollars. Power costs are escalated at 7.5% per year. Operating and maintenance manpower for the system is estimated to cost \$30,000 per man-year in 1984 dollars, including overhead and benefits, escalated at 7.5% per year. Operating and maintenance material costs are estimated to be equal to 3% of the capital costs of the heat source and 1% of the capital costs of the piping on an annual basis, escalated at 7.5%. Steam costs are calculated using \$2.07 per thousand pounds in 1984, escalated at 1.0% per year. The quantities of replacement electricity, pumping power and steam were determined from the load duration curve.

Capacity factors were applied to the different districts based on the percentage of the available load that could reasonably be expected to connect to the system. In the core area a capacity factor of 85% was used as the size of the customers and their location to the power plant in this district combine to produce generally favorable economics and short paybacks. For the saturated core area, the general size of the customers is less, resulting in slightly less favorable paybacks. Therefore, the capacity factor was reduced to 70%. While the customers in the industrial corridor are generally quite large and the piping relatively inexpensive compared to the available load, thus favoring a higher capacity factor, some of the potential customers are burning waste and investing in other such conservation measures that led to the selection of a 70% capacity factor for this district also. As the remaining customers in the residential and commercial district tend to be smaller than in the others and located further from the heat source, a lower capacity factor of 50% was assumed for this district.

The system economics were analyzed for several different cases and are presented in Appendix A. The cases studied were:

- Case 1: Phase 1 with no further investment, 100% capacity factor
- Case 2: Phase 1 with no further investment, 85% capacity factor
- Case 3: Phases 1 & 2 with no further investment
- Case 4: Phases 1, 2 & 3 with no further investment
- Case 5: All phases
- Case 6: All phases with a 9.75% bond rate

As the City of Jamestown has a good bond rating, a bond rate of 7% is realistic in today's economic market and was used in the majority of the cases. A bond rate of 9.75% was used for Case 6 to study the effect of a major slump in bond prices on the system economics.

The results of the economic analysis for Case 6 are shown in Table 7-1 and graphically in Figure 7-1. The complete economic analysis for the six cases is presented in Appendix A.

CUSTOMER RETROFIT ANALYSIS

A 20-year economic analysis was performed for each of the core area customers to determine their annual cash flow and payback.

Total estimated retrofit costs were escalated to 1985 dollars at 6.5%, and an annual load payment was determined based on the percentage of the retrofit cost financed and the financing terms of a 9% loan for 15 years for each customer. Each customer's annual energy costs with natural gas were determined based on present annual consumption and an average cost of gas of \$5.68 per million Btu, which was received from National Fuel Gas Inc. for January 1984 and escalated at 7.5% per year. Each customer's annual energy costs with district heating were determined based on current consumption, current boiler efficiency, potential end-use energy savings, and the calculated unit cost of district heat.

Potential end-use energy savings from conversion for present steam users are achieved by eliminating trap losses and decreasing line losses. Each customer's yearly tax effects were based on tax rate, depreciation, interest payments and energy costs.

All of the annual costs for energy, financing and taxes were used to determine an actual annual savings for the customer who would switch to district heating. From this calculation, two types of payback periods were calculated. The first, a traditional payback period assuming no financing and the second, a payback with financing where payback is achieved when the accumulated savings exceed the unpaid principal plus any cash investment.

DISTRICT HEATING FOR JAMESTOWN, NY

MUNICIPAL OWNERSHIP

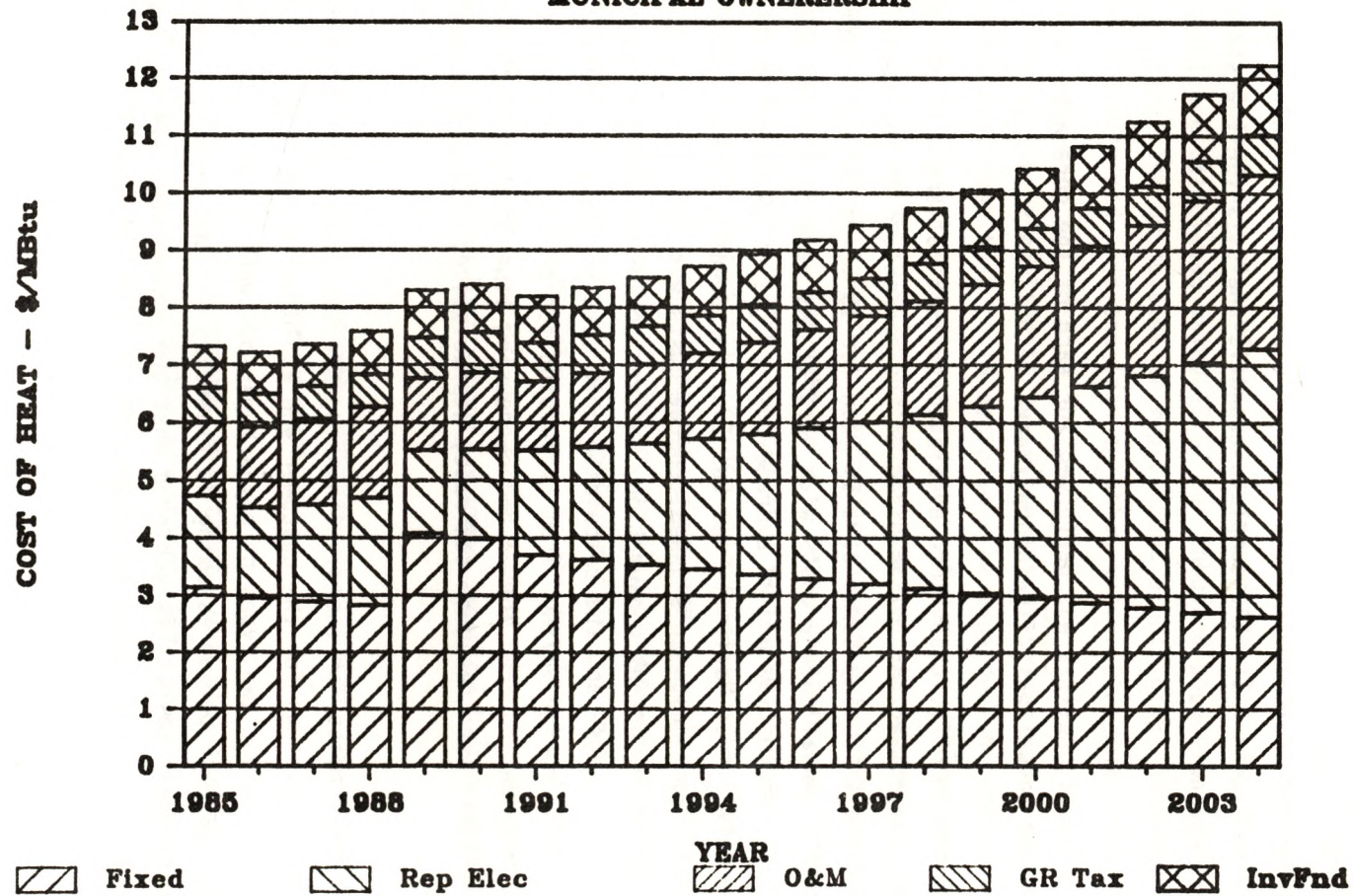


Figure 7-1

The economics for several representative customers were performed with the unit costs of heat development in each of the six system economics cases discussed previously. The results of this analysis are presented in Appendix B and summarized in Table 7-2, which shows payback for each of the representative customers with the unit costs of heat developed in Case 2, Phase 1 with no further expansion and 85% capacity factor, and Case 5, all phases combined.

Table 7-1
ECONOMIC ANALYSIS RESULTS
Bond Rate 7%

	<u>Phase 1</u>	<u>Phase 2</u>	<u>Phase 3</u>	<u>Phase 4</u>
Implementation Date	1985	1986	1989	1991
Peak Load (Mwt)	12.96	16.50	30.70	76.20
Annual Sales (MBtu)	117,309	144,929	253,614	508,917
Investments (1984 Dollars)				
Power Plant	\$ 633,00	157,000	2,473,000	0
Piping	<u>2,558,000</u>	<u>394,000</u>	<u>1,789,000</u>	<u>5,330,000</u>
Total	\$3,191,000	551,000	4,262,000	5,330,000

UNIT COST OF HEAT
(\$/MBtu)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1. Fixed Expenses	\$3.15	\$2.96	\$2.89	\$2.83	\$4.08	\$3.99	\$3.71	\$3.63	\$3.54	\$3.46
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$1.44	\$1.55	\$1.82	\$1.96	\$2.10	\$2.26
3. Operating Expenses	\$1.27	\$1.39	\$1.48	\$1.57	\$1.24	\$1.33	\$1.19	\$1.28	\$1.38	\$1.48
4. Gross Receipts Tax	\$0.59	\$0.57	\$0.56	\$0.57	\$0.71	\$0.70	\$0.67	\$0.67	\$0.66	\$0.66
5. Reinvestment Fund	\$0.73	\$0.72	\$0.74	\$0.76	\$0.83	\$0.84	\$0.82	\$0.84	\$0.85	\$0.87
	<u>\$7.33</u>	<u>\$7.22</u>	<u>\$7.37</u>	<u>\$7.60</u>	<u>\$8.30</u>	<u>\$8.42</u>	<u>\$8.21</u>	<u>\$8.37</u>	<u>\$8.54</u>	<u>\$8.73</u>

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. Fixed Expenses	\$3.38	\$3.29	\$3.21	\$3.13	\$3.04	\$2.96	\$2.88	\$2.79	\$2.71	\$2.63
2. Replacement Electricity	\$2.43	\$2.61	\$2.81	\$3.02	\$3.25	\$3.49	\$3.75	\$4.03	\$4.34	\$4.66
3. Operating Expenses	\$1.59	\$1.71	\$1.84	\$1.98	\$2.12	\$2.28	\$2.45	\$2.64	\$2.84	\$3.05
4. Gross Receipts Tax	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.67	\$0.68	\$0.69	\$0.70
5. Reinvestment Fund	\$0.89	\$0.92	\$0.94	\$0.97	\$1.01	\$1.04	\$1.08	\$1.13	\$1.17	\$1.22
	<u>\$8.95</u>	<u>\$9.19</u>	<u>\$9.46</u>	<u>\$9.75</u>	<u>\$10.08</u>	<u>\$10.44</u>	<u>\$10.83</u>	<u>\$11.27</u>	<u>\$11.74</u>	<u>\$12.26</u>

Table 7-2
CUSTOMER ECONOMIC ANALYSIS SUMMARY
Payback Year

	<u>CASE 2</u>	<u>CASE 5</u>
Boys Club	3	3
City Hall	2	2
Federal Building	4	4
General Hospital	4	4
Jamestown Plywood	3	3
WCA Hospital	2	2
YMCA	3	3
YWCA	4	3

Section 8 ANALYSIS OF FINANCING ALTERNATIVES

The following analysis is based on the recommendation that the Jamestown district heating system be owned and operated by the City of Jamestown.

In the context of municipal ownership, the normal source of funding for a district heating project would be obtained through the issuance of long-term revenue or general obligation bonds. A long-term municipal bond offers a fixed interest rate over the life of the project.

Recent volatility and relatively high levels of interest rates on long-term obligations have lead to the development of a broader spectrum of tax-exempt alternatives, including short-term, as well as floating rate, longer term instruments. Short-term, tax-exempt alternatives present opportunities for taking advantage of substantially lower interest rates, particularly during the construction period. Generally speaking, however, short-term, tax-exempt alternatives are only available if long-term bonds are intended to be the ultimate debt. A short-term debt is considered to be any debt having a maturity of less than one year. Municipal, short-term debt instruments include Tax Exempt Commercial Paper (TECP) and Bond Anticipation Notes (BAN's).

In certain cases, financing combining both long-term and short-term characteristics may be applicable, and such an approach was used for the St. Paul, Minn. bond financing which permitted a 30-year maturity, but at a temporary floating rate, resulting in discounts of over 200 basis points from an equivalent fixed-rate facility. Examples of such facilities are floating/fixed-rate bonds (F/FRB's) and adjustable/fixed rate bonds (A/FRB's).

FLOATING FIXED-RATE BONDS

Floating fixed-rate bonds, or alternatively known as "lower floaters," are instruments which "float" for a specified period, and then at the initiation of the sponsor "fix" for the remaining life of the bonds. During the floating period, the sponsor would benefit from short-term interest rates (about 1/4% to 1% above TECP rates). F/FRB's or "lower floaters" always require some form of third-party liquidity support, normally a commercial bank letter of credit during the floating period. The advantage of F/FRB's over other instruments is that F/FRB's are long-term bonds which reduce the risk that the obligations cannot be financed at maturity.

ADJUSTABLE FIXED-RATE BONDS

Another combined long-term, short-term financing technique is adjustable/fixed-rate bonds (A/FRB's). A/FRB's are long-term bonds which bear a fixed rate of interest for a defined period (usually 1, 3 or 5 years) with a new interest rate to be established at the conclusion of each period based upon the interest rates prevailing in the market for securities with comparable ratings and maturities. In effect, 30-year A/FRB's could be structured as a series of shorter term maturities, for example 10 periods of 3 years each. A/FRB's, like F/FRB's, have mechanisms for fixing the rate if long-term rates become favorable.

LEVERAGE LEASE

A leverage lease approach, whereby the assets of a project are sold to a buyer of the tax benefits and leased back by the original owner who may not be able to use such tax benefits, while attractive from the standpoint of project financing costs, appears to be precluded from use by a New York State municipality under the General Municipality Law, Sec. 109-B. Therefore, this approach has not been pursued further in the context of municipality ownership.

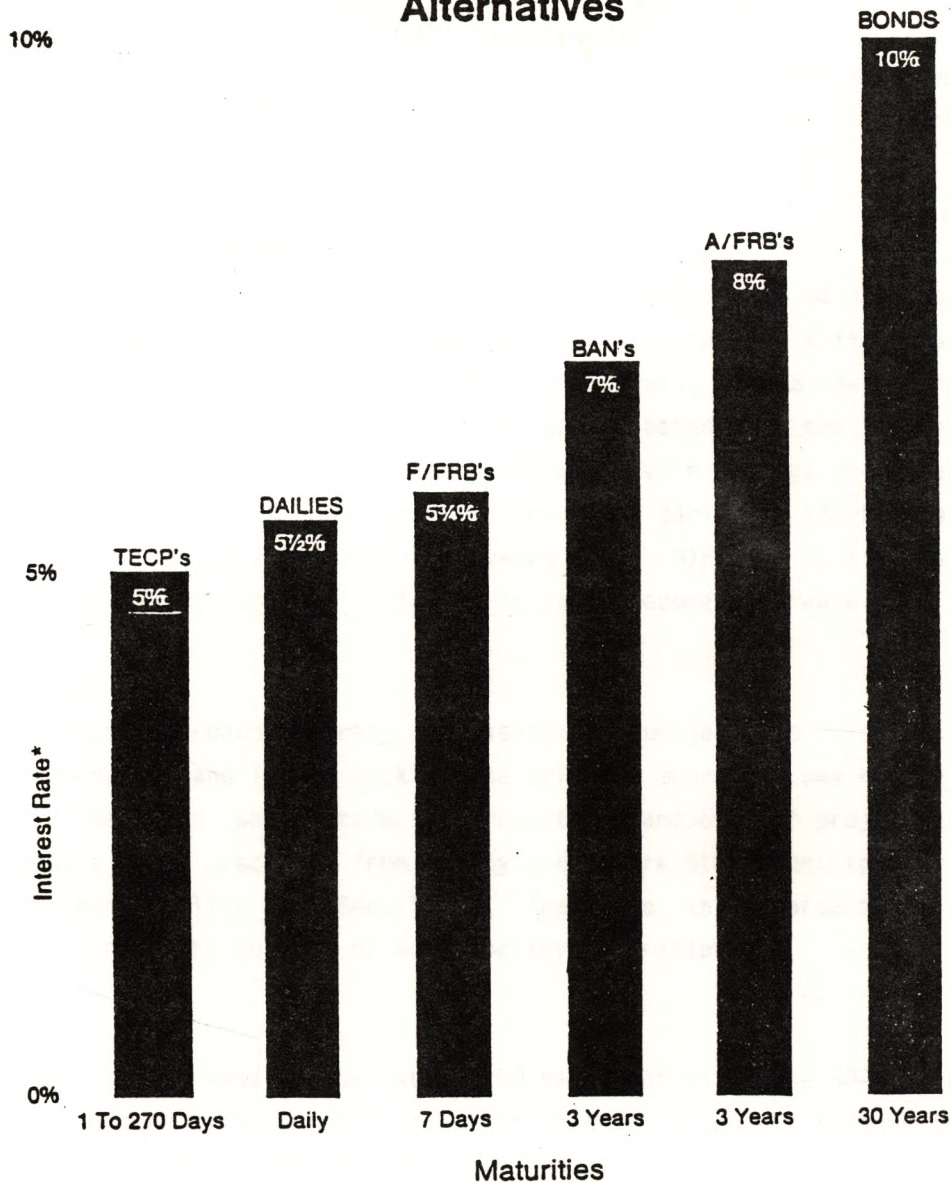
CONCLUSIONS

St. Paul was able to save approximately 200 basis points in the 30-year tax-exempt revenue bond financing for the district heating project through the employment of a "lower floater" type of instrument. Under present interest rates (Figure 8-1), savings on F/FRB's or "lower floater" type instruments com-

pared to fixed-rate, long-term bonds could be as significant as 400 basis points. However, the requirement for a letter of credit during the floating period of the bond reduces such savings by at least 100-150 basis points. On balance, the approach of a floating fixed-rate instrument should be considered seriously during the initial financial planning for the district heating project.

BURNS AND ROE, INC.

Municipal Tax Exempt Financing Alternatives



*Current Market

Figure 8-1

Section 9

END USER CONTINGENCY COMMITMENT TERMS

Section 9

END USER CONTINGENCY COMMITMENT TERMS

PRELIMINARY DRAFT
DISTRICT HEATING SYSTEM CUSTOMER CONTINGENT COMMITMENT

This Agreement entered this _____ day of _____, 19____,
between the Jamestown Board of Public Utilities, a department of the City of
Jamestown, New York ("BPU"), and _____

..... ("Customer").

WITNESSETH:

WHEREAS, Customer owns the building located at _____,
Jamestown, New York.

WHEREAS, BPU, as a municipally owned utility, is considering the construction and operation of a district heating system to supply heat energy, through the medium of hot water, efficiently and economically to customers in certain areas of Jamestown.

WHEREAS, Customer is willing to commit to participation as a customer in the Jamestown District Heating System.

NOW, THEREFORE, in consideration of the premises the parties hereto agree as follows:

1. Contingent upon Article 4 below and the other terms and conditions of this agreement, BPU will use its best efforts to plan, design, finance and construct a district heating system (the System) designed to provide efficient, economical and reliable hot water heating to Customer and others in certain areas of the City of Jamestown.

2. Contingent upon Article 4 below and the other terms and conditions of this agreement, Customer agrees that it will participate in the district heating system by converting its building to use hot water heat provided by the System, consistent with standards set by the BPU; and by purchasing hot water heat energy from the System to provide for the heat requirements of the building for:

- a. space/comfort heating; and
- b. _____;
- c. _____.

for a period of years.

3. Both parties agree that upon the occurrence of the contingencies set forth in 4 below, they will forthwith execute a detailed "Hot Water Delivery Agreement" consistent with this agreement and containing the additional provisions outlined herein.

4. This agreement is contingent upon:

a. The execution of a District Heating System Customer Contingent Commitment by customers representing an aggregate hot water heat demand sufficient to warrant proceeding with the System.

b. Subsequent to a. above, determination by the BPU to proceed.

5. The BPU will use its best efforts to explore and secure assistance for Customer in the financing of retrofit costs.

6. The BPU will work with the customers and, as required, the State Public Service Commission, to set rates for hot water heat service which are the most economical for Customer given the costs of service and regulatory requirements.

7. The detailed "Hot Water Delivery Agreement" will contain provisions as outlined below:

a. Establish the BPU's obligation to continuously provide hot water in accordance with aggregate demand figures and the provisions of the agreement.

b. Establish the terms and conditions applicable to rates, subject to Public Service Commission regulation. It is anticipated that customer monthly bills will consist of a monthly demand charge (based in part on Customer's portion of the system's aggregate peak demand) and a monthly thermal energy charge (based upon Customer's metered volume of hot water delivered and temperature difference).

c. Establish the completion date for the Customer's conversion.

d. Establish the Customer's point of delivery for hot water.

e. Establish the Customer's initial demand capacity and utilization factor (equivalent hours at full load).

- f. Establish BPU's obligation to connect its system to customer's at the point of delivery.
- g. Establish the designed temperature conditions for the system.
- h. Establish the procedures and policies applicable to: allocation of service, service interruption, access of Customer's facilities, billing and payment, metering, modification to the system, and termination or assignment of the delivery agreement.

Section 10 PILOT PROJECT

INTRODUCTION

Based on the favorably results of this second phase feasibility study and the high level of community support that was developed during the course of the study, the City of Jamestown extended the study scope to include the detailed design of a pilot district heating project. The objective of the pilot project design was to develop a limited district heating system by implementing a small portion of the full scale plans incurring minimal expense. The pilot system is to incorporate all the characteristics of the full-scale system. The pilot system will generate hot water at the Steele Street Plant and transport it through a limited transmission system to a few representative customers. This section of the report presents the pilot system design.

PILOT SYSTEM HEAT LOAD SELECTION

In developing a load for the pilot system, the objective was to connect customers that were both close to the heat source and that were representative of the overall potential district heating load. Four customers were identified that together satisfied this objective. They are Jamestown General Hospital, Jamestown Plywood Corporation, the Board of Public Utilities Warehouse and the Department of Public Works Garage. The Jamestown General Hospital represents an institutional-type load that is representative of facilities that required 24 hours per day without set-back hours. This load is typical of the type of load that is associated with large residential institutions such as nursing homes and residential buildings. The Jamestown Plywood Corporation is representative of the industrial customer that heats large open areas, has a large exhaust air flow and employs night and weekend temperature set-backs. The Board of Public Utilities Warehouse contains garage facilities on the ground floor and storerooms and offices on the second floor. The second floor is representative of a commercial-type load which requires heat during business hours for people who are relatively inactive. The Board of Public Utilities Warehouse employs night and weekend temperature set-backs. The Department of Public Works Garage is typical of a facility which requires a fast heat recovery and loses large amounts of heat as a result of opening large overhead doors.

All four buildings presently heat with two-pipe steam systems and would require conversion to hot water.

The heat load for the four buildings is summarized in Table 10-1.

PILOT SYSTEM PLANT RETROFIT

The objective in designing the pilot system plant retrofit is to isolate from the full-scale retrofit a minimal plant retrofit that will supply hot water for the pilot system. The retrofit should be capable of supplying the small load of the pilot system and should be fully usable for the full-scale project. It was determined that this objective could be satisfied by installing a portion of the first phase plant retrofit described in Section 3 of this report.

The first phase heat source development recommendation involves extracting steam from the blanked-off 11th stage of the Unit 6 turbine for use in a new district heating condenser for loads up to 7 MWt. For loads above 7 MWt, additional steam is taken from the auxiliary steam header and used in the existing Unit 6 auxiliary heat exchanger that will be arranged in series with the new district heating condenser. The auxiliary heat exchanger is intended to be used when the system load is between 7 MWt and the peak load. For the pilot system heat source development, the Unit 6 auxiliary heater, alone, would be used to supply district heat. This approach would save the expenses associated with installing anew district heating heat exchanger and associated controls and piping by making use of existing equipment. The district heating system piping would be tied into the existing auxiliary heater piping and additional valving would be provided to allow the auxiliary heater to be used for its original function or for district heating.

Pumps will be required to circulate the district water through the plant and to the district heating customers. It has been determined that the flow rate required for the pilot system customers is approximately equal to the summer flow associated with the first phase of development for the full-scale system. As a result, installing only the summer pumps for the pilot system will provide sufficient pumping capacity.

To control the pilot system, control valves will be required on the auxiliary steam header connection to control the steam input to the auxiliary heater for district heating and thus the district heat output.

Table 10-1
PILOT SYSTEM HEAT LOAD 1

<u>Building</u>	Comfort Load (MMBTU/HR)	Internal Use Load (MMBTU/HR)	Total Peak Load (MMBTU/HR)
Jamestown Plywood Corp.	3.227	-	3.227
Jamestown General Hospital	1.891	1.734	3.625
BPU Warehouse	.722	-	.722
DPW Garage	1.330	-	<u>1.330</u>
		Total	8.904 MMBTU/HR

Notes: 1 - For further details see Figures 2-5 and 2-6.

Additional equipment that will be required will be an expansion/head tank for the system, miscellaneous instrumentation and controls and piping. Makeup to the system will be provided from the existing plant makeup system.

The overall arrangement of the heat source for the pilot system is shown in Figure 10-1.

The overall cost of the heat source development for the pilot system is estimated to be \$320,000.

PILOT SYSTEM TRANSMISSION/DISTRIBUTION SYSTEM

The piping system design for the pilot system would be identical to that for the full-scale system. The four customers chosen for the pilot system are the four closest customers to the heat source. The Department of Public Works Garage and the Board of Public Utilities Warehouse are directly across the street from the Steele Street Plant, the Jamestown Plywood Corporation is approximately 1200 feet east of the plant on Steele Street and the Jamestown General Hospital is approximately 500 feet south of the Plywood Corporation. The pipe routing used for the pilot system would be identical to the routing used for the full-scale system. In addition, the pipe sizes must be based on the system capacity for the full system so that when the system is expanded the piping installed for the pilot system does not require replacing and only requires continuation.

Following this criteria for the pilot system piping, approximately 1200 feet of 12-inch transmission piping would be required along Steele Street. The transmission piping would end at the distribution piping connections for the Plywood Corporation which would require approximately 75 feet of 3-inch piping. The distribution piping to the hospital would connect approximately 80 feet upstream of the Plywood Corporation connection and would require approximately 500 feet of 3 inch piping to reach the hospital. The distribution piping for the municipal building would originate at the southeast corner of the plant and would require approximately 200 feet of 2-inch pipe and 150 feet of 1 1/2-inch piping.

The piping for the pilot system is shown in Figure 10-2. The estimated cost of the pilot system transmission/distribution system is \$250,000, including installation.

STEELE STREET PLANT DISTRICT HEATING RETROFIT

System Arrangement

Pilot Project

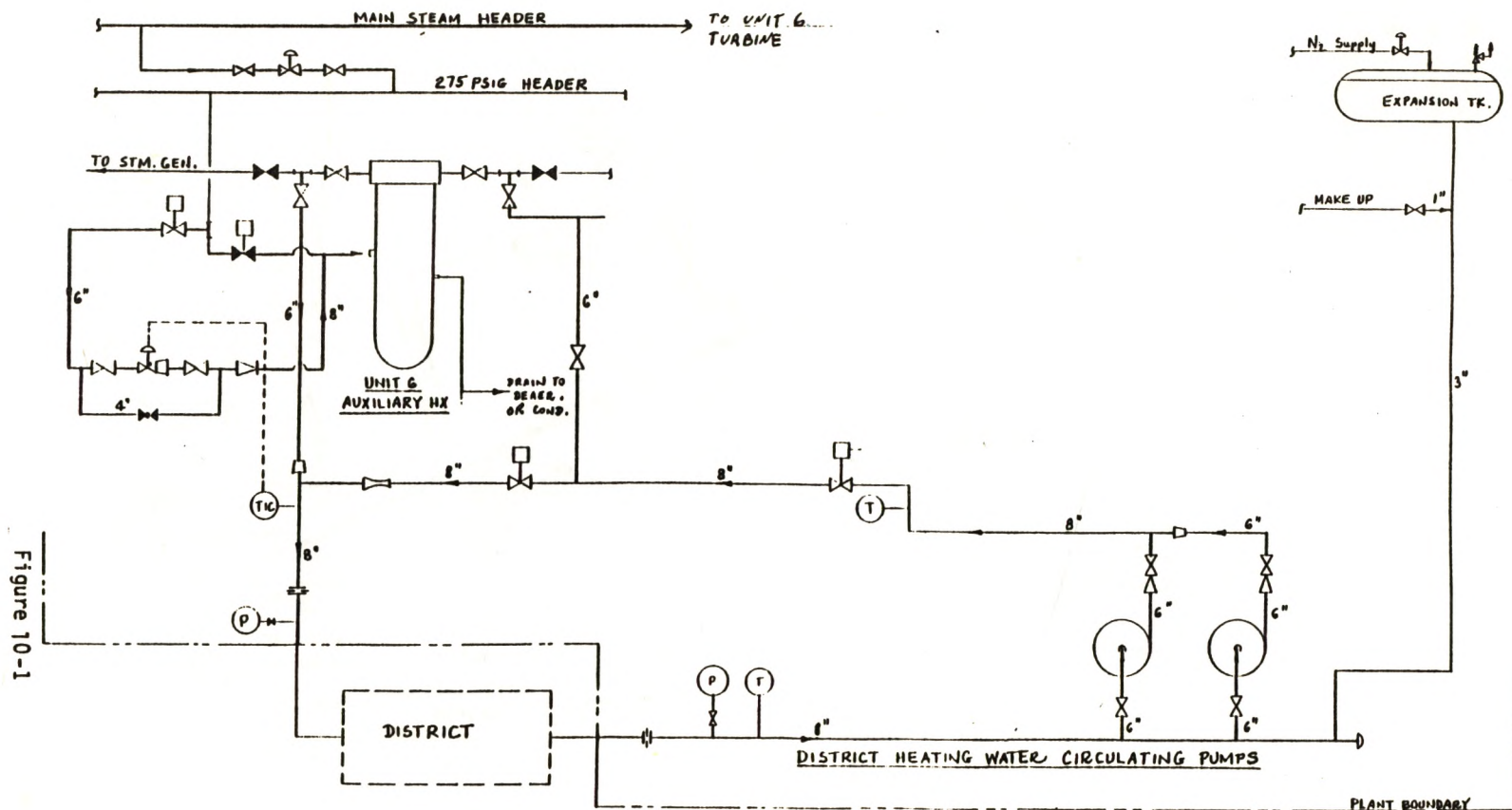


Figure 10-1

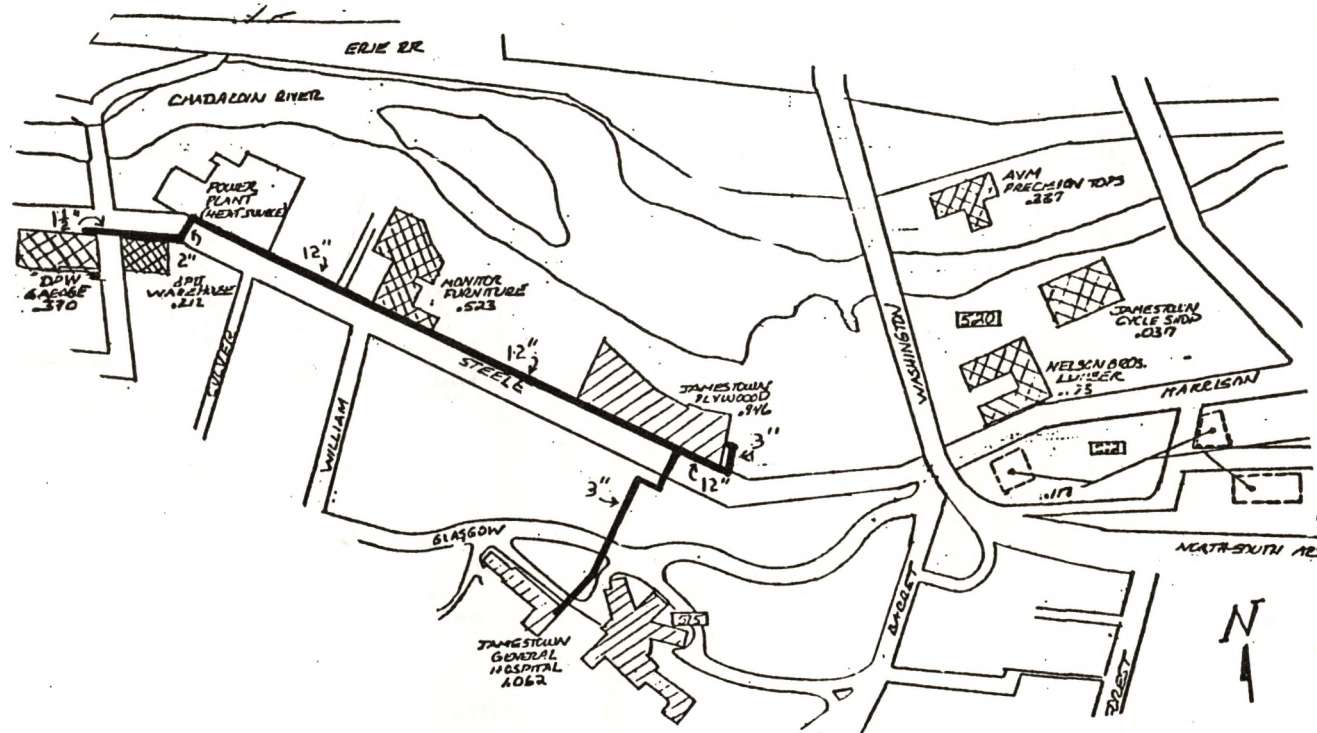


Figure 10-2 Pilot System Transmission/Distribution System

PILOT PROJECT BUILDING RETROFIT ANALYSIS

Each of the pilot system customers currently use two-pipe steam systems for heating their facilities. These steam systems must be converted to hot water systems to be compatible with the district heating system. As part of this study, retrofit designs were developed for each of the pilot customers. These designs were used to develop conversion cost estimates and specifications. A description of each of the pilot customer conversions follow.

Jamestown Plywood Corporation

The present heating system is primarily a two-pipe low pressure steam system. Approximately 38 cast iron radiators, 15 fin-tube radiators, 6 wall-mounted pipe manifold-type radiators, and 20 unit heaters comprise the terminal steam heating units. In addition, several electric baseboard radiators are installed (in offices).

Low-pressure steam is delivered via pressure-reducing valves from a high-pressure steam boiler plant fired with both natural gas and on-site wood scrap material. The high-pressure steam is utilized by various process equipment associated with the facility's manufacture of wood products. Low-pressure steam is also utilized by humidifiers in the product storage area.

Domestic hot water needs are provided by several electric hot water heaters located in various areas of the building.

Due to the availability of wood scrap materials as well as the high temperature requirements of the process equipment, the process heating load would not be provided by district heating. The existing boilers would remain in service to meet this load.

In addition, as domestic hot water needs are minimal and extensive piping runs as well as a heat exchanger would be required, the domestic hot water load also would not be provided by the district heating system.

Accordingly, the building retrofit considers only the conversion work required for comfort heating. A design comfort heat load of 4,120,000 Btuh has been estimated for this building and is the basis for the retrofit design.

The conversion to hot water district heating can then be accomplished as follows:

- o Isolate the low-pressure steam comfort heating system from the high-pressure process steam supply steam. This requires a new condensate return system for the process equipment as the existing condensate lines will be utilized for the hot water circulating system.
- o Retrofit terminal heating units to hot water service and establish hot water circulating piping system.
- o Run new low-pressure steam lines (via pressure-reducing valves) from the high-pressure steam lines to provide the humidification requirements.
- o Retire existing condensate pumping stations and install new hot water return piping.
- o Connect the district heating supply and return water directly to the building heating system. This requires the installation of a pressure-reducing valve to reduce the district heating supply water pressure to an acceptable level, a mixing valve to temper the district heating water supply with building heating system return water, and two 100 percent-capacity pumps to return the district heating water to the system.
- o Control building supply temperature in response to outdoor temperature. On the design day, a water supply temperature of 195°F and a flowrate of 218 gpm will satisfy the estimated heat load of 4,120,000 Btuh. Return water temperature would be 157°F.
- o Individual terminal heating units would be controlled by their respective supply valves.

Jamestown General Hospital

The hospital complex is composed of several interconnected building with the major portion of the heating requirements provided by two 60 psig high-pressure boilers. The main hospital, comprised of four wings, north, south, east and west is physically joined to the nearby Professional Building by recently constructed core and ancillary additions. A separate building complex houses the steam boilers in a maintenance area in addition to facilities for the Family Health Center and the Humphrey Pavillion, a business office.

In general, high-pressure steam is distributed from the central plant to each building where a pressure-reducing station is furnished for low-pressure conversion. The north wing, east wing, portions of the south and west wings, the Professional Building, the maintenance area and the Humphrey Pavillion rely on the low-pressure steam for space heating. Periphery units include cast iron radiators, cabinet-type, fin-tube convectors and baseboard fin tubing. The steam supply serves the second floor of the east wing which employs floor-mounted unit ventilators and a couple of unit heaters, while the kitchen and cafeteria in the west wing have several overhead unit ventilators.

The core and ancillary areas and the remaining portions of the south and west wings depend on a central air system comprised of approximately 32 heat pumps for comfort heating. Acting as a heat source, relatively hot water is circulated to individual heat pumps which deliver this heat to air ducts serving the occupied areas. In cold weather, supplementary heat is supplied to the closed water system to boost the water temperature for proper heat pump performance. This supplementary heat is provided to the system via a shell-and-tube heat exchanger located in the penthouse which utilizes central plant steam to produce hot water. Additional central air temperature control is achieved by 12 steam coils and humidifiers located upstream of the heat pumps which preheat and humidify the air as required. Further upstream, several air-to-air exchangers including a "Z" duct design in the ancillary unit are provided for heat recovery of warm room exhaust air which is continuously replaced in accordance with health codes. Final room temperature control is achieved utilizing electric reheat in the individual rooms.

In addition to space heating demands, steam is produced for process requirements. High-pressure steam is used directly by seven sterilizers, bed pan hop-

pers at nursing stations and steam pressure cookers in the kitchen. Domestic hot water for the main hospital is generated with a steam-heated exchanger bundle immersed in a storage tank in the penthouse.

Several decentralized facilities for heating and hot water production have been introduced at the hospital. The Family Health Center is heated solely by independent gas-fired equipment. A small gas-fired domestic hot water heater is provided for the maintenance area, Family Health Center and Humphrey Pavillion. Another water heater is installed in the Professional Building to supply a small laundry.

Analysis of the fuel consumption records indicates that the peak comfort heating load for the hospital is 2,700,000 Btu/hr. A peak demand of 2,000,000 Btu/hr is expected for hot water generation. Knowing the heat load requirement and the performance capability of the heating system, a hot water retrofit could be accomplished with a district water supply of about 130 gpm and a temperature drop from 250°F to 160°F. Estimates for building water system operation were based on a flow of 200 gpm with a temperature rise from 170°F to 190°F for the periphery and air preheat coil system, a flow of 175 gpm with a temperature rise from 70°F to 100°F for supplementary heat pump system, and a flow of 45 gpm with a temperature rise from 40°F to 130°F for domestic hot water.

In a hot water retrofit, the penthouse replaces the boiler room as the central equipment location. The penthouse would house a plate-type heat exchanger dedicated to the periphery and air preheat coil load presently handling by the steam boilers. Another two-plate exchanger would replace the existing shell-and-tube exchangers situated in the penthouse for supplemental heating to the heat pump system and domestic hot water. The exchangers presently installed were intended for steam service and may be unsuitable in a conversion to hot water.

Associated with each exchanger is a closed hot water system which circulates hot water to terminal users in the complex. Each building hot water system is independent, governed by different temperature requirements. Periphery units such as radiators and fin tubing demand a higher operating temperature than the systems for domestic hot water and heat pump service. Temperature control for each building hot water system is effected by throttling the district water supply.

The three plate exchangers identified are arranged in series on the district water side to maximize the temperature drop. Entering the penthouse from the street, district water is directed to the exchanger dedicated to the periphery and air preheat coil load. The partially cooled district water supply proceeds to the next exchanger, being responsible for supplemental heating to the heat pump system which has a lower temperature requirement than the periphery units. Ultimately, the district supply passes through the plate exchanger designated for domestic hot water production.

With the creation of a new closed hot water system for periphery units and the air preheat coils, a main circulation pump and boosters for the Professional Building and Humphrey Pavillion are required with provisions for an expansion tank, air removal devices instrumentation and controls. The other water systems at the hospital for the heat pump and domestic hot water remain intact except for the installation of the heat exchangers.

The air preheat coils in the ducts leading to the core and ancillary areas require replacement, the present coils being designed for steam service. Individual terminal units, including radiators, convectors, etc., must be retrofitted for hot water services.

To satisfy the high-pressure steam requirements at the hospital, the retrofit considers the installation of a small gas-fired steam boiler capable of generating 60 psig steam for sterilization and cooking needs.

Study of condensate return lines indicates the need to replace or provide additional piping to carry the flow anticipated in the hot water system. New piping, serving as district water supply and return to the penthouse, must also be installed.

Municipal Buildings

Both municipal buildings are currently heated with steam supplied from the Steele Street Plant. This steam is taken from the auxiliary steam header at the plant, reduced in pressure and supplied to the two buildings through underground piping. The condensate from the buildings is returned to the plant. Considering that this steam is generated as high-pressure steam which could be used to generate electricity at the plant, the use of this steam for low-pressure

heating is inefficient and expensive. Conversion of these buildings to district heating based on cogeneration of electric and heat will result in much more efficient use of the plant resources.

The heating equipment in the two municipal buildings consists of a combination of cast iron radiation and overhead air-handling units.

The district heating conversion for the buildings would involve isolating each building's internal system using a plate heat exchanger. The plate heat exchanger would use district heating water from the plant on the primary side and circulate the building water on the secondary side. The building system will become a closed system. Circulating pumps will be added to the building's systems to circulate the water. The piping system serving a building will remain essentially unchanged except for small changes local to overhead air-handling units. The terminal units will be converted to hot water in accordance with the procedures described in Section 5 of this report. These changes would be simple in nature, involving removal of steam traps and installation of balancing valves on all terminal units. In addition, the overhead units would be retrofitted with solenoid valves to control the blowers.

Each building would be supplied with an automatic control system that would control the building's heat based on the outdoor temperature.

The retrofit costs and payback periods for each of the pilot customers is presented in Table 10-2. The payback periods have been calculated based on the rates determined for the first phase of development.

Table 10-2
PILOT CUSTOMER ECONOMICS

<u>Customer</u>	<u>Retrofit Cost</u>	<u>Payback Period</u>
Jamestown Plywood Corporation	\$ 44,200	3 yrs
Jamestown General Hospital	\$220,000	4 yrs
B.P.U. Warehouse	\$ 10,400	Not Applicable
D.P.W. Garage	\$ 12,000	Not Applicable

APPENDIX A
ALTERNATIVE SYSTEM CASH FLOW ANALYSIS

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
ANNUAL CARRYING CHARGES**

A-1

Investment for Phase 1		Economic Factors								
Initial Operation	1985	Preferred Stock Ratio	0		Book Life - Yrs		30			
Cost Basis	1984	Return on Preferred Stock - %	0		Income Tax Rate - %		0			
Capital Cost - \$1000		Common Stock Ratio	0		Tax Credit - %		0			
Heat Source	633	Return on Common Stock - %	0		Tax Life - Yrs		30			
Piping	2538	Debt Ratio	1		Accelerated Tax Depreciation		0			
Total	3191	Debt Cost - %	7		Property Tax - %		0			
Escalation - \$1000	102	Weighted Cost of Capital - %	7		Insurance Rate - %		0.5			
AFDC - \$1000	113									
Total Cost - \$1000	3406									
Start of Evaluation	1985									

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	3406	3293	3179	3066	2952	2839	2725	2612	2498	2384
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	238	230	223	215	207	199	191	183	175	167
Book Depreciation	114	114	114	114	114	114	114	114	114	114
Tax Depreciation	114	114	114	114	114	114	114	114	114	114
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	17	17	17	17	17	17	17	17	17	17
Annual Carrying Charges	369	361	353	345	337	329	321	313	305	297

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	2271	2157	2044	1930	1817	1703	1590	1476	1363	1249
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	159	151	143	135	127	119	111	103	95	87
Book Depreciation	114	114	114	114	114	114	114	114	114	114
Tax Depreciation	114	114	114	114	114	114	114	114	114	114
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	17	17	17	17	17	17	17	17	17	17
Annual Carrying Charges	290	282	274	266	258	250	242	234	226	218

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-2

CASE 1

Start of Evaluation			1985		Economic Factors						
Unit Costs	1984	Escalation	Preferred Stock Ratio			0	Book Life - Yrs			30	
			Return on Preferred Stock - %			0	Income Tax Rate - %			0	
Electricity - \$/MWh	30	7.5	Common Stock Ratio			0	Tax Credit - %			0	
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %			0	Tax Life - Yrs			30	
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio			1	Accel. Tax Deprec.			0	
O&M Materials -% Cost	----	7.5	Debt Cost - %			7	Insurance Rate - %			0.5	
Property Taxes - %	0	2.5	Weighted Cost of Capital - %			7	Gross Receipts Tax-%			5	
Steam - \$/1000 Lbs	2.07	1									
Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	
A. Annual Quantities											
1. District Heat - MBtu/yr	138011	138011	138011	138011	138011	138011	138011	138011	138011	138011	
2. Electricity Loss - MWh/yr	6460	6460	6460	6460	6460	6460	6460	6460	6460	6460	
3. Pumping Energy - Mwh/yr	851	851	851	851	851	851	851	851	851	851	
4. Steam - 1000 Lbs/yr	13911	13911	13911	13911	13911	13911	13911	13911	13911	13911	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46	
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83	
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62	
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29	
C. Investments - \$1000											
	3406	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$1000/yr											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	238	230	223	215	207	199	191	183	175	167	
4. Book Depreciation	114	114	114	114	114	114	114	114	114	114	
5. Tax Depreciation	114	114	114	114	114	114	114	114	114	114	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	17	17	17	17	17	17	17	17	17	17	
Sub- Total	369	361	353	345	337	329	321	313	305	297	
E. Operating Expenses - \$1000/yr											
1. Replacement Electricity	208	224	241	267	287	308	361	388	417	449	
2. O&M Labor	65	69	75	80	86	93	100	107	115	124	
3. O&M Materials	48	51	55	59	64	68	73	79	85	91	
4. Pumping Cost	27	30	32	34	37	39	42	46	49	53	
5. Steam Cost	29	29	30	30	30	31	31	31	31	32	
Sub- Total	377	403	432	470	503	539	607	651	698	748	
F. Gross Receipts Tax-\$1000/yr											
	71	71	71	71	72	72	74	74	75	76	
G. Required Revenues- \$1000/yr											
	817	836	856	886	912	940	1002	1039	1078	1122	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$2.67	\$2.62	\$2.56	\$2.50	\$2.44	\$2.39	\$2.33	\$2.27	\$2.21	\$2.16	
2. Replacement Electricity	\$1.51	\$1.62	\$1.74	\$1.93	\$2.08	\$2.23	\$2.62	\$2.81	\$3.02	\$3.25	
3. Operating Expenses	\$1.22	\$1.30	\$1.38	\$1.47	\$1.57	\$1.67	\$1.78	\$1.90	\$2.03	\$2.17	
4. Gross Receipts Tax	\$0.52	\$0.52	\$0.51	\$0.52	\$0.52	\$0.52	\$0.53	\$0.54	\$0.54	\$0.55	
5. Reinvestment Fund	\$0.66	\$0.67	\$0.69	\$0.71	\$0.73	\$0.76	\$0.81	\$0.84	\$0.87	\$0.90	
20-Nov-84	\$6.58	\$6.73	\$6.89	\$7.14	\$7.34	\$7.57	\$8.07	\$8.36	\$8.68	\$9.03	

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-3

CASE 1

Start of Evaluation	1985		Economic Factors							
Unit Costs	1984	Escalation	Preferred Stock Ratio		0	Book Life - Yrs		30		
			Return on Preferred Stock - %		0	Income Tax Rate - %		0		
Electricity - \$/MWh	30	7.5	Common Stock Ratio		0	Tax Credit - %		0		
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %		0	Tax Life - Yrs		30		
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio		1	Accel. Tax Deprec.		0		
O&M Materials -% Cost	----	7.5	Debt Cost - %		7	Insurance Rate - %		0.5		
Property Taxes - %	0	2.5	Weighted Cost of Capital - %		7	Gross Receipts Tax-%		5		
Steam - \$/1000 Lbs	2.07	1								
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
A. Annual Quantities										
1. District Heat - MBtu/yr	138011	138011	138011	138011	138011	138011	138011	138011	138011	138011
2. Electricity Loss - MWh/yr	6460	6460	6460	6460	6460	6460	6460	6460	6460	6460
3. Pumping Energy - Mwh/yr	851	851	851	851	851	851	851	851	851	851
4. Steam - 1000 Lbs/yr	13911	13911	13911	13911	13911	13911	13911	13911	13911	13911
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53
C. Investments - \$1000										
	0	0	0	0	0	0	0	0	0	0
D. Annual Carrying Charges-\$100										
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	159	151	143	135	127	119	111	103	95	87
4. Book Depreciation	114	114	114	114	114	114	114	114	114	114
5. Tax Depreciation	114	114	114	114	114	114	114	114	114	114
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	17	17	17	17	17	17	17	17	17
Sub- Total	290	282	274	266	258	250	242	234	226	218
E. Operating Expenses - \$1000/										
1. Replacement Electricity	482	519	557	599	644	692	744	800	860	925
2. O&M Labor	133	143	154	165	178	191	205	221	237	255
3. O&M Materials	98	105	113	122	131	141	151	163	175	188
4. Pumping Cost	57	61	65	70	76	81	87	94	101	108
5. Steam Cost	32	32	33	33	33	34	34	34	35	35
Sub- Total	802	860	922	990	1062	1139	1222	1312	1408	1511
F. Gross Receipts Tax-\$1000/yr										
	77	79	80	82	84	86	89	92	95	99
G. Required Revenues- \$1000/yr										
	1169	1220	1276	1337	1403	1475	1553	1638	1729	1828
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$2.10	\$2.04	\$1.98	\$1.93	\$1.87	\$1.81	\$1.75	\$1.69	\$1.64	\$1.58
2. Replacement Electricity	\$3.49	\$3.76	\$4.04	\$4.34	\$4.67	\$5.02	\$5.39	\$5.80	\$6.23	\$6.70
3. Operating Expenses	\$2.32	\$2.47	\$2.65	\$2.83	\$3.02	\$3.24	\$3.46	\$3.71	\$3.97	\$4.25
4. Gross Receipts Tax	\$0.56	\$0.57	\$0.58	\$0.59	\$0.61	\$0.63	\$0.65	\$0.67	\$0.69	\$0.72
5. Reinvestment Fund	\$0.94	\$0.98	\$1.03	\$1.08	\$1.13	\$1.19	\$1.25	\$1.32	\$1.39	\$1.47
20-Nov-84	\$9.41	\$9.82	\$10.28	\$10.77	\$11.30	\$11.88	\$12.51	\$13.18	\$13.92	\$14.72

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

A-4

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	817329	833547	855823	886463	911939	940017	1002400	1038642	1078293	1121608
Reinvestment Fund Revenues	90814	92839	95091	98496	101327	104446	111378	115405	119810	124623
Total Operating Revenues	908143	928385	950914	984959	1013265	1044463	1113777	1154047	1198104	1246231
OPERATING EXPENSES										
Production	284522	303971	324860	355060	379742	406255	464747	497596	532889	570808
Transmission Distribution	81583	87702	94280	101331	108952	117123	125908	135351	145502	156415
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	113546	113546	113546	113546	113546	113546	113546	113546	113546	113546
Contributions in Lieu of Tax	71362	71148	71032	71410	71542	71797	73687	74331	75138	76119
Total Operating Expenses	561850	588016	616240	654829	688253	724279	794610	838801	886401	937663
NET HEATING OPERATING INCOME	346293	340369	334674	330130	325012	320184	319167	315246	311703	308568
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	346293	340369	334674	330130	325012	320184	319167	315246	311703	308568
INCOME DEDUCTIONS										
Interest on Long Term Debt	238447	230499	222550	214602	206654	198706	190757	182809	174861	166913
NET INCOME	\$107,846	\$109,870	\$112,123	\$115,528	\$118,358	\$121,478	\$128,410	\$132,437	\$136,842	\$141,655

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-5

CASE 2

Start of Evaluation 1985			Economic Factors							
Unit Costs	1984	Escalation								
Electricity - \$/MWh	30	7.5	Preferred Stock Ratio	0	Book Life - Yrs	30				
Pumping Power-\$/MWh	30	7.5	Return on Preferred Stock - %	0	Income Tax Rate - %	0				
O&M Labor -\$/ManYr	30,000	7.5	Common Stock Ratio	0	Tax Credit - %	0				
O&M Materials -% Cost	----	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30				
Property Taxes - %	0	2.5	Debt Ratio	1	Accel. Tax Deprec.	0				
Steam - \$/1000 Lbs	2.07	1	Debt Cost - %	7	Insurance Rate - %	0.5				
			Weighted Cost of Capital - %	7	Gross Receipts Tax-%	5				
Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. Annual Quantities										
1. District Heat - MBtu/yr	117309	117309	117309	117309	117309	117309	117309	117309	117309	117309
2. Electricity Loss - MWh/yr	5791	5791	5791	5791	5791	5791	5791	5791	5791	5791
3. Pumping Energy - MWh/yr	723	723	723	723	723	723	723	723	723	723
4. Steam - 1000 Lbs/yr	6528	6528	6528	6528	6528	6528	6528	6528	6528	6528
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29
C. Investments - \$1000										
	3406	0	0	0	0	0	0	0	0	0
D. Annual Carrying Charges-\$1000/yr										
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	238	230	223	215	207	199	191	183	175	167
4. Book Depreciation	114	114	114	114	114	114	114	114	114	114
5. Tax Depreciation	114	114	114	114	114	114	114	114	114	114
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	17	17	17	17	17	17	17	17	17
Sub- Total	369	361	353	345	337	329	321	313	305	297
E. Operating Expenses - \$1000/yr										
1. Replacement Electricity	187	201	216	239	257	276	324	348	374	402
2. O&M Labor	65	69	75	80	86	93	100	107	115	124
3. O&M Materials	48	51	55	59	64	68	73	79	85	91
4. Pumping Cost	23	25	27	29	31	33	36	39	42	45
5. Steam Cost	14	14	14	14	14	14	14	15	15	15
Sub- Total	336	360	386	421	452	485	547	587	630	677
F. Gross Receipts Tax-\$1000/yr										
	69	69	69	69	69	69	71	71	72	73
G. Required Revenues- \$1000/yr										
	774	790	808	835	858	883	939	972	1008	1047
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$3.15	\$3.08	\$3.01	\$2.94	\$2.87	\$2.81	\$2.74	\$2.67	\$2.60	\$2.54
2. Replacement Electricity	\$1.59	\$1.71	\$1.84	\$2.04	\$2.19	\$2.35	\$2.76	\$2.97	\$3.19	\$3.43
3. Operating Expenses	\$1.27	\$1.36	\$1.45	\$1.55	\$1.66	\$1.78	\$1.90	\$2.04	\$2.18	\$2.34
4. Gross Receipts Tax	\$0.59	\$0.59	\$0.59	\$0.59	\$0.59	\$0.59	\$0.60	\$0.61	\$0.61	\$0.62
5. Reinvestment Fund	\$0.66	\$0.67	\$0.69	\$0.71	\$0.73	\$0.76	\$0.81	\$0.84	\$0.87	\$0.90
20-Nov-84	\$7.33	\$7.48	\$7.65	\$7.91	\$8.13	\$8.37	\$8.90	\$9.21	\$9.54	\$9.91

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-6

CASE 2

Start of Evaluation 1985			Economic Factors								
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30					
			Return on Preferred Stock - %	0	Income Tax Rate - %	0					
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0 <th>Tax Credit - %</th> <td>0<th colspan="5"></th></td>	Tax Credit - %	0 <th colspan="5"></th>					
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0 <th>Tax Life - Yrs</th> <td>30<th colspan="5"></th></td>	Tax Life - Yrs	30 <th colspan="5"></th>					
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1 <th>Accel. Tax Deprec.</th> <td>0<th colspan="5"></th></td>	Accel. Tax Deprec.	0 <th colspan="5"></th>					
O&M Materials -% Cost	----	7.5	Debt Cost - %	7 <th>Insurance Rate - %</th> <td>0.5<th colspan="5"></th></td>	Insurance Rate - %	0.5 <th colspan="5"></th>					
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	7 <th>Gross Receipts Tax-%</th> <td>5<th colspan="5"></th></td>	Gross Receipts Tax-%	5 <th colspan="5"></th>					
Steam - \$/1000 Lbs	2.07	1									
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
A. Annual Quantities											
1. District Heat - MBtu/yr	117309	117309	117309	117309	117309	117309	117309	117309	117309	117309	
2. Electricity Loss - MWh/yr	5791	5791	5791	5791	5791	5791	5791	5791	5791	5791	
3. Pumping Energy - Mwh/yr	723	723	723	723	723	723	723	723	723	723	
4. Steam - 1000 Lbs/yr	6528	6528	6528	6528	6528	6528	6528	6528	6528	6528	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15	
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44	
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127	
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53	
C. Investments - \$1000											
	0	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$100											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	159	151	143	135	127	119	111	103	95	87	
4. Book Depreciation	114	114	114	114	114	114	114	114	114	114	
5. Tax Depreciation	114	114	114	114	114	114	114	114	114	114	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	17	17	17	17	17	17	17	17	17	17	
Sub- Total	290	282	274	266	258	250	242	234	226	218	
E. Operating Expenses - \$1000/											
1. Replacement Electricity	432	465	500	537	577	621	667	717	771	829	
2. O&M Labor	133	143	154	165	178	191	205	221	237	255	
3. O&M Materials	98	105	113	122	131	141	151	163	175	188	
4. Pumping Cost	48	52	56	60	64	69	74	80	86	92	
5. Steam Cost	15	15	15	16	16	16	16	16	16	16	
Sub- Total	727	780	838	899	966	1037	1114	1197	1285	1381	
F. Gross Receipts Tax-\$1000/yr	74	75	76	78	79	81	84	86	89	92	
G. Required Revenues- \$1000/yr	1090	1136	1187	1243	1303	1368	1440	1517	1600	1691	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$2.47	\$2.40	\$2.33	\$2.26	\$2.20	\$2.13	\$2.06	\$1.99	\$1.93	\$1.86	
2. Replacement Electricity	\$3.69	\$3.96	\$4.26	\$4.58	\$4.92	\$5.29	\$5.69	\$6.12	\$6.57	\$7.07	
3. Operating Expenses	\$2.51	\$2.69	\$2.88	\$3.09	\$3.31	\$3.55	\$3.81	\$4.08	\$4.38	\$4.70	
4. Gross Receipts Tax	\$0.63	\$0.64	\$0.65	\$0.66	\$0.68	\$0.69	\$0.71	\$0.74	\$0.76	\$0.79	
5. Reinvestment Fund	\$0.94	\$0.98	\$1.03	\$1.08	\$1.13	\$1.19	\$1.25	\$1.32	\$1.39	\$1.47	
20-Nov-84	\$10.32	\$10.76	\$11.24	\$11.77	\$12.34	\$12.96	\$13.63	\$14.37	\$15.16	\$16.02	

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

A-7

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	774145	790178	808115	835407	858139	883278	939250	971875	1007648	1046805
Reinvestment Fund Revenues	77192	78913	80828	83721	86128	88779	94671	98094	101839	105930
Total Operating Revenues	851337	869090	888942	919128	944267	972058	1033921	1069969	1109487	1152735
OPERATING EXPENSES										
Production	247512	265188	284181	311550	334002	358129	410958	440838	472949	507460
Transmission Distribution	77467	83277	89522	96237	103454	111213	119554	128521	138160	148522
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	113546	113546	113546	113546	113546	113546	113546	113546	113546	113546
Contributions in Lieu of Tax	69306	68988	68761	68979	68980	69096	70680	71152	71774	72557
Total Operating Expenses	518666	542647	568532	603773	634454	667541	731461	772034	815755	862860
NET HEATING OPERATING INCOME	332671	326443	320410	315356	309813	304517	302460	297935	293732	289874
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	332671	326443	320410	315356	309813	304517	302460	297935	293732	289874
INCOME DEDUCTIONS										
Interest on Long Term Debt	238447	230499	222550	214602	206654	198706	190757	182809	174861	166913
NET INCOME	\$94,224	\$95,945	\$97,860	\$100,753	\$103,159	\$105,811	\$111,703	\$115,126	\$118,871	\$122,962

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN**

JAMESTOWN, NEW YORK

A-8

ANNUAL CARRYING CHARGES

Investment for Phase	2	Economic Factors			
Initial Operation	1986	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	157	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	394	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	551	Debt Cost - %	7	Property Tax - %	0
Escalation - \$1000	55	Weighted Cost of Capital - %	7	Insurance Rate - %	0.5
AFDC - \$1000	21				
Total Cost - \$1000	626				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	626	606	585	564	543	522	501	480	459
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	44	42	41	39	38	37	35	34	32
Book Depreciation	0	21	21	21	21	21	21	21	21	21
Tax Depreciation	0	21	21	21	21	21	21	21	21	21
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	3	3	3	3	3	3	3	3	3
Annual Carrying Charges	0	68	66	65	63	62	61	59	58	56

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	438	418	397	376	355	334	313	292	271	251
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	31	29	28	26	25	23	22	20	19	18
Book Depreciation	21	21	21	21	21	21	21	21	21	21
Tax Depreciation	21	21	21	21	21	21	21	21	21	21
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	3	3	3	3	3	3	3	3	3	3
Annual Carrying Charges	55	53	52	50	49	47	46	44	43	42

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-9

CASE 3

Start of Evaluation 1985			Economic Factors							
Unit Costs	1984	Escalation								
Electricity - \$/MWh	30	7.5	Preferred Stock Ratio	0	Book Life - Yrs	30				
Pumping Power-\$/MWh	30	7.5	Return on Preferred Stock - %	0	Income Tax Rate - %	0				
O&M Labor -\$/ManYr	30,000	7.5	Common Stock Ratio	0	Tax Credit - %	0				
O&M Materials -% Cost	---	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30				
Property Taxes - %	0	2.5	Debt Ratio	1	Accel. Tax Deprec.	0				
Steam - \$/1000 Lbs	2.07	1	Debt Cost - %	7	Insurance Rate - %	0.5				
			Weighted Cost of Capital - %	7	Gross Receipts Tax-%	5				
Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. Annual Quantities										
1. District Heat - MBtu/yr	117309	144929	144929	144929	144929	144929	144929	144929	144929	144929
2. Electricity Loss - MWh/yr	5791	6589	6589	6589	6589	6589	6589	6589	6589	6589
3. Pumping Energy - Mwh/yr	723	921	921	921	921	921	921	921	921	921
4. Steam - 1000 Lbs/yr	6528	19304	19304	19304	19304	19304	19304	19304	19304	19304
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29
C. Investments - \$1000										
1. Annual Carrying Charges-\$1000/yr	3406	626	0	0	0	0	0	0	0	0
D. Annual Carrying Charges-\$1000/yr										
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	238	274	265	256	246	237	227	218	208	199
4. Book Depreciation	114	134	134	134	134	134	134	134	134	134
5. Tax Depreciation	114	134	134	134	134	134	134	134	134	134
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	20	20	20	20	20	20	20	20	20
Sub- Total	369	429	420	410	401	391	382	372	363	354
E. Operating Expenses - \$1000/yr										
1. Replacement Electricity	187	228	246	272	292	314	368	396	426	458
2. O&M Labor	65	69	75	80	86	93	100	107	115	124
3. O&M Materials	48	60	64	69	74	80	86	92	99	107
4. Pumping Cost	23	32	34	37	40	43	46	49	53	57
5. Steam Cost	14	41	41	42	42	42	43	43	44	44
Sub- Total	336	430	460	500	535	572	643	688	737	789
F. Gross Receipts Tax-\$1000/yr										
6. Required Revenues- \$1000/yr	69	82	82	82	82	82	84	84	85	86
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$3.15	\$2.96	\$2.89	\$2.83	\$2.76	\$2.70	\$2.64	\$2.57	\$2.51	\$2.44
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$2.02	\$2.17	\$2.54	\$2.73	\$2.94	\$3.16
3. Operating Expenses	\$1.27	\$1.39	\$1.48	\$1.57	\$1.67	\$1.78	\$1.89	\$2.01	\$2.15	\$2.29
4. Gross Receipts Tax	\$0.59	\$0.57	\$0.56	\$0.57	\$0.57	\$0.57	\$0.58	\$0.58	\$0.58	\$0.59
5. Reinvestment Fund	\$0.73	\$0.72	\$0.74	\$0.76	\$0.78	\$0.81	\$0.86	\$0.89	\$0.92	\$0.95
20-Nov-84	\$7.33	\$7.22	\$7.37	\$7.60	\$7.80	\$8.01	\$8.50	\$8.78	\$9.08	\$9.42

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-10

CASE 3

Start of Evaluation 1985			Economic Factors								
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30					
			Return on Preferred Stock - %	0	Income Tax Rate - %	0					
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0	Tax Credit - %	0 <th colspan="5"></th>					
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30 <th colspan="5"></th>					
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1	Accel. Tax Deprec.	0 <th colspan="5"></th>					
O&M Materials -% Cost	----	7.5	Debt Cost - %	7	Insurance Rate - %	0.5 <th colspan="5"></th>					
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	7	Gross Receipts Tax-%	5 <th colspan="5"></th>					
Steam - \$/1000 Lbs	2.07	1									
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
A. Annual Quantities											
1. District Heat - MBtu/yr	144929	144929	144929	144929	144929	144929	144929	144929	144929	144929	
2. Electricity Loss - MWh/yr	6589	6589	6589	6589	6589	6589	6589	6589	6589	6589	
3. Pumping Energy - Mwh/yr	921	921	921	921	921	921	921	921	921	921	
4. Steam - 1000 Lbs/yr	19304	19304	19304	19304	19304	19304	19304	19304	19304	19304	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15	
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44	
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127	
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53	
C. Investments - \$1000											
	0	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$100											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	190	180	171	161	152	143	133	124	114	105	
4. Book Depreciation	134	134	134	134	134	134	134	134	134	134	
5. Tax Depreciation	134	134	134	134	134	134	134	134	134	134	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	20	20	20	20	20	20	20	20	20	20	
	----	----	----	----	----	----	----	----	----	----	
Sub- Total	344	335	325	316	307	297	288	278	269	260	
E. Operating Expenses - \$1000/											
1. Replacement Electricity	492	529	569	611	657	706	759	816	877	943	
2. O&M Labor	133	143	154	165	178	191	205	221	237	255	
3. O&M Materials	115	123	133	143	153	165	177	191	205	220	
4. Pumping Cost	61	66	71	76	82	88	94	102	109	117	
5. Steam Cost	45	45	45	46	46	47	47	48	48	49	
	----	----	----	----	----	----	----	----	----	----	
Sub- Total	846	906	971	1041	1116	1197	1283	1377	1477	1584	
F. Gross Receipts Tax-\$1000/yr											
	87	88	89	91	93	95	98	100	104	107	
G. Required Revenues- \$1000/yr											
	1276	1329	1386	1448	1516	1589	1669	1755	1849	1951	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$2.38	\$2.31	\$2.25	\$2.18	\$2.12	\$2.05	\$1.99	\$1.92	\$1.86	\$1.79	
2. Replacement Electricity	\$3.39	\$3.65	\$3.92	\$4.22	\$4.53	\$4.87	\$5.24	\$5.63	\$6.05	\$6.51	
3. Operating Expenses	\$2.44	\$2.60	\$2.78	\$2.97	\$3.17	\$3.38	\$3.62	\$3.87	\$4.14	\$4.42	
4. Gross Receipts Tax	\$0.60	\$0.61	\$0.62	\$0.63	\$0.64	\$0.66	\$0.67	\$0.69	\$0.72	\$0.74	
5. Reinvestment Fund	\$0.99	\$1.03	\$1.08	\$1.12	\$1.18	\$1.24	\$1.30	\$1.37	\$1.44	\$1.52	
	----	----	----	----	----	----	----	----	----	----	
20-Nov-84	\$9.79	\$10.19	\$10.62	\$11.10	\$11.62	\$12.18	\$12.79	\$13.46	\$14.18	\$14.96	

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

A-11

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	774145	941455	961339	991843	1017134	1045135	1108189	1144645	1184648	1228464
Reinvestment Fund Revenues	86016	104606	107009	110592	113596	116901	124101	128345	132984	138046
Total Operating Revenues	860161	1046061	1068348	1102436	1130730	1162037	1232289	1272990	1317632	1366510
OPERATING EXPENSES										
Production	247512	319831	341169	372000	397198	424257	483928	517438	553433	592100
Transmission Distribution	77467	90128	96888	104155	111966	120364	129391	139095	149527	160742
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	113546	134427	134427	134427	134427	134427	134427	134427	134427	134427
Contributions in Lieu of Tax	69306	82157	81824	81996	81920	81974	83696	84152	84776	85583
Total Operating Expenses	518666	638193	666830	706040	739982	776578	848165	893089	941489	993626
NET HEATING OPERATING INCOME	341495	407868	401517	396396	390748	385459	384125	379901	376143	372884
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	341495	407868	401517	396396	390748	385459	384125	379901	376143	372884
INCOME DEDUCTIONS										
Interest on Long Term Debt	238447	274348	264938	255528	246119	236709	227299	217889	208479	199069
NET INCOME	\$103,048	\$133,520	\$136,579	\$140,867	\$144,630	\$148,750	\$156,826	\$162,012	\$167,664	\$173,814

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
ANNUAL CARRYING CHARGES**

A-12

Investment for Phase 3		Economic Factors			
Initial Operation	1989	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	2473	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	1789	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	4262	Debt Cost - %	7	Property Tax - %	0
Escalation - \$1000	1396	Weighted Cost of Capital - %	7	Insurance Rate - %	0.5
AFDC - \$1000	195				
Total Cost - \$1000	5853				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	0	0	0	5853	5658	5463	5268	5073	4878
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	410	396	382	369	355	341
Book Depreciation	0	0	0	0	195	195	195	195	195	195
Tax Depreciation	0	0	0	0	195	195	195	195	195	195
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	29	29	29	29	29	29
Annual Carrying Charges	0	0	0	0	634	620	607	593	579	566

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	4682	4487	4292	4097	3902	3707	3512	3317	3122	2927
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	328	314	300	287	273	259	246	232	219	205
Book Depreciation	195	195	195	195	195	195	195	195	195	195
Tax Depreciation	195	195	195	195	195	195	195	195	195	195
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	29	29	29	29	29	29	29	29	29	29
Annual Carrying Charges	552	538	525	511	498	484	470	457	443	429

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-13

CASE 4

Start of Evaluation	1985		Economic Factors							
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30				
			Return on Preferred Stock - %	0	Income Tax Rate - %	0				
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0	Tax Credit - %	0				
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30				
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1	Accel. Tax Deprec.	0				
O&M Materials -% Cost	----	7.5	Debt Cost - %	7	Insurance Rate - %	0.5				
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	7	Gross Receipts Tax-%	5				
Steam - \$/1000 Lbs	2.07	1								
Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. Annual Quantities										
1. District Heat - MBtu/yr	117309	144929	144929	144929	253614	253614	253614	253614	253614	253614
2. Electricity Loss - MWh/yr	5791	6589	6589	6589	8256	8256	8256	8256	8256	8256
3. Pumping Energy - Mwh/yr	723	921	921	921	1673	1673	1673	1673	1673	1673
4. Steam - 1000 Lbs/yr	6528	19304	19304	19304	0	0	0	0	0	0
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29
C. Investments - \$1000										
D. Annual Carrying Charges-\$1000/yr	3406	626	0	0	5853	0	0	0	0	0
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	238	274	265	256	656	633	610	587	564	540
4. Book Depreciation	114	134	134	134	330	330	330	330	330	330
5. Tax Depreciation	114	134	134	134	330	330	330	330	330	330
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	20	20	20	49	49	49	49	49	49
Sub- Total	369	429	420	410	1035	1012	989	966	943	919
E. Operating Expenses - \$1000/yr										
1. Replacement Electricity	187	228	246	272	366	394	462	496	533	573
2. O&M Labor	65	69	75	80	86	93	100	107	115	124
3. O&M Materials	48	60	64	69	156	168	180	194	209	224
4. Pumping Cost	23	32	34	37	72	77	83	90	96	103
5. Steam Cost	14	41	41	42	0	0	0	0	0	0
Sub- Total	336	430	460	500	681	732	825	887	953	1025
F. Gross Receipts Tax-\$1000/yr	69	82	82	82	179	178	178	176	175	174
G. Required Revenues- \$1000/yr	774	941	961	992	1895	1921	1991	2029	2071	2119
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$3.15	\$2.96	\$2.89	\$2.83	\$4.08	\$3.99	\$3.90	\$3.81	\$3.72	\$3.63
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$1.44	\$1.55	\$1.82	\$1.96	\$2.10	\$2.26
3. Operating Expenses	\$1.27	\$1.39	\$1.48	\$1.57	\$1.24	\$1.33	\$1.43	\$1.54	\$1.66	\$1.78
4. Gross Receipts Tax	\$0.59	\$0.57	\$0.56	\$0.57	\$0.71	\$0.70	\$0.70	\$0.70	\$0.69	\$0.69
5. Reinvestment Fund	\$0.73	\$0.72	\$0.74	\$0.76	\$0.83	\$0.84	\$0.87	\$0.89	\$0.91	\$0.93
20-Nov-84	\$7.33	\$7.22	\$7.37	\$7.60	\$8.30	\$8.42	\$8.72	\$8.89	\$9.07	\$9.28

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-14

CASE 4

Start of Evaluation 1985			Economic Factors								
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30					
			Return on Preferred Stock - %	0	Income Tax Rate - %	0					
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0	Tax Credit - %	0					
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30					
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1	Accel. Tax Deprec.	0					
O&M Materials -% Cost	----	7.5	Debt Cost - %	7	Insurance Rate - %	0.5					
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	7	Gross Receipts Tax-%	5					
Steam - \$/1000 Lbs	2.07	1									
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
A. Annual Quantities											
1. District Heat - MBtu/yr	253614	253614	253614	253614	253614	253614	253614	253614	253614	253614	
2. Electricity Loss - MWh/yr	8256	8256	8256	8256	8256	8256	8256	8256	8256	8256	
3. Pumping Energy - Mwh/yr	1673	1673	1673	1673	1673	1673	1673	1673	1673	1673	
4. Steam - 1000 Lbs/yr	0	0	0	0	0	0	0	0	0	0	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15	
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44	
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127	
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53	
C. Investments - \$1000											
	0	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$100											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	517	494	471	448	425	402	379	356	333	310	
4. Book Depreciation	330	330	330	330	330	330	330	330	330	330	
5. Tax Depreciation	330	330	330	330	330	330	330	330	330	330	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	49	49	49	49	49	49	49	49	49	49	
Sub- Total	896	873	850	827	804	781	758	735	712	689	
E. Operating Expenses - \$1000/											
1. Replacement Electricity	616	663	712	766	823	885	951	1023	1099	1182	
2. O&M Labor	133	143	154	165	178	191	205	221	237	255	
3. O&M Materials	241	259	279	299	322	346	372	400	430	462	
4. Pumping Cost	111	120	129	138	149	160	172	185	198	213	
5. Steam Cost	0	0	0	0	0	0	0	0	0	0	
Sub- Total	1102	1184	1273	1369	1471	1582	1700	1828	1965	2112	
F. Gross Receipts Tax-\$1000/yr											
	174	174	173	174	175	176	177	179	181	184	
G. Required Revenues- \$1000/yr											
	2172	2231	2297	2370	2450	2538	2635	2742	2858	2985	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$3.53	\$3.44	\$3.35	\$3.26	\$3.17	\$3.08	\$2.99	\$2.90	\$2.81	\$2.72	
2. Replacement Electricity	\$2.43	\$2.61	\$2.81	\$3.02	\$3.25	\$3.49	\$3.75	\$4.03	\$4.34	\$4.66	
3. Operating Expenses	\$1.91	\$2.06	\$2.21	\$2.38	\$2.55	\$2.75	\$2.95	\$3.17	\$3.41	\$3.67	
4. Gross Receipts Tax	\$0.69	\$0.68	\$0.68	\$0.69	\$0.69	\$0.69	\$0.70	\$0.71	\$0.72	\$0.73	
5. Reinvestment Fund	\$0.95	\$0.98	\$1.01	\$1.04	\$1.07	\$1.11	\$1.15	\$1.20	\$1.25	\$1.31	
20-Nov-84	\$9.52	\$9.77	\$10.06	\$10.38	\$10.73	\$11.12	\$11.55	\$12.01	\$12.52	\$13.08	

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

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Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	774145	941455	961339	991843	1894882	1920967	1991343	2028790	2071108	2118664
Reinvestment Fund Revenues	86016	104606	106815	110205	210542	213441	221260	225421	230123	235407
Total Operating Revenues	860161	1046061	1068154	1102048	2105424	2134407	2212603	2254211	2301231	2354072
OPERATING EXPENSES										
Production	247512	319831	341169	372000	429171	461359	534315	574388	617467	663777
Transmission Distribution	77467	90128	96888	104155	144374	155202	166842	179355	192807	207267
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	113546	134427	134427	134427	329527	329527	329527	329527	329527	329527
Contributions in Lieu of Tax	69306	82157	81824	81996	179461	177565	177778	176422	175299	174425
Total Operating Expenses	518666	638193	666830	706040	1097004	1139208	1225184	1277670	1334426	1395772
NET HEATING OPERATING INCOME	341495	407868	401323	396008	1008421	995199	987419	976541	966805	958299
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	341495	407868	401323	396008	1008421	995199	987419	976541	966805	958299
INCOME DEDUCTIONS										
Interest on Long Term Debt	238447	274348	264938	255528	655829	632762	609695	586628	563561	540494
NET INCOME	\$103,048	\$133,520	\$136,385	\$140,480	\$352,592	\$362,437	\$377,724	\$389,913	\$403,244	\$417,805

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
ANNUAL CARRYING CHARGES**

A-16

Investment for Phase 4		Economic Factors			
Initial Operation	1991	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	0	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	5330	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	5330	Debt Cost - %	7	Property Tax - %	0
Escalation - \$1000	2696	Weighted Cost of Capital - %	7	Insurance Rate - %	0.5
AFDC - \$1000	276				
Total Cost - \$1000	8302				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	0	0	0	0	0	8302	8025	7749	7472
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	0	0	581	562	542	523
Book Depreciation	0	0	0	0	0	0	277	277	277	277
Tax Depreciation	0	0	0	0	0	0	277	277	277	277
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	0	0	42	42	42	42
Annual Carrying Charges	0	0	0	0	0	0	899	880	861	841

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	7195	6918	6642	6365	6088	5812	5535	5258	4981	4705
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	504	484	465	446	426	407	387	368	349	329
Book Depreciation	277	277	277	277	277	277	277	277	277	277
Tax Depreciation	277	277	277	277	277	277	277	277	277	277
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	42	42	42	42	42	42	42	42	42	42
Annual Carrying Charges	822	803	783	764	744	725	706	686	667	648

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
COMPOSITE ANNUAL CARRYING CHARGES**

A-17

Phase			Year Investment		Economic Factors							
1	1985	3406	Preferred Stock Ratio		0	Book Life - Yrs		30				
2	1986	626	Return on Preferred Stock - %		0	Income Tax Rate - %		0				
3	1989	5853	Common Stock Ratio		0	Tax Credit - %		0				
4	1991	8302	Return on Common Stock - %		0	Tax Life - Yrs		30				
			Debt Ratio		1	Accelerated Tax Depreciation		0				
			Debt Cost - %		7	Property Tax - %		0				
			Weighted Cost of Capital - %		7.00	Insurance Rate - %		0.05				
Year			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value			3406	3919	3785	3650	9369	9039	17012	16406	15800	15193
Return on Preferred Stock			0	0	0	0	0	0	0	0	0	0
Return on Common Stock			0	0	0	0	0	0	0	0	0	0
Interest			238	274	265	256	656	633	1191	1148	1106	1064
Book Depreciation			114	134	134	134	330	330	606	606	606	606
Tax Depreciation			114	134	134	134	330	330	606	606	606	606
Income Taxes			0	0	0	0	0	0	0	0	0	0
Deferred Taxes			0	0	0	0	0	0	0	0	0	0
Property Tax			0	0	0	0	0	0	0	0	0	0
Insurance			17	20	20	20	49	49	91	91	91	91
Annual Carrying Charges			369	429	420	410	1035	1012	1888	1846	1803	1761
Year			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value			14587	13981	13374	12768	12162	11556	10949	10343	9737	9131
Return on Preferred Stock			0	0	0	0	0	0	0	0	0	0
Return on Common Stock			0	0	0	0	0	0	0	0	0	0
Interest			1021	979	936	894	851	809	766	724	682	639
Book Depreciation			606	606	606	606	606	606	606	606	606	606
Tax Depreciation			606	606	606	606	606	606	606	606	606	606
Income Taxes			0	0	0	0	0	0	0	0	0	0
Deferred Taxes			0	0	0	0	0	0	0	0	0	0
Property Tax			0	0	0	0	0	0	0	0	0	0
Insurance			91	91	91	91	91	91	91	91	91	91
Annual Carrying Charges			1718	1676	1633	1591	1549	1506	1464	1421	1379	1336

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

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CASE 5

Start of Evaluation 1985			Economic Factors							
Unit Costs	1984	Escalation								
Electricity - \$/MWh	30	7.5	Preferred Stock Ratio	0	Book Life - Yrs		30			
Pumping Power-\$/MWh	30	7.5	Return on Preferred Stock - %	0	Income Tax Rate - %		0			
O&M Labor -\$/ManYr	30,000	7.5	Common Stock Ratio	0	Tax Credit - %		0			
O&M Materials -% Cost	---	7.5	Return on Common Stock - %	0	Tax Life - Yrs		30			
Property Taxes - %	0	2.5	Debt Ratio	1	Accel. Tax Deprec.		0			
Steam - \$/1000 Lbs	2.07	1	Debt Cost - %	7	Insurance Rate - %		0.5			
			Weighted Cost of Capital - %	7	Gross Receipts Tax-%		5			
Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. Annual Quantities										
1. District Heat - MBtu/yr	117309	144929	144929	144929	253614	253614	508917	508917	508917	508917
2. Electricity Loss - MWh/yr	5791	6589	6589	6589	8256	8256	16568	16568	16568	16568
3. Pumping Energy - MWh/yr	723	921	921	921	1673	1673	4221	4221	4221	4221
4. Steam - 1000 Lbs/yr	6528	19304	19304	19304	0	0	0	0	0	0
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29
C. Investments - \$1000										
3406	626	0	0	5853	0	8302	0	0	0	0
D. Annual Carrying Charges-\$1000/yr										
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	238	274	265	256	656	633	1191	1148	1106	1064
4. Book Depreciation	114	134	134	134	330	330	606	606	606	606
5. Tax Depreciation	114	134	134	134	330	330	606	606	606	606
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	20	20	20	49	49	91	91	91	91
Sub- Total	369	429	420	410	1035	1012	1888	1846	1803	1761
E. Operating Expenses - \$1000/yr										
1. Replacement Electricity	187	228	246	272	366	394	926	996	1070	1151
2. O&M Labor	65	69	75	80	86	93	100	107	115	124
3. O&M Materials	48	60	64	69	156	168	296	319	343	368
4. Pumping Cost	23	32	34	37	72	77	210	226	243	261
5. Steam Cost	14	41	41	42	0	0	0	0	0	0
Sub- Total	336	430	460	500	681	732	1532	1647	1771	1904
F. Gross Receipts Tax-\$1000/yr										
69	82	82	82	179	178	341	339	337	335	335
G. Required Revenues- \$1000/yr										
774	941	961	992	1895	1921	3762	3832	3911	4000	4000
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$3.15	\$2.96	\$2.89	\$2.83	\$4.08	\$3.99	\$3.71	\$3.63	\$3.54	\$3.46
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$1.44	\$1.55	\$1.82	\$1.96	\$2.10	\$2.26
3. Operating Expenses	\$1.27	\$1.39	\$1.48	\$1.57	\$1.24	\$1.33	\$1.19	\$1.28	\$1.38	\$1.48
4. Gross Receipts Tax	\$0.59	\$0.57	\$0.56	\$0.57	\$0.71	\$0.70	\$0.67	\$0.67	\$0.66	\$0.66
5. Reinvestment Fund	\$0.73	\$0.72	\$0.74	\$0.76	\$0.83	\$0.84	\$0.82	\$0.84	\$0.86	\$0.88
20-Nov-84	\$7.33	\$7.22	\$7.37	\$7.60	\$8.30	\$8.42	\$8.21	\$8.37	\$8.54	\$8.73

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

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CASE 5

Start of Evaluation 1985			Economic Factors								
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30					
	----	-----	Return on Preferred Stock - %	0	Income Tax Rate - %	0					
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0 <th>Tax Credit - %</th> <td>0<th colspan="5"></th></td>	Tax Credit - %	0 <th colspan="5"></th>					
Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0 <td>Tax Life - Yrs</td> <td>30<th colspan="5"></th></td>	Tax Life - Yrs	30 <th colspan="5"></th>					
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1 <td>Accel. Tax Deprec.</td> <td>0<th colspan="5"></th></td>	Accel. Tax Deprec.	0 <th colspan="5"></th>					
O&M Materials -% Cost	----	7.5	Debt Cost - %	7 <td>Insurance Rate - %</td> <td>0.5<th colspan="5"></th></td>	Insurance Rate - %	0.5 <th colspan="5"></th>					
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	7 <td>Gross Receipts Tax-%</td> <td>5<th colspan="5"></th></td>	Gross Receipts Tax-%	5 <th colspan="5"></th>					
Steam - \$/1000 Lbs	2.07	1									
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
A. Annual Quantities											
1. District Heat - MBtu/yr	508917	508917	508917	508917	508917	508917	508917	508917	508917	508917	
2. Electricity Loss - MWh/yr	16568	16568	16568	16568	16568	16568	16568	16568	16568	16568	
3. Pumping Energy - Mwh/yr	4221	4221	4221	4221	4221	4221	4221	4221	4221	4221	
4. Steam - 1000 Lbs/yr	0	0	0	0	0	0	0	0	0	0	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15	
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44	
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127	
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53	
C. Investments - \$1000											
	0	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$100											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	1021	979	936	894	851	809	766	724	682	639	
4. Book Depreciation	606	606	606	606	606	606	606	606	606	606	
5. Tax Depreciation	606	606	606	606	606	606	606	606	606	606	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	91	91	91	91	91	91	91	91	91	91	
	----	----	----	----	----	----	----	----	----	----	
Sub- Total	1718	1676	1633	1591	1549	1506	1464	1421	1379	1336	
E. Operating Expenses - \$1000/											
1. Replacement Electricity	1237	1330	1430	1537	1652	1776	1909	2052	2206	2372	
2. O&M Labor	133	143	154	165	178	191	205	221	237	255	
3. O&M Materials	396	426	457	492	529	568	611	657	706	759	
4. Pumping Cost	281	302	324	349	375	403	433	465	500	538	
5. Steam Cost	0	0	0	0	0	0	0	0	0	0	
	----	----	----	----	----	----	----	----	----	----	
Sub- Total	2046	2200	2365	2542	2733	2938	3158	3395	3650	3923	
F. Gross Receipts Tax-\$1000/yr											
	334	334	334	334	336	338	341	344	349	354	
G. Required Revenues- \$1000/yr											
	4099	4209	4332	4468	4617	4782	4962	5161	5377	5614	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$3.38	\$3.29	\$3.21	\$3.13	\$3.04	\$2.96	\$2.88	\$2.79	\$2.71	\$2.63	
2. Replacement Electricity	\$2.43	\$2.61	\$2.81	\$3.02	\$3.25	\$3.49	\$3.75	\$4.03	\$4.34	\$4.66	
3. Operating Expenses	\$1.59	\$1.71	\$1.84	\$1.98	\$2.12	\$2.28	\$2.45	\$2.64	\$2.84	\$3.05	
4. Gross Receipts Tax	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.66	\$0.67	\$0.68	\$0.69	\$0.70	
5. Reinvestment Fund	\$0.90	\$0.92	\$0.95	\$0.98	\$1.01	\$1.05	\$1.09	\$1.13	\$1.18	\$1.23	
	----	----	----	----	----	----	----	----	----	----	
20-Nov-84	\$8.95	\$9.19	\$9.46	\$9.75	\$10.08	\$10.44	\$10.83	\$11.27	\$11.74	\$12.26	

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

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Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	774145	941455	961339	991843	1894882	1920967	3761548	3831598	3910698	3999528
Reinvestment Fund Revenues	86016	104606	106815	110205	210542	213441	417950	428301	437090	446959
Total Operating Revenues	860161	1046061	1068154	1102048	2105424	2134407	4179498	4259899	4347788	4446487
OPERATING EXPENSES										
Production	247512	319831	341169	372000	429171	461359	999007	1073932	1154477	1241063
Transmission Distribution	77467	90128	96888	104155	144374	155202	293630	315652	339326	364776
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	113546	134427	134427	134427	329527	329527	606266	606266	606266	606266
Contributions in Lieu of Tax	69306	82157	81824	81996	179461	177565	341141	338703	336696	335152
Total Operating Expenses	518666	638193	666830	706040	1097004	1139208	2256767	2352531	2456091	2568031
NET HEATING OPERATING INCOME	341495	407868	401323	396008	1008421	995199	1922731	1907368	1891697	1878456
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	341495	407868	401323	396008	1008421	995199	1922731	1907368	1891697	1878456
INCOME DEDUCTIONS										
Interest on Long Term Debt	238447	274348	264938	255528	655829	632762	1190847	1148408	1105969	1063531
NET INCOME	\$103,048	\$133,520	\$136,385	\$140,480	\$352,592	\$362,437	\$731,884	\$758,960	\$785,728	\$814,925

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
ANNUAL CARRYING CHARGES**

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Investment for Phase 1		Economic Factors								
Initial Operation	1983	Preferred Stock Ratio	0	Book Life - Yrs	30					
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0					
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0					
Heat Source	633	Return on Common Stock - %	0	Tax Life - Yrs	30					
Piping	2538	Debt Ratio	1	Accelerated Tax Depreciation	0					
Total	3191	Debt Cost - %	9.75	Property Tax - %	0					
Escalation - \$1000	102	Weighted Cost of Capital - %	9.75	Insurance Rate - %	0.5					
AFDC - \$1000	157									
Total Cost - \$1000	3450									
Start of Evaluation	1985									

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	3450	3335	3220	3105	2990	2875	2760	2645	2530	2415
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	336	325	314	303	292	280	269	258	247	235
Book Depreciation	115	115	115	115	115	115	115	115	115	115
Tax Depreciation	115	115	115	115	115	115	115	115	115	115
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	17	17	17	17	17	17	17	17	17	17
Annual Carrying Charges	449	457	446	435	424	413	401	390	379	368

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	2300	2185	2070	1955	1840	1725	1610	1495	1380	1265
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	224	213	202	191	179	168	157	146	135	123
Book Depreciation	115	115	115	115	115	115	115	115	115	115
Tax Depreciation	115	115	115	115	115	115	115	115	115	115
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	17	17	17	17	17	17	17	17	17	17
Annual Carrying Charges	356	345	334	323	312	300	289	278	267	256

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK**

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ANNUAL CARRYING CHARGES

Investment for Phase 2		Economic Factors			
Initial Operation	1986	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	157	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	394	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	551	Debt Cost - %	9.75	Property Tax - %	0
Escalation - \$1000	55	Weighted Cost of Capital - %	9.75	Insurance Rate - %	0.5
AFDC - \$1000	29				
Total Cost - \$1000	634				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	634	613	592	571	550	529	508	486	465
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	62	60	58	56	54	52	49	47	45
Book Depreciation	0	21	21	21	21	21	21	21	21	21
Tax Depreciation	0	21	21	21	21	21	21	21	21	21
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	3	3	3	3	3	3	3	3	3
Annual Carrying Charges	0	86	84	82	80	78	76	74	72	70

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	444	423	402	381	360	338	317	296	275	254
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	43	41	39	37	35	33	31	29	27	25
Book Depreciation	21	21	21	21	21	21	21	21	21	21
Tax Depreciation	21	21	21	21	21	21	21	21	21	21
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	3	3	3	3	3	3	3	3	3	3
Annual Carrying Charges	68	66	63	61	59	57	55	53	51	49

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK
ANNUAL CARRYING CHARGES**

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Investment for Phase 3		Economic Factors			
Initial Operation	1989	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	2473	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	1789	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	4262	Debt Cost - %	9.75	Property Tax - %	0
Escalation - \$1000	1396	Weighted Cost of Capital - %	9.75	Insurance Rate - %	0.5
AFDC - \$1000	269				
Total Cost - \$1000	5928				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	0	0	0	5928	5730	5533	5335	5137	4940
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	578	559	539	520	501	482
Book Depreciation	0	0	0	0	198	198	198	198	198	198
Tax Depreciation	0	0	0	0	198	198	198	198	198	198
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	30	30	30	30	30	30
Annual Carrying Charges	0	0	0	0	805	786	767	747	728	709

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	4742	4545	4347	4149	3952	3754	3557	3359	3161	2964
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	462	443	424	405	385	366	347	328	308	289
Book Depreciation	198	198	198	198	198	198	198	198	198	198
Tax Depreciation	198	198	198	198	198	198	198	198	198	198
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	30	30	30	30	30	30	30	30	30	30
Annual Carrying Charges	690	670	651	632	613	593	574	555	535	516

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK**

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ANNUAL CARRYING CHARGES

Investment for Phase 4		Economic Factors			
Initial Operation	1991	Preferred Stock Ratio	0	Book Life - Yrs	30
Cost Basis	1984	Return on Preferred Stock - %	0	Income Tax Rate - %	0
Capital Cost - \$1000		Common Stock Ratio	0	Tax Credit - %	0
Heat Source	0	Return on Common Stock - %	0	Tax Life - Yrs	30
Piping	5330	Debt Ratio	1	Accelerated Tax Depreciation	0
Total	5330	Debt Cost - %	9.75	Property Tax - %	0
Escalation - \$1000	2696	Weighted Cost of Capital - %	9.75	Insurance Rate - %	0.5
AFDC - \$1000	382				
Total Cost - \$1000	8408				
Start of Evaluation	1985				

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value	0	0	0	0	0	0	8408	8128	7848	7567
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	0	0	820	792	765	738
Book Depreciation	0	0	0	0	0	0	280	280	280	280
Tax Depreciation	0	0	0	0	0	0	280	280	280	280
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	0	0	0	0	0	0	42	42	42	42
Annual Carrying Charges	0	0	0	0	0	0	1142	1115	1087	1060

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value	7287	7007	6727	6446	6166	5886	5605	5325	5045	4765
Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
Return on Common Stock	0	0	0	0	0	0	0	0	0	0
Interest	710	683	656	629	601	574	547	519	492	465
Book Depreciation	280	280	280	280	280	280	280	280	280	280
Tax Depreciation	280	280	280	280	280	280	280	280	280	280
Income Taxes	0	0	0	0	0	0	0	0	0	0
Deferred Taxes	0	0	0	0	0	0	0	0	0	0
Property Tax	0	0	0	0	0	0	0	0	0	0
Insurance	42	42	42	42	42	42	42	42	42	42
Annual Carrying Charges	1033	1005	978	951	923	896	869	842	814	787

**ECONOMIC ANALYSIS OF DISTRICT HEATING
IN
JAMESTOWN, NEW YORK**

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COMPOSITE ANNUAL CARRYING CHARGES

Phase Year Investment			Economic Factors									
1	1985	3450	Preferred Stock Ratio	0	Book Life - Yrs	30						
2	1986	634	Return on Preferred Stock - %	0	Income Tax Rate - %	0						
3	1989	3928	Common Stock Ratio	0	Tax Credit - %	0						
4	1991	8408	Return on Common Stock - %	0	Tax Life - Yrs	30						
			Debt Ratio	1	Accelerated Tax Depreciation	0						
			Debt Cost - %	9.75	Property Tax - %	0						
			Weighted Cost of Capital - %	9.75	Insurance Rate - %	0.05						
Year			1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Remaining Book Value			3450	3969	3833	3697	9489	9155	17229	16615	16001	15387
Return on Preferred Stock			0	0	0	0	0	0	0	0	0	0
Return on Common Stock			0	0	0	0	0	0	0	0	0	0
Interest			336	387	374	360	925	893	1680	1620	1560	1500
Book Depreciation			115	136	136	136	334	334	614	614	614	614
Tax Depreciation			115	136	136	136	334	334	614	614	614	614
Income Taxes			0	0	0	0	0	0	0	0	0	0
Deferred Taxes			0	0	0	0	0	0	0	0	0	0
Property Tax			0	0	0	0	0	0	0	0	0	0
Insurance			17	20	20	20	50	50	92	92	92	92
Annual Carrying Charges			469	544	530	517	1309	1276	2386	2326	2266	2206
Year			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Remaining Book Value			14773	14159	13545	12931	12317	11703	11089	10475	9861	9247
Return on Preferred Stock			0	0	0	0	0	0	0	0	0	0
Return on Common Stock			0	0	0	0	0	0	0	0	0	0
Interest			1440	1381	1321	1261	1201	1141	1081	1021	961	902
Book Depreciation			614	614	614	614	614	614	614	614	614	614
Tax Depreciation			614	614	614	614	614	614	614	614	614	614
Income Taxes			0	0	0	0	0	0	0	0	0	0
Deferred Taxes			0	0	0	0	0	0	0	0	0	0
Property Tax			0	0	0	0	0	0	0	0	0	0
Insurance			92	92	92	92	92	92	92	92	92	92
Annual Carrying Charges			2147	2087	2027	1967	1907	1847	1787	1727	1668	1608

**ECONOMIC ANALYSIS OF DISTRICT HEATING
JAMESTOWN, NEW YORK**

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CASE 6

Start of Evaluation 1985			Economic Factors							
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30				
			Return on Preferred Stock - %	0	Income Tax Rate - %	0				
			Common Stock Ratio	0	Tax Credit - %	0				
Electricity - \$/MWh	30	7.5	Return on Common Stock - %	0	Tax Life - Yrs	30				
Pumping Power-\$/MWh	30	7.5	Debt Ratio	1	Accel. Tax Deprec.	0				
O&M Labor -\$/ManYr	30,000	7.5	Debt Cost - %	9.75	Insurance Rate - %	0.5				
O&M Materials -% Cost	-----	7.5	Weighted Cost of Capital - %	9.75	Gross Receipts Tax-%	5				
Property Taxes - %	0	2.5								
Steam - \$/1000 Lbs	2.07	1								

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
A. Annual Quantities										
1. District Heat - MBtu/yr	117309	144929	144929	144929	253614	253614	508917	508917	508917	508917
2. Electricity Loss - MWh/yr	5791	6589	6589	6589	8256	8256	16568	16568	16568	16568
3. Pumping Energy - MWh/yr	723	921	921	921	1673	1673	4221	4221	4221	4221
4. Steam - 1000 Lbs/yr	6528	19304	19304	19304	0	0	0	0	0	0
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%
B. Unit Costs										
1. Replacement Elec. - \$/MWh	32.25	34.67	37.27	41.27	44.36	47.69	55.91	60.10	64.61	69.46
2. Pumping Electricity-\$/MWh	32.25	34.67	37.27	40.06	43.07	46.30	49.77	53.50	57.52	61.83
3. O&M Labor - \$1000/ManYr	32	35	37	40	43	46	50	54	58	62
4. Steam - \$/1000 Lbs	2.09	2.11	2.13	2.15	2.18	2.20	2.22	2.24	2.26	2.29
C. Investments - \$1000										
	3450	634	0	0	5928	0	8408	0	0	0
D. Annual Carrying Charges-\$1000/yr										
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0
3. Interest	336	387	374	360	925	893	1680	1620	1560	1500
4. Book Depreciation	115	136	136	136	334	334	614	614	614	614
5. Tax Depreciation	115	136	136	136	334	334	614	614	614	614
6. Income Taxes	0	0	0	0	0	0	0	0	0	0
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0
8. Property Tax	0	0	0	0	0	0	0	0	0	0
9. Insurance	17	20	20	20	50	50	92	92	92	92
Sub- Total	469	544	530	517	1309	1276	2386	2326	2266	2206
E. Operating Expenses - \$1000/yr										
1. Replacement Electricity	187	228	246	272	366	394	926	996	1070	1151
2. O&M Labor	65	69	75	80	86	93	100	107	115	124
3. O&M Materials	48	61	65	70	158	170	300	323	347	373
4. Pumping Cost	23	32	34	37	72	77	210	226	243	261
5. Steam Cost	14	41	41	42	0	0	0	0	0	0
Sub- Total	336	431	461	501	683	734	1536	1651	1775	1908
F. Gross Receipts Tax-\$1000/yr										
	75	88	88	88	194	192	368	365	362	360
G. Required Revenues- \$1000/yr										
	880	1063	1079	1105	2186	2202	4291	4342	4404	4474
H. Unit Cost of Heat - \$/MBtu										
1. Fixed Expenses	\$3.99	\$3.75	\$3.66	\$3.57	\$5.16	\$5.03	\$4.69	\$4.57	\$4.45	\$4.34
2. Replacement Electricity	\$1.59	\$1.58	\$1.69	\$1.88	\$1.44	\$1.55	\$1.82	\$1.96	\$2.10	\$2.26
3. Operating Expenses	\$1.28	\$1.40	\$1.49	\$1.58	\$1.25	\$1.34	\$1.20	\$1.29	\$1.38	\$1.49
4. Gross Receipts Tax	\$0.64	\$0.61	\$0.61	\$0.61	\$0.77	\$0.76	\$0.72	\$0.72	\$0.71	\$0.71
5. Reinvestment Fund	\$0.83	\$0.82	\$0.83	\$0.85	\$0.96	\$0.97	\$0.94	\$0.95	\$0.96	\$0.98
21-Nov-84	\$8.33	\$8.15	\$8.27	\$8.48	\$9.58	\$9.65	\$9.37	\$9.48	\$9.61	\$9.77

ECONOMIC ANALYSIS OF DISTRICT HEATING

JAMESTOWN, NEW YORK

A-27

CASE 6

Start of Evaluation			1985		Economic Factors						
Unit Costs	1984	Escalation	Preferred Stock Ratio	0	Book Life - Yrs	30	Return on Preferred Stock - %	0	Income Tax Rate - %	0	
Electricity - \$/MWh	30	7.5	Common Stock Ratio	0 <th>Tax Credit - %</th> <th>0</th> <td>Pumping Power-\$/MWh</td> <td>30</td> <td>7.5</td> <td>Return on Common Stock - %</td> <td>0</td>	Tax Credit - %	0	Pumping Power-\$/MWh	30	7.5	Return on Common Stock - %	0
O&M Labor -\$/ManYr	30,000	7.5	Debt Ratio	1 <th>Accel. Tax Deprec.</th> <th>0</th> <td>O&M Materials -% Cost</td> <td>----</td> <td>7.5</td> <td>Debt Cost - %</td> <td>9.75</td>	Accel. Tax Deprec.	0	O&M Materials -% Cost	----	7.5	Debt Cost - %	9.75
Property Taxes - %	0	2.5	Weighted Cost of Capital - %	9.75 <th>Insurance Rate - %</th> <th>0.5</th> <td>Steam - \$/1000 Lbs</td> <td>2.07</td> <td>1</td> <th>Gross Receipts Tax-%</th> <th>5</th>	Insurance Rate - %	0.5	Steam - \$/1000 Lbs	2.07	1	Gross Receipts Tax-%	5
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
A. Annual Quantities											
1. District Heat - MBtu/yr	508917	508917	508917	508917	508917	508917	508917	508917	508917	508917	
2. Electricity Loss - MWh/yr	16568	16568	16568	16568	16568	16568	16568	16568	16568	16568	
3. Pumping Energy - MWh/yr	4221	4221	4221	4221	4221	4221	4221	4221	4221	4221	
4. Steam - 1000 Lbs/yr	0	0	0	0	0	0	0	0	0	0	
5. O&M Labor - ManYr/yr	2	2	2	2	2	2	2	2	2	2	
6. O&M Material-% year's Inv	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	1.40%	
B. Unit Costs											
1. Replacement Elec. - \$/MWh	74.67	80.27	86.29	92.76	99.71	107.19	115.23	123.87	133.17	143.15	
2. Pumping Electricity-\$/MWh	66.47	71.45	76.81	82.57	88.77	95.42	102.58	110.27	118.54	127.44	
3. O&M Labor - \$1000/ManYr	66	71	77	83	89	95	103	110	119	127	
4. Steam - \$/1000 Lbs	2.31	2.33	2.36	2.38	2.40	2.43	2.45	2.48	2.50	2.53	
C. Investments - \$1000											
	0	0	0	0	0	0	0	0	0	0	
D. Annual Carrying Charges-\$100											
1. Return on Preferred Stock	0	0	0	0	0	0	0	0	0	0	
2. Return on Common Stock	0	0	0	0	0	0	0	0	0	0	
3. Interest	1440	1381	1321	1261	1201	1141	1081	1021	961	902	
4. Book Depreciation	614	614	614	614	614	614	614	614	614	614	
5. Tax Depreciation	614	614	614	614	614	614	614	614	614	614	
6. Income Taxes	0	0	0	0	0	0	0	0	0	0	
7. Deferred Taxes	0	0	0	0	0	0	0	0	0	0	
8. Property Tax	0	0	0	0	0	0	0	0	0	0	
9. Insurance	92	92	92	92	92	92	92	92	92	92	
Sub- Total	2147	2087	2027	1967	1907	1847	1787	1727	1668	1608	
E. Operating Expenses - \$1000/											
1. Replacement Electricity	1237	1330	1430	1537	1652	1776	1909	2052	2206	2372	
2. O&M Labor	133	143	154	165	178	191	205	221	237	255	
3. O&M Materials	401	431	463	498	535	576	619	665	715	769	
4. Pumping Cost	281	302	324	349	375	403	433	465	500	538	
5. Steam Cost	0	0	0	0	0	0	0	0	0	0	
Sub- Total	2051	2205	2371	2549	2740	2945	3166	3403	3659	3933	
F. Gross Receipts Tax-\$1000/yr	358	356	355	355	356	357	359	361	365	370	
G. Required Revenues- \$1000/yr	4536	4648	4753	4871	5002	5149	5312	5492	5691	5910	
H. Unit Cost of Heat - \$/MBtu											
1. Fixed Expenses	\$4.22	\$4.10	\$3.98	\$3.86	\$3.75	\$3.63	\$3.51	\$3.39	\$3.28	\$3.16	
2. Replacement Electricity	\$2.43	\$2.61	\$2.81	\$3.02	\$3.25	\$3.49	\$3.75	\$4.03	\$4.34	\$4.66	
3. Operating Expenses	\$1.60	\$1.72	\$1.85	\$1.99	\$2.14	\$2.30	\$2.47	\$2.65	\$2.85	\$3.07	
4. Gross Receipts Tax	\$0.70	\$0.70	\$0.70	\$0.70	\$0.70	\$0.70	\$0.70	\$0.71	\$0.72	\$0.73	
5. Reinvestment Fund	\$1.00	\$1.02	\$1.04	\$1.06	\$1.09	\$1.13	\$1.16	\$1.20	\$1.25	\$1.29	
21-Nov-84	\$9.95	\$10.15	\$10.38	\$10.63	\$10.92	\$11.24	\$11.60	\$11.99	\$12.43	\$12.90	

CITY OF JAMESTOWN
MUNICIPAL HEATING SYSTEM
OPERATING STATEMENT

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Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
OPERATING INCOME										
Operating Revenues - Heat	879781	1063123	1078992	1105487	2186029	2202283	4290505	4342477	4403522	4474320
Reinvestment Fund Revenues	97753	118143	119928	122893	242975	244833	476910	482782	489661	497624
Total Operating Revenues	977534	1181266	1198920	1228380	2429004	2447116	4767416	4825259	4893183	4971944
OPERATING EXPENSES										
Production	247770	320110	341468	372322	429516	461730	999406	1074362	1154939	1241559
Transmission Distribution	77815	90503	97291	104588	144840	155702	294168	316231	339948	365444
Cust. Accounting/Collecting	6192	6656	7156	7692	8269	8889	9556	10273	11043	11872
Administrative and General	4644	4992	5367	5769	6202	6667	7167	7705	8282	8904
Depreciation	114996	136143	136143	136143	333735	333735	614007	614007	614007	614007
Contributions in Lieu of Tax	74750	88428	87887	87852	194464	192060	368399	365026	362085	359609
Total Operating Expenses	526168	646833	675312	714366	1117026	1158784	2292703	2387603	2490305	2601394
NET HEATING OPERATING INCOME	451366	534433	523608	514014	1311978	1288332	2474712	2437656	2402878	2370550
OTHER INCOME	0	0	0	0	0	0	0	0	0	0
GROSS INCOME	451366	534433	523608	514014	1311978	1288332	2474712	2437656	2402878	2370550
INCOME DEDUCTIONS										
Interest on Long Term Debt	336363	387007	373733	360459	925140	892601	1679859	1619993	1560127	1500262
NET INCOME	\$115,003	\$147,426	\$149,875	\$153,555	\$386,838	\$395,732	\$794,853	\$817,663	\$842,751	\$870,288

APPENDIX B
END USER CASH FLOW PROTECTIONS

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 1
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I				TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU		ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	6.58	25871	15334	6123	1940	23397	0	2474	2474	10537
1986	6.56	6.73	27811	15683	800	1874	18357	0	9454	11928	12128
1987	7.06	6.89	29897	16056	872	1802	18730	0	11167	23095	13841
1988	7.59	7.14	32140	16639	951	1723	19313	0	12827	35922	15501
1989	8.15	7.34	34550	17105	1036	1638	19779	0	14771	50693	17445
1990	8.77	7.57	37141	17641	1130	1545	20315	0	16826	67520	19501
1991	9.42	8.07	39927	18806	1231	1443	21480	0	18447	85967	21121
1992	10.13	8.36	42921	19482	1342	1332	22156	0	20766	106732	23440
1993	10.89	8.68	46141	20227	1463	1211	22902	0	23239	129971	25913
1994	11.71	9.03	49601	21043	1595	1080	23717	0	25884	155855	28558
1995	12.58	9.41	53321	21929	1738	936	24603	0	28718	184573	31393
1996	13.53	9.82	57320	22884	1894	780	25558	0	31762	216336	34436
1997	14.54	10.28	61619	23956	2065	609	26630	0	34989	251325	37663
1998	15.63	10.77	66241	25098	2251	423	27772	0	38469	289793	41143
1999	16.81	11.3	71209	26333	2453	221	29007	0	42202	331995	44876
2000	18.07	11.88	76549	27685	0	0	27685	0	48865	380860	48865
2001	19.42	12.51	82291	29153	0	0	29153	0	53138	433998	53138
2002	20.88	13.18	88462	30714	0	0	30714	0	57748	491747	57748
2003	22.44	13.92	95097	32438	0	0	32438	0	62659	554405	62659
2004	24.13	14.72	102229	34303	0	0	34303	0	67927	622332	67927

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 2
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25871	17081	6123	1940	25145	0	727	727	8790
1986	6.56	7.48	27811	17431	800	1874	20105	0	7706	8433	10380
1987	7.06	7.65	29897	17827	872	1802	20501	0	9396	17829	12070
1988	7.59	7.91	32140	18433	951	1723	21107	0	11032	28861	13707
1989	8.15	8.13	34550	18946	1036	1638	21620	0	12930	41791	15604
1990	8.77	8.37	37141	19505	1130	1545	22179	0	14962	56754	17636
1991	9.42	8.9	39927	20740	1231	1443	23414	0	16513	73266	19187
1992	10.13	9.21	42921	21463	1342	1332	24137	0	18785	92051	21439
1993	10.89	9.54	46141	22232	1463	1211	24906	0	21235	113286	23909
1994	11.71	9.91	49601	23094	1595	1080	25768	0	23833	137119	26507
1995	12.58	10.32	53321	24049	1738	936	26723	0	26598	163717	29272
1996	13.53	10.76	57320	25075	1894	780	27749	0	29572	193288	32246
1997	14.54	11.24	61619	26193	2065	609	28867	0	32752	226040	35426
1998	15.63	11.77	66241	27428	2251	423	30102	0	36138	262179	38813
1999	16.81	12.34	71209	28757	2453	221	31431	0	39778	301957	42452
2000	18.07	12.96	76549	30201	0	0	30201	0	46348	348305	46348
2001	19.42	13.63	82291	31763	0	0	31763	0	50528	398833	50528
2002	20.88	14.37	88462	33487	0	0	33487	0	54975	453808	54975
2003	22.44	15.16	95097	35328	0	0	35328	0	59769	513578	59769
2004	24.13	16.02	102229	37332	0	0	37332	0	64897	578475	64897

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25871	17081	6123	1940	25145	0	727	727	8790
1986	6.56	7.22	27811	16825	800	1874	19499	0	8312	9039	10986
1987	7.06	7.37	29897	17175	872	1802	19849	0	10048	19087	12723
1988	7.59	7.6	32140	17711	951	1723	20385	0	11755	30842	14429
1989	8.15	7.8	34550	18177	1036	1638	20851	0	13699	44541	16373
1990	8.77	8.01	37141	18666	1130	1545	21340	0	15801	60342	18475
1991	9.42	8.5	39927	19808	1231	1443	22482	0	17445	77787	20119
1992	10.13	8.78	42921	20460	1342	1332	23135	0	19787	97574	22461
1993	10.89	9.08	46141	21160	1463	1211	23834	0	22307	119881	24981
1994	11.71	9.42	49601	21952	1595	1080	24626	0	24975	144856	27649
1995	12.58	9.79	53321	22814	1738	936	25488	0	27833	172689	30507
1996	13.53	10.19	57320	23746	1894	780	26420	0	30900	203589	33574
1997	14.54	10.62	61619	24748	2065	609	27422	0	34197	237785	36871
1998	15.63	11.1	66241	25867	2251	423	28541	0	37700	275485	40374
1999	16.81	11.62	71209	27079	2453	221	29753	0	41456	316941	44130
2000	18.07	12.18	76549	28384	0	0	28384	0	48166	365107	48166
2001	19.42	12.79	82291	29805	0	0	29805	0	52486	417592	52486
2002	20.88	13.46	88462	31367	0	0	31367	0	57096	474688	57096
2003	22.44	14.18	95097	33044	0	0	33044	0	62053	536741	62053
2004	24.13	14.96	102229	34862	0	0	34862	0	67367	604109	67367

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 4
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25871	17081	6123	1940	25145	0	727	727	8790
1986	6.56	7.22	27811	16825	800	1874	19499	0	8312	9039	10986
1987	7.06	7.37	29897	17175	872	1802	19849	0	10048	19087	12723
1988	7.59	7.6	32140	17711	951	1723	20385	0	11755	30842	14429
1989	8.15	8.3	34550	19342	1036	1638	22016	0	12534	43376	15208
1990	8.77	8.42	37141	19622	1130	1545	22296	0	14846	58222	17520
1991	9.42	8.72	39927	20321	1231	1443	22995	0	16932	75154	19606
1992	10.13	8.89	42921	20717	1342	1332	23391	0	19530	94684	22205
1993	10.89	9.07	46141	21136	1463	1211	23810	0	22330	117014	25004
1994	11.71	9.28	49601	21626	1595	1080	24300	0	25301	142316	27975
1995	12.58	9.52	53321	22185	1738	936	24859	0	28462	170778	31136
1996	13.53	9.77	57320	22768	1894	780	25442	0	31879	202656	34553
1997	14.54	10.06	61619	23443	2065	609	26117	0	35502	238158	38176
1998	15.63	10.38	66241	24189	2251	423	26863	0	39378	277536	42052
1999	16.81	10.73	71209	25005	2453	221	27679	0	43530	321066	46204
2000	18.07	11.12	76549	25913	0	0	25913	0	50636	371702	50636
2001	19.42	11.53	82291	26916	0	0	26916	0	55375	427077	55375
2002	20.88	12.01	88462	27988	0	0	27988	0	60475	487552	60475
2003	22.44	12.52	95097	29176	0	0	29176	0	65921	553473	65921
2004	24.13	13.08	102229	30481	0	0	30481	0	71748	625222	71748

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 5
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25871	17081	6123	1940	25145	0	727	727	8790
1986	6.56	7.22	27811	16825	800	1874	19499	0	8312	9039	10986
1987	7.06	7.37	29897	17175	872	1802	19849	0	10048	19087	12723
1988	7.59	7.6	32140	17711	951	1723	20385	0	11755	30842	14429
1989	8.15	8.3	34550	19342	1036	1638	22016	0	12534	43376	15208
1990	8.77	8.42	37141	19622	1130	1545	22296	0	14846	58222	17520
1991	9.42	8.21	39927	19132	1231	1443	21806	0	18121	76342	20795
1992	10.13	8.37	42921	19505	1342	1332	22179	0	20742	97085	23416
1993	10.89	8.54	46141	19901	1463	1211	22575	0	23565	120650	26239
1994	11.71	8.73	49601	20344	1595	1080	23018	0	26583	147233	29257
1995	12.58	8.95	53321	20857	1738	936	23531	0	29790	177023	32465
1996	13.53	9.19	57320	21416	1894	780	24090	0	33230	210253	35904
1997	14.54	9.46	61619	22045	2065	609	24719	0	36900	247153	39574
1998	15.63	9.75	66241	22721	2251	423	25395	0	40846	287999	43520
1999	16.81	10.08	71209	23490	2453	221	26164	0	45045	333044	47719
2000	18.07	10.44	76549	24329	0	0	24329	0	52221	385264	52221
2001	19.42	10.83	82291	25238	0	0	25238	0	57053	442317	57053
2002	20.88	11.27	88462	26263	0	0	26263	0	62199	504517	62199
2003	22.44	11.74	95097	27358	0	0	27358	0	67739	572256	67739
2004	24.13	12.26	102229	28570	0	0	28570	0	73659	645915	73659

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: BOY'S CLUB
CASE: 6
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$25,300
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$26,945
PERCENT FINANCED: 80%
CASH INVESTMENT: \$5,389
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,674
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 5%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4237			4237
ESTIMATED DH CONSUMPTION (MILLION BTU):				2330
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	DISTRICT HEATING CONVERSION					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	8.33	25871	19412	6123	1940	27475	0	-1604	-1604	6459
1986	6.56	8.15	27811	18992	800	1874	21667	0	6145	4541	8819
1987	7.06	8.27	29897	19272	872	1802	21946	0	7951	12492	10625
1988	7.59	8.48	32140	19761	951	1723	22436	0	9704	22196	12378
1989	8.15	9.58	34550	22325	1036	1638	24999	0	9551	31748	12225
1990	8.77	9.65	37141	22488	1130	1545	25162	0	11979	43727	14653
1991	9.42	9.37	39927	21835	1231	1443	24510	0	15417	59144	18097
1992	10.13	9.48	42921	22092	1342	1332	24766	0	18156	77300	20830
1993	10.89	9.61	46141	22395	1463	1211	25069	0	21072	98372	23746
1994	11.71	9.77	49601	22768	1595	1080	25442	0	24159	122531	26834
1995	12.58	9.95	53321	23187	1738	936	25861	0	27460	149991	30134
1996	13.53	10.15	57320	23653	1894	780	26327	0	30993	180984	33667
1997	14.54	10.38	61619	24189	2065	609	26863	0	34756	215740	37430
1998	15.63	10.63	66241	24772	2251	423	27446	0	38795	254535	41469
1999	16.81	10.92	71209	25447	2453	221	28122	0	43087	297622	45761
2000	18.07	11.24	76549	26193	0	0	26193	0	50356	347979	50356
2001	19.42	11.6	82291	27032	0	0	27032	0	55259	403237	55259
2002	20.88	11.99	88462	27941	0	0	27941	0	60522	463759	60522
2003	22.44	12.43	95097	28966	0	0	28966	0	66131	529890	66131
2004	24.13	12.9	102229	30062	0	0	30062	0	72168	602058	72168

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 1
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			7065
ESTIMATED DH CONSUMPTION (MILLION BTU):				4592
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	6.58	43139	30217	4780	1514	36511	0	6628	6628	12922
1986	6.56	6.73	46374	30906	625	1463	32993	0	13381	20009	15468
1987	7.06	6.89	49852	31641	681	1407	33728	0	16124	36133	18212
1988	7.59	7.14	53591	32789	742	1345	34876	0	18715	54848	20803
1989	8.15	7.34	57611	33707	809	1279	35795	0	21816	76664	23904
1990	8.77	7.57	61931	34763	882	1206	36851	0	25081	101744	27168
1991	9.42	8.07	66576	37059	961	1126	39147	0	27429	129174	29517
1992	10.13	8.36	71570	38391	1048	1040	40479	0	31091	160265	33178
1993	10.89	8.68	76937	39861	1142	946	41948	0	34989	195254	37077
1994	11.71	9.03	82708	41468	1245	843	43556	0	39152	234406	41240
1995	12.58	9.41	88911	43213	1357	731	45301	0	43610	278016	45698
1996	13.53	9.82	95579	45096	1479	609	47183	0	48395	326411	50483
1997	14.54	10.28	102747	47208	1612	476	49296	0	53451	379862	55539
1998	15.63	10.77	110453	49459	1757	330	51546	0	58907	438770	60995
1999	16.81	11.3	118737	51892	1915	172	53980	0	64757	503527	66845
2000	18.07	11.88	127643	54556	0	0	54556	0	73087	576614	73087
2001	19.42	12.51	137216	57449	0	0	57449	0	79767	656381	79767
2002	20.88	13.18	147507	60526	0	0	60526	0	86981	743362	86981
2003	22.44	13.92	158570	63924	0	0	63924	0	94646	838008	94646
2004	24.13	14.72	170463	67598	0	0	67598	0	102865	940873	102865

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 2
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			7065
ESTIMATED DH CONSUMPTION (MILLION BTU):				4592
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DH ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC.	DISTRICT HEATING CONVERSION INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	7.33	43139	33661	4780	1514	39955	0	3183	3183	9478
1986	6.56	7.48	46374	34350	625	1463	36438	0	9937	13120	12024
1987	7.06	7.65	49852	35131	681	1407	37218	0	12634	25754	14722
1988	7.59	7.91	53591	36325	742	1345	38412	0	15179	40933	17267
1989	8.15	8.13	57611	37335	809	1279	39423	0	18188	59121	20276
1990	8.77	8.37	61931	38437	882	1206	40525	0	21407	80528	23494
1991	9.42	8.9	66576	40871	961	1126	42959	0	23618	104146	25705
1992	10.13	9.21	71570	42295	1048	1040	44382	0	27187	131333	29275
1993	10.89	9.54	76937	43810	1142	946	45898	0	31040	162373	33127
1994	11.71	9.91	82708	45309	1245	843	47597	0	35111	197484	37198
1995	12.58	10.32	88911	47392	1357	731	49480	0	39431	236915	41519
1996	13.53	10.76	95579	49413	1479	609	51500	0	44079	280994	46166
1997	14.54	11.24	102747	51617	1612	476	53704	0	49043	330037	51130
1998	15.63	11.77	110453	54051	1757	330	56138	0	54315	384352	56403
1999	16.81	12.34	118737	56668	1915	172	58756	0	59981	444333	62069
2000	18.07	12.96	127643	59516	0	0	59516	0	68127	512460	68127
2001	19.42	13.63	137216	62592	0	0	62592	0	74624	587084	74624
2002	20.88	14.37	147507	65991	0	0	65991	0	81516	668600	81516
2003	22.44	15.16	158570	69619	0	0	69619	0	88952	757552	88952
2004	24.13	16.02	170463	73568	0	0	73568	0	96895	854447	96895

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			7065
ESTIMATED DH CONSUMPTION (MILLION BTU):				4592
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	7.33	43139	33661	4780	1514	39955	0	3183	3183	9478
1986	6.56	7.22	46374	33156	625	1463	35244	0	11131	14314	13218
1987	7.06	7.37	49852	33845	681	1407	35932	0	13920	28234	16007
1988	7.59	7.6	53591	34901	742	1345	36989	0	16603	44837	18690
1989	8.15	7.8	57611	35820	809	1279	37907	0	19704	64540	21791
1990	8.77	8.01	61931	36784	882	1206	38871	0	23060	87600	25148
1991	9.42	8.5	66576	39034	961	1126	41122	0	25455	113055	27542
1992	10.13	8.78	71570	40320	1048	1040	42407	0	29162	142217	31250
1993	10.89	9.08	76937	41698	1142	946	43785	0	33152	175369	35240
1994	11.71	9.42	82708	43259	1245	843	45347	0	37361	212730	39449
1995	12.58	9.79	88911	44958	1357	731	47046	0	41865	254595	43952
1996	13.53	10.19	95579	46795	1479	609	48883	0	46696	301291	48784
1997	14.54	10.62	102747	48770	1612	476	50857	0	51890	353182	53978
1998	15.63	11.1	110453	50974	1757	330	53062	0	57392	410573	59479
1999	16.81	11.62	118737	53362	1915	172	55449	0	63288	473861	65375
2000	18.07	12.18	127643	55934	0	0	55934	0	71709	545570	71709
2001	19.42	12.79	137216	58735	0	0	58735	0	78481	624051	78481
2002	20.88	13.46	147507	61812	0	0	61812	0	85695	709747	85695
2003	22.44	14.18	158570	65118	0	0	65118	0	93452	803199	93452
2004	24.13	14.96	170463	68700	0	0	68700	0	101763	904962	101763

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 4
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			7065
ESTIMATED DH CONSUMPTION (MILLION BTU):				4592
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION		TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
					PRINC.	INTER.					
1985	6.11	7.33	43139	33661	4780	1514	39955	0	3183	3183	9478
1986	6.56	7.22	46374	33156	625	1463	35244	0	11131	14314	13218
1987	7.06	7.37	49852	33845	681	1407	35932	0	13920	28234	16007
1988	7.59	7.6	53591	34901	742	1345	36989	0	16603	44837	18690
1989	8.15	8.3	57611	38116	809	1279	40203	0	17407	62244	19495
1990	8.77	8.42	61931	38667	882	1206	40754	0	21177	83421	23265
1991	9.42	8.72	66576	40044	961	1126	42132	0	24444	107866	26532
1992	10.13	8.89	71570	40825	1048	1040	42913	0	28657	136523	30744
1993	10.89	9.07	76937	41652	1142	946	43739	0	33198	169721	35286
1994	11.71	9.28	82708	42616	1245	843	44704	0	38004	207725	40091
1995	12.58	9.52	88911	43718	1357	731	45806	0	43105	250829	45192
1996	13.53	9.77	95579	44866	1479	609	46954	0	48625	299455	50713
1997	14.54	10.06	102747	46198	1612	476	48286	0	54462	353916	56549
1998	15.63	10.38	110453	47668	1757	330	49755	0	60698	414615	62786
1999	16.81	10.73	118737	49275	1915	172	51362	0	67375	481990	69463
2000	18.07	11.12	127643	51066	0	0	51066	0	76577	558566	76577
2001	19.42	11.55	137216	53040	0	0	53040	0	84175	642742	84175
2002	20.88	12.01	147507	55153	0	0	55153	0	92354	735096	92354
2003	22.44	12.52	158570	57495	0	0	57495	0	101075	836171	101075
2004	24.13	13.08	170463	60067	0	0	60067	0	110396	946567	110396

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 5
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			7065
ESTIMATED DH CONSUMPTION (MILLION BTU):				4592
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	DISTRICT HEATING					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	CONVERSION ENERGY COSTS	AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	43139	33661	4780	1514	39955	0	3183	3183	9478
1986	6.56	7.22	46374	33156	625	1463	35244	0	11131	14314	13218
1987	7.06	7.37	49852	33845	681	1407	35932	0	13920	28234	16007
1988	7.59	7.6	53591	34901	742	1345	36989	0	16603	44837	18690
1989	8.15	8.3	57611	38116	809	1279	40203	0	17407	62244	19495
1990	8.77	8.42	61931	38667	882	1206	40754	0	21177	83421	23265
1991	9.42	8.21	66576	37702	961	1126	39790	0	26786	110208	28874
1992	10.13	8.37	71570	38437	1048	1040	40525	0	31045	141253	33132
1993	10.89	8.54	76937	39218	1142	946	41305	0	35632	176885	37719
1994	11.71	8.73	82708	40090	1245	843	42178	0	40530	217414	42617
1995	12.58	8.95	88911	41101	1357	731	43188	0	45722	263137	47810
1996	13.53	9.19	95579	42203	1479	609	44290	0	51289	314425	53376
1997	14.54	9.46	102747	43443	1612	476	45530	0	57217	371642	59305
1998	15.63	9.75	110453	44774	1757	330	46862	0	63591	435234	65679
1999	16.81	10.08	118737	46290	1915	172	48377	0	70360	505594	72448
2000	18.07	10.44	127643	47943	0	0	47943	0	79700	585293	79700
2001	19.42	10.83	137216	49734	0	0	49734	0	87482	672775	87482
2002	20.88	11.27	147507	51755	0	0	51755	0	95752	768528	95752
2003	22.44	11.74	158570	53913	0	0	53913	0	104657	873185	104657
2004	24.13	12.26	170463	56301	0	0	56301	0	114162	987347	114162

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: CITY HALL
CASE: 6
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$19,750
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$21,034
PERCENT FINANCED: 80%
CASH INVESTMENT: \$4,207
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$2,088
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 0%
ESTIMATED CURRENT BOILER EFFICIENCY: 65.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	7065			
ESTIMATED DH CONSUMPTION (MILLION BTU):	4592			
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	[----- DISTRICT HEATING -----]					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	8.33	43139	38253	4780	1514	44548	0	-1409	-1409	4885
1986	6.56	8.15	46374	37427	625	1463	39514	0	6860	5451	8947
1987	7.06	8.27	49852	37978	681	1407	40065	0	9787	15238	11874
1988	7.59	8.48	53591	38942	742	1345	41030	0	12561	27800	14649
1989	8.15	9.58	57611	43994	809	1279	46081	0	11529	39329	13617
1990	8.77	9.65	61931	44315	882	1206	46403	0	15529	54858	17616
1991	9.42	9.37	66576	43029	961	1126	45117	0	21459	76317	23547
1992	10.13	9.48	71570	43535	1048	1040	45622	0	25947	102264	28035
1993	10.89	9.61	76937	44132	1142	946	46219	0	30718	132983	32806
1994	11.71	9.77	82708	44866	1245	843	46954	0	35754	168736	37841
1995	12.58	9.95	88911	45693	1357	731	47780	0	41130	209867	43218
1996	13.53	10.15	95579	46611	1479	609	48699	0	46880	256747	48968
1997	14.54	10.38	102747	47668	1612	476	49755	0	52992	309739	55080
1998	15.63	10.63	110453	48816	1757	330	50903	0	59550	369289	61638
1999	16.81	10.92	118737	50147	1915	172	52235	0	66502	435792	68590
2000	18.07	11.24	127643	51617	0	0	51617	0	76026	511817	76026
2001	19.42	11.6	137216	53270	0	0	53270	0	83946	595763	83946
2002	20.88	11.99	147507	55061	0	0	55061	0	92446	688209	92446
2003	22.44	12.43	158570	57082	0	0	57082	0	101488	789698	101488
2004	24.13	12.9	170463	59240	0	0	59240	0	111223	900920	111223

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)

CASE: 1

PRESENT YEAR: 1984

HOOKUP YEAR: 1985

TOTAL CONVERSION COST (PRESENT YEAR): \$35,700

ESCALATION RATE: 6.50%

TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021

PERCENT FINANCED: 80%

CASH INVESTMENT: \$7,604

TERM OF LOAN (YEARS): 15

INTEREST RATE: 9.00%

ANNUAL PAYMENT: \$3,773

TAX RATE: 0%

YEARS OF DEPRECIATION: 0

ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0

POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%

ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%

HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DH ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC.	DISTRICT HEATING CONVERSION INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	6.58	25114	13018	8640	2737	24395	0	719	719	12096
1986	6.56	6.73	26998	13314	1129	2644	17088	0	9910	10629	13683
1987	7.06	6.89	29022	13631	1231	2543	17404	0	11618	22247	15391
1988	7.59	7.14	31199	14125	1342	2432	17899	0	13300	35547	17074
1989	8.15	7.34	33539	14521	1462	2311	18295	0	15244	50791	19018
1990	8.77	7.57	36054	14976	1594	2179	18750	0	17305	68096	21078
1991	9.42	8.07	38758	15965	1737	2036	19739	0	19020	87116	22793
1992	10.13	8.36	41665	16539	1894	1880	20312	0	21353	108469	25126
1993	10.89	8.68	44790	17172	2064	1709	20946	0	23845	132313	27618
1994	11.71	9.03	48149	17865	2250	1523	21638	0	26512	158825	30285
1995	12.58	9.41	51761	18616	2452	1321	22390	0	29371	188196	33144
1996	13.53	9.82	55643	19427	2673	1100	23201	0	32442	220638	36215
1997	14.54	10.28	59816	20337	2914	860	24111	0	35705	256343	39478
1998	15.63	10.77	64302	21307	3176	597	25080	0	39222	295565	42995
1999	16.81	11.3	69125	22355	3462	312	26129	0	42996	338561	46769
2000	18.07	11.88	74309	23503	0	0	23503	0	50806	389367	50806
2001	19.42	12.51	79882	24749	0	0	24749	0	55133	444500	55133
2002	20.88	13.18	85874	26075	0	0	26075	0	59799	504299	59799
2003	22.44	13.92	92314	27539	0	0	27539	0	64775	569074	64775
2004	24.13	14.72	99238	29121	0	0	29121	0	70116	639191	70116

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)

CASE: 2
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$35,700
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$7,604
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$3,773
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%
 ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25114	14501	8640	2737	25879	0	-765	-765	10613
1986	6.56	7.48	26998	14798	1129	2644	18572	0	8426	7661	12199
1987	7.06	7.65	29022	15134	1231	2543	18908	0	10115	17776	13888
1988	7.59	7.91	31199	15649	1342	2432	19422	0	11777	29552	15550
1989	8.15	8.13	33539	16084	1462	2311	19857	0	13682	43234	17455
1990	8.77	8.37	36054	16559	1594	2179	20332	0	15722	58956	19496
1991	9.42	8.9	38758	17607	1737	2036	21381	0	17378	76334	21151
1992	10.13	9.21	41665	18221	1894	1880	21994	0	19671	96005	23445
1993	10.89	9.54	44790	18873	2064	1709	22647	0	22143	118148	25917
1994	11.71	9.91	48149	19605	2250	1523	23379	0	24771	142919	28544
1995	12.58	10.32	51761	20417	2452	1321	24190	0	27571	170490	31344
1996	13.53	10.76	55643	21287	2673	1100	25061	0	30582	201072	34356
1997	14.54	11.24	59816	22237	2914	860	26010	0	33806	234878	37579
1998	15.63	11.77	64302	23285	3176	597	27059	0	37244	272121	41017
1999	16.81	12.34	69125	24413	3462	312	28186	0	40939	313060	44712
2000	18.07	12.96	74309	25639	0	0	25639	0	48670	361729	48670
2001	19.42	13.63	79882	26965	0	0	26965	0	52917	414647	52917
2002	20.88	14.37	85874	28429	0	0	28429	0	57445	472092	57445
2003	22.44	15.16	92314	29992	0	0	29992	0	62322	534414	62322
2004	24.13	16.02	99238	31693	0	0	31693	0	67544	601958	67544

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$35,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021
PERCENT FINANCED: 80%
CASH INVESTMENT: \$7,604
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,773
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DH ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	7.33	25114	14501	8640	2737	25879	0	-765	-765	10613
1986	6.56	7.22	26998	14284	1129	2644	18057	0	8940	8176	12714
1987	7.06	7.37	29022	14580	1231	2543	18354	0	10668	18844	14442
1988	7.59	7.6	31199	15035	1342	2432	18809	0	12390	31234	16164
1989	8.15	7.8	33539	15431	1462	2311	19205	0	14334	45568	18108
1990	8.77	8.01	36054	15847	1594	2179	19620	0	16434	62003	20208
1991	9.42	8.5	38758	16816	1737	2036	20589	0	18169	80172	21942
1992	10.13	8.78	41665	17370	1894	1880	21143	0	20522	100694	24295
1993	10.89	9.08	44790	17963	2064	1709	21737	0	23053	123747	26827
1994	11.71	9.42	48149	18636	2250	1523	22410	0	25740	149487	29513
1995	12.58	9.79	51761	19368	2452	1321	23142	0	28619	178106	32393
1996	13.53	10.19	55643	20159	2673	1100	23933	0	31710	209816	35483
1997	14.54	10.62	59816	21010	2914	860	24784	0	35032	244849	38806
1998	15.63	11.1	64302	21960	3176	597	25733	0	38569	283418	42342
1999	16.81	11.62	69125	22988	3462	312	26762	0	42363	325781	46136
2000	18.07	12.18	74309	24096	0	0	24096	0	50213	375993	50213
2001	19.42	12.79	79882	25303	0	0	25303	0	54579	430573	54579
2002	20.88	13.46	85874	26629	0	0	26629	0	59245	489818	59245
2003	22.44	14.18	92314	28053	0	0	28053	0	64261	554079	64261
2004	24.13	14.96	99238	29596	0	0	29596	0	69641	623720	69641

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)
CASE: 4
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$35,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021
PERCENT FINANCED: 80%
CASH INVESTMENT: \$7,604
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,773
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	25114	14501	8640	2737	25879	0	-765	-765	10613
1986	6.56	7.22	26998	14284	1129	2644	18037	0	8940	8176	12714
1987	7.06	7.37	29022	14580	1231	2543	18354	0	10668	18844	14442
1988	7.59	7.6	31199	15035	1342	2432	18809	0	12390	31234	16164
1989	8.15	8.3	33539	16420	1462	2311	20194	0	13345	44579	17119
1990	8.77	8.42	36054	16658	1594	2179	20431	0	15623	60202	19397
1991	9.42	8.72	38758	17251	1737	2036	21025	0	17734	77936	21507
1992	10.13	8.89	41665	17588	1894	1880	21361	0	20304	98241	24078
1993	10.89	9.07	44790	17944	2064	1709	21717	0	23073	121314	26847
1994	11.71	9.28	48149	18359	2250	1523	22133	0	26017	147331	29790
1995	12.58	9.52	51761	18834	2452	1321	22607	0	29153	176484	32927
1996	13.53	9.77	55643	19329	2673	1100	23102	0	32541	209025	36314
1997	14.54	10.06	59816	19902	2914	860	23676	0	36140	245165	39914
1998	15.63	10.38	64302	20535	3176	597	24309	0	39993	285159	43767
1999	16.81	10.73	69125	21228	3462	312	25001	0	44124	329282	47897
2000	18.07	11.12	74309	21999	0	0	21999	0	52310	381592	52310
2001	19.42	11.55	79882	22850	0	0	22850	0	57032	438625	57032
2002	20.88	12.01	85874	23760	0	0	23760	0	62114	500738	62114
2003	22.44	12.52	92314	24769	0	0	24769	0	67545	568283	67545
2004	24.13	13.08	99238	25877	0	0	25877	0	73361	641644	73361

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)

CASE: 5

PRESENT YEAR: 1984

HOOKUP YEAR: 1985

TOTAL CONVERSION COST (PRESENT YEAR): \$35,700

ESCALATION RATE: 6.50%

TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021

PERCENT FINANCED: 80%

CASH INVESTMENT: \$7,604

TERM OF LOAN (YEARS): 15

INTEREST RATE: 9.00%

ANNUAL PAYMENT: \$3,773

TAX RATE: 0%

YEARS OF DEPRECIATION: 0

ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0

POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%

ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%

HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT		ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	CONVERSION ENERGY COSTS	AMORTIZATION PRINC.	INTER.	TOTAL COSTS		HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	
1985	6.11	7.33	25114	14501	8640	2737	25879	0	-765	-765	10613
1986	6.56	7.22	26998	14284	1129	2644	18057	0	8940	8176	12714
1987	7.06	7.37	29022	14580	1231	2543	18354	0	10668	18844	14442
1988	7.59	7.6	31199	15035	1342	2432	18809	0	12390	31234	16164
1989	8.15	8.3	33539	16420	1462	2311	20194	0	13345	44579	17119
1990	8.77	8.42	36054	16658	1594	2179	20431	0	15623	60202	19397
1991	9.42	8.21	38758	16242	1737	2036	20016	0	18743	78945	22516
1992	10.13	8.37	41665	16559	1894	1880	20332	0	21333	100278	25107
1993	10.89	8.54	44790	16895	2064	1709	20669	0	24122	124400	27895
1994	11.71	8.73	48149	17271	2250	1523	21044	0	27105	151505	30878
1995	12.58	8.95	51761	17706	2452	1321	21480	0	30281	181786	34054
1996	13.53	9.19	55643	18181	2673	1100	21954	0	33688	215474	37462
1997	14.54	9.46	59816	18715	2914	860	22489	0	37327	252802	41101
1998	15.63	9.75	64302	19289	3176	597	23062	0	41240	294041	45013
1999	16.81	10.08	69125	19942	3462	312	23715	0	45410	339451	49183
2000	18.07	10.44	74309	20654	0	0	20654	0	53655	393106	53655
2001	19.42	10.83	79882	21426	0	0	21426	0	58457	451563	58457
2002	20.88	11.27	85874	22296	0	0	22296	0	63578	515140	63578
2003	22.44	11.74	92314	23226	0	0	23226	0	69088	584229	69088
2004	24.13	12.26	99238	24255	0	0	24255	0	74983	659212	74983

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: FEDERAL BUILDING (POST OFFICE)

CASE: 6
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$35,700
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$38,021
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$7,604
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$3,773
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 12%
 ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	4113			4113
ESTIMATED DH CONSUMPTION (MILLION BTU):				1978
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION		TOTAL COSTS						
	\$/MMBTU	\$/MMBTU			PRINC.	INTER.					
1985	6.11	8.33	25114	16480	8640	2737	27857	0	-2743	-2743	8634
1986	6.56	8.15	26998	16124	1129	2644	19897	0	7101	4357	10874
1987	7.06	8.27	29022	16361	1231	2543	20134	0	8888	13245	12661
1988	7.59	8.48	31199	16776	1342	2432	20550	0	10649	23894	14423
1989	8.15	9.58	33539	18953	1462	2311	22726	0	10813	34707	14586
1990	8.77	9.65	36054	19091	1594	2179	22865	0	13190	47897	16963
1991	9.42	9.37	38758	18537	1737	2036	22311	0	16448	64345	20221
1992	10.13	9.48	41665	18755	1894	1880	22528	0	19137	83482	22911
1993	10.89	9.61	44790	19012	2064	1709	22785	0	22005	105487	25778
1994	11.71	9.77	48149	19329	2250	1523	23102	0	25048	130534	28821
1995	12.58	9.95	51761	19685	2452	1321	23458	0	28303	158837	32076
1996	13.53	10.15	55643	20080	2673	1100	23854	0	31789	190626	35562
1997	14.54	10.38	59816	20535	2914	860	24309	0	35507	226133	39281
1998	15.63	10.63	64302	21030	3176	597	24803	0	39499	265632	43272
1999	16.81	10.92	69125	21604	3462	312	25377	0	43748	309380	47521
2000	18.07	11.24	74309	22237	0	0	22237	0	52072	361453	52072
2001	19.42	11.6	79882	22949	0	0	22949	0	56933	418386	56933
2002	20.88	11.99	85874	23720	0	0	23720	0	62153	480539	62153
2003	22.44	12.43	92314	24591	0	0	24591	0	67723	548262	67723
2004	24.13	12.9	99238	25521	0	0	25521	0	73717	621979	73717

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 1
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$46,860
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$23,254
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
 ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	[----- DISTRICT HEATING -----]				TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	CONVERSION ENERGY COSTS	AMORTIZATION PRINC.	INTER.					
1985	6.11	6.58	131792	65330	53244	16870	135444	0	-3652	-3652	66461
1986	6.56	6.73	141676	66820	6959	16295	90073	0	51603	47951	74857
1987	7.06	6.89	152302	68408	7585	15669	91662	0	60640	108591	83894
1988	7.59	7.14	163725	70890	8267	14986	94144	0	69581	178171	92834
1989	8.15	7.34	176004	72876	9012	14242	96130	0	79874	258046	103128
1990	8.77	7.57	189204	75160	9823	13431	98413	0	90791	348837	114045
1991	9.42	8.07	203395	80124	10707	12547	103378	0	100017	448854	123271
1992	10.13	8.36	218649	83003	11670	11583	106257	0	112392	561246	135646
1993	10.89	8.68	235048	86181	12721	10533	109434	0	125614	686860	148867
1994	11.71	9.03	252677	89656	13865	9388	112909	0	139767	826627	163021
1995	12.58	9.41	271627	93429	15113	8140	116682	0	154945	981572	178199
1996	13.53	9.82	291999	97499	16473	6780	120753	0	171246	1152818	194500
1997	14.54	10.28	313899	102066	17956	5298	125320	0	188579	1341398	211833
1998	15.63	10.77	337442	106931	19572	3682	130185	0	207257	1548654	230510
1999	16.81	11.3	362750	112194	21334	1920	135447	0	227303	1775957	250556
2000	18.07	11.88	389956	117952	0	0	117952	0	272004	2047961	272004
2001	19.42	12.51	419203	124207	0	0	124207	0	294995	2342956	294995
2002	20.88	13.18	450643	130859	0	0	130859	0	319784	2662740	319784
2003	22.44	13.92	484441	138207	0	0	138207	0	346235	3008974	346235
2004	24.13	14.72	520774	146150	0	0	146150	0	374625	3383599	374625

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 2
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$46,860
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$23,254
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
 ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DISTRICT HEATING			TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	AMORTIZATION PRINC.	INTER.					
1985	6.11	7.33	131792	72777	53244	16870	142891	0	-11099	-11099	59015
1986	6.56	7.48	141676	74266	6959	16295	97520	0	44156	33058	67410
1987	7.06	7.65	152302	75954	7585	15669	99208	0	53094	86152	76348
1988	7.59	7.91	163725	78536	8267	14986	101789	0	61936	148088	85189
1989	8.15	8.13	176004	80720	9012	14242	103973	0	72031	220118	95284
1990	8.77	8.37	189204	83103	9823	13431	106356	0	82848	302966	106102
1991	9.42	8.9	203395	88365	10707	12547	111618	0	91776	394742	115030
1992	10.13	9.21	218649	91443	11670	11583	114696	0	103953	498695	127206
1993	10.89	9.54	235048	94719	12721	10533	117973	0	117075	615770	140329
1994	11.71	9.91	252677	98393	13865	9388	121646	0	131030	746801	154284
1995	12.58	10.32	271627	102464	15113	8140	125717	0	145910	892711	169164
1996	13.53	10.76	291999	106832	16473	6780	130086	0	161914	1054624	185167
1997	14.54	11.24	313899	111598	17956	5298	134852	0	179048	1233672	202301
1998	15.63	11.77	337442	116860	19572	3682	140114	0	197328	1431000	220582
1999	16.81	12.34	362750	122519	21334	1920	145773	0	216977	1647977	240230
2000	18.07	12.96	389956	128675	0	0	128675	0	261281	1909258	261281
2001	19.42	13.63	419203	135327	0	0	135327	0	283875	2193133	283875
2002	20.88	14.37	450643	142675	0	0	142675	0	307968	2501102	307968
2003	22.44	15.16	484441	150518	0	0	150518	0	333923	2835025	333923
2004	24.13	16.02	520774	159057	0	0	159057	0	361717	3196742	361717

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 3
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$46,860
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$23,254
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
 ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DISTRICT HEATING				TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.						
1985	6.11	7.33	131792	72777	53244	16870		142891	0	-11099	-11099	59015
1986	6.56	7.22	141676	71685	6959	16295		94938	0	46738	35639	69992
1987	7.06	7.37	152302	73174	7585	15669		96428	0	55874	91514	79128
1988	7.59	7.6	163725	75458	8267	14986		98711	0	65013	156527	88267
1989	8.15	7.8	176004	77443	9012	14242		100697	0	75307	231834	98561
1990	8.77	8.01	189204	79528	9823	13431		102782	0	86422	318256	109676
1991	9.42	8.5	203395	84393	10707	12547		107647	0	95748	414004	119001
1992	10.13	8.78	218649	87173	11670	11583		110427	0	108222	522226	131476
1993	10.89	9.08	235048	90152	12721	10533		113406	0	121642	643868	144896
1994	11.71	9.42	252677	93528	13865	9388		116781	0	135895	779764	159149
1995	12.58	9.79	271627	97201	15113	8140		120455	0	151172	930936	174426
1996	13.53	10.19	291999	101173	16473	6780		124426	0	167573	1098509	190826
1997	14.54	10.62	313899	105442	17956	5298		128696	0	185204	1283712	208457
1998	15.63	11.1	337442	110208	19572	3682		133462	0	203980	1487693	227234
1999	16.81	11.62	362750	115371	21334	1920		138624	0	224125	1711818	247379
2000	18.07	12.18	389956	120931	0	0		120931	0	269025	1980843	269025
2001	19.42	12.79	419203	126987	0	0		126987	0	292215	2273059	292215
2002	20.88	13.46	450643	133639	0	0		133639	0	317004	2590062	317004
2003	22.44	14.18	484441	140788	0	0		140788	0	343653	2933715	343653
2004	24.13	14.96	520774	148532	0	0		148532	0	372242	3305957	372242

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 4
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$46,860
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$23,254
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
 ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	131792	72777	53244	16870	142891	0	-11099	-11099	59015
1986	6.56	7.22	141676	71685	6959	16295	94938	0	46738	35639	69992
1987	7.06	7.37	152302	73174	7585	15669	96428	0	55874	91514	79128
1988	7.59	7.6	163725	75458	8267	14986	98711	0	65013	156527	88267
1989	8.15	8.3	176004	82408	9012	14242	105661	0	70343	226870	93596
1990	8.77	8.42	189204	83599	9823	13431	106853	0	82352	309221	105605
1991	9.42	8.72	203395	86578	10707	12547	109831	0	93563	402785	116817
1992	10.13	8.89	218649	88266	11670	11583	111519	0	107130	509915	130384
1993	10.89	9.07	235048	90053	12721	10533	113306	0	121742	631656	144995
1994	11.71	9.28	252677	92138	13865	9388	115391	0	137285	768941	160539
1995	12.58	9.52	271627	94521	15113	8140	117774	0	153853	922794	177107
1996	13.53	9.77	291999	97003	16473	6780	120256	0	171743	1094537	194997
1997	14.54	10.06	313899	99882	17956	5298	123136	0	190764	1285301	214017
1998	15.63	10.38	337442	103059	19572	3682	126313	0	211129	1496430	234382
1999	16.81	10.73	362750	106534	21334	1920	129788	0	232962	1729392	256216
2000	18.07	11.12	389956	110406	0	0	110406	0	279550	2008941	279550
2001	19.42	11.55	419203	114676	0	0	114676	0	304527	2313468	304527
2002	20.88	12.01	450643	119243	0	0	119243	0	331400	2644868	331400
2003	22.44	12.52	484441	124307	0	0	124307	0	360135	3005003	360135
2004	24.13	13.08	520774	129867	0	0	129867	0	390908	3395911	390908

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 5
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$46,860
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$23,254
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
 ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	131792	72777	53244	16870	142891	0	-11099	-11099	59015
1986	6.56	7.22	141676	71685	6959	16295	94938	0	46738	35639	69992
1987	7.06	7.37	152302	73174	7585	15669	96428	0	55874	91514	79128
1988	7.59	7.6	163725	75458	8267	14986	98711	0	65013	156527	88267
1989	8.15	8.3	176004	82408	9012	14242	105661	0	70343	226870	93596
1990	8.77	8.42	189204	83599	9823	13431	106853	0	82352	309221	105605
1991	9.42	8.21	203395	81514	10707	12547	104768	0	98627	407848	121881
1992	10.13	8.37	218649	83103	11670	11583	106356	0	112293	520141	135547
1993	10.89	8.54	235048	84791	12721	10533	108044	0	127004	647145	150257
1994	11.71	8.73	252677	86677	13865	9388	109931	0	142746	789891	166000
1995	12.58	8.95	271627	88861	15113	8140	112115	0	159512	949403	182766
1996	13.53	9.19	291999	91244	16473	6780	114498	0	177502	1126905	200755
1997	14.54	9.46	313899	93925	17956	5298	117179	0	196721	1323625	219974
1998	15.63	9.75	337442	96804	19572	3682	120058	0	217384	1541009	240637
1999	16.81	10.08	362750	100081	21334	1920	123334	0	239416	1780425	262669
2000	18.07	10.44	389956	103655	0	0	103655	0	286301	2066726	286301
2001	19.42	10.83	419203	107527	0	0	107527	0	311676	2378402	311676
2002	20.88	11.27	450643	111896	0	0	111896	0	338747	2717149	338747
2003	22.44	11.74	484441	116562	0	0	116562	0	367879	3085028	367879
2004	24.13	12.26	520774	121725	0	0	121725	0	399049	3484077	399049

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN GENERAL HOSPITAL

CASE: 6
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$220,000
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$234,300
PERCENT FINANCED: 80%
CASH INVESTMENT: \$46,860
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$23,254
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 52.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	21584			21584
ESTIMATED DH CONSUMPTION (MILLION BTU):				9929
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	8.33	131792	82706	53244	16870	152819	0	-21027	-21027	49086
1986	6.56	8.15	141676	80918	6959	16295	104172	0	37504	16477	60758
1987	7.06	8.27	152302	82110	7585	15669	105363	0	46939	63416	70192
1988	7.59	8.48	163725	84195	8267	14986	107448	0	56276	119692	79530
1989	8.15	9.58	176004	95116	9012	14242	118370	0	57634	177326	80888
1990	8.77	9.65	189204	95811	9823	13431	119065	0	70139	247465	93393
1991	9.42	9.37	203395	93031	10707	12547	116285	0	87110	334575	110363
1992	10.13	9.48	218649	94124	11670	11583	117377	0	101272	435847	124526
1993	10.89	9.61	235048	95414	12721	10533	118668	0	116380	552227	139634
1994	11.71	9.77	252677	97003	13865	9388	120256	0	132420	684647	155674
1995	12.58	9.95	271627	98790	15113	8140	122044	0	149584	834231	172837
1996	13.53	10.15	291999	100776	16473	6780	124029	0	167970	1002201	191224
1997	14.54	10.38	313899	103059	17956	5298	126313	0	187586	1189787	210840
1998	15.63	10.63	337442	105541	19572	3682	128795	0	208647	1398434	231900
1999	16.81	10.92	362750	108421	21334	1920	131674	0	231075	1629510	254329
2000	18.07	11.24	389956	111598	0	0	111598	0	278358	1907868	278358
2001	19.42	11.6	419203	115172	0	0	115172	0	304031	2211898	304031
2002	20.88	11.99	450643	119044	0	0	119044	0	331599	2543497	331599
2003	22.44	12.43	484441	123413	0	0	123413	0	361028	2904525	361028
2004	24.13	12.9	520774	128079	0	0	128079	0	392695	3297220	392695

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD
CASE: 1
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
PERCENT FINANCED: 80%
CASH INVESTMENT: \$9,415
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$4,672
TAX RATE: 50%
YEARS OF DEPRECIATION: 5
ACCELERATED DEPRECIATION? (1=YES,0=NO): 1
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED DH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	6.58	77259	39131	10697	3389	53217	-13839	10203	10203	38129
1986	6.56	6.73	83054	40023	1398	3274	44695	-14701	23659	33861	43031
1987	7.06	6.89	89283	40974	1524	3148	45646	-17638	25999	59861	48308
1988	7.59	7.14	95979	42461	1661	3011	47133	-20311	28535	88396	53518
1989	8.15	7.34	103177	43650	1810	2861	48322	-23390	31465	119861	59527
1990	8.77	7.57	110916	45018	1973	2698	49690	-31600	29626	149487	65897
1991	9.42	8.07	119234	47992	2151	2521	52663	-34361	32210	181697	71243
1992	10.13	8.36	128177	49716	2345	2327	54388	-38067	35722	217419	78461
1993	10.89	8.68	137790	51619	2556	2116	56291	-42027	39472	256890	86171
1994	11.71	9.03	148124	53701	2786	1886	58372	-46269	43483	300374	94424
1995	12.58	9.41	159234	55960	3036	1635	60632	-50819	47783	348156	103273
1996	13.53	9.82	171176	58399	3310	1362	63071	-55708	52398	400554	112778
1997	14.54	10.28	184014	61134	3608	1064	65806	-60908	57300	457855	122880
1998	15.63	10.77	197816	64048	3932	740	68720	-66514	62582	520436	133767
1999	16.81	11.3	212652	67200	4286	386	71872	-72533	68247	588683	145452
2000	18.07	11.88	228601	70649	0	0	70649	-78976	78976	667659	157951
2001	19.42	12.51	245746	74396	0	0	74396	-85675	85675	753333	171350
2002	20.88	13.18	264177	78380	0	0	78380	-92898	92898	846232	185796
2003	22.44	13.92	283990	82781	0	0	82781	-100604	100604	946836	201209
2004	24.13	14.72	305289	87539	0	0	87539	-108875	108875	1055711	217750

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD

CASE: 2
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$9,415
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$4,672
 TAX RATE: 50%
 YEARS OF DEPRECIATION: 5
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 1
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
 ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED OH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	OH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I			TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.					
1985	6.11	7.33	77259	43591	10697	3389	57677	-11609	7973	7973	33668
1986	6.56	7.48	83054	44483	1398	3274	49155	-12470	21428	29401	38571
1987	7.06	7.65	89283	45494	1524	3148	50166	-15378	23739	53141	43789
1988	7.59	7.91	95979	47040	1661	3011	51712	-18021	26246	79386	48939
1989	8.15	8.13	103177	48348	1810	2861	53020	-21041	29116	108502	54829
1990	8.77	8.37	110916	49776	1973	2698	54447	-29221	27247	135749	61140
1991	9.42	8.9	119234	52927	2151	2521	57599	-31893	29742	165491	66307
1992	10.13	9.21	128177	54771	2345	2327	59443	-35539	33195	198686	73406
1993	10.89	9.54	137790	56734	2556	2116	61405	-39470	36915	235601	81057
1994	11.71	9.91	148124	58934	2786	1886	63606	-43652	40866	276467	89190
1995	12.58	10.32	159234	61372	3036	1635	66044	-48113	45077	321544	97862
1996	13.53	10.76	171176	63989	3310	1362	68661	-52913	49603	371147	107187
1997	14.54	11.24	184014	66843	3608	1064	71515	-58053	54446	425593	117171
1998	15.63	11.77	197816	69995	3932	740	74667	-63540	59608	485201	127820
1999	16.81	12.34	212652	73385	4286	386	78057	-69441	65154	550355	139267
2000	18.07	12.96	228601	77072	0	0	77072	-75764	75764	626119	151529
2001	19.42	13.63	245746	81056	0	0	81056	-82345	82345	708464	164689
2002	20.88	14.37	264177	85457	0	0	85457	-89360	89360	797824	178719
2003	22.44	15.16	283990	90155	0	0	90155	-96917	96917	894741	193835
2004	24.13	16.02	305289	95269	0	0	95269	-105010	105010	999751	210019

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
PERCENT FINANCED: 80%
CASH INVESTMENT: \$9,415
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$4,672
TAX RATE: 50%
YEARS OF DEPRECIATION: 5
ACCELERATED DEPRECIATION? (1=YES,0=NO): 1
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED DH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	77259	43591	10697	3389	57677	-11609	7973	7973	33668
1986	6.56	7.22	83054	42937	1398	3274	47609	-13244	22202	30174	40117
1987	7.06	7.37	89283	43829	1524	3148	48501	-16210	24572	54746	45454
1988	7.59	7.6	95979	45197	1661	3011	49868	-18943	27167	81914	50782
1989	8.15	7.8	103177	46386	1810	2861	51058	-22022	30097	112011	56791
1990	8.77	8.01	110916	47635	1973	2698	52307	-30291	28318	140329	63281
1991	9.42	8.5	119234	50549	2151	2521	55221	-33082	30931	171260	68686
1992	10.13	8.78	128177	52214	2345	2327	56886	-36818	34473	205733	75963
1993	10.89	9.08	137790	53998	2556	2116	58670	-40838	38282	244015	83792
1994	11.71	9.42	148124	56020	2786	1886	60692	-45109	42323	286339	92104
1995	12.58	9.79	159234	58220	3036	1635	62892	-49689	46653	332991	101013
1996	13.53	10.19	171176	60599	3310	1362	65271	-54608	51298	384289	110577
1997	14.54	10.62	184014	63156	3608	1064	67828	-59897	56289	440579	120858
1998	15.63	11.1	197816	66011	3932	740	70683	-65533	61600	502179	131805
1999	16.81	11.62	212652	69103	4286	386	73775	-71581	67295	569474	143549
2000	18.07	12.18	228601	72433	0	0	72433	-78084	78084	647558	156167
2001	19.42	12.79	245746	76061	0	0	76061	-84842	84842	732400	169685
2002	20.88	13.46	264177	80045	0	0	80045	-92066	92066	824466	184131
2003	22.44	14.18	283990	84327	0	0	84327	-99831	99831	924297	199663
2004	24.13	14.96	305289	88966	0	0	88966	-108162	108162	1032459	216323

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD

CASE: 4
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$9,415
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$4,672
 TAX RATE: 50%
 YEARS OF DEPRECIATION: 5
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 1
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
 ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED DH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	77259	43591	10697	3389	57677	-11609	7973	7973	33668
1986	6.56	7.22	83054	42937	1398	3274	47609	-13244	22202	30174	40117
1987	7.06	7.37	89283	43829	1524	3148	48501	-16210	24572	54746	45454
1988	7.59	7.6	95979	45197	1661	3011	49868	-18943	27167	81914	50782
1989	8.15	8.3	103177	49359	1810	2861	54031	-20536	28610	110524	53818
1990	8.77	8.42	110916	50073	1973	2698	54745	-29072	27099	137623	60843
1991	9.42	8.72	119234	51857	2151	2521	56529	-32428	30277	167900	67377
1992	10.13	8.89	128177	52868	2345	2327	57540	-36491	34146	202046	75309
1993	10.89	9.07	137790	53938	2556	2116	58610	-40868	38312	240358	83852
1994	11.71	9.28	148124	55187	2786	1886	59859	-45525	42740	283098	92937
1995	12.58	9.52	159234	56615	3036	1635	61286	-50492	47455	330553	102619
1996	13.53	9.77	171176	58101	3310	1362	62773	-55856	52547	383100	113075
1997	14.54	10.06	184014	59826	3608	1064	64498	-61562	57955	441054	124189
1998	15.63	10.38	197816	61729	3932	740	66401	-67673	63741	504796	136087
1999	16.81	10.73	212652	63810	4286	386	68482	-74228	69942	574737	148841
2000	18.07	11.12	228601	66130	0	0	66130	-81235	81235	655973	162471
2001	19.42	11.55	245746	68687	0	0	68687	-88529	88529	744502	177059
2002	20.88	12.01	264177	71422	0	0	71422	-96377	96377	840879	192754
2003	22.44	12.52	283990	74455	0	0	74455	-104767	104767	945647	209534
2004	24.13	13.08	305289	77786	0	0	77786	-113752	113752	1059398	227503

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD
CASE: 5
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
PERCENT FINANCED: 80%
CASH INVESTMENT: \$9,415
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$4,672
TAX RATE: 50%
YEARS OF DEPRECIATION: 5
ACCELERATED DEPRECIATION? (1=YES,0=NO): 1
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED DH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I				TAX EFFECTS	DISTRICT HEATING SAVINGS	CUMULATIVE SAVINGS	ENERGY COST SAVINGS
	\$/MMBTU	\$/MMBTU	ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	(\$)	(\$)	(\$)	(\$)
1985	6.11	7.33	77259	43591	10697	3389	57677	-11609	7973	7973	33668
1986	6.56	7.22	83054	42937	1398	3274	47609	-13244	22202	30174	40117
1987	7.06	7.37	89283	43829	1524	3148	48501	-16210	24572	54746	45454
1988	7.59	7.6	95979	45197	1661	3011	49868	-18943	27167	81914	50782
1989	8.15	8.3	103177	49359	1810	2861	54031	-20536	28610	110524	53818
1990	8.77	8.42	110916	50073	1973	2698	54745	-29072	27099	137623	60843
1991	9.42	8.21	119234	48824	2151	2521	53496	-33945	31794	169416	70410
1992	10.13	8.37	128177	49776	2345	2327	54447	-38037	35692	205109	78401
1993	10.89	8.54	137790	50787	2556	2116	55458	-42444	39888	244997	87003
1994	11.71	8.73	148124	51917	2786	1886	56588	-47161	44375	289372	96208
1995	12.58	8.95	159234	53225	3036	1635	57897	-52187	49150	338522	106009
1996	13.53	9.19	171176	54652	3310	1362	59324	-57581	54271	392793	116524
1997	14.54	9.46	184014	56258	3608	1064	60930	-63346	59739	452532	127757
1998	15.63	9.75	197816	57982	3932	740	62654	-69547	65615	518147	139833
1999	16.81	10.08	212652	59945	4286	386	64617	-76161	71874	590021	152707
2000	18.07	10.44	228601	62086	0	0	62086	-83257	83257	673278	166515
2001	19.42	10.83	245746	64405	0	0	64405	-90670	90670	763949	181341
2002	20.88	11.27	264177	67022	0	0	67022	-98577	98577	862526	197155
2003	22.44	11.74	283990	69817	0	0	69817	-107087	107087	969613	214173
2004	24.13	12.26	305289	72909	0	0	72909	-116190	116190	1085803	232380

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: JAMESTOWN PLYWOOD

CASE: 6
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$44,200
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$47,073
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$9,415
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$4,672
 TAX RATE: 50%
 YEARS OF DEPRECIATION: 5
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 1
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 13%
 ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	12653			12653
ESTIMATED DH CONSUMPTION (MILLION BTU):				5947
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	DISTRICT HEATING				TAX EFFECTS	DISTRICT HEATING SAVINGS	CUMULATIVE SAVINGS	ENERGY COST SAVINGS
	\$/MMBTU	\$/MMBTU	ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	(\$)	(\$)	(\$)	(\$)
1985	6.11	8.33	77259	49538	10697	3389	63624	-8636	4999	4999	27721
1986	6.56	8.15	83054	48467	1398	3274	53139	-10478	19436	24436	34586
1987	7.06	8.27	89283	49181	1524	3148	53853	-13534	21896	46331	40102
1988	7.59	8.48	95979	50430	1661	3011	55102	-16326	24551	70882	45549
1989	8.15	9.58	103177	56971	1810	2861	61643	-16730	24804	95687	46206
1990	8.77	9.65	110916	57388	1973	2698	62060	-25415	23441	119128	53528
1991	9.42	9.37	119234	55723	2151	2521	60394	-30495	28344	147472	63512
1992	10.13	9.48	128177	56377	2345	2327	61049	-34736	32392	179864	71800
1993	10.89	9.61	137790	57150	2556	2116	61822	-39262	36706	216570	80640
1994	11.71	9.77	148124	58101	2786	1886	62773	-44068	41283	257853	90023
1995	12.58	9.95	159234	59172	3036	1635	63844	-49213	46177	304030	100062
1996	13.53	10.15	171176	60361	3310	1362	65033	-54726	51417	355447	110815
1997	14.54	10.38	184014	61729	3608	1064	66401	-60611	57003	412450	122286
1998	15.63	10.63	197816	63216	3932	740	67888	-66930	62998	475448	134600
1999	16.81	10.92	212652	64940	4286	386	69612	-73663	69377	544824	147711
2000	18.07	11.24	228601	66843	0	0	66843	-80879	80879	625703	161757
2001	19.42	11.6	245746	68984	0	0	68984	-88381	88381	714084	176761
2002	20.88	11.99	264177	71303	0	0	71303	-96437	96437	810520	192873
2003	22.44	12.43	283990	73920	0	0	73920	-105035	105035	915555	210070
2004	24.13	12.9	305289	76715	0	0	76715	-114287	114287	1029842	228574

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL

CASE: 1
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$19,085
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$9,471
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 22
 ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	42115			42115
ESTIMATED DH CONSUMPTION (MILLION BTU):				28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I			TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	AMORTIZATION PRINC.	INTER.					
1985	6.11	6.58	257154	188439	21685	6871	216995	0	40159	40159	68715
1986	6.56	6.73	276441	192735	2834	6637	202206	0	74235	114395	83706
1987	7.06	6.89	297174	197317	3089	6381	206788	0	90386	204781	99857
1988	7.59	7.14	319462	204477	3367	6103	213947	0	105515	310295	114985
1989	8.15	7.34	343421	210204	3670	5800	219675	0	123747	434042	133217
1990	8.77	7.57	369178	216791	4000	5470	226262	0	142916	576958	152387
1991	9.42	8.07	396866	231110	4361	5110	240581	0	156286	733244	165756
1992	10.13	8.36	426631	239415	4753	4718	248886	0	177746	910989	187216
1993	10.89	8.68	458629	248580	5181	4290	258050	0	200579	1111568	210049
1994	11.71	9.03	493026	258603	5647	3824	268074	0	224952	1336520	234423
1995	12.58	9.41	530003	269485	6155	3315	278956	0	251047	1587567	260517
1996	13.53	9.82	569753	281227	6709	2761	290698	0	279055	1866623	288526
1997	14.54	10.28	612485	294401	7313	2158	303871	0	308613	2175236	318084
1998	15.63	10.77	658421	308433	7971	1499	317904	0	340517	2515753	349988
1999	16.81	11.3	707803	323612	8689	782	333082	0	374720	2890473	384191
2000	18.07	11.88	760888	340222	0	0	340222	0	420666	3311139	420666
2001	19.42	12.51	817954	358264	0	0	358264	0	459690	3770830	459690
2002	20.88	13.18	879301	377451	0	0	377451	0	501849	4272679	501849
2003	22.44	13.92	945248	398644	0	0	398644	0	546605	4819284	546605
2004	24.13	14.72	1016142	421554	0	0	421554	0	594588	5413871	594588

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL

CASE: 2
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$19,085
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$9,471
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 2%
 ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE	
	PRIMARY GAS	BACKUP BACKUP TOTAL
FUEL TYPE:		
CONSUMPTION (MILLION BTU):	42115	42115
ESTIMATED DH CONSUMPTION (MILLION BTU):		28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68	
FUEL ESCALATION RATE:	7.50%	

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	DISTRICT HEATING				TAX EFFECTS	DISTRICT HEATING SAVINGS	CUMULATIVE SAVINGS	ENERGY COST SAVINGS
	\$/MMBTU	\$/MMBTU	ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	(\$)	(\$)	(\$)	(\$)
1985	6.11	7.33	257154	209918	21685	6871	238473	0	18681	18681	47236
1986	6.56	7.48	276441	214214	2834	6637	223684	0	52756	71437	62227
1987	7.06	7.65	297174	219082	3089	6381	228553	0	68621	140058	78092
1988	7.59	7.91	319462	226528	3367	6103	235999	0	83463	223521	92934
1989	8.15	8.13	343421	232829	3670	5800	242299	0	101122	324644	110593
1990	8.77	8.37	369178	239702	4000	5470	249172	0	120006	444650	129476
1991	9.42	8.9	396866	254880	4361	5110	264351	0	132516	577166	141986
1992	10.13	9.21	426631	263758	4753	4718	273228	0	153403	730569	162874
1993	10.89	9.54	458629	273208	5181	4290	282679	0	175950	906518	185420
1994	11.71	9.91	493026	283805	5647	3824	293275	0	199751	1106269	209221
1995	12.58	10.32	530003	295546	6155	3315	305017	0	224986	1331255	234457
1996	13.53	10.76	569753	308147	6709	2761	317618	0	252136	1583391	261606
1997	14.54	11.24	612485	321893	7313	2158	331364	0	281121	1864512	290591
1998	15.63	11.77	658421	337072	7971	1499	346542	0	311879	2176390	321349
1999	16.81	12.34	707803	353395	8689	782	362866	0	344937	2521327	354407
2000	18.07	12.96	760888	371151	0	0	371151	0	389737	2911064	389737
2001	19.42	13.63	817954	390339	0	0	390339	0	427616	3338679	427616
2002	20.88	14.37	879301	411531	0	0	411531	0	467770	3806449	467770
2003	22.44	15.16	945248	434155	0	0	434155	0	511093	4317542	511093
2004	24.13	16.02	1016142	458784	0	0	458784	0	557358	4874901	557358

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
PERCENT FINANCED: 80%
CASH INVESTMENT: \$19,085
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$9,471
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 2%
ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	42115			42115
ESTIMATED DH CONSUMPTION (MILLION BTU):				28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	257154	209918	21685	6871	238473	0	18681	18681	47236
1986	6.56	7.22	276441	206768	2834	6637	216238	0	60202	78883	69673
1987	7.06	7.37	297174	211064	3089	6381	220534	0	26640	155523	86110
1988	7.59	7.6	319462	217650	3367	6103	227121	0	92341	247864	101812
1989	8.15	7.8	343421	223378	3670	5800	232849	0	110573	358437	120044
1990	8.77	8.01	369178	229392	4000	5470	238863	0	130316	488752	139786
1991	9.42	8.5	396866	243425	4361	5110	252895	0	143971	632724	153442
1992	10.13	8.78	426631	251443	4753	4718	260914	0	165717	798441	175188
1993	10.89	9.08	458629	260035	5181	4290	269505	0	189123	987565	198594
1994	11.71	9.42	493026	269772	5647	3824	279242	0	213784	1201348	223254
1995	12.58	9.79	530003	280368	6155	3315	289839	0	240164	1441512	249635
1996	13.53	10.19	569753	291823	6709	2761	301294	0	268459	1709972	277930
1997	14.54	10.62	612485	304138	7313	2158	313608	0	298876	2008848	308347
1998	15.63	11.1	658421	317884	7971	1499	327355	0	331066	2339914	340537
1999	16.81	11.62	707803	332776	8689	782	342246	0	365556	2705471	375027
2000	18.07	12.18	760888	348813	0	0	348813	0	412074	3117545	412074
2001	19.42	12.79	817954	366283	0	0	366283	0	451672	3569217	451672
2002	20.88	13.46	879301	385470	0	0	385470	0	493831	4063047	493831
2003	22.44	14.18	945248	406090	0	0	406090	0	539159	4602206	539159
2004	24.13	14.96	1016142	428427	0	0	428427	0	587715	5189921	587715

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL

CASE: 4
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$19,085
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$9,471
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 2%
 ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	42115			42115
ESTIMATED DH CONSUMPTION (MILLION BTU):				28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	[----- DISTRICT HEATING -----]			TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.					
1985	6.11	7.33	257154	209918	21685	6871	238473	0	18681	18681	47236
1986	6.56	7.22	276441	206768	2834	6637	216238	0	60202	78883	69673
1987	7.06	7.37	297174	211064	3089	6381	220534	0	76640	155523	86110
1988	7.59	7.6	319462	217650	3367	6103	227121	0	92341	247864	101812
1989	8.15	8.3	343421	237697	3670	5800	247168	0	96254	344118	105724
1990	8.77	8.42	369178	241134	4000	5470	250604	0	118574	462692	128044
1991	9.42	8.72	396866	249725	4361	5110	259196	0	137671	600362	147141
1992	10.13	8.89	426631	254594	4753	4718	264064	0	162567	762930	172038
1993	10.89	9.07	458629	259748	5181	4290	269219	0	189410	952340	198880
1994	11.71	9.28	493026	265762	5647	3824	275233	0	217793	1170132	227263
1995	12.58	9.52	530003	272636	6155	3315	282106	0	247897	1418029	257367
1996	13.53	9.77	569753	279795	6709	2761	289266	0	280487	1698516	289958
1997	14.54	10.06	612485	288100	7313	2158	297571	0	314914	2013430	324384
1998	15.63	10.38	658421	297265	7971	1499	306735	0	351686	2365116	361156
1999	16.81	10.73	707803	307288	8689	782	316758	0	391044	2756160	400515
2000	18.07	11.12	760888	318457	0	0	318457	0	442431	3198591	442431
2001	19.42	11.55	817954	330771	0	0	330771	0	487183	3685774	487183
2002	20.88	12.01	879301	343945	0	0	343945	0	535356	4221130	535356
2003	22.44	12.52	945248	358550	0	0	358550	0	586698	4807828	586698
2004	24.13	13.08	1016142	374588	0	0	374588	0	641554	5449383	641554

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL

CASE: 5
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$19,085
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$9,471
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 2%
 ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	42115			42115
ESTIMATED DH CONSUMPTION (MILLION BTU):				28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	DH ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC. INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	7.33	257154	209918	21685 6871	238473	0	18681	18681	47236
1986	6.56	7.22	276441	206768	2834 6637	216238	0	60202	78883	67673
1987	7.06	7.37	297174	211064	3089 6381	220534	0	76640	155523	86110
1988	7.59	7.6	319462	217650	3367 6103	227121	0	92341	247864	101812
1989	8.15	8.3	343421	237697	3670 5800	247168	0	96254	344118	105724
1990	8.77	8.42	369178	241134	4000 5470	250604	0	118574	462692	128044
1991	9.42	8.21	396866	235120	4361 5110	244590	0	152276	614968	161747
1992	10.13	8.37	426631	239702	4753 4718	249172	0	177459	792427	186930
1993	10.89	8.54	458629	244570	5181 4290	254041	0	204588	997015	214059
1994	11.71	8.73	493026	250011	5647 3824	259482	0	233544	1230559	243014
1995	12.58	8.95	530003	256312	6155 3315	265782	0	264220	1494779	273691
1996	13.53	9.19	569753	263185	6709 2761	272656	0	297098	1791877	306568
1997	14.54	9.46	612485	270917	7313 2158	280388	0	332097	2123974	341567
1998	15.63	9.75	658421	279222	7971 1499	288693	0	369728	2493702	379198
1999	16.81	10.08	707803	288673	8689 782	298144	0	409659	2903361	419129
2000	18.07	10.44	760888	298983	0 0	298983	0	461905	3365265	461905
2001	19.42	10.83	817954	310152	0 0	310152	0	507803	3873068	507803
2002	20.88	11.27	879301	322753	0 0	322753	0	556548	4429616	556548
2003	22.44	11.74	945248	336212	0 0	336212	0	609036	5038652	609036
2004	24.13	12.26	1016142	351104	0 0	351104	0	665038	5703690	665038

PAYBACK (NO FINANCING) IN YEAR: 1986

PAYBACK (WITH FINANCING) IN YEAR: 1986

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: WCA HOSPITAL

CASE: 6
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$89,600
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$95,424
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$19,085
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$9,471
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 22
 ESTIMATED CURRENT BOILER EFFICIENCY: 70.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	42115			42115
ESTIMATED DH CONSUMPTION (MILLION BTU):				28638
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	I----- ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC. INTER.	-----I TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	8.33	257154	238556	21685 6871	267112	0	-9957	-9957	18598
1986	6.56	8.15	276441	233401	2834 6637	242872	0	33569	23611	43039
1987	7.06	8.27	297174	236838	3089 6381	246308	0	50865	74477	60336
1988	7.59	8.48	319462	242852	3367 6103	252322	0	67139	141616	76610
1989	8.15	9.58	343421	274354	3670 5800	283825	0	59597	201213	69068
1990	8.77	9.65	369178	276359	4000 5470	285829	0	83349	284562	92819
1991	9.42	9.37	396866	268340	4361 5110	277810	0	119056	403618	128527
1992	10.13	9.48	426631	271490	4753 4718	280961	0	145671	549289	155141
1993	10.89	9.61	458629	275213	5181 4290	284684	0	173945	723234	183416
1994	11.71	9.77	493026	279795	5647 3824	289266	0	203760	926994	213231
1995	12.58	9.95	530003	284950	6155 3315	294421	0	235582	1162576	245053
1996	13.53	10.15	569753	290678	6709 2761	300148	0	269605	1432181	279075
1997	14.54	10.38	612485	297265	7313 2158	306735	0	305750	1737931	315220
1998	15.63	10.63	658421	304424	7971 1499	313895	0	344526	2082457	353997
1999	16.81	10.92	707803	312729	8689 782	322200	0	385603	2468060	395073
2000	18.07	11.24	760888	321893	0 0	321893	0	438994	2907054	438994
2001	19.42	11.6	817954	332203	0 0	332203	0	485751	3392805	485751
2002	20.88	11.99	879301	343372	0 0	343372	0	535929	3928734	535929
2003	22.44	12.43	945248	355973	0 0	355973	0	589276	4518010	589276
2004	24.13	12.9	1016142	369433	0 0	369433	0	646709	5164719	646709

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 1
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS						
1985	6.11	6.58	36099	21162	9124	2891	33177	0	2922	2922	14937
1986	6.56	6.73	38806	21645	1192	2792	25629	0	13177	16098	17162
1987	7.06	6.89	41717	22159	1300	2685	26144	0	15573	31671	19557
1988	7.59	7.14	44845	22963	1417	2568	26948	0	17897	49568	21982
1989	8.15	7.34	48209	23606	1544	2441	27591	0	20617	70186	24602
1990	8.77	7.57	51824	24346	1683	2302	28331	0	23493	93679	27478
1991	9.42	8.07	55711	25954	1835	2150	29939	0	25772	119451	29757
1992	10.13	8.36	59889	26887	2000	1985	30872	0	29018	148469	33003
1993	10.89	8.68	64381	27916	2180	1805	31901	0	32480	180949	36465
1994	11.71	9.03	69210	29042	2376	1609	33026	0	36183	217133	40168
1995	12.58	9.41	74401	30264	2590	1395	34249	0	40152	257285	44137
1996	13.53	9.82	79981	31582	2823	1162	35567	0	44413	301698	48398
1997	14.54	10.28	85979	33062	3077	908	37047	0	48932	350630	52917
1998	15.63	10.77	92428	34638	3354	631	38623	0	53805	404435	57790
1999	16.81	11.3	99360	36342	3656	329	40327	0	59033	463468	63017
2000	18.07	11.88	106812	38208	0	0	38208	0	68604	532072	68604
2001	19.42	12.51	114822	40234	0	0	40234	0	74589	606661	74589
2002	20.88	13.18	123434	42389	0	0	42389	0	81046	687706	81046
2003	22.44	13.92	132692	44769	0	0	44769	0	87923	775629	87923
2004	24.13	14.72	142644	47341	0	0	47341	0	95302	870931	95302

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1987

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 2
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	----- CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I				TAX EFFECTS	DISTRICT HEATING SAVINGS	CUMULATIVE SAVINGS	ENERGY COST SAVINGS
	\$/MMBTU	\$/MMBTU	COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	(\$)	(\$)	(\$)	(\$)
1985	6.11	7.33	36099	23574	9124	2891	35589	0	510	510	12524
1986	6.56	7.48	38806	24057	1192	2792	28041	0	10765	11274	14749
1987	7.06	7.65	41717	24603	1300	2685	28588	0	13128	24402	17113
1988	7.59	7.91	44845	25440	1417	2568	29424	0	15421	39823	19406
1989	8.15	8.13	48209	26147	1544	2441	30132	0	18077	57900	22062
1990	8.77	8.37	51824	26919	1683	2302	30904	0	20920	78821	24905
1991	9.42	8.9	55711	28624	1835	2150	32608	0	23103	101923	27088
1992	10.13	9.21	59889	29621	2000	1985	33605	0	26284	128207	30269
1993	10.89	9.54	64381	30682	2180	1805	34667	0	29714	157922	33699
1994	11.71	9.91	69210	31872	2376	1609	35857	0	33353	191275	37338
1995	12.58	10.32	74401	33190	2590	1395	37175	0	37225	228500	41210
1996	13.53	10.76	79981	34606	2823	1162	38590	0	41390	269890	45375
1997	14.54	11.24	85979	36149	3077	908	40134	0	45845	315735	49830
1998	15.63	11.77	92428	37854	3354	631	41839	0	50589	366324	54574
1999	16.81	12.34	99360	39687	3656	329	43672	0	55688	422012	59673
2000	18.07	12.96	106812	41681	0	0	41681	0	65131	487143	65131
2001	19.42	13.63	114822	43836	0	0	43836	0	70987	558129	70987
2002	20.88	14.37	123434	46216	0	0	46216	0	77218	635348	77218
2003	22.44	15.16	132692	48757	0	0	48757	0	83935	719283	83935
2004	24.13	16.02	142644	51522	0	0	51522	0	91121	810404	91121

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES, 0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	I----- CURRENT ENERGY	DISTRICT HEATING CONVERSION AMORTIZATION	-----I TOTAL	TAX EFFECTS	DISTRICT HEATING	CUMULATIVE	ENERGY		
	\$/MMBTU	\$/MMBTU	COSTS	ENERGY COSTS	PRINC.	INTER.	COSTS	(\$)	SAVINGS	SAVINGS	COST SAVINGS
1985	6.11	7.33	36099	23574	9124	2891	35589	0	510	510	12524
1986	6.56	7.22	38806	23220	1192	2792	27205	0	11601	12110	15586
1987	7.06	7.37	41717	23703	1300	2685	27688	0	14029	26139	18014
1988	7.59	7.6	44845	24443	1417	2568	28427	0	16418	42557	20403
1989	8.15	7.8	48209	25086	1544	2441	29071	0	19138	61695	23123
1990	8.77	8.01	51824	25761	1683	2302	29746	0	22078	83773	26063
1991	9.42	8.5	55711	27337	1835	2150	31322	0	24389	108163	28374
1992	10.13	8.78	59889	28238	2000	1985	32222	0	27667	135830	31652
1993	10.89	9.08	64381	29202	2180	1805	33187	0	31194	167024	35179
1994	11.71	9.42	69210	30296	2376	1609	34281	0	34929	201953	38914
1995	12.58	9.79	74401	31486	2590	1395	35471	0	38930	240882	42915
1996	13.53	10.19	79981	32772	2823	1162	36757	0	43223	284106	47208
1997	14.54	10.62	85979	34155	3077	908	38140	0	47839	331945	51824
1998	15.63	11.1	92428	35699	3354	631	39684	0	52744	384688	56728
1999	16.81	11.62	99360	37371	3656	329	41356	0	58003	442692	61988
2000	18.07	12.18	106812	39172	0	0	39172	0	67639	510331	67639
2001	19.42	12.79	114822	41134	0	0	41134	0	73688	584019	73688
2002	20.88	13.46	123434	43289	0	0	43289	0	80145	664164	80145
2003	22.44	14.18	132692	45605	0	0	45605	0	87087	751251	87087
2004	24.13	14.96	142644	48113	0	0	48113	0	94530	845781	94530

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 4
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	DISTRICT HEATING					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	36099	23574	9124	2891	35589	0	510	510	12524
1986	6.56	7.22	38806	23220	1192	2792	27205	0	11601	12110	15586
1987	7.06	7.37	41717	23703	1300	2685	27688	0	14029	26139	18014
1988	7.59	7.6	44845	24443	1417	2568	28427	0	16418	42557	20403
1989	8.15	8.3	48209	26694	1544	2441	30679	0	17530	60087	21515
1990	8.77	8.42	51824	27080	1683	2302	31065	0	20760	80847	24745
1991	9.42	8.72	55711	28045	1835	2150	32029	0	23682	104528	27666
1992	10.13	8.89	59889	28591	2000	1985	32576	0	27313	131842	31298
1993	10.89	9.07	64381	29170	2180	1805	33155	0	31226	163068	35211
1994	11.71	9.28	69210	29846	2376	1609	33830	0	35379	198447	39364
1995	12.58	9.52	74401	30618	2590	1395	34602	0	39798	238245	43783
1996	13.53	9.77	79981	31422	2823	1162	35406	0	44574	282819	48559
1997	14.54	10.06	85979	32354	3077	908	36339	0	49640	332459	53625
1998	15.63	10.38	92428	33383	3354	631	37368	0	55059	387519	59044
1999	16.81	10.73	99360	34509	3656	329	38494	0	60866	448384	64851
2000	18.07	11.12	106812	35763	0	0	35763	0	71048	519433	71048
2001	19.42	11.55	114822	37146	0	0	37146	0	77676	597109	77676
2002	20.88	12.01	123434	38626	0	0	38626	0	84808	681917	84808
2003	22.44	12.52	132692	40266	0	0	40266	0	92426	774343	92426
2004	24.13	13.08	142644	42067	0	0	42067	0	100577	874919	100577

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 5
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I			TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
				ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.				
1985	6.11	7.33	36099	23574	9124	2891	35589	0	510	12524
1986	6.56	7.22	38806	23220	1192	2792	27205	0	11601	15586
1987	7.06	7.37	41717	23703	1300	2685	27688	0	14029	18014
1988	7.59	7.6	44845	24443	1417	2568	28427	0	16418	20403
1989	8.15	8.3	48209	26694	1544	2441	30679	0	17530	21515
1990	8.77	8.42	51824	27080	1683	2302	31065	0	20760	24745
1991	9.42	8.21	55711	26404	1835	2150	30389	0	25322	29307
1992	10.13	8.37	59889	26919	2000	1985	30904	0	28986	32970
1993	10.89	8.54	64381	27466	2180	1805	31451	0	32931	36915
1994	11.71	8.73	69210	28077	2376	1609	32062	0	37148	41133
1995	12.58	8.95	74401	28784	2590	1395	32769	0	41631	45616
1996	13.53	9.19	79981	29556	2823	1162	33541	0	46440	50424
1997	14.54	9.46	85979	30425	3077	908	34409	0	51570	55555
1998	15.63	9.75	92428	31357	3354	631	35342	0	57085	61070
1999	16.81	10.08	99360	32419	3656	329	36403	0	62956	66941
2000	18.07	10.44	106812	33576	0	0	33576	0	73235	73235
2001	19.42	10.83	114822	34831	0	0	34831	0	79992	79992
2002	20.88	11.27	123434	36246	0	0	36246	0	87188	87188
2003	22.44	11.74	132692	37757	0	0	37757	0	94934	94934
2004	24.13	12.26	142644	39430	0	0	39430	0	103214	103214

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 6
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$37,700
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$40,151
PERCENT FINANCED: 80%
CASH INVESTMENT: \$8,030
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$3,985
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 6%
ESTIMATED CURRENT BOILER EFFICIENCY: 60.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	5912			5912
ESTIMATED DH CONSUMPTION (MILLION BTU):				3216
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	DISTRICT HEATING					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	8.33	36099	26790	9124	2891	38805	0	-2707	-2707	9308
1986	6.56	8.15	38806	26211	1192	2792	30196	0	8610	5903	12595
1987	7.06	8.27	41717	26597	1300	2685	30582	0	11134	17038	15119
1988	7.59	8.48	44845	27273	1417	2568	31258	0	13588	30625	17573
1989	8.15	9.58	48209	30811	1544	2441	34795	0	13413	44039	17398
1990	8.77	9.65	51824	31036	1683	2302	35020	0	16804	60842	20789
1991	9.42	9.37	55711	30135	1835	2150	34120	0	21591	82434	25576
1992	10.13	9.48	59889	30489	2000	1985	34474	0	25416	107849	29401
1993	10.89	9.61	64381	30907	2180	1805	34892	0	29489	137339	33474
1994	11.71	9.77	69210	31422	2376	1609	35406	0	33803	171142	37788
1995	12.58	9.95	74401	32000	2590	1395	35985	0	38415	209557	42400
1996	13.53	10.15	79981	32644	2823	1162	36629	0	43352	252909	47337
1997	14.54	10.38	85979	33383	3077	908	37368	0	48611	301520	52596
1998	15.63	10.63	92428	34187	3354	631	38172	0	54255	355775	58240
1999	16.81	10.92	99360	35120	3656	329	39105	0	60255	416030	64239
2000	18.07	11.24	106812	36149	0	0	36149	0	70662	486692	70662
2001	19.42	11.6	114822	37307	0	0	37307	0	77515	564208	77515
2002	20.88	11.99	123434	38561	0	0	38561	0	84873	649080	84873
2003	22.44	12.43	132692	39976	0	0	39976	0	92715	741796	92715
2004	24.13	12.9	142644	41488	0	0	41488	0	101155	842951	101155

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YWCA
CASE: 1
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
PERCENT FINANCED: 80%
CASH INVESTMENT: \$3,365
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$1,670
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE		DH FUEL RATE		DISTRICT HEATING			TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS		ENERGY COST SAVINGS (\$)
	\$/MMBTU	\$/MMBTU	CURRENT ENERGY COSTS	DH ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS		CUMULATIVE SAVINGS (\$)		
1985	6.11	6.58	13415	7864	3824	1212	12900	0	515	515	5551
1986	6.56	6.73	14421	8043	500	1170	9714	0	4707	5223	6378
1987	7.06	6.89	15503	8235	545	1125	9905	0	5598	10821	7268
1988	7.59	7.14	16665	8533	594	1076	10204	0	6462	17282	8132
1989	8.15	7.34	17915	8773	647	1023	10443	0	7473	24755	9143
1990	8.77	7.57	19259	9047	705	965	10717	0	8541	33296	10211
1991	9.42	8.07	20703	9645	769	901	11315	0	9388	42684	11058
1992	10.13	8.36	22256	9992	838	832	11662	0	10594	53279	12264
1993	10.89	8.68	23925	10374	914	756	12044	0	11881	65160	13551
1994	11.71	9.03	25720	10792	996	674	12462	0	13257	78417	14927
1995	12.58	9.41	27648	11247	1085	585	12917	0	14732	93149	16402
1996	13.53	9.82	29722	11737	1183	487	13407	0	16316	109464	17986
1997	14.54	10.28	31951	12286	1290	380	13956	0	17995	127459	19665
1998	15.63	10.77	34348	12872	1406	264	14542	0	19806	147265	21476
1999	16.81	11.3	36924	13505	1532	138	15175	0	21748	169013	23418
2000	18.07	11.88	39693	14199	0	0	14199	0	25494	194508	25494
2001	19.42	12.51	42670	14952	0	0	14952	0	27718	222226	27718
2002	20.88	13.18	45870	15752	0	0	15752	0	30118	252344	30118
2003	22.44	13.92	49310	16637	0	0	16637	0	32674	285018	32674
2004	24.13	14.72	53009	17593	0	0	17593	0	35416	320434	35416

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 2
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
PERCENT FINANCED: 80%
CASH INVESTMENT: \$3,365
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$1,670
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	13415	8761	3824	1212	13796	0	-381	-381	4654
1986	6.56	7.48	14421	8940	500	1170	10610	0	3811	3430	5481
1987	7.06	7.65	15503	9143	545	1125	10813	0	4690	8119	6360
1988	7.59	7.91	16665	9454	594	1076	11124	0	5541	13661	7211
1989	8.15	8.13	17915	9717	647	1023	11387	0	6528	20189	8198
1990	8.77	8.37	19259	10004	705	965	11674	0	7585	27775	9255
1991	9.42	8.9	20703	10637	769	901	12307	0	8396	36171	10066
1992	10.13	9.21	22256	11007	838	832	12678	0	9578	45749	11248
1993	10.89	9.54	23925	11402	914	756	13072	0	10853	56602	12523
1994	11.71	9.91	25720	11844	996	674	13514	0	12205	68808	13875
1995	12.58	10.32	27648	12334	1085	585	14004	0	13644	82452	15314
1996	13.53	10.76	29722	12860	1183	487	14530	0	15192	97644	16862
1997	14.54	11.24	31951	13434	1290	380	15104	0	16848	114492	18518
1998	15.63	11.77	34348	14067	1406	264	15737	0	18610	133102	20281
1999	16.81	12.34	36924	14748	1532	138	16418	0	20505	153608	22175
2000	18.07	12.96	39693	15489	0	0	15489	0	24204	177811	24204
2001	19.42	13.63	42670	16290	0	0	16290	0	26380	204191	26380
2002	20.88	14.37	45870	17175	0	0	17175	0	28696	232887	28696
2003	22.44	15.16	49310	18119	0	0	18119	0	31192	264078	31192
2004	24.13	16.02	53009	19147	0	0	19147	0	33862	297941	33862

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YWCA
CASE: 3
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
PERCENT FINANCED: 80%
CASH INVESTMENT: \$3,365
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$1,670
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	7.33	13415	8761	3824	1212	13796	0	-381	-381	4654
1986	6.56	7.22	14421	8629	500	1170	10299	0	4122	3741	5792
1987	7.06	7.37	15503	8808	545	1125	10478	0	5024	8765	6694
1988	7.59	7.6	16665	9083	594	1076	10753	0	5912	14677	7582
1989	8.15	7.8	17915	9322	647	1023	10992	0	6923	21600	8593
1990	8.77	8.01	19259	9573	705	965	11243	0	8015	29615	9686
1991	9.42	8.5	20703	10159	769	901	11829	0	8874	38489	10544
1992	10.13	8.78	22256	10494	838	832	12164	0	10092	48582	11762
1993	10.89	9.08	23925	10852	914	756	12522	0	11403	59985	13073
1994	11.71	9.42	25720	11258	996	674	12929	0	12791	72776	14461
1995	12.58	9.79	27648	11701	1085	585	13371	0	14278	87053	15948
1996	13.53	10.19	29722	12179	1183	487	13849	0	15873	102927	17543
1997	14.54	10.62	31951	12693	1290	380	14363	0	17589	120515	19259
1998	15.63	11.1	34348	13266	1406	264	14936	0	19411	139927	21081
1999	16.81	11.62	36924	13888	1532	138	15558	0	21366	161292	23036
2000	18.07	12.18	39693	14557	0	0	14557	0	25136	186428	25136
2001	19.42	12.79	42670	15286	0	0	15286	0	27384	213812	27384
2002	20.88	13.46	45870	16087	0	0	16087	0	29783	243595	29783
2003	22.44	14.18	49310	16947	0	0	16947	0	32363	275958	32363
2004	24.13	14.96	53009	17880	0	0	17880	0	35129	311087	35129

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
 CASE: 4
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$3,365
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$1,670
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
 ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE -----			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE	DH FUEL RATE	CURRENT ENERGY COSTS	I----- DISTRICT HEATING -----I				TAX EFFECTS	DISTRICT HEATING SAVINGS	CUMULATIVE SAVINGS	ENERGY COST SAVINGS
	\$/MMBTU	\$/MMBTU	ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS	(\$)	(\$)	(\$)	(\$)
1985	6.11	7.33	13415	8761	3824	1212	13796	0	-381	-381	4654
1986	6.56	7.22	14421	8629	500	1170	10299	0	4122	3741	5792
1987	7.06	7.37	15503	8808	545	1125	10478	0	5024	8765	6694
1988	7.59	7.6	16665	9083	594	1076	10753	0	5912	14677	7582
1989	8.15	8.3	17915	9920	647	1023	11590	0	6325	21002	7995
1990	8.77	8.42	19259	10063	705	965	11733	0	7525	28528	9195
1991	9.42	8.72	20703	10422	769	901	12092	0	8611	37139	10281
1992	10.13	8.89	22256	10625	838	832	12295	0	9961	47100	11631
1993	10.89	9.07	23925	10840	914	756	12510	0	11415	58515	13085
1994	11.71	9.28	25720	11091	996	674	12761	0	12958	71473	14628
1995	12.58	9.52	27648	11378	1085	585	13048	0	14600	86073	16270
1996	13.53	9.77	29722	11677	1183	487	13347	0	16375	102449	18045
1997	14.54	10.06	31951	12023	1290	380	13693	0	18258	120707	19928
1998	15.63	10.38	34348	12406	1406	264	14076	0	20272	140978	21942
1999	16.81	10.73	36924	12824	1532	138	14494	0	22430	163408	24100
2000	18.07	11.12	39693	13290	0	0	13290	0	26403	189811	26403
2001	19.42	11.55	42670	13804	0	0	13804	0	28866	218676	28866
2002	20.88	12.01	45870	14354	0	0	14354	0	31516	250193	31516
2003	22.44	12.52	49310	14964	0	0	14964	0	34347	284540	34347
2004	24.13	13.08	53009	15633	0	0	15633	0	37376	321916	37376

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YWCA
 CASE: 5
 PRESENT YEAR: 1984
 HOOKUP YEAR: 1985
 TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
 ESCALATION RATE: 6.50%
 TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
 PERCENT FINANCED: 80%
 CASH INVESTMENT: \$3,365
 TERM OF LOAN (YEARS): 15
 INTEREST RATE: 9.00%
 ANNUAL PAYMENT: \$1,670
 TAX RATE: 0%
 YEARS OF DEPRECIATION: 0
 ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
 POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
 ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
 HEATING EQUIPMENT TYPE: GAS BOILER

	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	CURRENT ENERGY COSTS	ENERGY COSTS	DISTRICT HEATING CONVERSION AMORTIZATION PRINC. INTER.	TOTAL COSTS	TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
1985	6.11	7.33	13415	8761	3824 1212	13796	0	-381	-381	4654
1986	6.56	7.22	14421	8629	500 1170	10299	0	4122	3741	5792
1987	7.06	7.37	15503	8808	545 1125	10478	0	5024	8765	6694
1988	7.59	7.6	16665	9083	594 1076	10753	0	5912	14677	7582
1989	8.15	8.3	17915	9920	647 1023	11590	0	6325	21002	7995
1990	8.77	8.42	19259	10063	705 965	11733	0	7525	28528	9195
1991	9.42	8.21	20703	9812	769 901	11482	0	9221	37748	10891
1992	10.13	8.37	22256	10004	838 832	11674	0	10582	48331	12252
1993	10.89	8.54	23925	10207	914 756	11877	0	12048	60379	13718
1994	11.71	8.73	25720	10434	996 674	12104	0	13616	73995	15286
1995	12.58	8.95	27648	10697	1085 585	12367	0	15282	89277	16952
1996	13.53	9.19	29722	10984	1183 487	12654	0	17069	106345	18739
1997	14.54	9.46	31951	11306	1290 380	12976	0	18975	125320	20645
1998	15.63	9.75	34348	11653	1406 264	13323	0	21025	146345	22695
1999	16.81	10.08	36924	12047	1532 138	13717	0	23206	169551	24876
2000	18.07	10.44	39693	12478	0 0	12478	0	27215	196767	27215
2001	19.42	10.83	42670	12944	0 0	12944	0	29726	226493	29726
2002	20.88	11.27	45870	13470	0 0	13470	0	32401	258893	32401
2003	22.44	11.74	49310	14031	0 0	14031	0	35279	294173	35279
2004	24.13	12.26	53009	14653	0 0	14653	0	38356	332529	38356

PAYBACK (NO FINANCING) IN YEAR: 1987

PAYBACK (WITH FINANCING) IN YEAR: 1988

JAMESTOWN DISTRICT HEATING

COST COMPARISON FOR: YMCA
CASE: 6
PRESENT YEAR: 1984
HOOKUP YEAR: 1985
TOTAL CONVERSION COST (PRESENT YEAR): \$15,800
ESCALATION RATE: 6.50%
TOTAL CONVERSION COST (HOOKUP YEAR): \$16,827
PERCENT FINANCED: 80%
CASH INVESTMENT: \$3,365
TERM OF LOAN (YEARS): 15
INTEREST RATE: 9.00%
ANNUAL PAYMENT: \$1,670
TAX RATE: 0%
YEARS OF DEPRECIATION: 0
ACCELERATED DEPRECIATION? (1=YES,0=NO): 0
POTENTIAL END USE ENERGY SAVINGS FROM CONVERSION: 9%
ESTIMATED CURRENT BOILER EFFICIENCY: 63.0%
HEATING EQUIPMENT TYPE: GAS BOILER

	CURRENT ANNUAL FUEL USE			
	PRIMARY	BACKUP	BACKUP	TOTAL
FUEL TYPE:	GAS			
CONSUMPTION (MILLION BTU):	2197			2197
ESTIMATED DH CONSUMPTION (MILLION BTU):				1195
CURRENT FUEL RATE (\$/MILLION BTU):	5.68			
FUEL ESCALATION RATE:	7.50%			

YEAR	CURRENT FUEL RATE \$/MMBTU	DH FUEL RATE \$/MMBTU	I----- DISTRICT HEATING -----I					TAX EFFECTS (\$)	DISTRICT HEATING SAVINGS (\$)	CUMULATIVE SAVINGS (\$)	ENERGY COST SAVINGS (\$)
			CURRENT ENERGY COSTS	ENERGY COSTS	CONVERSION AMORTIZATION PRINC.	INTER.	TOTAL COSTS				
1985	6.11	8.33	13415	9956	3824	1212	14991	0	-1576	-1576	3459
1986	6.56	8.15	14421	9741	500	1170	11411	0	3010	1434	4680
1987	7.06	8.27	15503	9884	545	1125	11554	0	3949	5383	5619
1988	7.59	8.48	16665	10135	594	1076	11805	0	4860	10243	6530
1989	8.15	9.58	17915	11450	647	1023	13120	0	4795	15038	6465
1990	8.77	9.65	19259	11533	705	965	13203	0	6055	21094	7725
1991	9.42	9.37	20703	11199	769	901	12869	0	7834	28928	9504
1992	10.13	9.48	22256	11330	838	832	13000	0	9256	38184	10926
1993	10.89	9.61	23925	11486	914	756	13156	0	10770	48953	12440
1994	11.71	9.77	25720	11677	996	674	13347	0	12373	61326	14043
1995	12.58	9.95	27648	11892	1085	585	13562	0	14087	75413	15757
1996	13.53	10.15	29722	12131	1183	487	13801	0	15921	91334	17591
1997	14.54	10.38	31951	12406	1290	380	14076	0	17875	109209	19545
1998	15.63	10.63	34348	12705	1406	264	14375	0	19973	129182	21643
1999	16.81	10.92	36924	13051	1532	138	14721	0	22202	151385	23872
2000	18.07	11.24	39693	13434	0	0	13434	0	26259	177644	26259
2001	19.42	11.6	42670	13864	0	0	13864	0	28806	206450	28806
2002	20.88	11.99	45870	14330	0	0	14330	0	31540	237990	31540
2003	22.44	12.43	49310	14856	0	0	14856	0	34455	272445	34455
2004	24.13	12.9	53009	15418	0	0	15418	0	37591	310036	37591

PAYBACK (NO FINANCING) IN YEAR: 1988

PAYBACK (WITH FINANCING) IN YEAR: 1989

APPENDIX C
END-USER BUILDING RETROFIT ANALYSIS

FEDERAL BUILDINGS

I. EXISTING SYSTEM

The present Federal Building heating system is a two-pipe low-pressure steam system with primarily gas-fired boilers and condensate vacuum pumps. Terminal heating units presently in use include fin-tube convectors and 3 thru-the-wall units in the administration/offices areas and 16 unit heaters and several fin tube convectors in the post office mail processing/work rooms areas of the east wing.

Additionally, 2 vestibule cabinet heaters and several penthouse air handling units with heating coils are connected to the steam heating system. However, these units have not been utilized in recent years.

Each of the north, south, east, and west exposures perimeter fin-tube radiation are provided with a zone control valve operating in response to a room thermostat. Unit heaters are individually controlled by their respective room thermostats. Condensate return headers are interconnected between zones prior to return to the boiler.

Domestic hot water is provided by a gas-fired water heater with a steam coil in the back to generate hot water during the heating season.

II. CONVERSION TO HOT WATER DISTRICT HEATING SYSTEM

A design comfort heating load of 1,200,000 Btuh was determined based on fuel consumption records for the building and is the basis for the heating system retrofit design. On the design day the system should be capable of producing a 24°F drop with 183°F water supplied to all heating equipment presently in use. The system flow rate would be approximately 100 gpm at a return temperature of 159°F.

The conversion to hot water district heating can be accomplished as follows:

- o Retire (in-place) the existing boilers and associated equipment and install a plate-type heat exchanger for both comfort and heating and domestic hot water needs.

- o Establish a separate independently controlled heating zone for each of the north, south, west, and east exposures perimeter fin-tube radiation in the administration/offices areas utilizing the existing steam and condensate lines.
- o Establish a primary hot water distribution system for supplying (and returning) the individual heating zones and the east wing (mail processing/work rooms). Two new 100 percent-capacity circulating pumps, expansion tank, air removal system, and a new return header are required. The existing main steam supply header will be used.
- o Control primary distribution supply water temperature in response to outdoor temperature.
- o Provide independent constant flow rate/variable temperature control for each of the four heating zones established in the administration/offices areas. Each zone requires an indoor-outdoor temperature controller, control valve and circulating pump. Individual terminal heating unit control/would be provided in the east wing.
- o Retrofit existing fin-tube convectors, unit heaters and vestibule cabinet heaters for hot water service.
- o Isolate penthouse heating coils which are not in use. The existing supply and return lines should remain connected to the primary distribution system, however, for future retrofit, if desired.
- o Remove all traps and modify existing steam and condensate lines as required to achieve zone separation and to establish the primary and secondary distribution system arrangement. Balancing valves should be added in risers supplying multiple terminal units and in main distribution lines as required.
- o Connect domestic hot water service lines to the heat exchanger, bypassing the existing gas-fired unit which would be shut down but remain connected for backup service.

JAMESTOWN PLYWOOD CORPORATION

I. EXISTING SYSTEM

The present heating system is primarily a two-pipe low pressure steam system. Approximately 38 cast iron radiators, 15 fin-tube radiators, 6 wall-mounted pipe manifold type radiators, and 20 unit heaters comprise the terminal steam heating units. In addition, several electric baseboard radiators are installed (in offices).

Low-pressure steam is delivered via pressure-reducing valves from a high-pressure steam boiler plant fired with both natural gas and on-site wood scrap material. The high-pressure steam is utilized by various process equipment associated with the facility's manufacture of wood products. Low-pressure steam is also utilized by humidifiers in the product storage area.

Domestic hot water needs are provided by several electric hot water heaters located in various areas of the building.

II. CONVERSION TO HOT WATER DISTRICT HEATING

Due to the availability of wood scrap materials as well as the high-temperature requirements of the process equipment, the process heating load would not be provided by district heating. The existing boilers would remain in service to meet this load.

In addition, as domestic hot water needs are minimal and extensive piping runs as well as a heat exchanger would be required, the domestic hot water load also would not be provided by the district heating system.

Accordingly, the building retrofit considers only the conversion work required for comfort heating. A design comfort heat load of 4,120,000 Btuh has been estimated for this building and is the basis for the retrofit design. It should be noted, however, that the heat load was determined based on fuel records of gas consumption only. A record of the quantity of wood scrap material used was not kept. As a result, a key assumption in the heat load assessment was that natural gas consumed in summer months reflected a constant average usage throughout the year to supplement the process load provided by wood scrap firing.

Based on the above it was considered that in lieu of using a heat exchanger, the district heating water be used directly by the building heating system to provide greater flexibility to ensure the actual peak heating load will be satisfied. This practice is common in European district heating systems, especially in industrial facilities.

The conversion to hot water district heating can then be accomplished as follows:

- o Isolate the low-pressure steam comfort heating system from the high pressure steam supply system. This required a new condensate return system for the process equipment as the existing condensate lines will be utilized for the hot water circulating system.
- o Retrofit terminal heating units to hot water service and establish hot water circulating piping system.
- o Run new low-pressure steam lines (via pressure-reducing valves) from the high-pressure steam lines to provide the humidification requirements.
- o Retire existing condensate pumping stations and install new hot water return piping.
- o Connect the district heating supply and return water directly to the building heating system. This requires the installation of a pressure-reducing valve to reduce the district heating supply water pressure to an acceptable level, a mixing valve to temper the district heating water supply with building heating system return water, and two 100 percent-capacity pumps to return the district heating water to the system.
- o Control building supply temperature in response to outdoor temperature. On the design day, a water supply temperature of 195°F and a flow rate of 218 gpm will satisfy the estimated heat load of 4,120,000 Btuh. Return water temperature would be 157°F.

- o Individual terminal heating units would be controlled by their respective supply valves.

YWCA

I. EXISTING SYSTEM

The present YWCA heating system is a two-pipe low-pressure steam system with a gas-fired boiler. One unit heater and a total of 55 cast iron and fin-tube radiators comprise the terminal heating equipment.

the majority of the radiators in use are controlled by a recently installed pneumatic control system which included 36 pneumatic radiator control valves, 14 pneumatic thermostats, and a control panel. The balance of the radiators have either self-contained thermostatic valves or manual steam supply valves.

Domestic hot water needs exclusive of the kitchen are provided by one gas-fired heater. The kitchen requirements are provided by a separate gas-fired unit. Kitchen facilities are only occasionally used.

II. CONVERSION TO HOT WATER

A design comfort heating load of 460,000 Btuh was determined based on fuel consumption records and is the basis for the heating system retrofit design. On the design day the heating system should be capable of producing a 30°F drop with 185°F water supplied to all heating equipment presently in use. The system flow rate would be approximately 31 gpm at a return temperature of 155°F.

Domestic hot water requirements to be provided by district heating will not include the kitchen due to the infrequent use of this facility.

The conversion to hot water district heating can be accomplished as follows:

- o Retire (in-place) the existing boiler and associated equipment.
- o Install a plate-type heat exchanger for both comfort heating and domestic hot water loads.
- o Establish the hot water distribution system utilizing the existing steam and condensate piping, and installing two percent-capacity circulating pumps, expansion tank, and air-removal system.

- o Retrofit unit heaters and radiators to hot water service. Existing pneumatic radiator control valves are adaptable to hot water service. Manual radiator steam supply valves and thermostatic supply valves should be replaced with self-contained thermostatic valves designed for hot water service.
- o Control system supply water temperature in response to outdoor temperature.
- o Utilize existing pneumatic control system as presently installed for indoor temperature control. The balance of radiators can be individually controlled by the thermostatic valves.
- o Connect domestic hot water service lines (excluding kitchen) to the heat exchanger, bypassing the existing gas-fired unit which would be shut down but remain connected for backup service.

YMCA

I. EXISTING SYSTEM

The YMCA obtains most of its space heat from a two-pipe steam system with a gas-fired boiler. This system has a total of 170 cast iron radiators and one air handler with a steam coil. Steam supply to the east side of the building has been retired as have many radiators. Additional heat is supplied by gas unit heaters in some areas and heat to the racketball courts is supplied by a roof-mounted air handler fired with natural gas.

Domestic hot is supplied by two steam heated hot water tanks. Heat for the pool is also obtained from steam.

II. CONVERSION TO HOT WATER

A design heat load of 1,491,000 Btuh was determined based on the building's fuel consumption records and is the basis for the retrofit design. This does not include that portion of the load now handled by the roof-mounted unit over the racketball courts as the cost to retrofit it to district heating would be prohibitive for the load it carrier. The gas unit heaters are not to be retrofitted for the same reason although their portion of the load could be picked up by reactivating the retired steam piping.

The system should be capable of achieving a 30°F temperature drop or larger. With a 30°F drop and a supply temperature of 190°F, the return temperature would be 160°F at an approximate flow of 100 gpm.

The conversion to hot water district heating can be accomplished as follows:

- o Retire (in-place) the existing steam system boiler. If desired it can be adapted to backup service.
- o Install a plate heat exchanger to replace the retired boiler.
- o Convert the steam system to hot water service including the presently retired east side portion. This requires that all steam traps be removed and that an expansion tank, an air separator, and

two 100 percent capacity pumps be installed. Air vents need to be installed at all system high points and all terminal units will require conversion to hot water service.

- o Retrofit the domestic hot water system by using the existing tank heater as storage and heating the water to system requirements with a plate exchanger.
- o Retire the present steam pool heater (in-place) and substitute a plate heat exchanger to provide heat for the pool.

CITY HALL

I. EXISTING SYSTEM

The City Hall is an ideal building for conversion to hot water district heating as it currently uses a hot water system. A hot water boiler fired by natural gas supplies hot water to radiant ceiling panels for space heating. The domestic hot water is also supplied by a natural gas boiler.

II. CONVERSION TO HOT WATER DISTRICT HEATING

A design heat load of 1,843,000 Btuh was determined based on the building's fuel consumption records and is the basis for the retrofit design. The system should be capable of achieving a 20°F temperature drop or larger. With a 20°F drop and a supply temperature of 160°F, the return temperature would be 140°F at an approximate flow of 185 gpm.

The conversion to hot water district heating can be accomplished as follows:

- o Retire (in-place) the existing hot water boiler.
- o Install a plate heat exchanger to replace the retired boiler.
- o Retrofit the existing domestic hot water system by retiring (in-place) the existing tank heater and replacing it with a plate-type heat exchanger large enough to meet the building's instantaneous demand.

BOYS' CLUB

I. EXISTING SYSTEM

At present the Boys' Club has two systems to provide space heating. In the addition there is a two-pipe steam system with a natural gas-fired boiler. This system has a total of 8 cast iron radiators, 14 finned tube radiators and 4 cabinet heaters. The original building structure is heated by a hot water system with its own separate gas boiler.

Domestic hot water is provided by a large once-through tank heater which is fired by natural gas. The pool heater is also fired by natural gas.

II. CONVERSION TO HOT WATER DISTRICT HEATING

A design heat load of 888,000 Btuh was DETERMINED based on the building's fuel consumption records and is the basis for the retrofit design. The system should be capable of achieving a 30°F temperature drop or larger. With a 30°F drop and a supply temperature of 190°F, the return temperature would be 160°F at an approximate flow rate of 60 gpm.

The conversion to hot water district heating can be accomplished as follows:

- o Retire (in-place) the existing steam and hot water system boilers. If desired, they can be adapted to backup service.
- o Install a plate heat exchanger to replace the retired boilers.
- o Convert the steam system to hot water service. This requires that all steam traps be removed and that an expansion tank, an air separator and two 100 percent-capacity pumps be installed. Air vents need to be installed at all system high points and all terminal units will require conversion to hot water service.
- o Establish independent temperature control for the two systems through the use of a mixing valve capable of tempering the supply water temperature with a portion of the cooler return water.

- o Retrofit the domestic hot water system by using the existing tank heater as storage and heating the water to system requirements with a plate exchanger. This also has the advantage of keeping a backup source of hot water as the present function of the heater will not be disturbed.
- o Retire the present gas pool heater in place and substitute a plate heat exchanger to provide heat for the pool.

JAMESTOWN GENERAL HOSPITAL

I. EXISTING SYSTEM

The hospital complex is composed of several interconnected buildings with the major portion of the heating requirements provided by two 60-psig high-pressure boilers. The main hospital, comprised of four wings, north, south, east and west is physically joined to the nearby Professional Building by recently constructed core and ancillary additions. A separate building complex houses the steam boilers in a maintenance area in addition to facilities for the Family Health Center and the Humphrey Pavillion, a business office.

In general, high-pressure steam is distributed from the central plant to each building where a pressure-reducing station is furnished for low-pressure conversion. The north wing, east wing, portions of the south and west wings, the Professional Building, the maintenance area and the Humphrey Pavillion rely on the low-pressure steam for space heating. Periphery units include cast iron radiators, cabinet-type fin-tube convectors and baseboard fin tubing. The steam supply serves the second floor of the east wing which employs floor-mounted unit ventilators and a couple of unit heaters while the kitchen and cafeteria in the west wing have several overhead unit ventilators.

the core and ancillary areas and the remaining portions of south and east wings depend on a central air system comprised of approximately 32 heat pumps for comfort heating. Acting as a heat source, relatively hot water is circulated to individual heat pumps which deliver this heat to air ducts serving the occupied areas. In cold weather, supplementary heat is supplied to the closed-water system to boost the water temperature for proper heat pump performance. This supplementary heat is provided to the system via a shell-and-tube heat exchanger located in the penthouse which utilizes central plant steam to produce hot water. Additional central air temperature control is achieved by 12 steam coils and humidifiers located upstream of the heat pumps which preheat and humidify the air as required. Further upstream, several air-to-air exchangers including a "Z" duct design in the ancillary unit are provided for heat recovery of warm room exhaust air which is continuously replaced in accordance with health codes. Final room temperature control is achieved utilizing electric reheat in the individual rooms.

In addition to space heating demands, steam is produced for process requirements. High-pressure steam is used directly by seven sterilizers, bed pan hoppers at nursing stations and steam pressure cookers in the kitchen. Domestic hot water for the main hospital is generated with a steam heated exchanger bundle immersed in a storage tank in the penthouse.

Several decentralized facilities for heating and hot water production have been introduced at the hospital. The Family Health Center is heated solely by independent gas-fired equipment. A small gas-fired domestic hot water heater is provided for the maintenance area, Family Health Center and Humphrey Pavillion. Another water heater is installed in the Professional Building to supply a small laundry.

II. CONVERSION TO HOT WATER DISTRICT HEATING

Analysis of the fuel consumption records indicates that the peak comfort heating load for the hospital is 2,700,000 Btu/hr. A peak demand of 2,000,000 Btu/hr is expected for hot water generation. Knowing the heat load requirement and the performance capability of the heating system, a hot water retrofit could be accomplished with a district water supply of about 130 gpm and a temperature drop from 250°F to 160°F. Estimates for building water system operation were based on a flow of 200 gpm with a temperature rise from 170°F to 190°F for the periphery and air preheat coil system, a flow of 175 gpm with a temperature rise from 70°F to 100°F for supplemental heat pump system and a flow of 45 gpm with a temperature rise from 40°F to 130°F for domestic hot water.

In a hot water retrofit, the penthouse replaces the boiler room as the central equipment location. the penthouse would house a plate-type heat exchanger dedicated to the periphery and air preheat coil load presently handled by the steam boilers. Two plate exchangers would replace the existing shell-and-tube exchangers situated in the penthouse for supplemental heating to the heat pump system and domestic hot water. The exchangers presently installed were intended for steam service and may be unsuitable in a conversion to hot water.

Associated with each exchanger is a closed hot water system which circulates hot water to terminal users in the complex. Each building hot water system is independent, governed by different temperature requirements. Periphery units such as radiators and fin tubing demand a higher operating temperature than the