BALTIMORE
THERMAL ENERGY
CORPORATION

DOE/CE/26574--T2

DOE/CE/26574--T2

DE90 009394

FEASIBILITY STUDY

CENTRAL CHILLED WATER SYSTEM

DOWNTOWN BALTIMORE MARYLAND

MARCH 5, 1990

PREPARED BY

BALTIMORE THERMAL ENERGY CORPORATION

1400 RIDGELY STREET

BALTIMORE, MARYLAND 21230

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SECTION 1. BACKGROUND

On September 6, 1988, Baltimore Thermal Energy Corporation (BTEC) received Contract DE-F01-88CE26574 from the U.S. Department of Energy (DOE). This contract in the amount of $54,275 was to conduct a feasibility study of the Baltimore Central Cooling Project (hereafter referred to as the Project). The Project period was from September 6, 1988 to March 5, 1990. This report is submitted under the requirements of this contract.

BTEC conducted a study of the feasibility of installing and operating a localized district cooling loop for a specified high density area in downtown Baltimore. This particular project was selected for study because of its high potential for implementation.

The Project consisted of four City owned buildings, Provident Bank Building, and Mercy Medical Center; all within a two block area (Figure 1). It is planned that a central cooling plant will be installed in the basement of the City Courthouse East and will distribute cooling water to the other nearby buildings in the project.

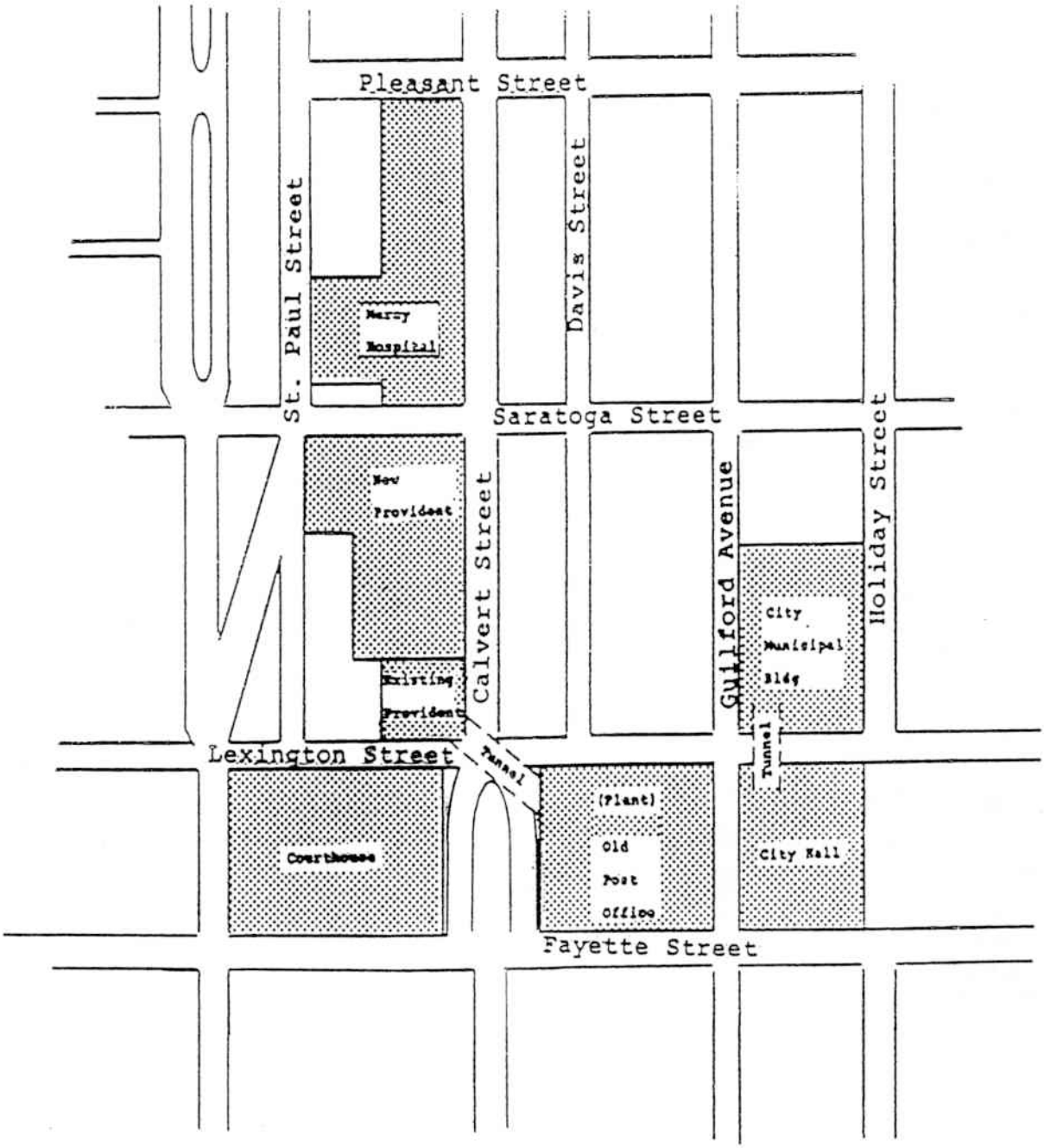


Figure 1. Chilled Water Loop Layout

BTEC proposed to utilize the existing District Steam System as a fuel source for the project in order to achieve additional benefit from its waste-to-energy resource. Based on this study, District Steam is a viable source of energy for the project.

BTEC is a subsidiary of Catalyst Thermal Energy Corporation (CTEC) which has demonstrated their intent to be the nation's leader in the acquisition, development, and operation of district heating and cooling systems.

The resources of BTEC, CTEC, and consultants were employed in the conduct of the Project. Based on the data collected, the initial systems selected, and the economic analysis performed, it was determined that the Project is a feasible one.

Before the project can be funded, equipment and construction costs must be refined and updated. In addition, the potential customers must sign long term service contracts. BTEC intends to pursue the implementation of this feasibility study.

SECTION 2. PROJECT PERFORMANCE

BTEC developed a Work Management Plan which described in detail the tasks to be performed (Figure 2). Each task listed the personnel assigned to perform the task and the man-hour effort required. A summary of the implementation of this Plan is as follows:

A. Assessment Work Group (AWG)

The purpose of the AWG was to obtain a group of interested parties who will participate and assist in the successful conduct of the Project. BTEC was very successful in obtaining membership from upper management in the City and potential customers. The members were

1. Bruno Rudaitis, City Planning Office
2. James Zito, City Transit Coordinator
3. Volker Multhopp, City General Services
4. Christopher Goudreau, Vice President Provident Bank
5. Thomas Anderson, Facilities Director Mercy Medical Center
6. James Himmel, City Environmental Liaison
7. Andrew J. O'Brien, City Council
8. G. Michael Larkin Jr., BTEC Director of Marketing
9. Steven Bergstrom, BTEC Manager Business Development
10. Ronald Overton, BTEC Manager Project Engineering.

Three meetings of the AWG were held with all members present. The Project Manager scheduled and conducted these meetings.

The AWG was instrumental in data collection, project direction and support, permitting, and economic analysis.

Figure 2

Work Management Plan

Task 1: Establish Assessment Work Group

Task 2: Establish Requirements of AWG Members

Task 3: Establish Capital Expenditure for Plant and Distribution System

Task 4: Establish Capital Expenditure for In-Building Services and Modifications

Task 5: Establish Annual Operating Cost for District Cooling Plant

Task 6: Establish Market Value of District Chilled Water

Task 7: Parametric Studies

Task 8: Prepare Final Feasibility Report

Task 9: Conduct Overall Project Management

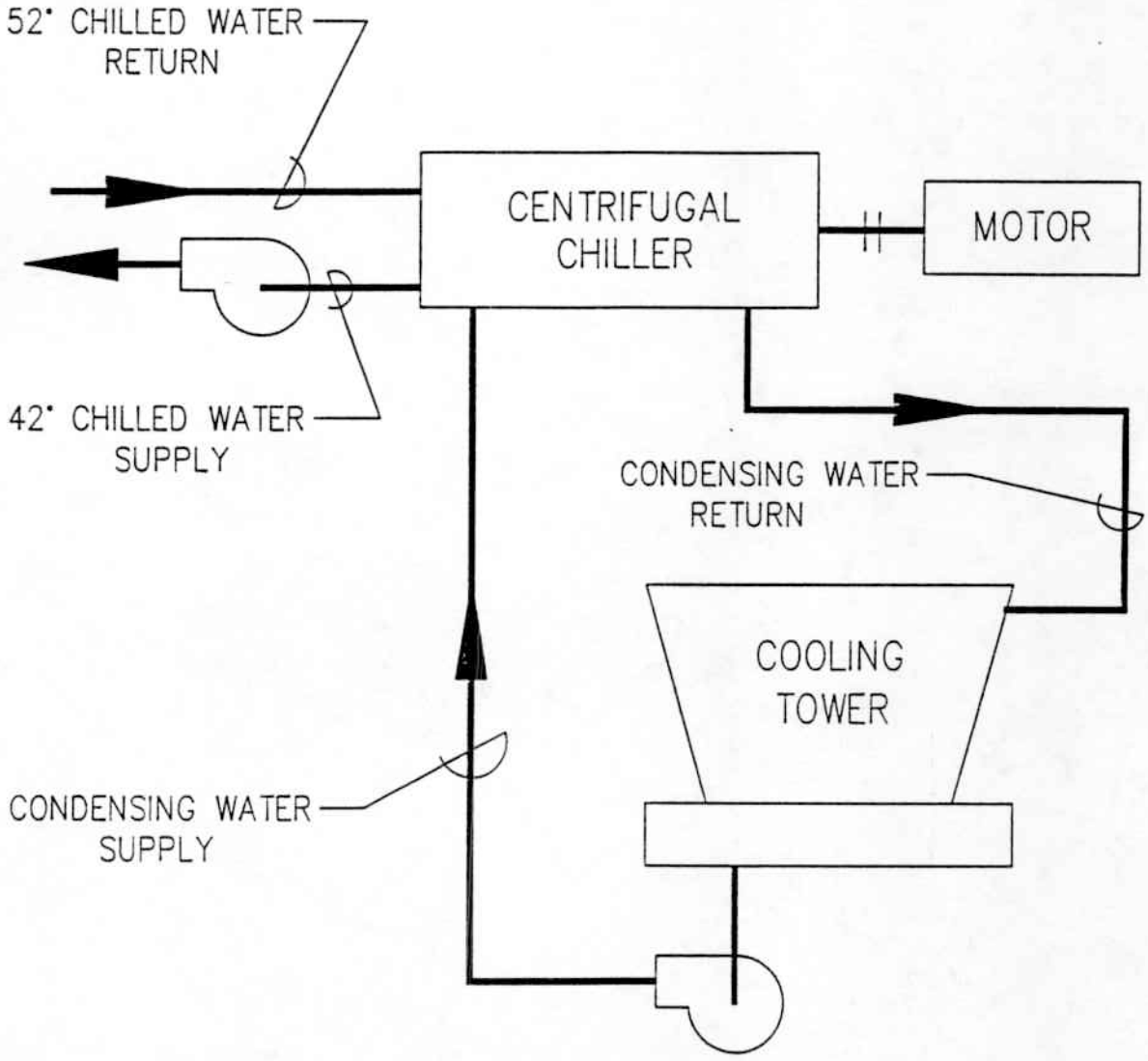
B. Plant and Distribution System Capital Costs

The Project staff selected three plant configurations for determination of layout and capital costs. The configurations were: All electric driven chillers; condensing steam turbine driven chillers; and steam driven centrifugal chillers exhausting to steam absorption equipment (Figures 3,4&5). The selection of the equipment, plant layout, equipment and operational costs was assigned to the CTEC engineering group in Nashville, Tennessee. This engineering group consists of technical and professional personnel who are experienced in the design, construction, start-up, and operations of thermal power plants. The results of their efforts are covered in detail in Appendix A of this report.

The routing and estimation of the capital cost of the distribution line was determined by CTEC engineering group.

The load requirements were determined for the individual facilities and the distances between the plant and the buildings to be serviced were estimated. BTEC's Distribution Engineer and Energy Economist visited Brookhaven National Laboratory to obtain additional information concerning distribution line costs. Their findings are described in Appendix B of this report.

Figure 3



TYPICAL ELECTRIC CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION 1400 RIDGELY STREET BALTIMORE, MD 21230		BY	DATE
	DRWN:	J.PINK	01/11/90
	CHK'D:		
	APPR'D:		
	ISSUED:		

CATALYST THERMAL ENERGY CORP.

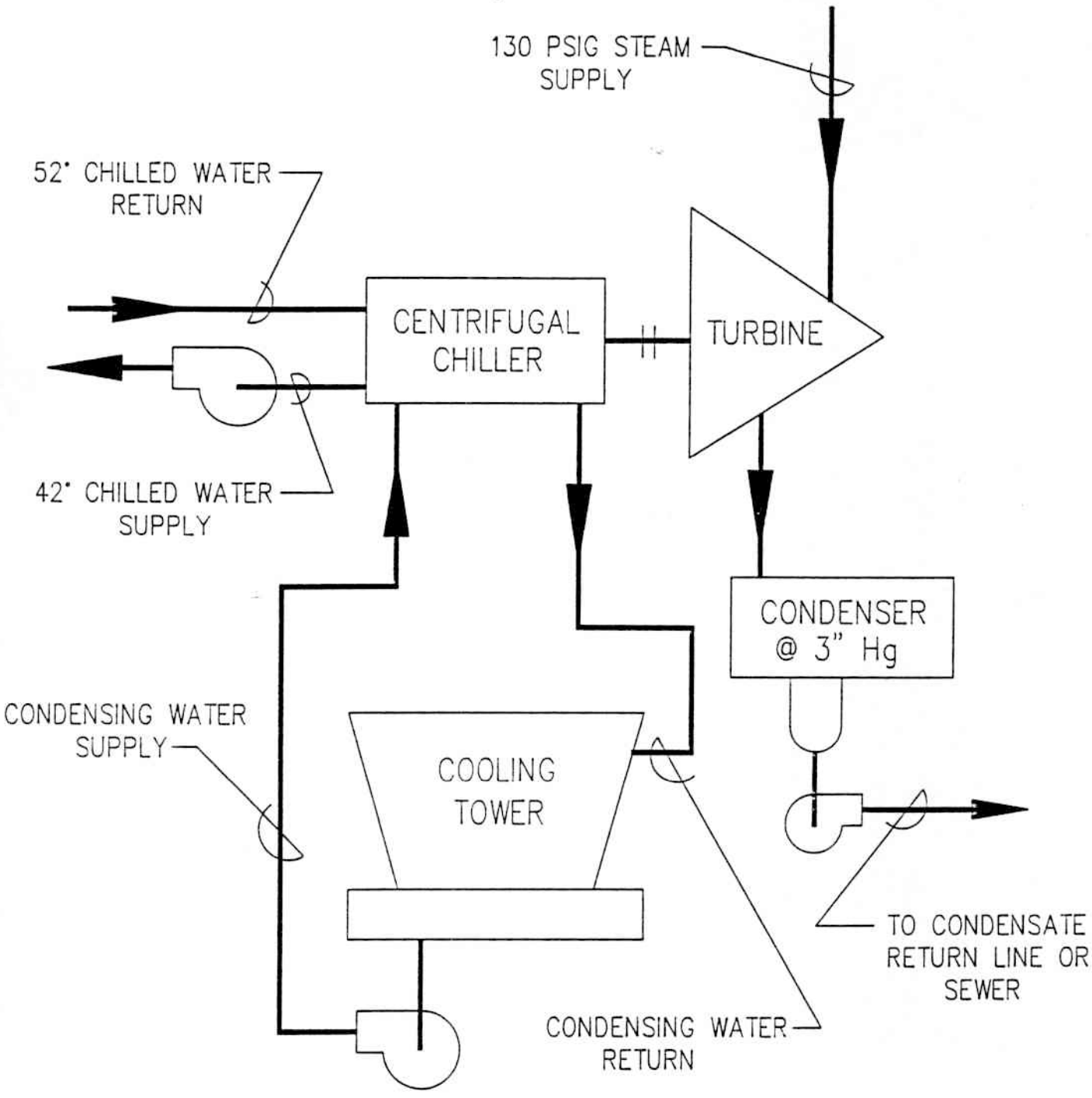
SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYP.ELECT.CENT.CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO. 4A300005

SHEET 1 OF 1

Figure 4



TYPICAL CONDENSING STEAM TURBINE DRIVEN CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION 1400 RIDGELY STREET BALTIMORE, MD 21230		BY	DATE
	DRWN:	J.PINK	01/11/90
	CHK'D:		
	APPR'D:		
	ISSUED:		

CATALYST THERMAL ENERGY CORP.

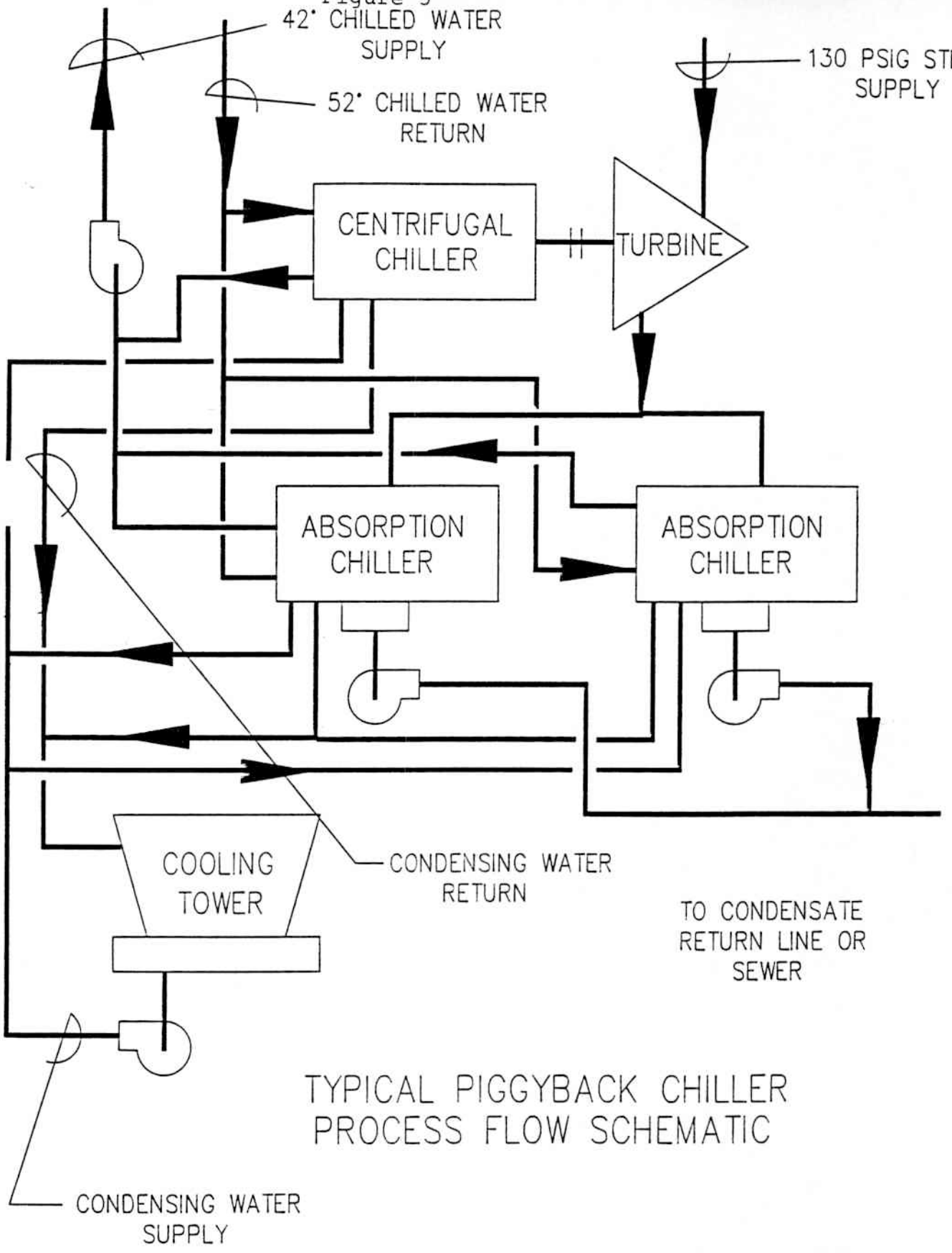
SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYPICAL CONDENSING STEAM TURBINE DRIVEN CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO. 4A300006

SHEET 1 OF 1

Figure 5



TYPICAL PIGGYBACK CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/11/90
CHK'D:		
APPR'D:		
ISSUED:		

CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYPICAL PIGGYBACK CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO. 4A300006

SHEET 1 OF 1

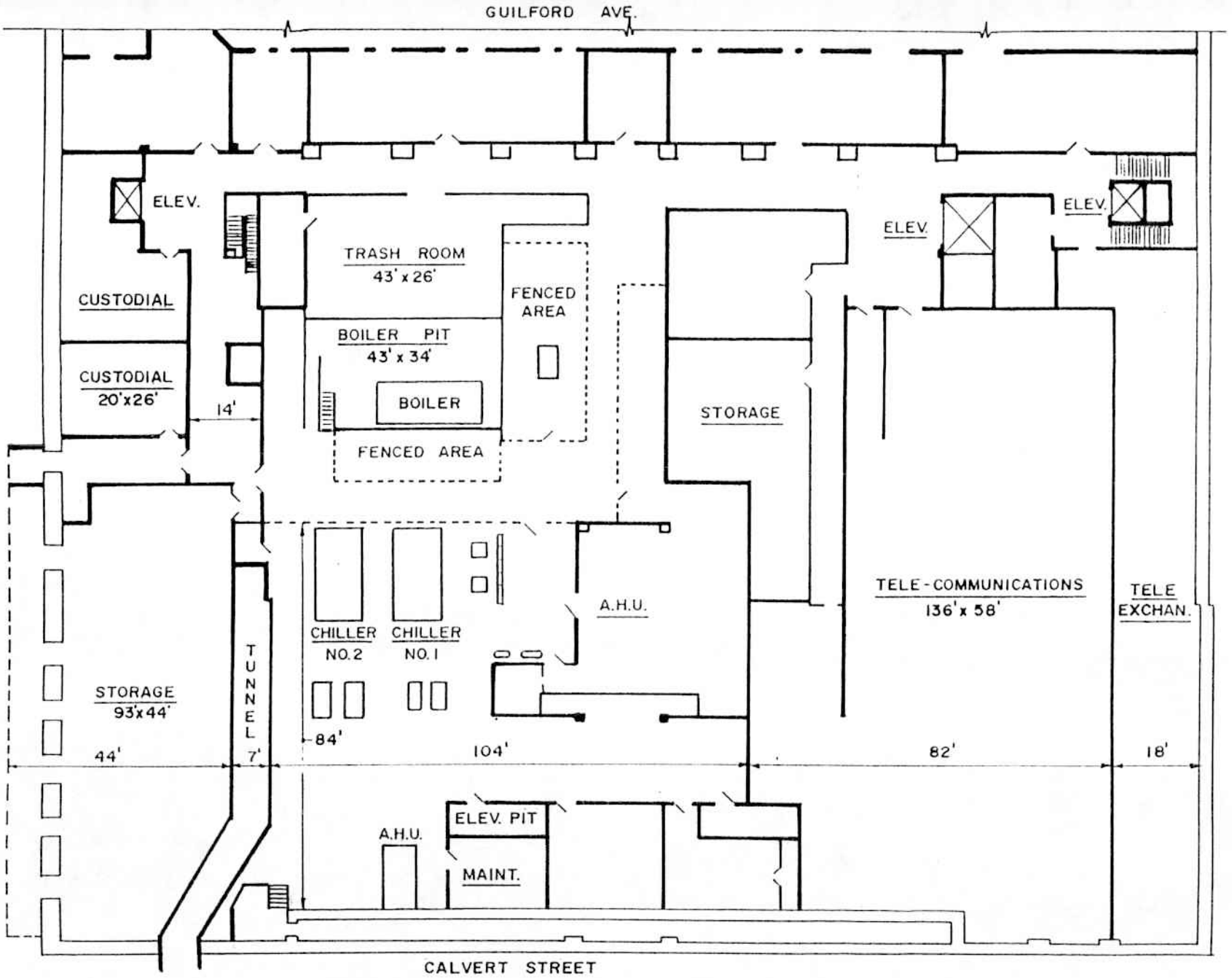
C. In-Building Operations

One of the inputs to the economic analysis of the cooling system, is the cost to the potential customers of their present chilled water operation and maintenance. The additional cost of performing any necessary modifications to their present system in order to accept district cooling is also required. The following information was determined by BTEC staff personnel and consultants under sub-contracts to BTEC:

1. Plant layout of present system. (Figures 6 thru 13)
2. Loads and configurations of system. (Appendix A)
3. Cost of in-building operations (Figure 17) and necessary plant modifications (Figure 15).

The layout of the present cooling equipment in the mechanical rooms of each facility was established by Bill Catterton, an Estimator under contract to BTEC. Present system piping and controls were identified and analyzed for possible Project use. A schematic diagram of each present system was produced and shown in Figure 6 thru 13.

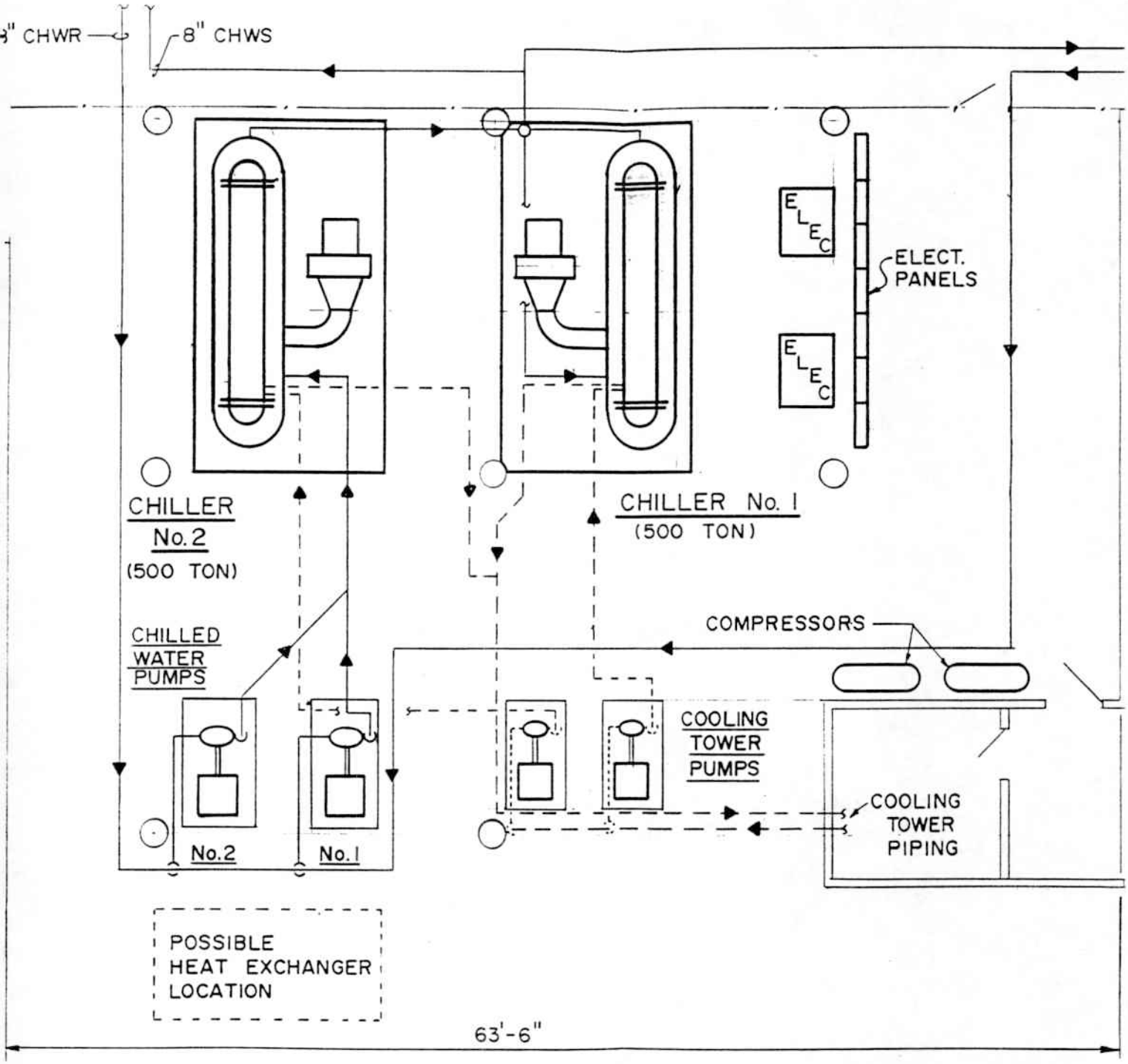
The cooling loads, operating and maintenance characteristics, and necessary present system modifications were obtained by Jack Ames, P.E., under contract to BTEC. The costs of the in-building operations and modifications were estimated by BTEC/CTEC engineering staff. A typical O&M cost schedule is attached as Figure 17.



OLD POST OFFICE BUILDING - GROUND FLOOR

SCALE: 1" = 30'

Figure 6



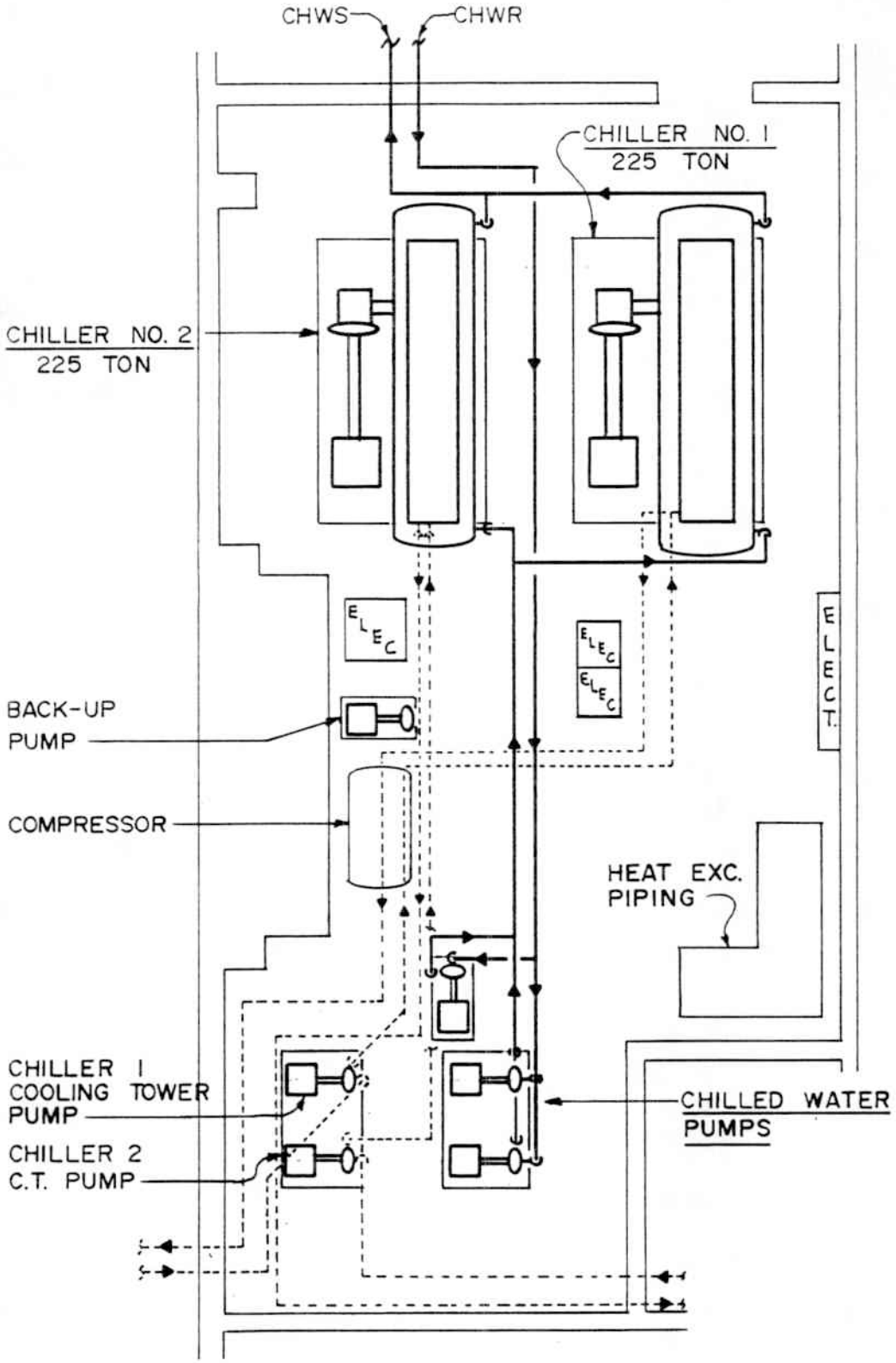
OLD POST OFFICE BUILDING
EXISTING EQUIPMENT LAYOUT

N

SCALE: 1/8" = 1'-0"

0 5 10

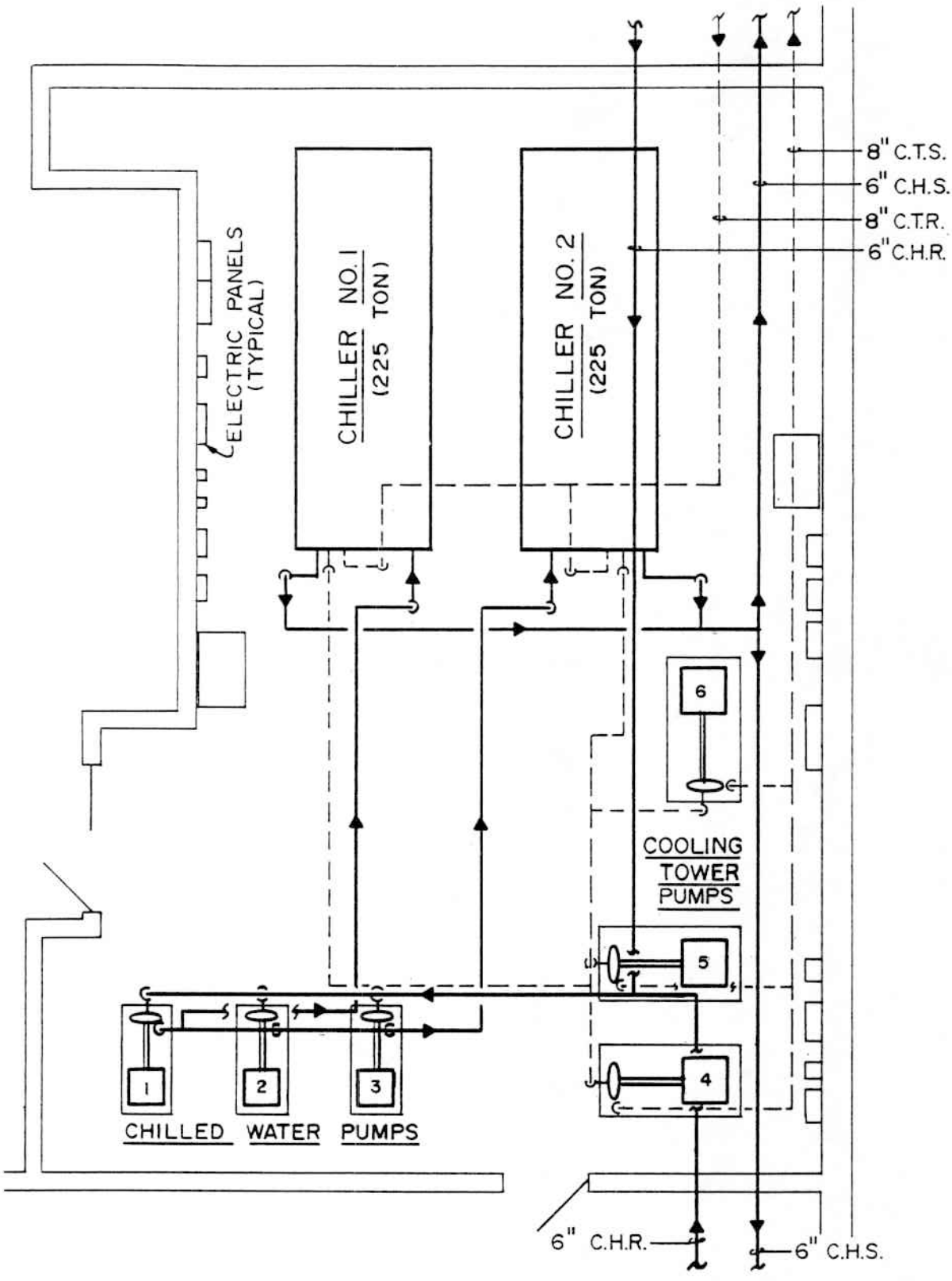
Figure 7



WEST COURT HOUSE BUILDING
EXISTING EQUIPMENT LAYOUT

SCALE: 1/8" = 1'-0"

Figure 8



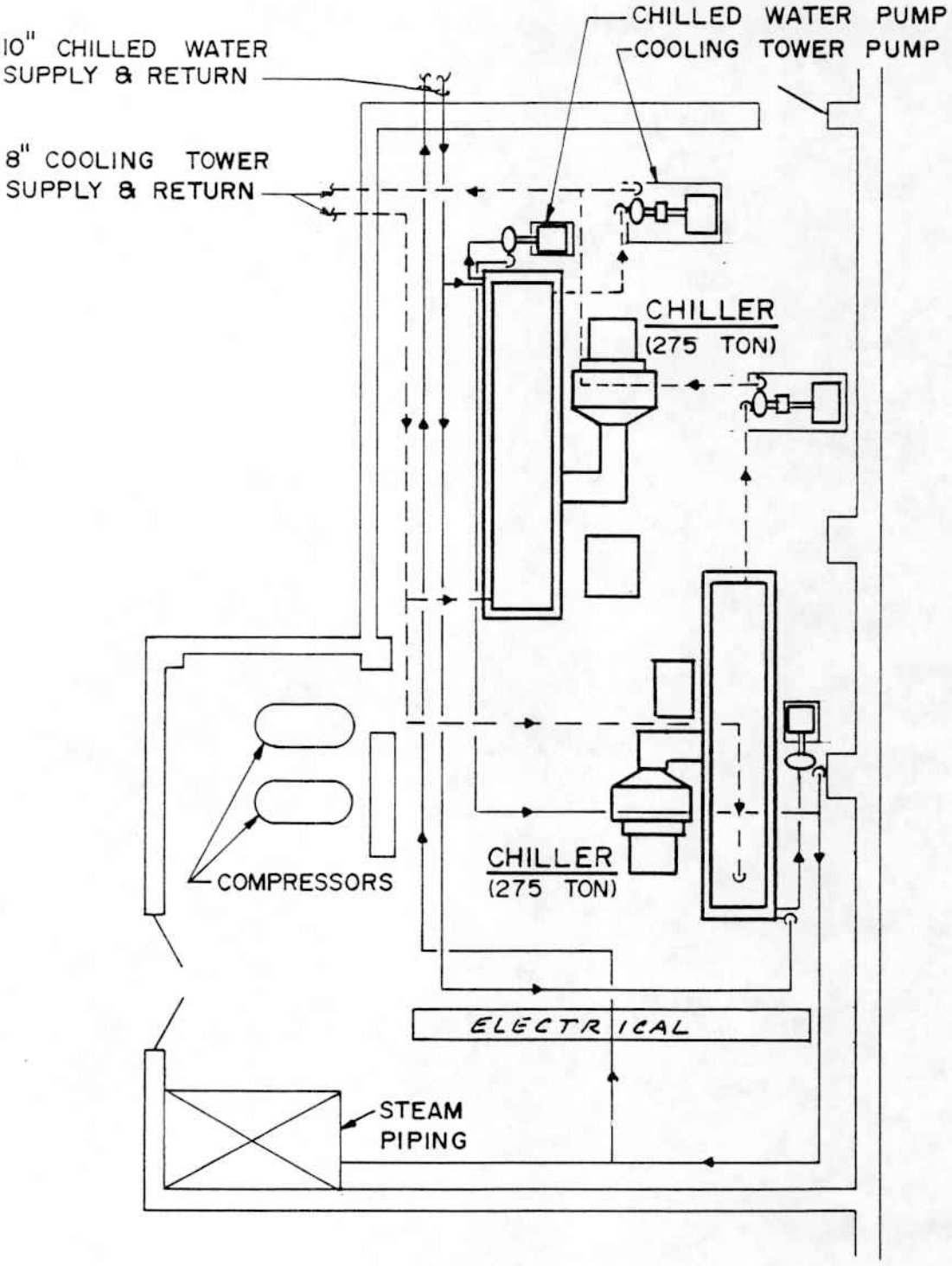
CITY HALL EQUIPMENT LAYOUT

SCALE : 3/16"=1'-0"

0 5 10

N

Figure 9

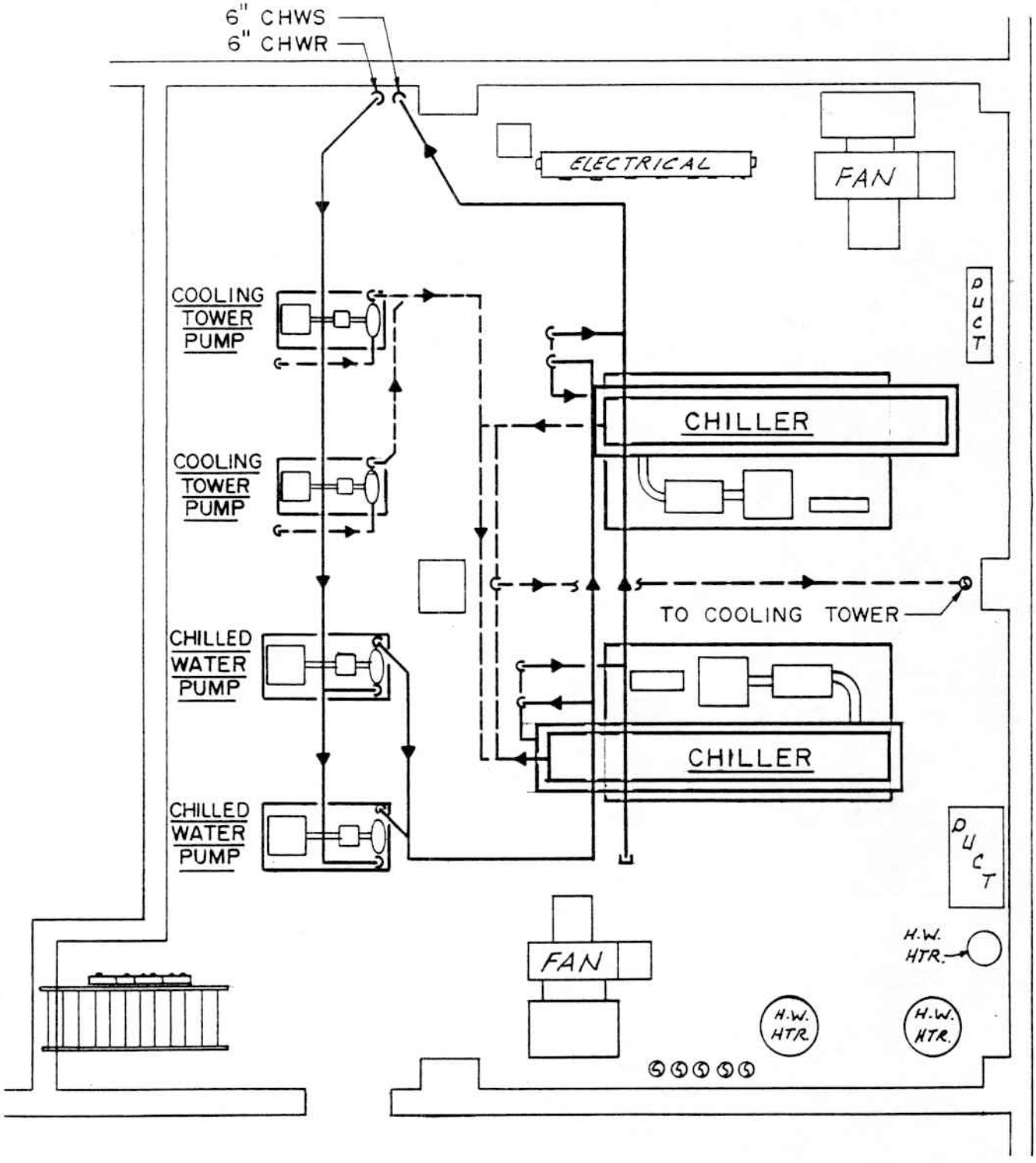


MUNICIPAL BUILDING

EXISTING EQUIPMENT LAYOUT

SCALE: 1/8"= 1'-0"

Figure 10

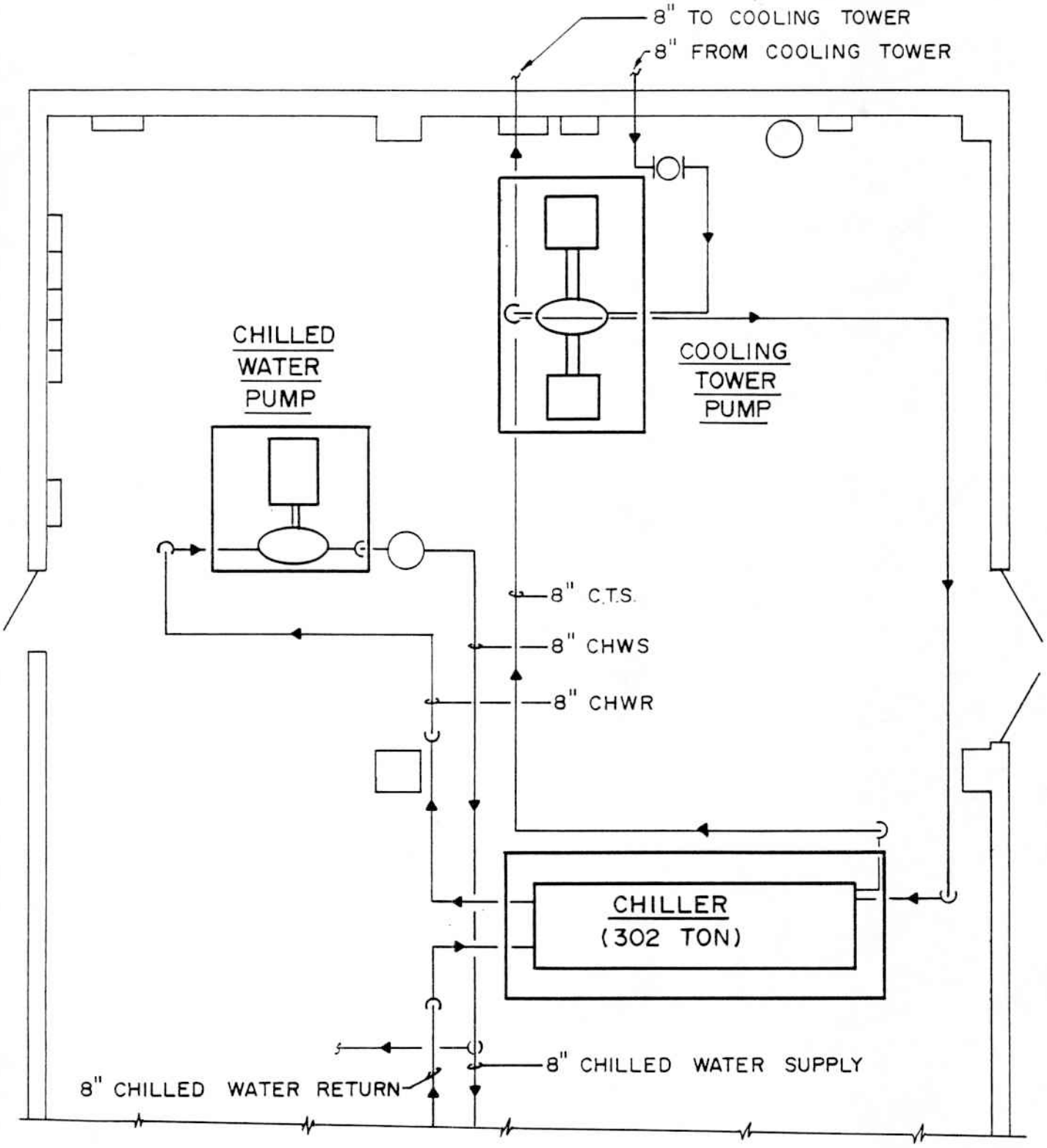


PROVIDENT BUILDING
EXISTING EQUIPMENT LAYOUT

SCALE: 3/16"= 1'-0"

0 5 10

Figure 11

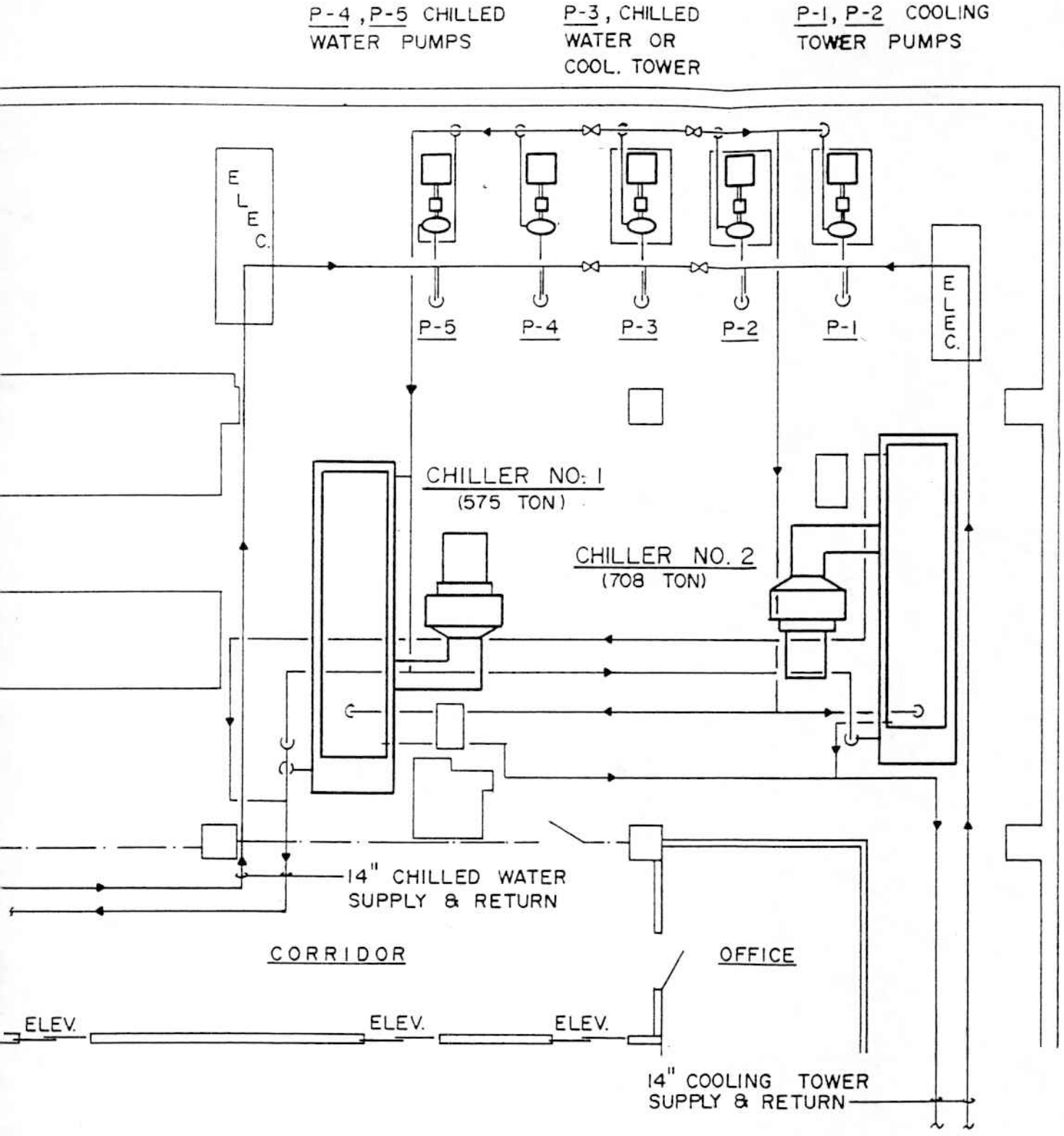


MERCY HOSPITAL – BURKE BUILDING

SCALE: 3/16" = 1'-0"

0 5 10

Figure 12



MERCY HOSPITAL — TOWER BUILDING

SCALE: 1/8" = 1'-0"

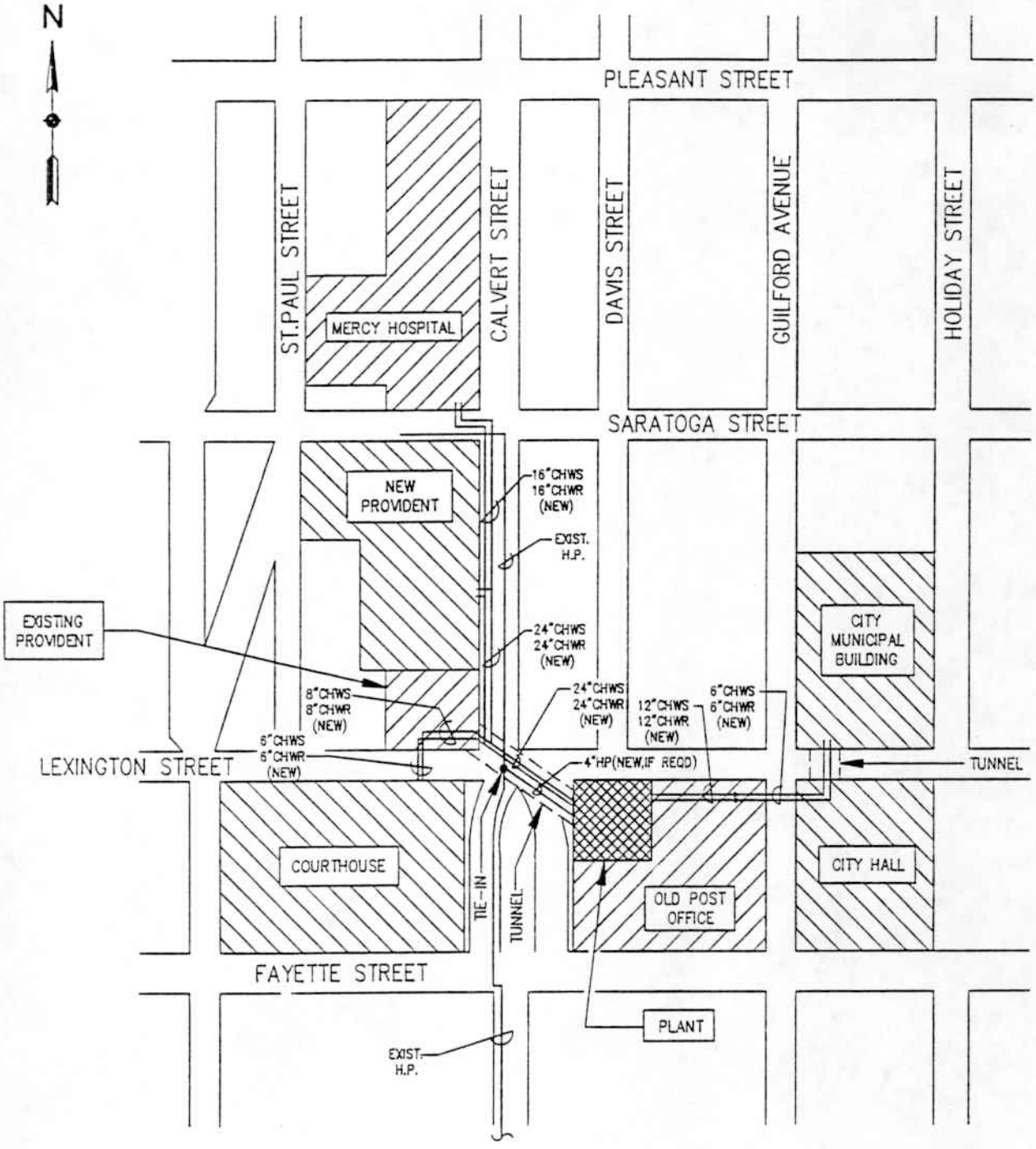
0 5 10

Figure 13

D. System Capital and Operating Costs

To determine overall system costs, two major cost elements had to be examined; plant and distribution line. These costs were assigned to CTEC engineering staff in Nashville. Distribution line route (Figure 14), size, and costs were determined as shown in Appendix A and summarized in Figure 16.

Figure 14



GRAPHIC SCALE (IN FEET)

0 100 200 400 600

BALTIMORE THERMAL ENERGY CORPORATION 1400 RIDGELY STREET BALTIMORE, MD 21230		BY	DATE
	DRWN:	J.PINK	01/10/90
	CHK'D:		
	APPR'D:		
	ISSUED:		

CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: CHILLED WATER LOOP LAYOUT

DRAWING NO. 4A300003 SHEET 1 OF 1

Figure 15

Costs of Conversion to District Cooling

(Within Buildings)

Costs were estimated for the conversion necessary for existing chilled water systems to receive district chilled water within the studied buildings. The costs of conversion include all work done within the confines of each building, (with the exception of work done in plant area of Court House East Building).

Conversion costs were split into two categories, the first being costs which necessarily accrue to the chilled water provider, and the second being costs which could potentially be borne by either the building owner or BTEC or apportioned between the two. The first category includes costs for metering, strainers, and service valves. The second category includes all piping, control valves, and system components not specifically mentioned as part of category one.

Phase I

Total costs for category one were estimated to be $66,650.

Total costs for category two were estimated to be $337,359.

Phase I & II

Total costs for category one were estimated to be $81,650.

Total costs for category two were estimated to be $437,359.

Figure 16

SYSTEM CHARACTERISTICS

1. Condensing Steam Turbine System - Phase I

Installed Chilling Capacity	2,850 tons
Annual Load	4,073 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$2,665,200
Simple Payback	5.8 years
Capital: Income Ratio	14.2
Return on Investment	35.3%

2. Condensing Steam Turbine System - Phase II

Installed Chilling Capacity	4,800 tons
Annual Load	6,885 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$4,370,000
Simple Payback	5.2 years
Capital: Income Ratio	11.1
Return on Investment	45.0%

3. Electric Centrifugal System - Phase I

Installed Chilling Capacity	2,850 tons
Annual Load	4,073 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$2,017,100
Simple Payback	5.2 years
Capital: Income Ratio	11.0
Return on Investment	45.5%

4. Electric Centrifugal System - Phase II

Installed Chilling Capacity	4,800 tons
Annual Load	6,885 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$3,497,900
Simple Payback	5.0 years
Capital: Income Ratio	10.0
Return on Investment	49.5%

5. Condensing Steam Turbine with Absorption Chillers System - Phase I

Installed Chilling Capacity	2,850 tons
Annual Load	4,073 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$2,356,700
Simple Payback	5.1 years
Capital: Income Ratio	10.5
Return on Investment	47.5%

6. Condensing Steam Turbine with Absorption Chillers System - Phase II

Installed Chilling Capacity	4,800 tons
Annual Load	6,885 MTH
Chilling Plant Load Factor	17.1%
Chilling Plant Diversity	105%
Project Capital Cost	$3,959,400
Simple Payback	4.9 years
Capital: Income Ratio	9.6
Return on Investment	51.9%

E. Chilled Water Pricing Analysis

In order for BTEC to determine a price to charge the customers for district chilled water it was necessary to determine or estimate the present cost for in-house chilled water production.

BTEC assigned the determination of in-house operation and maintenance costs to CTEC engineering in Nashville with the results shown in Figure 17 and summarized below.

System	200 ton	500 ton	1,000 ton	1,500 ton
Operational and Maintenance Cost per ton hour	$0.259	$0.257	$0.264	$0.263

Once the various district chilled water system costs were determined, a computer analysis was performed to determined the BTEC selling price required in order to meet corporate criteria on payback and return on investment. This was determined to be approximately $.24 per ton hour and was used in all economic analysis.

"IN-HOUSE" CHILLER PLANT OWNING/OPERATING COST

		200 Ton	500 Ton	1000 Ton	1500 Ton
1. Electricity Used:					
A. Chiller (1 KW Per Ton Seasonal Avg.) Ton Cap. X 1 KW/T X 8760 X Load Fact. = KWH/Yr Note - 1000 EFLH = 11.4% Load Fact.	KWH	200,000	500,000	1,000,000	1,500,000
B. Cond. Water Pumps HP = 3 GPM/Ton X Tons X Head (psi) / 1714 X .65 Effcy KW = HP X .746 / .90 Effcy KWH = KW X 8760 X L.F. Note - L.F. Of Aux's = 2.5 X L.F. of Chiller = 28.5%	KWH	100,400	251,000	5002,000	753,000
C. Cooling Tower Fans 0.12 HP/Ton = 0.10 KW/Ton L.F. = 28.5%	KWH	50,000	125,000	250,000	375,000
D. Misc. Pumps = Make Up, Water Treat., Air Compressors, Etc. E. 28.5% L.F. 0.02 KW/Ton	KWH	10,000	25,000	50,000	75,000
F. Total Elect. Consumption	KWH	360,400	901,000	1,802,000	2,703,000
G. Annual Cost $ @ 10.3¢/KWH		$37,121	$92,803	$185,606	$278,409
2. Water & Sewer Water = 0.05 GPM/Ton X Tons Cap. X 60 X 8760 X .30 L.F. X $2.54/1000		$ 2,670	$10,013	$ 20,026	$ 30,038
3. Water Treatment 50¢/Inst. Ton/Mo		$ 1,200	$ 3,000	$ 6,000	$ 9,000

Figure 17

	200 Ton	500 Ton	1000 Ton	1500 Ton
4. Maintenance & Repair				
Condensers, Evaporators & Compressors	$ 600	$ 1,200	$ 2,400	$ 3,600
Cooling Towers Incl. Fans & Motors	500	1,000	2,000	3,000
Ch. Wtr. & Cond. Wtr, Pumps & Drives	200	500	1,000	1,500
Air Compressor System	200	500	1,000	1,500
Instrumentation & Controls	300	600	1,200	1,800
Valves, Piping, Insulation & Painting	350	750	1,500	2,000
Lube Oils, Refrig. & Misc. Supplies	250	500	2,000	1,500
Contract Services	500	700	1,400	2,100
General Equipment Room Maint.	350	750	1,500	2,000
Total Maint. & Repair	$ 3,250	$ 6,500	$ 14,000	$ 19,000
5. Depreciation/Replacement Accrual	$ 4,000	$ 10,000	$ 20,000	$ 30,000
6. Operating Labor	$ 2,600	$ 3,240	$ 5,600	$ 9,100
7. Taxes, Insurance, G & A	$ 800	$ 2,600	$ 12,000	$ 18,000
8. Total Owning & Operating Cost	$51,641	$128,156	$263,232	$393,547
9. Annual Ton Hrs. @ 11.4% L. F. (1000 EFCH)	199,728	499,320	998,640	1,497,960
10. Cost/Ton-Hr.	$0.259	$0.257	$0.264	$0.263

Figure 17

F. Economic Analysis

To determine the economic benefits to BTEC and to the customers resulting from changing from an in-house system to district chilled water it was necessary to estimate the costs associated with each system. A summation of the analysis is as follows:

1. Customer Savings

Item	In-House	BTEC System
Load	4,800	4,800
Full Load Hours	1,500	1,500
O&M Costs @ $.26/TH	$1,872.000	-
Rehab Costs	$96,000	-
District Chilled Water @ $.24/TH	-	$1,728,000
Totals Cost	$1,968,000	$1,728,000
Savings/year		$240,000

2. BTEC Economic Summary

A. Phase I

Item	Turbine	Electric	Piggyback
Plant & Dist Cost	2,665,200	2,017,100	2,356,700
In-Building Cost	337,359	337,359	337,359
Total Investment	3,002,559	2,354,459	2,694,059
Revenue @ .24/TH	977,400	977,400	977,400
O&M Cost	521,409	590,813	516,669
Additional Property Tax	95,162	64,701	80,662
Net Contribution	360,829	321,886	380.069
Simple Payback, Years	8.32	7.31	7.09
Pre-Tax ROI	12.0%	13.7%	14.1%

B. Phase I & II

Item	Turbine	Electric	Piggyback
Plant & Dist Cost	4,370,000	3,497,900	3,959,000
In-Building Cost	437,359	437,359	437,359
Total Investment	4,807,359	3,935,259	4,396,359
Revenue @ .24/TH	1,652,400	3,935,259	1,652,400
O&M Cost	819,919	954,612	843,645
Additional Property Tax	192,621	150,064	172,586
Net Contribution	639,860	547,724	636,169
Simple Payback, Years	7.51	7.18	6.91
Pre-Tax ROI	13.3%	13.9%	14.5%

SECTION 3. CONCLUSIONS AND RECOMMENDATIONS

The initial results of this engineering and economic feasibility study indicate that a central chilled water system is very competitive , and in most cases, cheaper than in-building systems.

This report shows that a steam powered central chilled water system (Figure 4 and 5) is better economically than an all electric system. Supporting this position, with significant increases in electricity costs expected for the Baltimore area in the next few years, the margin between electric and steam systems will increase.

However, the type of steam system to be used (turbine-driven vs absorption) will require additional engineering analysis and specific equipment costing before a final economic analysis can be preformed and a particular system selected.

The next step is to perform engineering and design work on the selected system, obtain signed contracts from potential customers, and receive Corporate approval and financing.

APPENDIX A

FEASIBILITY STUDY

CALVERT STREET

4800 TON CENTRAL CHILLED WATER SYSTEM

BALTIMORE MARYLAND

January 12, 1990

Prepared By: Catalyst Thermal Energy Corporation
Engineering Department
Nashville, TN

TABLE OF CONTENTS

INTRODUCTION

Baltimore Thermal Energy Corporation was awarded a DOE grant to study the feasibility of a central chilled water system for downtown Baltimore. This report focuses on this assignment by evaluating three different chilled water equipment arrangements and options:

Option 1:
Centrifugal chillers with condensing steam turbine drives

Option 2:
Centrifugal chillers with electric motor drives

Option 3:
Steam driven centrifugal chiller(s) in conjunction with absorption chillers (piggyback system).

As conceived, the plant will be located in the northwest corner of the ground level of the Old Post Office Building at the corner of Lexington and Calvert Streets. The distribution piping will be routed through existing utility tunnels, building basement areas, and buried under city sidewalks.

Initially, the plant will have a demand of approximately 2715 tons (Phase I), with a hospital load of approximately 1875 tons (Phase II) being added at a later date making the final demand tonnage approximately 4590 tons.

EXECUTIVE SUMMARY

General Information:

Phase I Plant Installed Capacity:	2850 Tons
Phase II Plant Installed Capacity:	1950 Tons
Total Installed Plant Capacity	4800 Tons

Chilled Water Supply Temperature: 42x F
Chilled Water Return Temperature: 52x F

Plant Load Factor: 17.1%

Equivalent Full Load Hours: 1500

Phase I Plant Load:	4,072,500 Ton-Hours
Phase II Plant Load:	2,812,500 Ton-Hours
Total Plant Load:	6,885,000 Ton-Hours

PHASE I SUMMARY:

	Cond Turb OPTION 1	Electric OPTION 2	Piggyback OPTION 3
Capital Cost:	$2,665,200	$2,017,100	$2,356,700
Gross Revenue: @ 24ö/Ton-Hr	$977,400	$977,400	$977,400
O & M Cost:	$521,409	$590,813	$516,669
Net Revenue:	$455,991	$386,587	$460,731
80% Financing @ 11%:20 yrs:	$268,013	$202,840	$236,990
Cash after Debt Service:	$187,978	$183,747	$223,741
Simple Payback, Yrs: @ 20% Equity	5.8	5.2	5.1
Capital/Earnings Ratio:	14.2	11.0	10.5
ROI: @ 20% Equity	35.3%	45.5%	47.5%

PHASE I & II SUMMARY:

	Cond Turb OPTION 1	Electric OPTION 2	Piggyback OPTION 3
Capital Cost:	$4,370,000	$3,497,900	$3,959,400
Gross Revenue: @ 24ö/Ton-Hr	$1,652,400	$1,652,400	$1,652,400
O & M Cost:	$819,919	$954,612	$843,645
Net Revenue:	$832,481	$697,788	$808,755
80% Financing @ 11%:20 yrs:	$439,447	$351,749	$398,157
Cash after Debt Service:	$393,034	$346,039	$410,598
Simple Payback, Yrs: @ 20% Equity	5.2	5.0	4.9
Capital/Earnings Ratio:	11.1	10.1	9.6
ROI: @ 20% Equity	45.0%	49.5%	51.9%

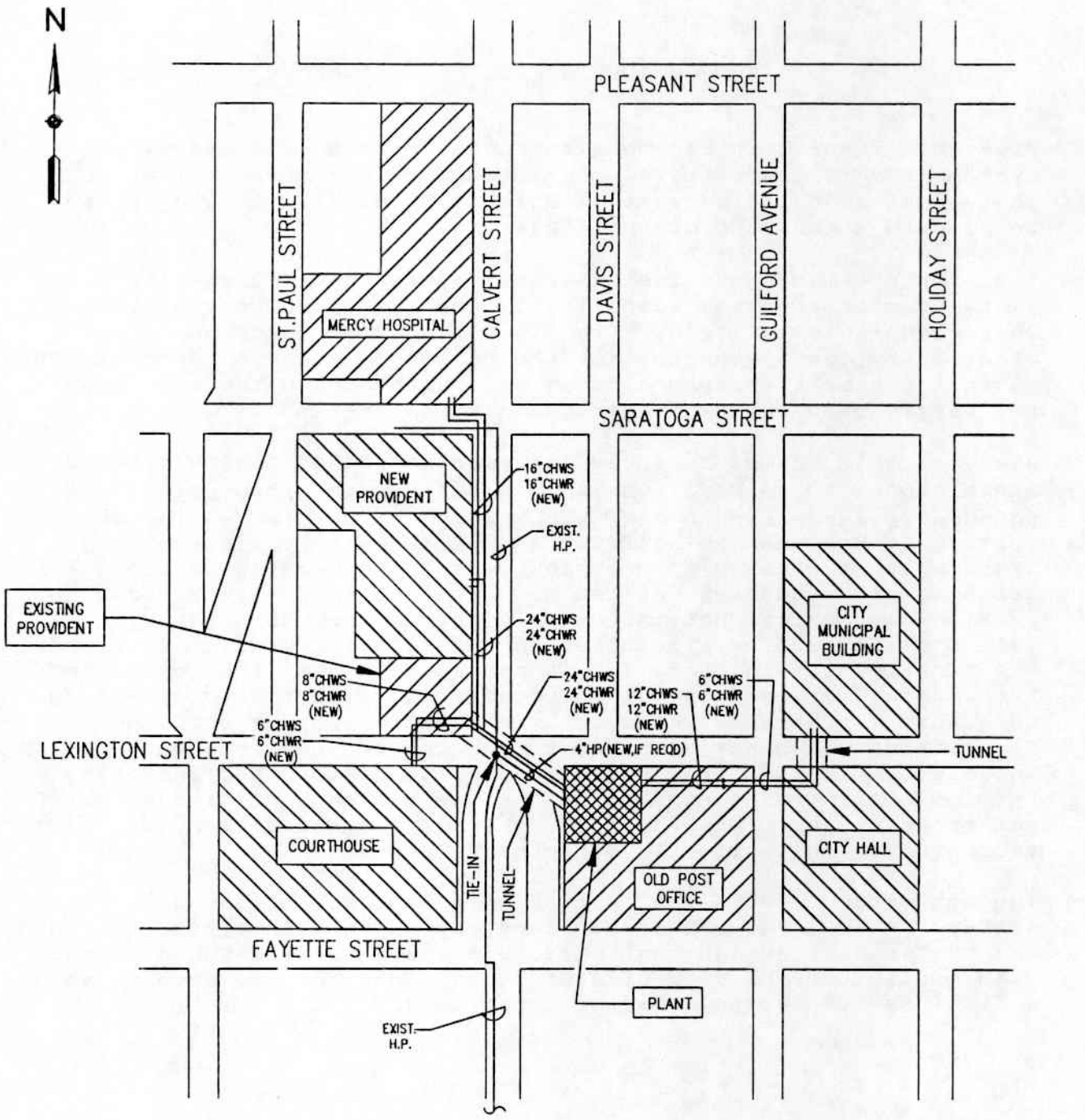
CONCLUSIONS & RECOMMENDATIONS

From this report, it can be seen that a central chilled water system is very competitive, and in most cases, cheaper than individual in-building systems which typically cost $.27 to $.30 to produce a ton-hour of chilling.

This report also shows that a steam powered central chilled water system performs better economically than an all electric system. Supporting this position, with significant increases in electricity costs expected for the Baltimore area in the next few years, if a multi-year pro forma was performed on these options, the margin between the electric and steam systems will increase.

However, this office reserves its recommendation of the type of steam system to be utilized (turbine-driven vs. absorption) until further research can be done with regard to chiller equipment costs. It has been this office's experience that piggyback systems are typically more expensive than condensing turbine arrangements. However, as can be seen from the chiller costs in Section 6, this was not the case in pricing for this report. This possibly can be attributed to the relative small size of the individual units in Phase I. It can be seen that the condensing turbine chiller in Phase II is significantly less in cost per ton than that in Phase I, whereas the absorption option shows no fluctuation. Another example of this can be seen from the increase in the ROI from Phase I to Phase II for the condensing turbine option. The condensing turbine option's ROI increased 10 points from Phase I to Phase II, whereas the absorption option's increase was only slightly more than 4 points.

The next step towards the reality of a central chilled water system would involve a preliminary engineering analysis inwhich the system designs and configurations could be fine-tuned, along with preliminary bidding of equipment. Once this is accomplished a final system design could be established.



GRAPHIC SCALE (IN FEET)

0 100 200 400 600

BALTIMORE THERMAL ENERGY CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/10/90
CHK'D:		
APPR'D:		
ISSUED:		

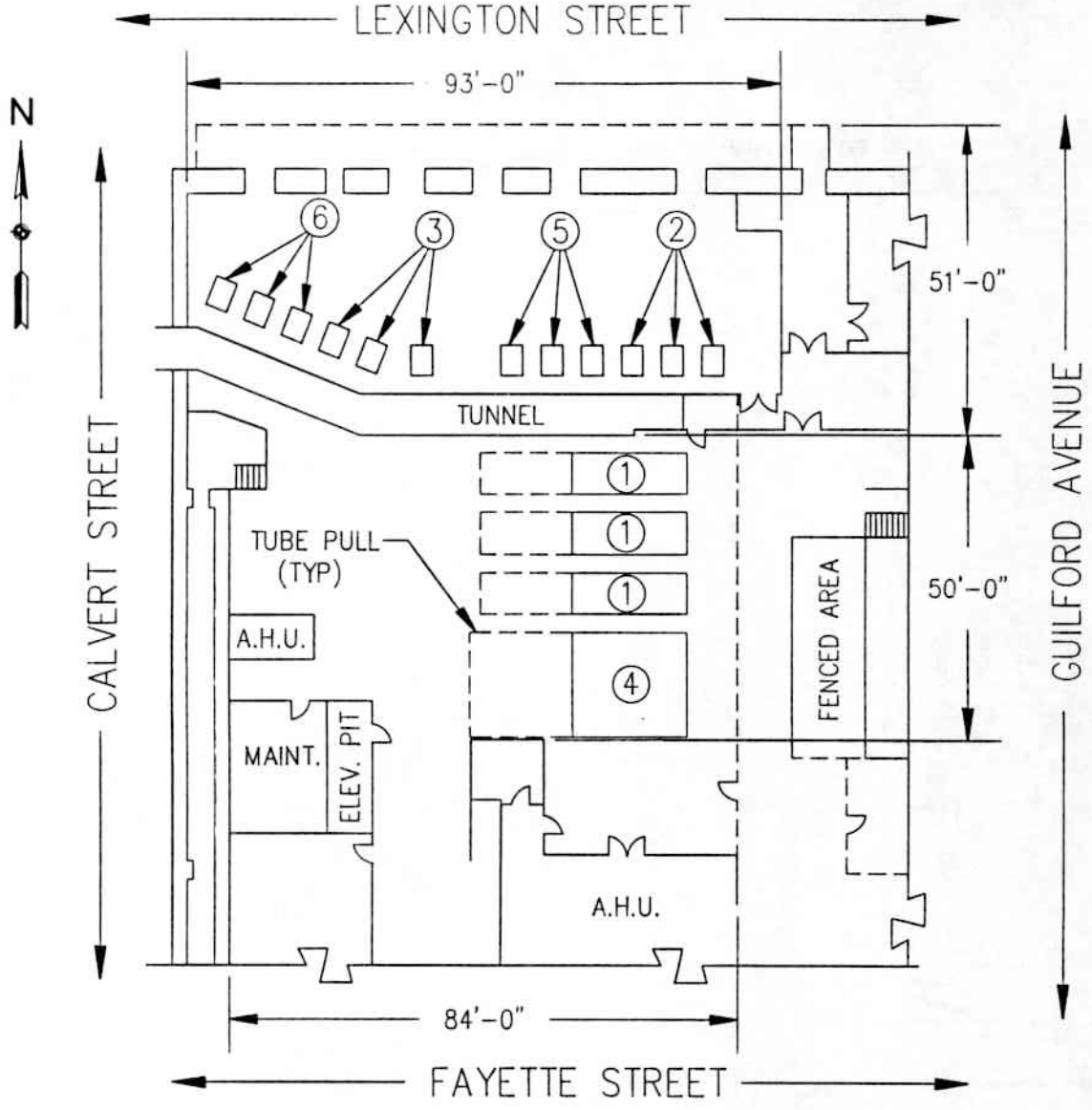
CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: CHILLED WATER LOOP LAYOUT

DRAWING NO. 4A300003

SHEET 1 OF 1



EQUIPMENT

1. 950 TON CENTRIFUGAL CHILLER
2. CHILLED WATER PUMP
3. CONDENSING WATER PUMP
4. 1950 TON CENTRIFUGAL CHILLER (PHASE II)
5. CHILLED WATER PUMP (PHASE II)
6. CONDENSING WATER PUMP (PHASE II)

GRAPHIC SCALE
(IN FEET)
0 10 20 30

BALTIMORE
THERMAL ENERGY
CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/11/90
CHK'D:		
APPR'D:		
ISSUED:		

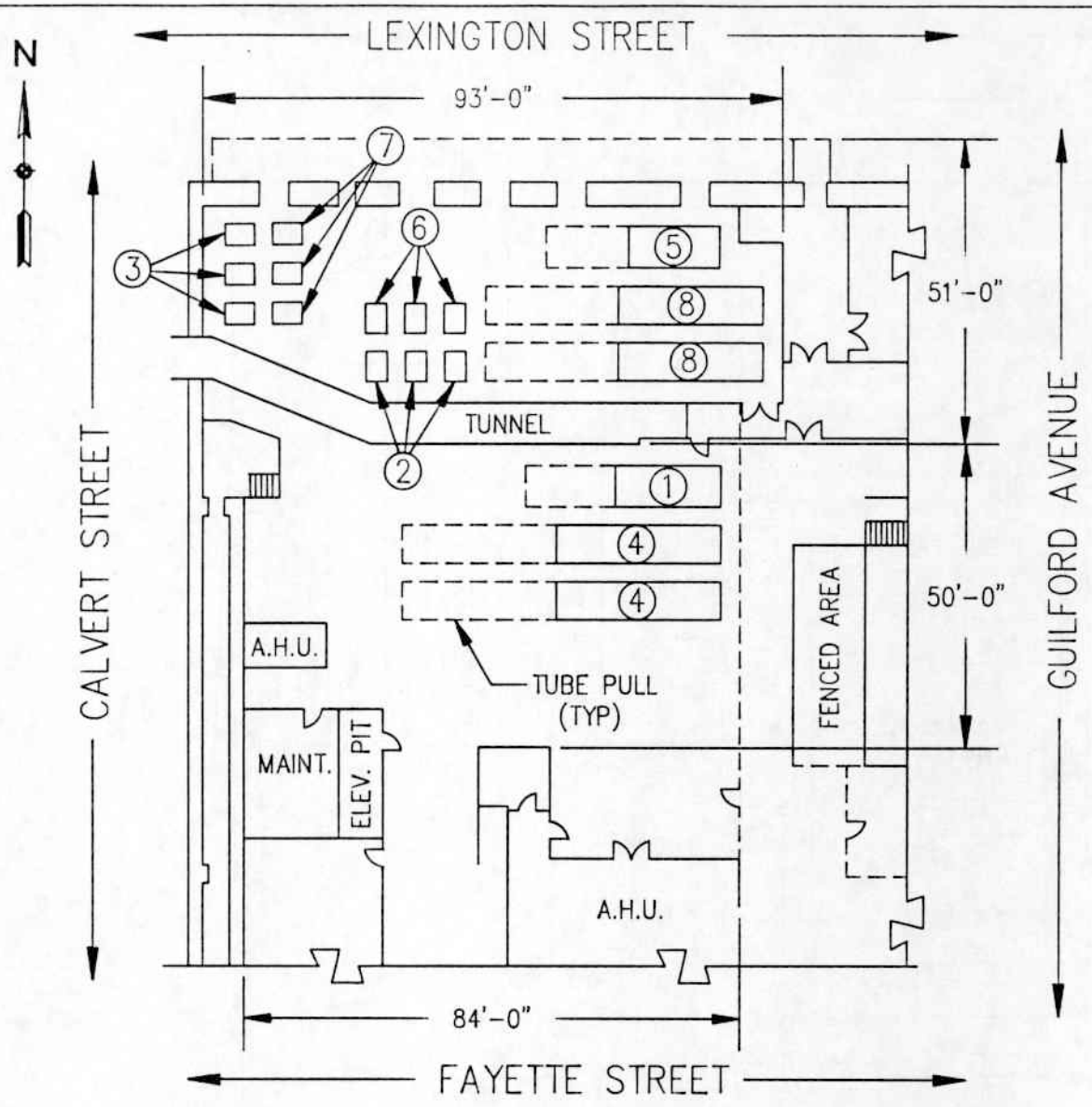
CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT
DOE CHILLED WATER STUDY

DESCRIPTION
OLD POST OFFICE
EQUIPMENT LAYOUT

DRAWING NO.
4A300002

SHEET 1 OF 1



EQUIPMENT

1. 950 TON CENTRIFUGAL CHILLER
2. CHILLED WATER PUMP
3. CONDENSING WATER PUMP
4. 950 TON ABSORPTION CHILLER
5. 650 TON CENTRIFUGAL CHILLER (PHASE II)
6. CHILLED WATER PUMP (PHASE II)
7. CONDENSING WATER PUMP (PHASE II)
8. 650 TON ABSORPTION CHILLER (PHASE II)

GRAPHIC SCALE (IN FEET)

0 10 20 30

BALTIMORE THERMAL ENERGY CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/11/90
CHK'D:		
APPR'D:		
ISSUED:		

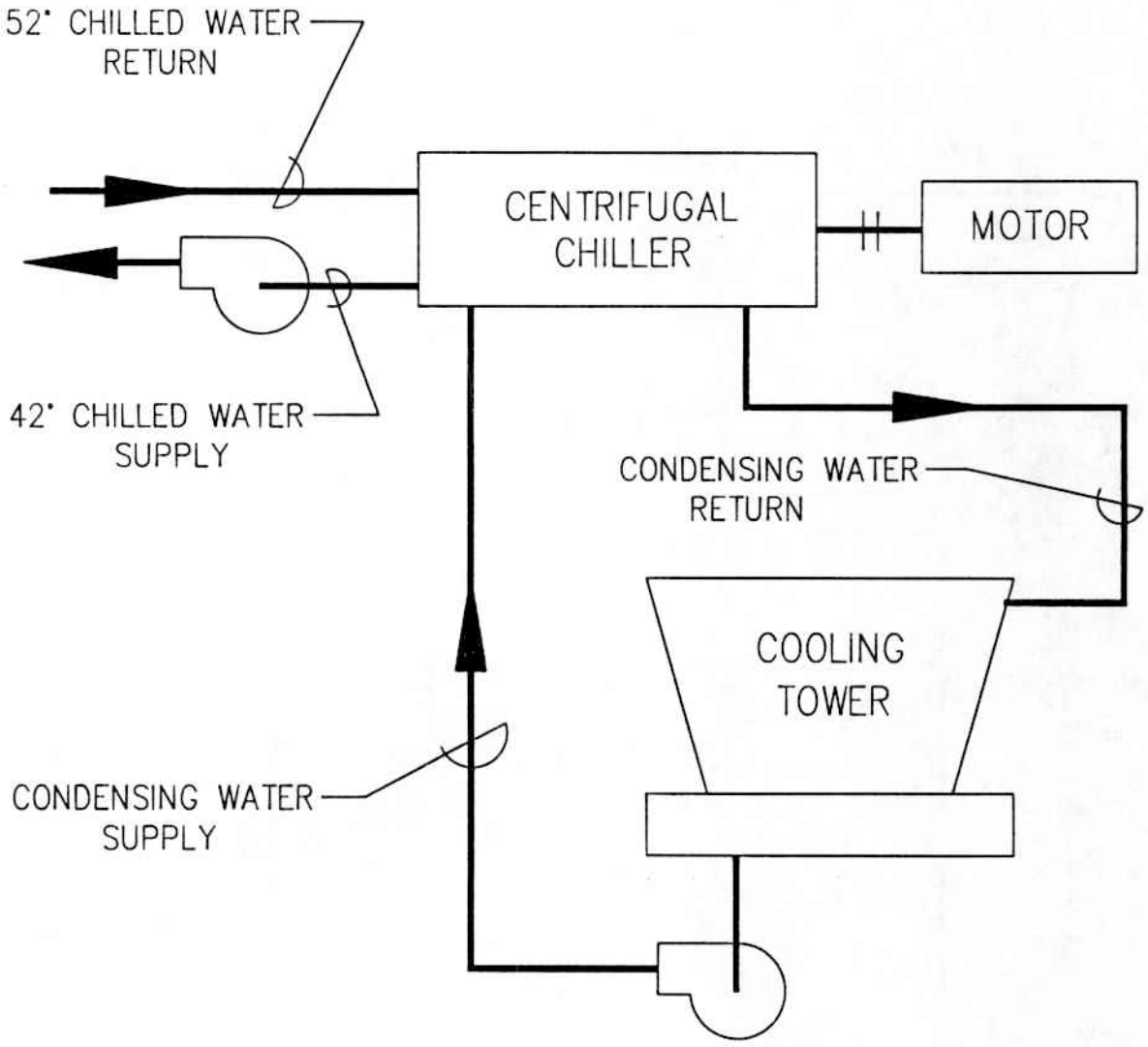
CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: OLD POST OFFICE EQUIPMENT LAYOUT

DRAWING NO. 4A300004

SHEET 1 OF 1



TYPICAL ELECTRIC CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION 1400 RIDGELY STREET BALTIMORE, MD 21230		BY	DATE
	DRWN:	J.PINK	01/11/90
	CHK'D:		
	APPR'D:		
	ISSUED:		

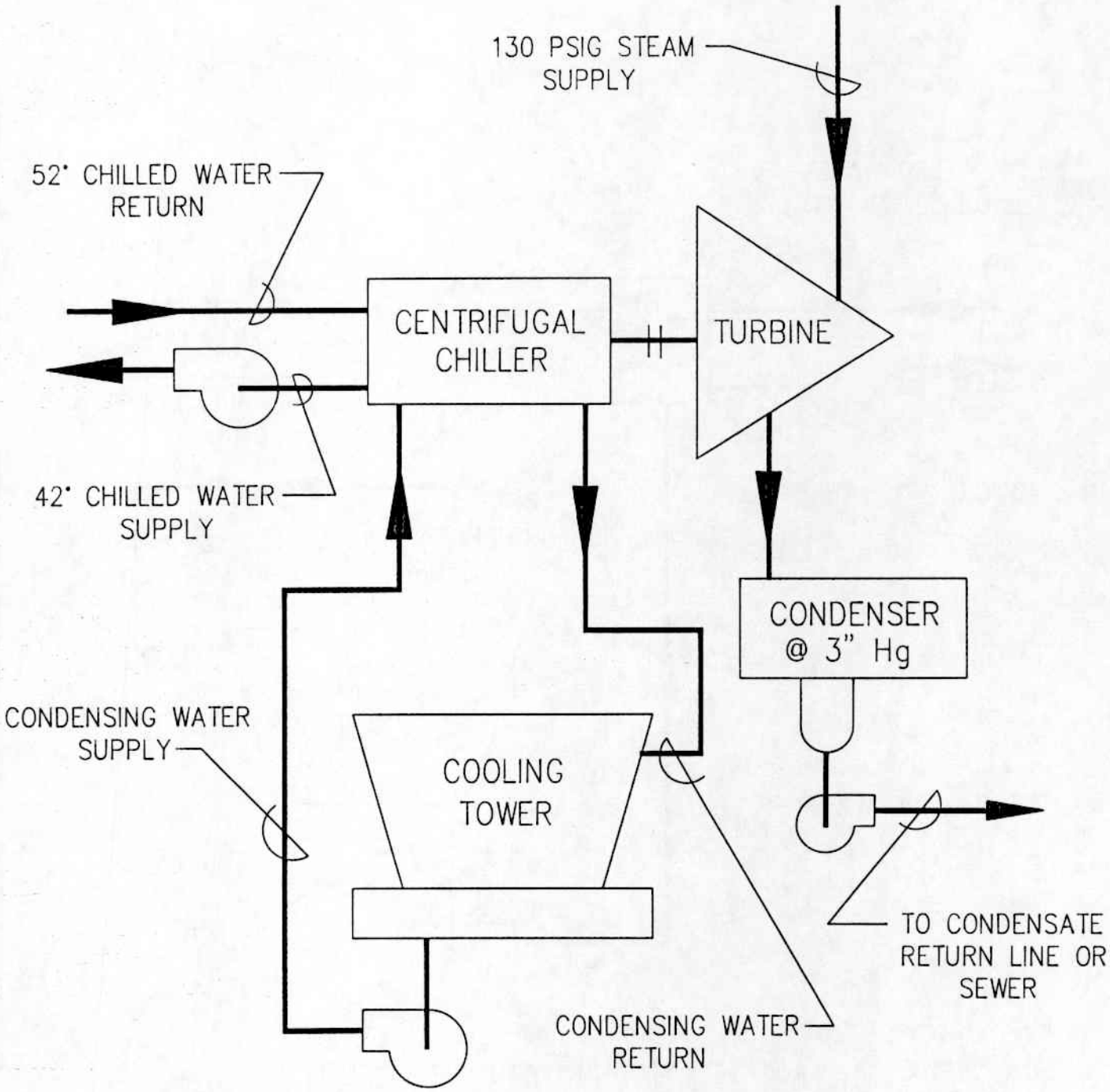
CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYP.ELECT.CENT.CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO.: 4A300005

SHEET 1 OF 1



TYPICAL CONDENSING STEAM TURBINE DRIVEN CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/11/90
CHK'D:		
APPR'D:		
ISSUED:		

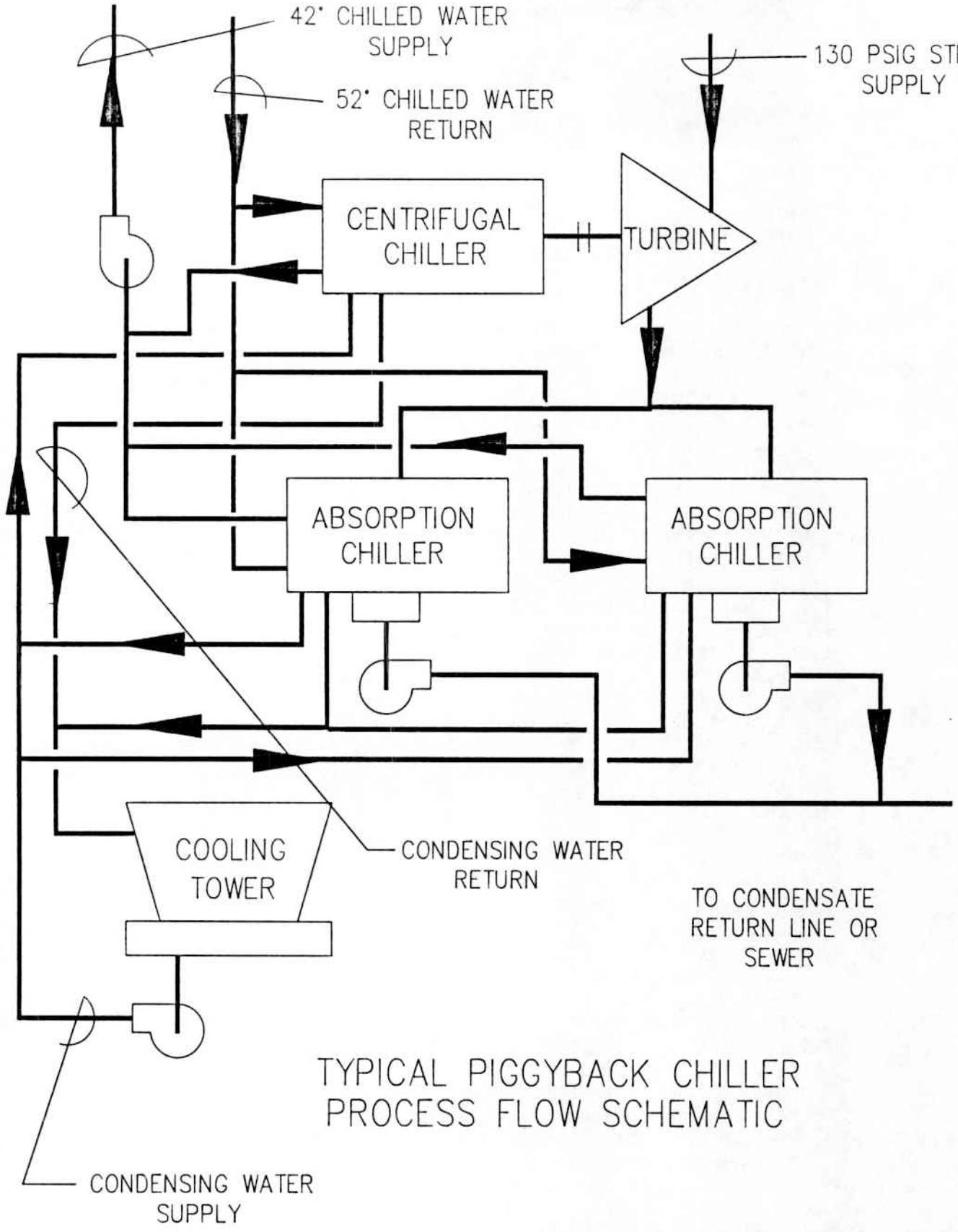
CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYPICAL CONDENSING STEAM TURBINE DRIVEN CENTRIFUGAL CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO. 4A300006

SHEET 1 OF 1



TYPICAL PIGGYBACK CHILLER PROCESS FLOW SCHEMATIC

BALTIMORE THERMAL ENERGY CORPORATION
1400 RIDGELY STREET
BALTIMORE, MD 21230

	BY	DATE
DRWN:	J.PINK	01/11/90
CHK'D:		
APPR'D:		
ISSUED:		

CATALYST THERMAL ENERGY CORP.

SECTION/PROJECT: DOE CHILLED WATER STUDY

DESCRIPTION: TYPICAL PIGGYBACK CHILLER PROCESS FLOW SCHEMATIC

DRAWING NO. 4A300006

SECTION 6
TABLE OF CONTENTS

CHILLING PLANT OPTIONS

1.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	2,850 TONS
BUILDING DEMAND LOAD	2,715 TONS
ANNUAL LOAD:	4,073 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

			Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$977,400		$.240	$.194
PRODUCTION COSTS:				
Steam Cost	$178,580		$.044	$.044
Condensate Credit	$0		$.016	$.016
Electric Cost	$65,353		$.016	$.016
Operating & Maintenance	$190,100		$.047	$.047
G&A, Taxes, Insurance	$87,376		$.021	$.021
B. TOTAL COST OF CHILLED WATER	$521,409		$.128	$.128
C. CASH BEFORE DEBT SERVICE	$455,991		$.112	$.066
PROJECT CAPITAL COST				
CHILLED WATER SYSTEM:				
CHILLED WATER EQUIPMENT	$1,395,200			
MISC EQUIPMENT & BUILDING	$851,000			
DISTRIBUTION SYSTEM	$179,000			
PLANT SITE LEASE	$0	(assumption)		
CAPITAL CONTRIBUTION	na			
TOTAL CAPITAL COST	$2,425,200			
ENGINEERING & CONTINGENCIES	$240,000			
D. TOTAL	$2,665,200			
E. PROJECT EQUITY @ 20%:	$533,040			
F. 80% Financing:				
Debt Service (11% @ 20yrs) CRF = .1257	$268,013		$.066	$.066
G. CASH AFTER DEBT SERVICE (C-F)	$187,979		$.046	$.000
H. SIMPLE PAYBACK, YRS: (D÷C)	5.8			
I. CAPITAL:INCOME RATIO (D÷G)	14.2			
J. RETURN ON INVESTMENT: (G÷E)	35.3%			

1.2 PRICING SUMMARY

PHASE I:

PROJECTED CHILLER ANNUAL PRODUCTION:	3,665,250	TON-HRS
PROJECTED FREE-COOLING PRODUCTION:	407,250	TON-HRS
	4,072,500	TON-HRS

TOTAL PROJECT CAPITAL COST:	$2,665,200	
PROJECT EQUITY: 20%	$533,040	
AMOUNT FINANCED:	$2,132,160	

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT SERV; 11%, 20 YRS, CRF:.1257	$241,211	$.0592	$26,801	$.0592
RETURN ON EQUITY: 20%	$95,947	$.0236	$10,661	$.0236
ENERGY OPERATING COST:	$237,398	$.0648	$6,535 #	$.0160
FIXED OPERATING COSTS:	$268,738	$.0660	$198,837	$.0660
ANNUAL REVENUE REQUIRED:	$843,294		$612,432	
PRICE REQ'D/T-HR:		$.2135		$.1648
			DIFFERENCE:	$.0487

Figure reflects no steam useage by the chillers

1.3 PROPOSED CUSTOMERS

1.3.1 COOLING LOADS: PHASE 1

I. TARGET LIST - Phase I BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,000
City Hall	440		220	330,000	$.24	$79,200
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,000
Court House West (Mitche						
J. RETURN ON INVESTM $90,000						
Provident Bank	na		170	255,000	$.24	$61,200
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,000
	3,510	0	2,715	4,072,500		$977,400
					AVG $/T-HR	$.2400

EQUIVALENT FULL LOAD HOURS 1,500

PLANT SIZING:

CENTRAL PLANT INST. CAPACITY: 2,850 TONS 3 @ 950 Tons Each

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON

CUSTOMER AREA SERVED BY 2700 TON PLAN 1,567,500 SQ FT

UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 3,919 TONS

ANNUAL TON-HOURS: 4,072,500

ANNUAL REVENUE @ AVERAGE $/T-HR: $977,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

1.4 FACILITY AND EQUIPMENT

1.4.1 DESIGN CRITERIA

1.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:

PRESSURE	130	PSIG
TEMPERATURE	355.6	°F
ENTHALPY	1191.70	BTU/LB
PRODUCTION COST:		
FUEL	incl	/MLB
CHEMICALS	incl	
WATER & SEWER	incl	
INCR. ELECTRIC	incl	
TOTAL	$4.61	/MLB

CHILLER DRIVE:

STEAM TURBINE:

THEOR STM RATE	8.59	LB/HPH
EFFICIENCY	65%	
THEOR DELTA h	296.37	BTU
ACTUAL DELTA h	192.64	BTU

EXHAUST STEAM:

PRESSURE	3	" Hg A
TEMPERATURE	115	°F
STM ENTHALPY	999.06	BTU/LB
COND. ENTHALPY	83.03	BTU/LB

CHILLERS:

CHILLED WATER SUPPLY:

PRESSURE	150	PSIG
TEMPERATURE	42	°F
ENTHALPY	10.04	BTU/LB
DENSITY	62.43	LB/CUFT

CHILLED WATER RETURN:

PRESSURE	140	PSIG
TEMPERATURE	52	°F
ENTHALPY	20.06	BTU/LB
DENSITY	62.41	LB/CUFT

CHILLED WATER SYSTEM:

TEMP RISE	10	°F
FLOW PER TON	2.39	GPM

ELECTRIC POWER

PRIMARY VOLTAGE AVAL	13800	VAC
AVG ELEC POWER COST	$.074	$/KWH

1.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

EQUIVALENT MAX TONS FOR 10 DEGREE RISE	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S	MAX HD LOSS/100'
0	0	0	NA	NA	NA
17	1	40	2	3.82	3.06
27	40	65	2.50	4.36	3.13
50	65	120	3	5.21	3.35
100	120	240	4	6.05	3.19
293	240	700	6	7.77	3.13
502	700	1200	8	7.70	2.20
753	1200	1800	10	7.32	1.52
1087	1800	2600	12	7.45	1.27
1255	2600	3000	14	7.12	1.04
1882	3000	4500	16	8.17	1.15
2509	4500	6000	18	8.61	1.11
2928	6000	7000	20	8.08	.86
4182	7000	10000	24	7.98	.68
7528	10000	18000	30	8.90	.63
10456	18000	25000	36	8.58	.47

1.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	2715 FIRM	2850
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	2715	2850
THREE CHILLERS EACH @ TONS =	905	950
COMPRESSOR RATING (HP/TON) =	.80	.80
STEAM TURBINE DRIVES - HP EACH =	724	760

1.4.3 CHILLING EQUIPMENT

1.4.3.1 CHILLERS

		OPERATING	RATING	
CHILLER DESIGN:				
OPEN DRIVE CENTRIFUGAL	@	905 TONS EA	950 TONS EA	(PAR 4.2)
CHILLED WATER SUPPLY	@	42 °F	42 °F	
CHILLED WATER RETURN	@	52 °F	52 °F	
CONDENSING WTR SUPPLY	@	85 °F	85 °F	
CONDENSING WTR RETURN	@	95 °F	95 °F	
CONDENSING WTR FLOW	@	2541 GPM	2667 GPM	
DRIVES:				
CONDENSING STM TURBINE	@	724 HP	760 HP	
THROTTLE STM CONDITIONS				
PRESSURE	@	130 PSIG	130 PSIG	
TEMPERATURE	@	355.60 °F	355.60 °F	
ENTHALPY	@	1191.7 BTU/LB	1191.7 BTU/LB	
EXHAUST STM CONDITIONS				
PRESSURE	@	3 " Hg	3 " Hg	
TEMPERATURE	@	115 °F	115 °F	
STM ENTHALPY	@	999.1 BTU/LB	999.1 BTU/LB	
COND. ENTHALPY	@	83.0 BTU/LB	83.0 BTU/LB	
ACTUAL STEAM RATE	@	13.21 LB/HPH	13.21 LB/HPH	
FULL LOAD STEAM REQ'D	@	9,565 LB/HR	10,040 LB/HR	
STEAM CONDENSING WATER (series flow w/chiller)				
CONDENSING WTR FLOW	@	2541 GPM	2667 GPM	
SUPPLY	@	95 °F	95 °F	
RETURN	@	102 °F	102 °F	
ANNUAL STEAM REQUIREMENTS				
CHILLER LOAD FACTOR	@	17.1%	17.1%	
CHILLERS REQUIRED	@	3	3	
ANNUAL MLBS STEAM	@	43,042 MLBS/YR	45,182 MLBS/YR	
ANNUAL COST OF STM	@	$198,422	$208,289	

1.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	6816	GPM	7155	GPM
PUMP EFFICIENCY	@	87%		87%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
DISTRIBUTION PIPING	@	20	FT	20	FT
IN-PLANT PIPING	@	50	FT	50	FT
CHILLERS	@	45	FT	45	FT
METERS/VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		140	FT	140	FT

DRIVES:

		MOTOR X TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	NA	LB/HR	NA	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	146	BHP EA	153	BHP EA

ANNUAL ENERGY REQUIREMENTS					
CW PUMP LOAD FACTOR	@	17.1%		17.1%	
STM DRIVERS REQUIRED	@	0		0	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2		2	
ANNUAL ELECT CONSUMPTION	@	327	MWH/YR	343	MWH/YR
ANNUAL COST OF ELECT	@	$24,180		$25,382	

1.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	8384	GPM TOTAL	8801	GPM TOTAL
PUMP EFFICIENCY	@	85%		85%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
CHILLER COND'R	@	20	FT	20	FT
IN-PLANT PIPING	@	25	FT	25	FT
DRIVE STM COND'R	@	20	FT	20	FT
VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		90	FT	90	FT

DRIVES:

		ELECTRIC MOTOR X CONDENSING TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	0	LB/HR	0	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	118	BHP EA	124	BHP EA

ANNUAL REQUIREMENTS					
CONDENSING WTR LOAD FACT	@	25.7%		25.7%	
STM DRIVERS REQUIRED	@	0		0	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2	(50% cap ea)	2	(50% cap ea)
ANNUAL ELECT CONSUMPTION	@	397	MWH/YR	416	MWH/YR
ANNUAL COST OF ELECT	@	$29,352		$30,812	

1.4.3.4 CONDENSER HOTWELL PUMPS

PUMP DESIGN - CHLR DRV. HW:		OPERATING	RATING
VOLUME REQUIRED	@	63 GPM	66 GPM
PUMP EFFICIENCY	@	64%	64%
NUMBER REQUIRED	@	2	2

PUMP DESIGN - CW PUMP DRV. HW:			
VOLUME REQUIRED	@	NA GPM	NA GPM
PUMP EFFICIENCY	@	42%	42%
NUMBER REQUIRED	@	0	0
HEAD REQUIRED			
CONDENSER VACUUM	@	30 FT	30 FT
IN-PLANT PIPING	@	20 FT	20 FT
VALVES	@	30 FT	30 FT
CONTINGENCY	@	10 FT	10 FT
TOTAL		90 FT	90 FT

ANNUAL ENERGY REQUIREMENTS					
CHL'R HOTWELL PUMPS	@	2	BHP EA	2	BHP EA
CHL'R HW LOAD FACT.	@	15.4%		15.4%	
CW PUMP HOTWELL PUMPS	@	0	BHP	0	BHP
CW PUMP HW LOAD FACT.	@	15.4%		15.4%	
MOTOR DRIVES REQUIRED	@	2		2	
ANNUAL ELECT CONSUMPTION	@	4.73	MWH/YR	4.97	MWH/YR
ANNUAL COST OF ELECT	@	$350		$367	

1.4.3.5 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	101 Deg F	101 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	8384 GPM	8801 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf	up to 1000 CF
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	$.074 /KWH	
MAKE-UP: EVAPORATION RATE	84 GPM	87 GPM
BLOWDOWN RATE	21 GPM	23 GPM
MAKE-UP RATE	105 GPM	110 GPM
ANNUAL CONSUMPTION	14,175,000 GAL/YR	14,850,000 GAL/YR
WATER COST	$5,677	$5,947
SEWER COST	$2,044	$2,238
ANNUAL WATER COST -	$7,720	$8,185
FANS -		
QUANTITY -	3	3
MOTOR -	30 BHP	40 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	71 KW	94 KW

1.5 OPERATING AND MAINTENANCE

1.5.1 CHILLED WATER EQUIPMENT

STEAM DRIVEN EQUIPMENT:

CHILLERS

NUMBER OPERATING	@	3	UNITS	
DESIGN LOAD	@	724	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	9,565	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	38,738	MLB	
ANNUAL COST	@	$178,580		

CHILLED WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	NA	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSING WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	
DESIGN FLOW	@	0	LB/HR	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	NA	MLB
HEAT RETURNED	@	NA	MMBTU
ANNUAL HEAT CREDIT	@	NA	
ANNUAL CHEM CREDIT	@	NA	(90% CREDIT)
ANNUAL WTR CREDIT	@	NA	(99% CREDIT)
ANNUAL SEWER CREDIT	@	NA	(99% CREDIT)

TOTAL ANNUAL STEAM COST = $178,580

ELECTRIC DRIVEN EQUIPMENT:

CHILLED WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	146	BHP	
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	294	MKWh	
ANNUAL COST	@	$21,762		

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	118	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	357	MKWh	
ANNUAL COST	@	$26,417		

HOTWELL PUMPS

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	13.9%		
ANNUAL CONSUMPTION	@	4	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$315		

COOLING TOWER				
NUMBER OPERATING	@	3	CELLS	
DESIGN LOAD	@	30	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	95	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$7,060		
MISC EQUIPMENT				
DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	44.10	MKWh	
ANNUAL COST	@	$3,264		
TOTAL ANNUAL ELEC. COST	=	$58,817		
TOTAL ANNUAL ENERGY COST:		$237,398		

1.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

STEAM DRIVEN EQUIPMENT: FREE COOLING

CHILLERS - NOT RUNNING

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	724	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	9,565	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CHILLED WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	NA	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSING WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	
DESIGN FLOW	@	0	LB/HR	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	na	MLB	
HEAT RETURNED	@	na	MMBTU	
ANNUAL HEAT CREDIT	@	na		
ANNUAL CHEM CREDIT	@	na	(90% CREDIT)	
ANNUAL WTR CREDIT	@	na	(99% CREDIT)	
ANNUAL SEWER CREDIT	@	na	(99% CREDIT)	

TOTAL ANNUAL STEAM COST = $0

ELECTRIC DRIVEN EQUIPMENT:

CHILLED WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	146	BHP	
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	33	MKWh	
ANNUAL COST	@	$2,418		

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	118	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	40	MKWh	
ANNUAL COST	@	$2,935		

HOTWELL PUMPS

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	1.5%		
ANNUAL CONSUMPTION	@	.5	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$35		

COOLING TOWER				
NUMBER OPERATING	@	3	CELLS	
DESIGN LOAD	@	30	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	11	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$784		
MISC EQUIPMENT				
DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	4.90	MKWh	
ANNUAL COST	@	$363		
TOTAL ANNUAL ELEC. COST	=	$6,535		
TOTAL ANNUAL ENERGY COST:		$6,535		

1.5.3 O&M LABOR & MATERIALS

	QUANT	UNITS	RATE	ANNUAL
OPERATING LABOR (1)				
PLANT SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	1	EA	$28,000	$28,000
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	1	EA	$18,000	$18,000
TOTAL LABOR COST				$46,000
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	1000	MGAL	$.84	$840
TOWER MAKE-UP	14,175	MGAL		$7,720
MISC	500	MGAL	$.84	$420
CHEMICALS & OIL				
CHILLED WATER	4,073	MTH	$.40	$1,629
TOWER	14,175	MGAL	$.60	$8,505
LUBE OILS	1500	GAL	$6.00	$9,000
DISTRIBUTION	1.2	1000'	$1,000	$1,190
CHILLER/TURBINE	2	EA	$18,000	$36,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	680	HP	$10	$6,795
PIPING, VALVES & MISC	1	LOT	$15,000	$15,000
INSTRUMENTATION & ELECT	1	LOT	$20,000	$20,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	1	LOT	$12,000	$12,000
TOTAL MATERIALS COST				$144,100
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$190,100

(1) - Plant to be manned for day shift only; remotely operated for second and third shifts

1.5.4 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$10,000	
TELEPHONE	$3,600	
OFFICE EQUIPMENT	$2,000	
POSTAGE	$1,200	
EDP COST	$0	
MISC. COST	$3,600	
TOTAL G & A	$20,400	
PROPERTY INSURANCE	$16,976	$.70 /$100 CAPITAL
LIABILITY INSURANCE	$6,353	$6.50 /$1000 SALES
TAXES:		
PERSONAL PROPERTY TAXES	$50,000	(ESTIMATE)
REAL PROPERTY TAXES	na	
SALES/GRT	na	
LICENSE FEES/TAXES	$0	
TOTAL TAXES	$50,000	
TOTAL G&A AND TAXES	$87,376	

1.5.5 SUMMARY O & M COSTS

SUMMARY O & M COSTS

Ton-Hours Sold: 4,072,500

	Units	Units/T-HR	Cost	Cost/T-Hr
Steam	38,738 Mlbs	.00951	$178,580	.0439
Electricity	883 MKwh	.00022	$65,353	.0160
Water & Sewer	15,675 MGAL	.00385	$8,980	.0022
Chemicals	na	na	$19,134	.0047
			$272,047	

1.6 CAPITAL COST

1.6.1 SUMMARY & TOTAL

PHASE I

CHILLED WATER EQUIPMENT	$1,395,200	$490 $/TON (REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$851,000	$299 $/TON (REF SEC 6.3)
DISTRIBUTION SYSTEM	$179,000	$63 $/TON (REF SEC 6.4)
PLANT SITE	$0	$0 $/TON
TOTAL CAPITAL	$2,425,200	$851 $/TON
ENGINEERING & DESIGN	$120,000	
CONTINGENCY	$120,000	
TOTAL CHILLING SYSTEM COST	$2,665,200	$935 $/TON

NOTE: All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means estimating Guide as commonly used by contractors

1.6.2 CHILLED WATER EQUIPMENT

PHASE I		QNTY	RATING	HP	DRV RPM	EQUIP COST
CHILLER	(TONS)	3	950	724	5400	$995,545
COOLING TOWER; CELLS		3		40		$180,000
PUMPS:						
CW w/TURBINE DRV	(GPM)	0	0	NA	1750	$0
CW w/MOTOR DRV	(GPM)	3	3,408	153	1750	$30,200
COND WTR W/TURBINE	(GPM)	0	0	NA	1750	$0
COND WTR W/MOTOR	(GPM)	3	4,192	124	1750	$32,500
CHILLER COND HTWL	(GPM)	3	32	2	1750	incl w/cond
CW PUMP COND HTWL	(GPM)	0	0	0	1750	$0
STEAM TURBINE DRIVES:						
CHILLER DRIVE		3	NA	724	5400	incl w/chlr
CW PUMP		0	NA	NA	5400	$0
COND WTR PUMP		0	NA	NA	5400	$0
STEAM SURFACE CONDENSER:						
CHILLER DRIVE	(LB/HR)	3	9,565	NA	NA	$157,000
CW PUMP	(LB/HR)	0	NA	NA	NA	NA
TOTAL CHILLED WATER EQUIPMENT				959		$1,395,245

1.6.3 MISC EQUIPMENT & BUILDING

PHASE I	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	NA			$396,000
MISC EQUIPMENT	1	NA	NA	$14,000
ELEC: MCC, TRANS., ETC. (AMPS)	1	NA	NA	$130,000
INSTRUMENTS & CONTROLS	1	NA	NA	$100,000
TOTAL MISC EQUIPMENT				$640,000
BUILDING				
BUILDING & STRUCTURE (SQ FT)				$160,000
FOUNDATION & CONCRETE (SQ FT)				incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	3800			$13,000
MECHANICAL & PLUMBING (SQ FT)	3800			$38,000
TOTAL BUILDING				$211,000

1.6.4 DISTRIBUTION SYSTEM

PHASE I

CHILLED WATER DISTRIBUTION PIPE COST TABLE

PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	146.67 PIPE EXCAVAT	162.06 PIPE BED BACKFILL	88.93 PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	260	$71,110	0	$0
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	0	$0
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	510	$54,060	40	$13,477
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	180	$12,375	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	140	$9,940	60	$10,917
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											1090		100	

SUB-TOTAL COSTS: $147,485 $24,394

TOTAL COSTS: $171,879

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	165	$7,178	0	$0

SUB-TOTAL COSTS: $7,178 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $7,178

TOTAL DISTRIBUTION COST: $179,000

2.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	4,800 TONS
BUILDING DEMAND LOAD	4,590 TONS
ANNUAL LOAD:	6,885 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

			Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$1,652,400		$.240	$.183
PRODUCTION COSTS:				
Steam Cost	$301,909		$.044	$.044
Condensate Credit	$0		$.016	$.016
Electric Cost	$110,433		$.016	$.016
Operating & Maintenance	$279,387		$.041	$.041
G&A, Taxes, Insurance	$128,190		$.019	$.019
B. TOTAL COST OF CHILLED WATER	$819,919		$.119	$.119
C. CASH BEFORE DEBT SERVICE	$832,481		$.121	$.064
PROJECT CAPITAL COST				
CHILLED WATER SYSTEM:				
CHILLED WATER EQUIPMENT	$2,193,000			
MISC EQUIPMENT & BUILDING	$1,223,000			
DISTRIBUTION SYSTEM	$554,000			
PLANT SITE LEASE	$0	(assumption)		
CAPITAL CONTRIBUTION	na			
TOTAL CAPITAL COST	$3,970,000			
ENGINEERING & CONTINGENCIES	$400,000			
D. TOTAL	$4,370,000			
E. PROJECT EQUITY @ 20%:	$874,000			
F. 80% Financing:				
Debt Service (11% @ 20yrs)	$439,447		$.064	$.064
CRF = .1257				
G. CASH AFTER DEBT SERVICE (C-F)	$393,034		$.057	$.000
H. SIMPLE PAYBACK, YRS: (D÷C)	5.2			
I. CAPITAL:INCOME RATIO (D÷G)	11.1			
J. RETURN ON INVESTMENT:(G÷E)	45.0%			

2.2 PRICING SUMMARY

PHASES I & II:

PROJECTED CHILLER ANNUAL PRODUCTION:		6,196,500	TON-HRS
PROJECTED FREE-COOLING PRODUCTION:		688,500	TON-HRS
		6,885,000	TON-HRS
TOTAL PROJECT CAPITAL COST:		$4,370,000	
PROJECT EQUITY:	20%	$874,000	
AMOUNT FINANCED:		$3,496,000	

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT SERV; 11%, 20 YRS, CRF:.1257	$395,502	$.0574	$43,945	$.0574
RETURN ON EQUITY: 20%	$157,320	$.0228	$17,480	$.0228
ENERGY OPERATING COST:	$401,299	$.0648	$11,043 *	$.0160
FIXED OPERATING COSTS:	$635,558	$.0923	$239,595	$.0923
ANNUAL REVENUE REQUIRED:	$1,589,679		$1,199,424	
PRICE REQ'D/T-HR:		$.2374		$.1886
			DIFFERENCE:	$.0487

* Figure reflects no steam useage by the chillers

2.3 PROPOSED CUSTOMERS

2.3.1 COOLING LOADS: PHASE 1 & 2

I. TARGET LIST - Phase I & II BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,000
City Hall	440		220	330,000	$.24	$79,200
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,000
Court House West (Mitchell)	na		250	375,000	$.24	$90,000
Provident Bank	na		170	255,000	$.24	$61,200
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,000
Provident Building	na		1,875	2,812,500	$.24	$675,000
	3,510	0	4,590	6,885,000		$1,652,400
					AVG $/T-HR	$.2400
EQUIVALENT FULL LOAD HOURS	1,500					

PLANT SIZING:

CENTRAL PLANT INST. CAPACITY:	2,850	TONS	3 @	950	Tons Each
	1,950	TONS	1 @	1,950	Tons Each
TOTAL:	4,800	TONS			

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON
CUSTOMER AREA SERVED BY 4800 TON PLANT: 2,640,000 SQ FT
UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 6,600 TONS

ANNUAL TON-HOURS: 6,885,000

ANNUAL REVENUE @ AVERAGE $/T-HR: $1,652,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

2.4 FACILITY AND EQUIPMENT

2.4.1 DESIGN CRITERIA

2.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:

PRESSURE	130	PSIG
TEMPERATURE	355.6	°F
ENTHALPY	1191.70	BTU/LB
PRODUCTION COST:		
FUEL	incl	/MLB
CHEMICALS	incl	
WATER & SEWER	incl	
INCR. ELECTRIC	incl	
TOTAL	$4.61	/MLB

CHILLER DRIVE:

STEAM TURBINE:

THEOR STM RATE	8.59	LB/HPH
EFFICIENCY	65%	
THEOR DELTA h	296.37	BTU
ACTUAL DELTA h	192.64	BTU

EXHAUST STEAM:

PRESSURE	3	" Hg A
TEMPERATURE	115	°F
STM ENTHALPY	999.06	BTU/LB
COND. ENTHALPY	83.03	BTU/LB

CHILLERS:

CHILLED WATER SUPPLY:

PRESSURE	150	PSIG
TEMPERATURE	42	°F
ENTHALPY	10.04	BTU/LB
DENSITY	62.43	LB/CUFT

CHILLED WATER RETURN:

PRESSURE	140	PSIG
TEMPERATURE	52	°F
ENTHALPY	20.06	BTU/LB
DENSITY	62.41	LB/CUFT

CHILLED WATER SYSTEM:

TEMP RISE	10	°F
FLOW PER TON	2.39	GPM

ELECTRIC POWER

PRIMARY VOLTAGE AVAL	13800	VAC
AVG ELEC POWER COST	$.074	$/KWH

2.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

EQUIVALENT MAX TONS FOR 10 DEGREE RISE	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S	MAX HD LOSS/100'
0	0	0	NA	NA	NA
17	1	40	2	3.82	3.06
27	40	65	2.50	4.36	3.13
50	65	120	3	5.21	3.35
100	120	240	4	6.05	3.19
293	240	700	6	7.77	3.13
502	700	1200	8	7.70	2.20
753	1200	1800	10	7.32	1.52
1087	1800	2600	12	7.45	1.27
1255	2600	3000	14	7.12	1.04
1882	3000	4500	16	8.17	1.15
2509	4500	6000	18	8.61	1.11
2928	6000	7000	20	8.08	.86
4182	7000	10000	24	7.98	.68
7528	10000	18000	30	8.90	.63
10456	18000	25000	36	8.58	.47

2.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	1875 FIRM	1950
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	1875	1950
ONE CHILLER @ TONS =	1875	1950
COMPRESSOR RATING (HP/TON) =	.80	.80
STEAM TURBINE DRIVES - HP EACH =	1500	1560

2.4.3 CHILLING EQUIPMENT

2.4.3.1 CHILLERS

		OPERATING	RATING	
CHILLER DESIGN:				
OPEN DRIVE CENTRIFUGAL	@	1875 TONS EA	1950 TONS EA	(PAR 4.2)
CHILLED WATER SUPPLY	@	42 °F	42 °F	
CHILLED WATER RETURN	@	52 °F	52 °F	
CONDENSING WTR SUPPLY	@	85 °F	85 °F	
CONDENSING WTR RETURN	@	95 °F	95 °F	
CONDENSING WTR FLOW	@	5264 GPM	5474 GPM	
DRIVES:				
CONDENSING STM TURBINE	@	1500 HP	1560 HP	
THROTTLE STM CONDITIONS				
PRESSURE	@	130 PSIG	130 PSIG	
TEMPERATURE	@	355.60 °F	355.60 °F	
ENTHALPY	@	1191.7 BTU/LB	1191.7 BTU/LB	
EXHAUST STM CONDITIONS				
PRESSURE	@	3 " Hg	3 " Hg	
TEMPERATURE	@	115 °F	115 °F	
STM ENTHALPY	@	999.1 BTU/LB	999.1 BTU/LB	
COND. ENTHALPY	@	83.0 BTU/LB	83.0 BTU/LB	
ACTUAL STEAM RATE	@	13.21 LB/HPH	13.21 LB/HPH	
FULL LOAD STEAM REQ'D	@	19,817 LB/HR	20,609 LB/HR	
STEAM CONDENSING WATER (series flow w/chiller)				
CONDENSING WTR FLOW	@	5264 GPM	5474 GPM	
SUPPLY	@	95 °F	95 °F	
RETURN	@	102 °F	102 °F	
ANNUAL STEAM REQUIREMENTS				
CHILLER LOAD FACTOR	@	17.1%	17.1%	
CHILLERS REQUIRED	@	1	1	
ANNUAL MLBS STEAM	@	29,725 MLBS/YR	30,914 MLBS/YR	
ANNUAL COST OF STM	@	$137,032	$142,513	

2.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	4707	GPM	4896	GPM
PUMP EFFICIENCY	@	87%		87%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
DISTRIBUTION PIPING	@	20	FT	20	FT
IN-PLANT PIPING	@	50	FT	50	FT
CHILLERS	@	45	FT	45	FT
METERS/VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		140	FT	140	FT

DRIVES:

		MOTOR X TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	NA	LB/HR	NA	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	101	BHP EA	105	BHP EA

ANNUAL ENERGY REQUIREMENTS					
CW PUMP LOAD FACTOR	@	17.1%		17.1%	
STM DRIVERS REQUIRED	@	0		0	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2		2	
ANNUAL ELECT CONSUMPTION	@	226	MWH/YR	235	MWH/YR
ANNUAL COST OF ELECT	@	$16,699		$17,367	

2.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	5790 GPM TOTAL	6021 GPM TOTAL
PUMP EFFICIENCY	@	85%	85%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
CHILLER COND'R	@	20 FT	20 FT
IN-PLANT PIPING	@	25 FT	25 FT
DRIVE STM COND'R	@	20 FT	20 FT
VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		90 FT	90 FT

DRIVES:

		ELECTRIC MOTOR X CONDENSING TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	NA	LB/HR	NA	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	82	BHP EA	85	BHP EA

ANNUAL REQUIREMENTS			
CONDENSING WTR LOAD FACT	@	25.7%	25.7%
STM DRIVERS REQUIRED	@	0	0
STM DRIVE CONSUMPTION	@	0 MLBS/YR	0 MLBS/YR
ANNUAL COST OF STM	@	$0	$0
MOTOR DRIVES REQUIRED	@	2 (50% cap ea)	2 (50% cap ea)
ANNUAL ELECT CONSUMPTION	@	274 MWH/YR	285 MWH/YR
ANNUAL COST OF ELECT	@	$20,271	$21,082

2.4.3.4 CONDENSER HOTWELL PUMPS

PUMP DESIGN - CHLR DRV. HW:		OPERATING	RATING
VOLUME REQUIRED	@	44 GPM	45 GPM
PUMP EFFICIENCY	@	64%	64%
NUMBER REQUIRED	@	2	2
PUMP DESIGN - CW PUMP DRV. HW:			
VOLUME REQUIRED	@	NA GPM	NA GPM
PUMP EFFICIENCY	@	42%	42%
NUMBER REQUIRED	@	0	0
HEAD REQUIRED			
CONDENSER VACUUM	@	30 FT	30 FT
IN-PLANT PIPING	@	20 FT	20 FT
VALVES	@	30 FT	30 FT
CONTINGENCY	@	10 FT	10 FT
TOTAL		90 FT	90 FT

ANNUAL ENERGY REQUIREMENTS			
CHL'R HOTWELL PUMPS	@	2 BHP EA	2 BHP EA
CHL'R HW LOAD FACT.	@	15.4%	15.4%
CW PUMP HOTWELL PUMPS	@	0 BHP	0 BHP
CW PUMP HW LOAD FACT.	@	15.4%	15.4%
MOTOR DRIVES REQUIRED	@	2	2
ANNUAL ELECT CONSUMPTION	@	3.27 MWH/YR	3.40 MWH/YR
ANNUAL COST OF ELECT	@	$242	$251

2.4.3.5 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	101 Deg F	101 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	5790 GPM	6021 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf up to 1000 CF	
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	$.074 /KWH	
MAKE-UP: EVAPORATION RATE	58 GPM	62 GPM
BLOWDOWN RATE	14 GPM	16 GPM
MAKE-UP RATE	72 GPM	78 GPM
ANNUAL CONSUMPTION	9,720,000 GAL/YR	10,530,000 GAL/YR
WATER COST	$3,893	$4,217
SEWER COST	$1,362	$1,557
ANNUAL WATER COST -	$5,255	$5,774
FANS -		
QUANTITY -	2	2
MOTOR -	30 BHP	40 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	47 KW	63 KW

2.5 OPERATING AND MAINTENANCE

2.5.1 CHILLED WATER EQUIPMENT

STEAM DRIVEN EQUIPMENT:

CHILLERS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	1,500	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	19,817	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	26,752	MLB	
ANNUAL COST	@	$123,329		

CHILLED WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	NA	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSING WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	
DESIGN FLOW	@	NA	LB/HR	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	NA	MLB
HEAT RETURNED	@	NA	MMBTU
ANNUAL HEAT CREDIT	@	NA	
ANNUAL CHEM CREDIT	@	NA	(90% CREDIT)
ANNUAL WTR CREDIT	@	NA	(99% CREDIT)
ANNUAL SEWER CREDIT	@	NA	(99% CREDIT)

TOTAL ANNUAL STEAM COST = $123,329

ELECTRIC DRIVEN EQUIPMENT:

CHILLED WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	101	BHP	
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	203	MKWh	
ANNUAL COST	@	$15,029		

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	82	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	247	MKWh	
ANNUAL COST	@	$18,244		

HOTWELL PUMPS

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	13.9%		
ANNUAL CONSUMPTION	@	3	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$218		

COOLING TOWER				
NUMBER OPERATING	@	2	CELLS	
DESIGN LOAD	@	30	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	64	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$4,707		
MISC EQUIPMENT				
DESIGN LOAD	@	10	BHP	(ESTIMATED)
DESIGN LOAD	@	8	KWh	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	32.10	MKWh	
ANNUAL COST	@	$2,376		
TOTAL ANNUAL ELEC. COST	=	$40,572		
TOTAL ANNUAL ENERGY COST:		$163,901		

2.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

STEAM DRIVEN EQUIPMENT: FREE COOLING

CHILLERS - NOT RUNNING

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	1,500	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	19,817	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CHILLED WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	NA	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSING WATER PUMP

NUMBER OPERATING	@	0	UNIT	
DESIGN LOAD	@	NA	BHP	
DESIGN FLOW	@	NA	LB/HR	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	NA	MLB	
HEAT RETURNED	@	NA	MMBTU	
ANNUAL HEAT CREDIT	@	NA		
ANNUAL CHEM CREDIT	@	NA	(90% CREDIT)	
ANNUAL WTR CREDIT	@	NA	(99% CREDIT)	
ANNUAL SEWER CREDIT	@	NA	(99% CREDIT)	

TOTAL ANNUAL STEAM COST = $0

ELECTRIC DRIVEN EQUIPMENT:

CHILLED WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	101	BHP	
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	23	MKWh	
ANNUAL COST	@	$1,670		

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	82	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	27	MKWh	
ANNUAL COST	@	$2,027		

HOTWELL PUMPS

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	1.5%		
ANNUAL CONSUMPTION	@	.3	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$24		

COOLING TOWER				
NUMBER OPERATING	@	2	CELLS	
DESIGN LOAD	@	30	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	7	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$523		
MISC EQUIPMENT				
DESIGN LOAD	@	10	BHP	(ESTIMATED)
DESIGN LOAD	@	8	KWh	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	3.57	MKWh	
ANNUAL COST	@	$264		
TOTAL ANNUAL ELEC. COST	=	$4,508		
TOTAL ANNUAL ENERGY COST:		$4,508		

2.5.3 O&M LABOR & MATERIALS

OPERATING LABOR	QUANT	UNITS	RATE	ANNUAL
PLANT SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	0	EA	$28,000	$0
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	0	EA	$18,000	$0
TOTAL LABOR COST				$0
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	700	MGAL	$.84	$588
TOWER MAKE-UP	9,720	MGAL		$5,255
MISC	350	MGAL	$.84	$294
CHEMICALS & OIL				
CHILLED WATER	2,813	MTH	$.40	$1,125
TOWER	9,720	MGAL	$.60	$5,832
LUBE OILS	1000	GAL	$6.00	$6,000
DISTRIBUTION	.6	1000'	$1,000	$565
CHILLER/TURBINE	1	EA	$18,000	$18,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	463	HP	$10	$4,628
PIPING, VALVES & MISC	1	LOT	$10,000	$10,000
INSTRUMENTATION & ELECT	1	LOT	$12,000	$12,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	0	LOT	$12,000	$0
TOTAL MATERIALS COST				$89,287
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$89,287

2.5.4 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$0	
TELEPHONE	$0	
OFFICE EQUIPMENT	$0	
POSTAGE	$0	
EDP COST	$0	
MISC. COST	$0	
TOTAL G & A	$0	
PROPERTY INSURANCE	$10,814	$.70 /$100 CAPITAL
LIABILITY INSURANCE	$6,353	$6.50 /$1000 SALES
TAXES:		
PERSONAL PROPERTY TAXES	$30,000	(ESTIMATE)
REAL PROPERTY TAXES	na	
SALES/GRT	na	
LICENSE FEES/TAXES	$0	
TOTAL TAXES	$30,000	
TOTAL G&A AND TAXES	$40,814	

2.5.5 SUMMARY O & M COSTS

SUMMARY O & M COSTS

PHASE II:

Ton-Hours Sold: 2,812,500

	Units		Units/T-HR	Cost	Cost/T-Hr
Steam	26,752	Mlbs	.00951	$123,329	.0439
Electricity	609	MKwh	.00022	$45,080	.0160
Water & Sewer	10,770	MGAL	.00383	$6,137	.0022
Chemicals	na		na	$12,957	.0046
				$187,503	

PHASE I & II:

Ton-Hours Sold: 6,885,000

	Units		Units/T-HR	Cost	Cost/T-Hr
Steam	65,490	Mlbs	.00951	$301,909	.0439
Electricity	1,492	MKwh	.00022	$110,433	.0160
Water & Sewer	26,445	MGAL	.00384	$15,118	.0022
Chemicals	na		na	$32,091	.0047
				$459,551	

2.6 CAPITAL COST

2.6.1 SUMMARY & TOTAL

PHASES I & II

CHILLED WATER EQUIPMENT	$2,193,000	$457 $/TON (REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$1,223,000	$255 $/TON (REF SEC 6.3)
DISTRIBUTION SYSTEM	$554,000	$115 $/TON (REF SEC 6.4)
PLANT SITE	$0	$0 $/TON
TOTAL CAPITAL	$3,970,000	$827 $/TON
ENGINEERING & DESIGN	$200,000	
CONTINGENCY	$200,000	
TOTAL CHILLING SYSTEM COST	$4,370,000	$910 $/TON

NOTE: All Phase II costs have been escalated based on a two year period between Phase I start-up and Phase II start-up
- All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means estimating Guide as commonly used by contractors

2.6.2 CHILLED WATER EQUIPMENT

PHASE II		QNTY	RATING	HP	DRV RPM	EQUIP COST
CHILLER	(TONS)	1	1,950	1500	5400	$560,000
COOLING TOWER; CELLS		2		40		$120,000
PUMPS:						
CW w/TURBINE DRV	(GPM)	0	0	NA	1750	$0
CW w/MOTOR DRV	(GPM)	3	2,354	105	1750	$18,500
COND WTR W/TURBINE	(GPM)	0	0	NA	1750	$0
COND WTR W/MOTOR	(GPM)	3	2,895	85	1150	$27,300
CHILLER COND HTWL	(GPM)	3	22	2	1750	incl w/cond
CW PUMP COND HTWL	(GPM)	0	0	0	1750	$0
STEAM TURBINE DRIVES:						
CHILLER DRIVE		1	NA	1500	5400	incl w/chlr
CW PUMP		0	NA	NA	5400	NA
STEAM SURFACE CONDENSER:						
CHILLER DRIVE	(LB/HR)	1	19,817	NA	NA	$72,000
CW PUMP	(LB/HR)	0	NA	NA	NA	NA
TOTAL CHILLED WATER EQUIPMENT				654		$797,800

2.6.3 MISC EQUIPMENT & BUILDING

PHASE II	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	NA			$167,000
MISC EQUIPMENT	1	NA	NA	$7,500
ELEC: MCC, TRANS., ETC. (AMPS)	1	NA	NA	$70,000
INSTRUMENTS & CONTROLS	1	NA	NA	$20,000
TOTAL MISC EQUIPMENT				$264,500
BUILDING				
BUILDING & STRUCTURE (SQ FT)				$92,000
FOUNDATION & CONCRETE (SQ FT)				incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	3800			$4,500
MECHANICAL & PLUMBING (SQ FT)	3800			$11,000
TOTAL BUILDING				$107,500

2.6.4 DISTRIBUTION SYSTEM

PHASE II

CHILLED WATER DISTRIBUTION PIPE COST TABLE

PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	146.67 PIPE EXCAVAT	162.06 PIPE BED BACKFILL	88.93 PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	70	$19,145	242	$194,998
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	253	$119,051
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	0	$0	0	$0
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	0	$0	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	0	$0	0	$0
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											70		495	

SUB-TOTAL COSTS: $19,145 $314,050

TOTAL COSTS: $333,195

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	165	$7,178	0	$0

SUB-TOTAL COSTS: $7,178 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $7,178

TOTAL DISTRIBUTION COST: $375,000

3.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	2,850 TONS
BUILDING DEMAND LOAD	2,715 TONS
ANNUAL LOAD:	4,073 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

		Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$977,400	$.240	$.195
PRODUCTION COSTS:			
Steam Cost	$0	$.000	$.000
Condensate Credit	$0	$.000	$.000
Electric Cost	$335,326	$.082	$.082
Operating & Maintenance	$172,647	$.042	$.042
G&A, Taxes, Insurance	$82,840	$.020	$.020
B. TOTAL COST OF CHILLED WATER	$590,813	$.145	$.145
C. CASH BEFORE DEBT SERVICE	$386,587	$.095	$.050
PROJECT CAPITAL COST			
CHILLED WATER SYSTEM:			
CHILLED WATER EQUIPMENT	$633,600		
MISC EQUIPMENT & BUILDING	$971,500		
DISTRIBUTION SYSTEM	$172,000		
PLANT SITE LEASE	$0 (ESTIMATE)		
CAPITAL CONTRIBUTION	$0		
TOTAL CAPITAL COST	$1,777,100		
ENGINEERING & CONTINGENCIES	$240,000		
D. TOTAL	$2,017,100		
E. PROJECT EQUITY @ 20%:	$403,420		
F. 80% Financing:			
Debt Service (11% @ 20yrs)	$202,840	$.050	$.050
CRF = .1257			
G. CASH AFTER DEBT SERVICE (C-F)	$183,748	$.045	($.000)
H. SIMPLE PAYBACK, YRS: (D÷C)	5.2		
I. CAPITAL:INCOME RATIO (D÷G)	11.0		
J. RETURN ON INVESTMENT:(G÷E)	45.5%		

3.2 PRICING SUMMARY

PHASE I:

PROJECTED CHILLER ANNUAL PROD:	3,665,250	TON-HRS
PROJECTED FREE-COOLING PROD:	407,250	TON-HRS
	4,072,500	TON-HRS

TOTAL PROJECT CAPITAL:	$2,017,100	
PROJECT EQUITY: 20%	$403,420	
AMOUNT FINANCED:	$1,613,680	

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT; 10%, 20 YRS, CRF: .1175	$170,647	$.0419	$18,961	$.0419
RETURN ON EQUITY: 20%	$72,616	$.0178	$8,068	$.0178
ENERGY OPERATING COST:	$327,759	$.0894	$7,567 *	$.0186
FIXED OPERATING COSTS:	$457,176	$.1123	$50,797	$.1123
ANNUAL REVENUE REQUIRED:	$1,028,197		$294,060	
PRICE REQ'D/T-HR:		$.2614		$.1906
			DIFFERENCE:	$.0708

* Figure reflects no electrical useage by the chillers

BROOKHAVEN NATIONAL LABORATORY

3.3 PROPOSED CUSTOMERS

3.3.1 COOLING LOADS: PHASE 1

I. TARGET LIST - Phase I BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,000
City Hall	440		220	330,000	$.24	$79,200
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,000
Court House West (Mitchell)	na		250	375,000	$.24	$90,000
Provident Bank	na		170	255,000	$.24	$61,200
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,000
	3,510	0	2,715	4,072,500		$977,400
					AVG $/T-HR	$.2400
EQUIVALENT FULL LOAD HOURS	1,500					

PLANT SIZING:

CENTRAL PLANT INST. CAPACITY: 2,850 TONS 3 @ 950

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON

CUSTOMER AREA SERVED BY 2850 TON PLANT: 1,567,500 SQ FT

UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 3,919 TONS

ANNUAL TON-HOURS: 4,072,500

ANNUAL REVENUE @ AVERAGE $/T-HR: $977,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

3.4 FACILITY AND EQUIPMENT

3.4.1 DESIGN CRITERIA

3.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:

PRESSURE	na	PSIG	
TEMPERATURE	na	°F	
ENTHALPY	na	BTU/LB	
PRODUCTION COST			
FUEL		na	/MLB
CHEMICALS		na	
WATER		na	
SEWER		na	
TOTAL		na	/MLB

CHILLER DRIVE:

STEAM TURBINE:

THEOR STM RATE	na	LB/HPH
EFFICIENCY	na	
THEOR DELTA h	na	BTU
ACTUAL DELTA h	na	BTU

EXHAUST STEAM:

PRESSURE	na	" Hg A
TEMPERATURE	na	°F
STM ENTHALPY	na	BTU/LB
COND. ENTHALPY	na	BTU/LB

CHILLERS:

CHILLED WATER SUPPLY:

PRESSURE	150	PSIG
TEMPERATURE	42	°F
ENTHALPY	10.04	BTU/LB
DENSITY	62.43	LB/CUFT

CHILLED WATER RETURN:

PRESSURE	140	PSIG
TEMPERATURE	52	°F
ENTHALPY	20.06	BTU/LB
DENSITY	62.39	LB/CUFT

CHILLED WATER SYSTEM:

TEMP RISE	10	°F
FLOW PER TON	2.39	GPM

ELECTRIC POWER

PRIMARY VOLTAGE AVAL	13800	VAC
AVG ELEC POWER COST	$.074	$/KWH

3.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

tons @ 10° rise	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S
0	0	0	NA	NA
17	1	40	2	3.82
27	40	65	2.50	4.36
50	65	120	3	5.21
100	120	240	4	6.05
293	240	700	6	7.77
502	700	1200	8	7.70
753	1200	1800	10	7.32
1087	1800	2600	12	7.45
1255	2600	3000	14	7.12
1882	3000	4500	16	8.17
2509	4500	6000	18	8.61
2927	6000	7000	20	8.08
4182	7000	10000	24	7.98
7527	10000	18000	30	8.90
10454	18000	25000	36	8.58
14845	25000	35500	42	8.51
19445	35500	46500	48	8.50
19445	46500			

3.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	2715 FIRM	2850
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	2715	2850
Three CHILLERS - EACH @ TONS =	905	950
COMPRESSOR RATING (HP/TON) =	.80	.80
MOTOR DRIVES - APPROX HP EACH =	724	760

3.4.3 CHILLING EQUIPMENT

3.4.3.1 CHILLERS

		OPERATING	RATING	
CHILLER OPERATING POINTS:				
OPEN DRIVE CENTRIFUGAL	@	905 TONS EA	950 TONS EA	(REF PAR 4.2)
CHILLED WATER SUPPLY	@	42 °F	42 °F	
CHILLED WATER RETURN	@	52 °F	52 °F	
CONDENSING WTR SUPPLY	@	85 °F	85 °F	
CONDENSING WTR RETURN	@	95 °F	95 °F	
CONDENSING WTR FLOW	@	2541 GPM	2667 GPM	
DRIVES:				
MOTOR DRIVE USEAGE	@	724 BHP	760 BHP	
ANNUAL ELECTRICAL REQUIREMENTS				
CHILLER LOAD FACTOR	@	17.1%	17.1%	
CHILLERS REQUIRED	@	3	3	
CHILLER RATING - THEORETICAL		.60 KWH/TON	.60 KWH/TON	
CHILLER RATING - ACTUAL		.96 KWH/TON	.96 KWH/TON	

3.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	6817 GPM	7156 GPM
PUMP EFFICIENCY	@	87%	87%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
DISTRIBUTION PIPING	@	20 FT	20 FT
IN-PLANT PIPING	@	50 FT	50 FT
CHILLERS	@	45 FT	45 FT
METERS/VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		140 FT	140 FT
PUMPS/DRIVES:			
MOTOR EFFICIENCY	@	95%	95%
REQUIRED RATING/PUMP	@	146 BHP	153 BHP
ANNUAL ENERGY REQUIREMENTS			
CW PUMP LOAD FACTOR	@	17.1%	17.1%
MOTOR DRIVES REQUIRED	@	2	2
ANNUAL ELECT CONSUMPTION	@	351,392 KWH/YR	368,864 KWH/YR
ANNUAL COST OF ELECT	@	$26,003	$27,296

3.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	8384 GPM TOTAL	8801 GPM TOTAL
PUMP EFFICIENCY	@	85%	85%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
CHILLER COND'R	@	20 FT	20 FT
IN-PLANT PIPING	@	25 FT	25 FT
DRIVE STM COND'R	@	20 FT	20 FT
VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		90 FT	90 FT
DRIVES:			
ELECTRIC MOTOR DRIVE; EA	@	118 BHP	124 BHP
ANNUAL REQUIREMENTS			
CONDENSING WTR LOAD FACT	@	25.7%	25.7%
MOTOR DRIVES REQUIRED	@	2	2
ANNUAL ELECT CONSUMPTION	@	396,650 KWH/YR	416,373 KWH/YR
ANNUAL COST OF ELECT	@	$29,352	$30,812

3.4.3.4 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	95 Deg F	95 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	8384 GPM	8801 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf up to 1000 CF	
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	$.074 /KWH	
MAKE-UP: EVAPORATION RATE	84 GPM	87 GPM
BLOWDOWN RATE	21 GPM	23 GPM
MAKE-UP RATE	105 GPM	110 GPM
ANNUAL CONSUMPTION	14,175,000 GAL/YR	14,850,000 GAL/YR
WATER COST	$5,677	$5,947
SEWER COST	$2,044	$2,238
ANNUAL WATER COST -	$7,720	$8,185
FANS -		
QUANTITY -	3	3
RATING -	40 BHP	50 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	94.2 KW	117.8 KW

3.5 OPERATING AND MAINTENANCE

3.5.1 CHILLED WATER EQUIPMENT

ACTIVE COOLING OPERATING EXPENSES
ELECTRIC DRIVEN EQUIPMENT:

CHILLER			
NUMBER OPERATING	@	3 UNITS	
DESIGN LOAD	@	.96 KW/TON	(REF PAR 4.3.1)
LOAD FACTOR	@	15.4%	
ANNUAL CONSUMPTION	@	3,508,890 KWh	
ANNUAL COST	@	$259,658	
CHILLED WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	146 BHP	(REF PAR 4.3.2)
LOAD FACTOR	@	15.4%	
ANNUAL CONSUMPTION	@	309,595 KWh	
ANNUAL COST	@	$22,910	
CONDENSING WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	118 BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.1%	
ANNUAL CONSUMPTION	@	375,773 KWh	
ANNUAL COST	@	$27,807	
COOLING TOWER			
NUMBER OPERATING	@	3 CELLS	
DESIGN LOAD	@	40 BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	23.1%	
ANNUAL CONSUMPTION	@	190,819 KWh	(REF PAR 4.3.4)
ANNUAL COST	@	$14,121	
MISC EQUIPMENT			
DESIGN LOAD	@	15 BHP	(ESTIMATED)
DESIGN LOAD	@	10 KWh	(ESTIMATED)
LOAD FACTOR	@	23.1%	
ANNUAL CONSUMPTION	@	44,102 KWh	
ANNUAL COST	@	$3,264	
TOTAL ANNUAL ELEC. COST	=	$327,759	

3.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

FREE COOLING OPERATING EXPENSES

ELECTRIC DRIVEN EQUIPMENT:

CHILLER			
NUMBER OPERATING	@	3 UNITS	
DESIGN LOAD	@	.96 KW/TON	(REF PAR 4.3.1)
LOAD FACTOR	@	1.7%	
ANNUAL CONSUMPTION	@	0 KWh	
ANNUAL COST	@	$0	
CHILLED WATER PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	146 BHP	(REF PAR 4.3.2)
LOAD FACTOR	@	1.7%	
ANNUAL CONSUMPTION	@	34,399 KWh	
ANNUAL COST	@	$2,546	
CONDENSING WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	118 BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	2.6%	
ANNUAL CONSUMPTION	@	41,753 KWh	
ANNUAL COST	@	$3,090	
COOLING TOWER			
NUMBER OPERATING	@	3 CELLS	
DESIGN LOAD	@	40 BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	2.6%	
ANNUAL CONSUMPTION	@	21,202 KWh	(REF PAR 4.3.4)
ANNUAL COST	@	$1,569	
MISC EQUIPMENT			
DESIGN LOAD	@	15 BHP	(ESTIMATED)
DESIGN LOAD	@	10 KWh	
LOAD FACTOR	@	2.6%	
ANNUAL CONSUMPTION	@	4,900 KWh	
ANNUAL COST	@	$363	
TOTAL ANNUAL ELEC. COST	=	$7,567	

3.5.3 TOTAL ENERGY CONSUMPTION & COST

TOTAL ENERGY CONSUMPTION & COST

	USAGE	COST
ACTIVE COOLING:	4,429,180 kwh	$327,759
FREE COOLING:	102,254 kwh	$7,567
TOTAL	4,531,434 kwh	$335,326
EQUIVALENT KW/TON:	1.11	

3.5.4 O&M LABOR & MATERIALS

	QUANT	UNITS	RATE	ANNUAL
OPERATING LABOR (1)				
CHIEF OPERATOR/SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	1.0	EA	$28,000	$28,000
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	1.0	EA	$18,000	$18,000
TOTAL LABOR COST				$46,000
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	1000	MGAL	$.84	$840
TOWER MAKE-UP	14,175	MGAL		$7,720
MISC	500	MGAL	$.84	$420
CHEMICALS & OIL				
CHILLED WATER	4,073	MTH	$.40	$1,629
TOWER	14,175	MGAL	$.60	$8,505
LUBE OILS	1500	GAL	$6.00	$9,000
DISTRIBUTION	1.2	1000'	$1,000	$1,190
CHILLER	2	EA	$10,000	$20,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	534	HP	$10	$5,342
PIPING, VALVES & MISC	1	LOT	$15,000	$15,000
INSTRUMENTATION & ELECT	1	LOT	$20,000	$20,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	1	LOT	$12,000	$12,000
TOTAL MATERIALS COST				$126,647
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$172,647

(1) - Plant to be manned for day shift only; remotely operated for second and third shifts

3.5.5 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$10,000	
TELEPHONE	$3,600	
OFFICE EQUIPMENT	$2,000	
POSTAGE	$1,200	
EDP COST	$0	
MISC. COST	$3,600	
TOTAL G & A	$20,400	
INSURANCE:		
PROPERTY	$12,440	$.70 /$100 CAPITAL
LIABILITY	$6,353	$6.50 /$1000 SALES
TAXES:		
REAL PROPERTY	$50,000	(ESTIMATE)
PERSONAL PROPERTY	na	
SALES/GRT	na	
LICENSE FEES	$0	
TOTAL TAXES	$50,000	
TOTAL G&A, TAXES, & INSURANCE	$82,840	

3.5.6 SUMMARY O & M COSTS

SUMMARY O & M COSTS

Ton-Hours Sold: 4,072,500

	Units	Units/T-HR	Cost	Cost/T-Hr
Steam	0 Mlbs	0	$0	0
Electricity	4,531 MKwh	.00111	$335,326	.0823
Water & Sewer	15,675 MGAL	.00385	$8,980	.0022
Chemicals	na	na	$19,134	.0047
			$363,441	

3.6 CAPITAL COST

3.6.1 SUMMARY & TOTAL

PHASE I

CHILLED WATER EQUIPMENT	$633,600	$222 $/TON	(REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$971,500	$341 $/TON	(REF SEC 6.3)
DISTRIBUTION SYSTEM	$172,000	$60 $/TON	(REF SEC 6.4)
PLANT SITE	$0	$0 $/TON	
TOTAL CAPITAL	$1,777,100	$624 $/TON	
ENGINEERING & DESIGN	$120,000		
CONTINGENCY	$120,000		
TOTAL CHILLING SYSTEM COST	$2,017,100	$708 $/TON	

NOTE: All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means estimating Guide as commonly used by contractors

3.6.2 CHILLED WATER EQUIPMENT

PHASE I		QNTY	RATING	HP	DRV RPM	EQUIP COST	
NEW CHILLER	(TONS)	3	950	724		$460,915	(1)
COOLING TOWER; CELLS		3		50		$110,000	(1)
PUMPS:							
CW w/TURBINE DRV	(GPM)	0	na	na	1750	$0	
CW w/MOTOR DRV	(GPM)	3	3,409	150	1750	$30,200	(1)
CONDENSING WATER	(GPM)	3	4,192	75	1750	$32,500	(1)
CHILLER COND HTWL	(GPM)	0	na	na	1750	$0	
CW PUMP COND HTWL	(GPM)	0	na	na	1750	$0	
STEAM TURBINE DRIVES:							
CHILLER DRIVE		0	na		na	$0	
CW PUMP		0	na	na	na	$0	
STEAM SURFACE CONDENSER:							
CHILLER DRIVE	(LB/HR)	0	na	na	na	$0	
CW PUMP	(LB/HR)	0	na	na	na	$0	
TOTAL CHILLED WATER EQUIPMENT				2997		$633,615	

(1) - budgetary quotes obtained

3.6.3 MISC EQUIPMENT & BUILDING

PHASE I	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	1 LOT			$396,000
MISC EQUIPMENT	1 LOT	NA	NA	$12,000
ELEC: MCC, TRANS., ETC. (AMPS)	1 LOT	NA	NA	$270,000
INSTRUMENTS & CONTROLS	1 LOT	NA	NA	$100,000
TOTAL MISC EQUIPMENT				$778,000
BUILDING				
BUILDING & STRUCTURE (SQ FT)	1 LOT			$153,000
FOUNDATION & CONCRETE (SQ FT)	1 LOT			incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	1 LOT			$10,500
MECHANICAL & PLUMBING (SQ FT)	1 LOT			$30,000
TOTAL BUILDING				$193,500

3.6.4 DISTRIBUTION SYSTEM

PHASE I

CHILLED WATER DISTRIBUTION PIPE COST TABLE

						146.67	162.06	88.93						
PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	PIPE EXCAVAT	PIPE BED BACKFILL	PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	260	$71,110	0	$0
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	0	$0
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	510	$54,060	40	$13,477
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	180	$12,375	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	140	$9,940	60	$10,917
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											1090		100	

SUB-TOTAL COSTS: $147,485 $24,394

TOTAL COSTS: $171,879

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0

SUB-TOTAL COSTS: $0 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $0

TOTAL DISTRIBUTION COST: $172,000

4.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	4,800 TONS
BUILDING DEMAND LOAD	4,590 TONS
ANNUAL LOAD:	6,885 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

			Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$1,652,400		$.240	$.190
PRODUCTION COSTS:				
Steam Cost	$0		$.000	$.000
Condensate Credit	$0		$.000	$.000
Electric Cost	$570,649		$.083	$.083
Operating & Maintenance	$261,877		$.038	$.038
G&A, Taxes, Insurance	$122,085		$.018	$.018
B. TOTAL COST OF CHILLED WATER	$954,612		$.139	$.139
C. CASH BEFORE DEBT SERVICE	$697,788		$.101	$.051
PROJECT CAPITAL COST				
CHILLED WATER SYSTEM:				
CHILLED WATER EQUIPMENT	$1,070,400			
MISC EQUIPMENT & BUILDING	$1,488,500			
DISTRIBUTION SYSTEM	$539,000			
PLANT SITE LEASE	$0	(ESTIMATE)		
CAPITAL CONTRIBUTION	$0			
TOTAL CAPITAL COST	$3,097,900			
ENGINEERING & CONTINGENCIES	$400,000			
D. TOTAL	$3,497,900			
E. PROJECT EQUITY @ 20%:	$699,580			
F. 80% Financing:				
Debt Service (11% @ 20yrs) CRF = .1257	$351,749		$.051	$.051
G. CASH AFTER DEBT SERVICE (C-F)	$346,039		$.050	$.000
H. SIMPLE PAYBACK, YRS: (D÷C)	5.0			
I. CAPITAL:INCOME RATIO (D÷G)	10.1			
J. RETURN ON INVESTMENT:(G÷E)	49.5%			

4.2 PRICING SUMMARY

PHASES I & II:

PROJECTED CHILLER ANNUAL PROD:	6,334,200 TON-HRS		
PROJECTED FREE-COOLING PROD:	550,800 TON-HRS		
	6,885,000 TON-HRS		
TOTAL PROJECT CAPITAL:	$3,497,900		
PROJECT EQUITY: 20%	$699,580		
AMOUNT FINANCED:	$2,798,320		

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT; 11%, 20 YRS, CRF: .1257	$323,609	$.0470	$323,609	$.0470
RETURN ON EQUITY: 20%	$128,723	$.0187	$128,723	$.0187
ENERGY OPERATING COST:	$558,921	$.0882	$11,728 *	$.0213
FIXED OPERATING COSTS:	$1,223,100	$.1776	$117,399	$.1776
ANNUAL REVENUE REQUIRED:	$2,234,353		$569,731	
PRICE REQ'D/T-HR:		$.3316		$.2646
			DIFFERENCE:	$.0669

* Figure reflects no electrical useage by the chillers

4.3 PROPOSED CUSTOMERS

4.3.1 COOLING LOADS: PHASE 1 & 2

I. TARGET LIST - Phase I & II BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,00
City Hall	440		220	330,000	$.24	$79,20
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,00
Court House West (Mitchell)	na		250	375,000	$.24	$90,00
Provident Bank	na		170	255,000	$.24	$61,20
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,00
Provident Building	na		1,875	2,812,500	$.24	$675,00
	3,510	0	4,590	6,885,000		$1,652,40
					AVG $/T-HR =	$.240

EQUIVALENT FULL LOAD HOURS 1,500

PLANT SIZING:

CENTRAL PLANT INST. CAPACITY:	2,850	TONS	3 @	950	
	1,950	TONS	1 @	1,950	
TOTAL:	4,800	TONS			

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON
CUSTOMER AREA SERVED BY 4800 TON PLANT: 2,640,000 SQ FT
UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 6,600 TONS

ANNUAL TON-HOURS: 6,885,000

ANNUAL REVENUE @ AVERAGE $/T-HR: $1,652,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

4.4 FACILITY AND EQUIPMENT

4.4.1 DESIGN CRITERIA

4.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:			
PRESSURE	na	PSIG	
TEMPERATURE	na	°F	
ENTHALPY	na	BTU/LB	
PRODUCTION COST			
FUEL		na	/MLB
CHEMICALS		na	
WATER		na	
SEWER		na	
TOTAL		na	/MLB
CHILLER DRIVE:			
STEAM TURBINE:			
THEOR STM RATE	na	LB/HPH	
EFFICIENCY	na		
THEOR DELTA h	na	BTU	
ACTUAL DELTA h	na	BTU	
EXHAUST STEAM:			
PRESSURE	na	" Hg A	
TEMPERATURE	na	°F	
STM ENTHALPY	na	BTU/LB	
COND. ENTHALPY	na	BTU/LB	
CHILLERS:			
CHILLED WATER SUPPLY:			
PRESSURE	150	PSIG	
TEMPERATURE	42	°F	
ENTHALPY	10.04	BTU/LB	
DENSITY	62.43	LB/CUFT	
CHILLED WATER RETURN:			
PRESSURE	140	PSIG	
TEMPERATURE	52	°F	
ENTHALPY	20.06	BTU/LB	
DENSITY	62.39	LB/CUFT	
CHILLED WATER SYSTEM:			
TEMP RISE	10	°F	
FLOW PER TON	2.39	GPM	
ELECTRIC POWER			
PRIMARY VOLTAGE AVAL	13800	VAC	
AVG ELEC POWER COST	$.074	$/KWH	

4.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

tons @ 10° rise	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S
0	0	0	NA	NA
17	1	40	2	3.82
27	40	65	2.50	4.36
50	65	120	3	5.21
100	120	240	4	6.05
293	240	700	6	7.77
502	700	1200	8	7.70
753	1200	1800	10	7.32
1087	1800	2600	12	7.45
1255	2600	3000	14	7.12
1882	3000	4500	16	8.17
2509	4500	6000	18	8.61
2927	6000	7000	20	8.08
4182	7000	10000	24	7.98
7527	10000	18000	30	8.90
10454	18000	25000	36	8.58
14845	25000	35500	42	8.51
19445	35500	46500	48	8.50
19445	46500			

4.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	1875 FIRM	1950
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	1875	1950
ONE CHILLERS - @ TONS =	1875	1950
COMPRESSOR RATING (HP/TON) =	.80	.80
MOTOR DRIVES - APPROX HP EACH =	1500	1560

4.4.3 CHILLING EQUIPMENT

4.4.3.1 CHILLERS

		OPERATING	RATING	
CHILLER OPERATING POINTS:				
OPEN DRIVE CENTRIFUGAL	@	1875 TONS EA	1950 TONS EA	(REF PAR 4.2)
CHILLED WATER SUPPLY	@	42 °F	42 °F	
CHILLED WATER RETURN	@	52 °F	52 °F	
CONDENSING WTR SUPPLY	@	85 °F	85 °F	
CONDENSING WTR RETURN	@	95 °F	95 °F	
CONDENSING WTR FLOW	@	5264 GPM	5474 GPM	
DRIVES:				
MOTOR DRIVE USEAGE	@	1500 BHP	1560 BHP	
ANNUAL ELECTRICAL REQUIREMENTS				
CHILLER LOAD FACTOR	@	17.1%	17.1%	
CHILLERS REQUIRED	@	1	1	
CHILLER RATING - THEORETICAL		.60 KWH/TON	.60 KWH/TON	
CHILLER RATING - ACTUAL		.96 KWH/TON	.96 KWH/TON	

4.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	4708 GPM	4896 GPM
PUMP EFFICIENCY	@	87%	87%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
DISTRIBUTION PIPING	@	20 FT	20 FT
IN-PLANT PIPING	@	50 FT	50 FT
CHILLERS	@	45 FT	45 FT
METERS/VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		140 FT	140 FT
PUMPS/DRIVES:			
MOTOR EFFICIENCY	@	95%	95%
REQUIRED RATING/PUMP	@	101 BHP	105 BHP
ANNUAL ENERGY REQUIREMENTS			
CW PUMP LOAD FACTOR	@	17.1%	17.1%
MOTOR DRIVES REQUIRED	@	2	2
ANNUAL ELECT CONSUMPTION	@	225,687 KWH/Y	234,714 KWH/YR
ANNUAL COST OF ELECT	@	$16,701	$17,369

4.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	5790 GPM TOTAL	6021 GPM TOTAL
PUMP EFFICIENCY	@	85%	85%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
CHILLER COND'R	@	20 FT	20 FT
IN-PLANT PIPING	@	25 FT	25 FT
DRIVE STM COND'R	@	20 FT	20 FT
VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		90 FT	90 FT

DRIVES:			
ELECTRIC MOTOR DRIVE; EA	@	82 BHP	85 BHP

ANNUAL REQUIREMENTS			
CONDENSING WTR LOAD FACT	@	25.7%	25.7%
MOTOR DRIVES REQUIRED	@	2	2
ANNUAL ELECT CONSUMPTION	@	273,929 KWH/YR	284,887 KWH/YR
ANNUAL COST OF ELECT	@	$20,271	$21,082

4.4.3.4 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	95 Deg F	95 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	5790 GPM	6021 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf up to 1000 CF	
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	$.074 /KWH	
MAKE-UP: EVAPORATION RATE	58 GPM	62 GPM
BLOWDOWN RATE	14 GPM	16 GPM
MAKE-UP RATE	72 GPM	78 GPM
ANNUAL CONSUMPTION	9,720,000 GAL/YR	10,530,000 GAL/YR
WATER COST	$3,893	$4,217
SEWER COST	$1,362	$1,557
ANNUAL WATER COST -	$5,255	$5,774
FANS -		
QUANTITY -	2	2
RATING -	40 BHP	50 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	62.8 KW	78.5 KW

4.5 OPERATING AND MAINTENANCE

4.5.1 CHILLED WATER EQUIPMENT

ACTIVE COOLING OPERATING EXPENSES

ELECTRIC DRIVEN EQUIPMENT:

CHILLER			
NUMBER OPERATING	@	1 UNITS	
DESIGN LOAD	@	.96 KW/TON	(REF PAR 4.3.1)
LOAD FACTOR	@	15.8%	
ANNUAL CONSUMPTION	@	2,477,117 KWh	
ANNUAL COST	@	$183,307	
CHILLED WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	101 BHP	(REF PAR 4.3.2)
LOAD FACTOR	@	15.8%	
ANNUAL CONSUMPTION	@	218,560 KWh	
ANNUAL COST	@	$16,173	
CONDENSING WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	82 BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.6%	
ANNUAL CONSUMPTION	@	265,279 KWh	
ANNUAL COST	@	$19,631	
COOLING TOWER			
NUMBER OPERATING	@	2 CELLS	
DESIGN LOAD	@	40 BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	23.6%	
ANNUAL CONSUMPTION	@	130,040 KWh	(REF PAR 4.3.4)
ANNUAL COST	@	$9,623	
MISC EQUIPMENT			
DESIGN LOAD	@	10 BHP	(ESTIMATED)
DESIGN LOAD	@	8 KWh	(ESTIMATED)
LOAD FACTOR	@	23.6%	
ANNUAL CONSUMPTION	@	32,815 KWh	
ANNUAL COST	@	$2,428	

TOTAL ANNUAL ELEC. COST = $231,162

4.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

FREE COOLING OPERATING EXPENSES
ELECTRIC DRIVEN EQUIPMENT:

CHILLER			
NUMBER OPERATING	@	1 UNITS	
DESIGN LOAD	@	.96 KW/TON	(REF PAR 4.3.1)
LOAD FACTOR	@	1.4%	
ANNUAL CONSUMPTION	@	0 KWh	
ANNUAL COST	@	$0	
CHILLED WATER PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	101 BHP	(REF PAR 4.3.2)
LOAD FACTOR	@	1.4%	
ANNUAL CONSUMPTION	@	19,005 KWh	
ANNUAL COST	@	$1,406	
CONDENSING WTR PUMP			
NUMBER OPERATING	@	2 UNITS	
DESIGN LOAD	@	82 BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	2.1%	
ANNUAL CONSUMPTION	@	23,068 KWh	
ANNUAL COST	@	$1,707	
COOLING TOWER			
NUMBER OPERATING	@	2 CELLS	
DESIGN LOAD	@	40 BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	2.1%	
ANNUAL CONSUMPTION	@	11,308 KWh	(REF PAR 4.3.4)
ANNUAL COST	@	$837	
MISC EQUIPMENT			
DESIGN LOAD	@	10 BHP	(ESTIMATED)
DESIGN LOAD	@	8 KWh	
LOAD FACTOR	@	2.1%	
ANNUAL CONSUMPTION	@	2,853 KWh	
ANNUAL COST	@	$211	
TOTAL ANNUAL ELEC. COST	=	$4,161	

4.5.3 TOTAL ENERGY CONSUMPTION & COST

TOTAL ENERGY CONSUMPTION & COST

	USAGE	COST
ACTIVE COOLING:	3,123,811 kwh	$231,162
FREE COOLING:	56,234 kwh	$4,161
TOTAL	3,180,045 kwh	$235,323
EQUIVALENT KW/TON:	1.13	

4.5.4 O&M LABOR & MATERIALS

	QUANT	UNITS	RATE	ANNUAL
OPERATING LABOR (1)				
CHIEF OPERATOR/SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	0	EA	$28,000	$0
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	0	EA	$18,000	$0
TOTAL LABOR COST				$0
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	600	MGAL	$.84	$504
TOWER MAKE-UP	9,720	MGAL		$5,255
MISC	350	MGAL	$.84	$294
CHEMICALS & OIL				
CHILLED WATER	255	MTH	$.40	$102
TOWER	9,720	MGAL	$.60	$5,832
LUBE OILS	1000	GAL	$6.00	$6,000
DISTRIBUTION	.6	1000'	$1,000	$565
CHILLER	2	EA	$10,000	$20,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	368	HP	$10	$3,678
PIPING, VALVES & MISC	1	LOT	$10,000	$10,000
INSTRUMENTATION & ELECT	1	LOT	$12,000	$12,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	.0	LOT	$12,000	$0
TOTAL MATERIALS COST				$89,231
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$89,231

(1) PLANT WILL BE OPERATED REMOTELY FROM CANAL ROAD LOCATION

4.5.5 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$0	
TELEPHONE	$0	
OFFICE EQUIPMENT	$0	
POSTAGE	$0	
EDP COST	$0	
MISC. COST	$0	
TOTAL G & A	$0	
INSURANCE:		
PROPERTY	$9,246	$.70 /$100 CAPITAL
LIABILITY	$6,353	$6.50 /$1000 SALES
TAXES:		
REAL PROPERTY	$30,000	(ESTIMATE)
PERSONAL PROPERTY	na	
SALES/GRT	na	
LICENSE FEES	$0	
TOTAL TAXES	$30,000	
TOTAL G&A, TAXES, & INSURANCE	$39,246	

4.5.6 SUMMARY O & M COSTS

SUMMARY O & M COSTS

PHASE II:

Ton-Hours Sold: 2,812,500

	Units		Units/T-HR	Cost	Cost/T-Hr
Steam	0	Mlbs	0	$0	0
Electricity	3,180	MKwh	.00113	$235,323	.0837
Water & Sewer	10,670	MGAL	.00379	$6,053	.0022
Chemicals	na		na	$11,934	.0042
				$253,310	

PHASE I & II:

Ton-Hours Sold: 6,885,000

	Units		Units/T-HR	Cost	Cost/T-Hr
Steam	0	Mlbs	0	$0	0
Electricity	7,711	MKwh	.00112	$570,649	.0829
Water & Sewer	26,345	MGAL	.00383	$15,034	.0022
Chemicals	na		na	$31,068	.0045
				$616,751	

4.6 CAPITAL COST

4.6.1 SUMMARY & TOTAL

PHASE I & II

CHILLED WATER EQUIPMENT	$1,070,400	$223 $/TON (REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$1,488,500	$310 $/TON (REF SEC 6.3)
DISTRIBUTION SYSTEM	$539,000	$112 $/TON (REF SEC 6.4)
PLANT SITE	$0	$0 $/TON
TOTAL CAPITAL	$3,097,900	$645 $/TON
ENGINEERING & DESIGN	$200,000	
CONTINGENCY	$200,000	
TOTAL CHILLING SYSTEM COST	$3,497,900	$729 $/TON

NOTE: All Phase II costs have been escalated based on a two year period between Phase I start-up and Phase II start-up.
- All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means estimating Guide as commonly used by contractors

4.6.2 CHILLED WATER EQUIPMENT

PHASE II		QNTY	RATING	HP	DRV RPM	EQUIP COST	
NEW CHILLER	(TONS)	1	1,950	1500		$316,000	(1)
COOLING TOWER; CELLS		2		50		$75,000	(1)
PUMPS:							
CW w/TURBINE DRV	(GPM)	0	na	na	1750	$0	
CW w/MOTOR DRV	(GPM)	3	2,354	100	1750	$18,500	(1)
CONDENSING WATER	(GPM)	3	2,895	75	1750	$27,300	(1)
CHILLER COND HTWL	(GPM)	0	na	na	1750	$0	
CW PUMP COND HTWL	(GPM)	0	na	na	1750	$0	
STEAM TURBINE DRIVES:							
CHILLER DRIVE		0	na			$0	
CW PUMP		0	na	na		$0	
STEAM SURFACE CONDENSER:							
CHILLER DRIVE	(LB/HR)	0	na	na	na	$0	
CW PUMP	(LB/HR)	0	na	na	na	$0	
TOTAL CHILLED WATER EQUIPMENT				2125		$436,800	

(1) - budgetary quotes obtained

4.6.3 MISC EQUIPMENT & BUILDING

PHASE II	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	1 LOT			$167,000
MISC EQUIPMENT	1 LOT	NA	NA	$7,000
ELEC: MCC, TRANS., ETC. (AMPS)	1 LOT	NA	NA	$216,000
INSTRUMENTS & CONTROLS	1 LOT	NA	NA	$20,000
TOTAL MISC EQUIPMENT				$410,000
BUILDING				
BUILDING & STRUCTURE (SQ FT)	1 LOT			$90,500
FOUNDATION & CONCRETE (SQ FT)	1 LOT			incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	1 LOT			$4,500
MECHANICAL & PLUMBING (SQ FT)	1 LOT			$12,000
TOTAL BUILDING				$107,000

4.6.4 DISTRIBUTION SYSTEM

PHASE II

CHILLED WATER DISTRIBUTION PIPE COST TABLE

PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	146.67 PIPE EXCAVAT	162.06 PIPE BED BACKFILL	88.93 PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	70	$19,145	242	$194,998
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	253	$119,051
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	0	$0	0	$0
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	0	$0	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	0	$0	0	$0
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											70		495	

SUB-TOTAL COSTS: $19,145 $314,050

TOTAL COSTS: $333,195

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0

SUB-TOTAL COSTS: $0 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $0

TOTAL DISTRIBUTION COST: $367,000

5.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	2,850 TONS
BUILDING DEMAND LOAD	2,715 TONS
ANNUAL LOAD:	4,073 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

			Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$977,400		$.240	$.185
PRODUCTION COSTS:				
Steam Cost	$227,050		$.056	$.056
Condensate Credit	$0		$.007	$.007
Electric Cost	$29,066		$.007	$.007
Operating & Maintenance	$175,335		$.043	$.043
G&A, Taxes, Insurance	$85,217		$.021	$.021
B. TOTAL COST OF CHILLED WATER	$516,669		$.127	$.127
C. CASH BEFORE DEBT SERVICE	$460,731		$.113	$.058
PROJECT CAPITAL COST				
CHILLED WATER SYSTEM:				
CHILLED WATER EQUIPMENT	$1,009,700			
MISC EQUIPMENT & BUILDING	$928,000			
DISTRIBUTION SYSTEM	$179,000			
PLANT SITE LEASE	$0	(assumption)		
CAPITAL CONTRIBUTION	na			
TOTAL CAPITAL COST	$2,116,700			
ENGINEERING & CONTINGENCIES	$240,000			
D. TOTAL	$2,356,700			
E. PROJECT EQUITY @ 20%:	$471,340			
F. 80% Financing:				
Debt Service (11% @ 20yrs) CRF = .1257	$236,990		$.058	$.058
G. CASH AFTER DEBT SERVICE (C-F)	$223,741		$.055	$.000
H. SIMPLE PAYBACK, YRS: (D÷C)	5.1			
I. CAPITAL:INCOME RATIO (D÷G)	10.5			
J. RETURN ON INVESTMENT: (G÷E)	47.5%			

5.2 PRICING SUMMARY

PHASE I:

PROJECTED CHILLER ANNUAL PRODUCTION:	3,665,250	TON-HRS
PROJECTED FREE-COOLING PRODUCTION:	407,250	TON-HRS
	4,072,500	TON-HRS

TOTAL PROJECT CAPITAL COST:	$2,356,700	
PROJECT EQUITY: 20%	$471,340	
AMOUNT FINANCED:	$1,885,360	

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT SERV; 11%, 20 YRS, CRF:.1257	$213,291	$.0524	$23,699	$.0524
RETURN ON EQUITY: 20%	$84,841	$.0208	$9,427	$.0208
ENERGY OPERATING COST:	$250,601	$.0684	$5,516 ‡	$.0135
FIXED OPERATING COSTS:	$234,497	$.0576	$26,055	$.0576
ANNUAL REVENUE REQUIRED:	$783,230		$324,187	
PRICE REQ'D/T-HR:		$.1992		$.1443
			DIFFERENCE:	$.0548

‡ Figure reflects no steam useage by the chillers

5.3 PROPOSED CUSTOMERS

5.3.1 COOLING LOADS: PHASE 1

I. TARGET LIST - Phase I BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,000
City Hall	440		220	330,000	$.24	$79,200
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,000
Court House West (Mitchell)	na		250	375,000	$.24	$90,000
Provident Bank	na		170	255,000	$.24	$61,200
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,000
	3,510	0	2,715	4,072,500		$977,400
					AVG $/T-HR	$.2400
EQUIVALENT FULL LOAD HOURS	1,500					

PLANT SIZING:

CENTRAL PLANT INST. TONNAGE:	2,850	CENTRIFUGAL:	1 @	950	Tons Each
		ABSORBERS:	2 @	950	Tons Each

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON

CUSTOMER AREA SERVED BY 2700 TON PLANT: 1,567,500 SQ FT

UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 3,919 TONS

ANNUAL TON-HOURS: 4,072,500

ANNUAL REVENUE @ AVERAGE $/T-HR: $977,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

5.4 FACILITY AND EQUIPMENT

5.4.1 DESIGN CRITERIA

5.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:

PRESSURE	130	PSIG
TEMPERATURE	355.6	°F
ENTHALPY	1193.50	BTU/LB
PRODUCTION COST:		
FUEL	incl	/MLB
CHEMICALS	incl	
WATER & SEWER	incl	
INCR. ELECTRIC	incl	
TOTAL	$4.61	/MLB

CHILLER STEAM CONDITIONS:

BACKPRESSURE STEAM TURBINE:

THEOR STM RATE	21.16	LB/HPH
EFFICIENCY	42%	
THEOR DELTA h	120.25	BTU
ACTUAL DELTA h	50.51	BTU

EXHAUST STEAM/ABSORBER INLET:

PRESSURE	15	PSIG
TEMPERATURE	250	°F
STM ENTHALPY	1142.99	BTU/LB

ABSORBER OUTLET:

PRESSURE	15	PSIG
TEMPERATURE	240	°F
COND. ENTHALPY	208.46	BTU/LB

CHILLERS:

CHILLED WATER SUPPLY:

PRESSURE	150	PSIG
TEMPERATURE	42	°F
ENTHALPY	10.04	BTU/LB
DENSITY	62.43	LB/CUFT

CHILLED WATER RETURN:

PRESSURE	140	PSIG
TEMPERATURE	52	°F
ENTHALPY	20.06	BTU/LB
DENSITY	62.41	LB/CUFT

CHILLED WATER SYSTEM:

TEMP RISE	10	°F
FLOW PER TON	2.39	GPM

ELECTRIC POWER

PRIMARY VOLTAGE AVAL	13800	VAC
AVG ELEC POWER COST	$.074	$/KWH

5.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

EQUIVALENT MAX TONS FOR 10 DEGREE RISE	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S	MAX HD LOSS/100'
0	0	0	NA	NA	NA
17	1	40	2	3.82	3.06
27	40	65	2.50	4.36	3.13
50	65	120	3	5.21	3.35
100	120	240	4	6.05	3.19
293	240	700	6	7.77	3.13
502	700	1200	8	7.70	2.20
753	1200	1800	10	7.32	1.52
1087	1800	2600	12	7.45	1.27
1255	2600	3000	14	7.12	1.04
1882	3000	4500	16	8.17	1.15
2509	4500	6000	18	8.61	1.11
2928	6000	7000	20	8.08	.86
4182	7000	10000	24	7.98	.68
7528	10000	18000	30	8.90	.63
10456	18000	25000	36	8.58	.47

5.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	2715 FIRM	2850
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	2715	2850
THREE CHILLERS EACH @ TONS =	905	950
COMPRESSOR RATING (HP/TON) =	.80	.80
STEAM TURBINE DRIVES - HP EACH =	724	760

5.4.3 CHILLING EQUIPMENT

5.4.3.1 CHILLERS

		OPERATING		RATING	
CENTRIFUGAL CHILLER DESIGN:					
OPEN DRIVE CENTRIFUGAL	@	905	TONS EA	950	TONS EA (PAR 4.2)
CHILLED WATER SUPPLY	@	42	°F	42	°F
CHILLED WATER RETURN	@	52	°F	52	°F
CONDENSING WTR SUPPLY	@	85	°F	85	°F
CONDENSING WTR RETURN	@	95	°F	95	°F
CONDENSING WTR FLOW	@	2541	GPM	2667	GPM
ABSORPTION CHILLER DESIGN:					
OPEN DRIVE CENTRIFUGAL	@	905	TONS EA	950	TONS EA
CHILLED WATER SUPPLY	@	42	°F	42	°F
CHILLED WATER RETURN	@	52	°F	52	°F
CONDENSING WTR SUPPLY	@	85	°F	85	°F
CONDENSING WTR RETURN	@	95	°F	95	°F
CONDENSING WTR FLOW	@	1270	GPM	1333	GPM
CENTRIFUGAL DRIVE:					
BACKPRESSURE STM TURBINE	@	724	HP	760	HP
THROTTLE STM CONDITIONS					
PRESSURE	@	130	PSIG	130	PSIG
TEMPERATURE	@	355.60	°F	355.60	°F
ENTHALPY	@	1193.5	BTU/LB	1193.5	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	250	°F	250	°F
STM ENTHALPY	@	1143.0	BTU/LB	1143.0	BTU/LB
ACTUAL TURBINE STM RATE	@	50.39	LB/HPH	50.39	LB/HPH
STEAM FLOW REQ'D	@	36,483	LB/HR	38,297	LB/HR
ABSORBER:					
THROTTLE STM CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	250.0	°F	250.0	°F
ENTHALPY	@	1143.0	BTU/LB	1143.0	BTU/LB
EXITING COND CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	240	°F	240	°F
COND ENTHALPY	@	208.5	BTU/LB	208.5	BTU/LB
CONDENSING WATER (ABSORBERS - SERIES FLOW w/CENTRIFUGAL)					
CONDENSING WTR FLOW	@	2541	GPM	2667	GPM
SUPPLY	@	85	°F	85	°F
RETURN	@	113	°F	113	°F
ANNUAL STEAM REQUIREMENTS					
CHILLER LOAD FACTOR	@	17.1%		17.1%	
ABSORPTION CLRS REQ'D	@	2		2	
CENTRIFUGAL CHLRS REQ'D	@	1		1	
ANNUAL MLBS STEAM	@	54,724	MLBS/YR	57,445	MLBS/YR
ANNUAL COST OF STM	@	$252,278		$264,822	

5.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	6816	GPM	7155	GPM
PUMP EFFICIENCY	@	87%		87%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
DISTRIBUTION PIPING	@	20	FT	20	FT
IN-PLANT PIPING	@	50	FT	50	FT
CHILLERS	@	45	FT	45	FT
METERS/VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		140	FT	140	FT

DRIVES:

		MOTOR X TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	0	LB/HR	0	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	146	BHP EA	153	BHP EA

ANNUAL ENERGY REQUIREMENTS					
CW PUMP LOAD FACTOR	@	17.1%		17.1%	
STM DRIVERS REQUIRED	@	0		0	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2		2	
ANNUAL ELECT CONSUMPTION	@	327	MWH/YR	343	MWH/YR
ANNUAL COST OF ELECT	@	$24,180		$25,382	

5.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING	RATING
VOLUME REQUIRED	@	2795 GPM TOTAL	2934 GPM TOTAL
PUMP EFFICIENCY	@	85%	85%
NUMBER REQUIRED	@	2	2
HEAD REQUIRED			
CHILLER COND'R	@	20 FT	20 FT
IN-PLANT PIPING	@	25 FT	25 FT
DRIVE STM COND'R	@	20 FT	20 FT
VALVES	@	10 FT	10 FT
CONTINGENCY	@	15 FT	15 FT
TOTAL		90 FT	90 FT

DRIVES:

		ELECTRIC MOTOR X CONDENSING TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	0	LB/HR	0	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	39	BHP EA	41	BHP EA

ANNUAL REQUIREMENTS					
CONDENSING WTR LOAD FACT	@	25.7%		25.7%	
STM DRIVERS REQUIRED	@	0		2	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2	(50% cap ea)	2	(50% cap ea)
ANNUAL ELECT CONSUMPTION	@	132	MWH/YR	139	MWH/YR
ANNUAL COST OF ELECT	@	$9,784		$10,271	

5.4.3.4 CONDENSER HOTWELL PUMPS

		OPERATING	RATING
PUMP DESIGN - CHLR DRV. HW:			
VOLUME REQUIRED	@	80 GPM	84 GPM
PUMP EFFICIENCY	@	64%	64%
NUMBER REQUIRED	@	1	1
PUMP DESIGN - CW PUMP DRV. HW:			
VOLUME REQUIRED	@	0 GPM	0 GPM
PUMP EFFICIENCY	@	42%	42%
NUMBER REQUIRED	@	0	0
HEAD REQUIRED			
CONDENSER VACUUM	@	30 FT	30 FT
IN-PLANT PIPING	@	20 FT	20 FT
VALVES	@	30 FT	30 FT
CONTINGENCY	@	10 FT	10 FT
TOTAL		90 FT	90 FT
ANNUAL ENERGY REQUIREMENTS			
CHL'R HOTWELL PUMPS	@	3 BHP EA	3 BHP EA
CHL'R HW LOAD FACT.	@	17.1%	17.1%
CW PUMP HOTWELL PUMPS	@	0 BHP	0 BHP
CW PUMP HW LOAD FACT.	@	17.1%	17.1%
MOTOR DRIVES REQUIRED	@	1	1
ANNUAL ELECT CONSUMPTION	@	1.67 MWH/YR	1.75 MWH/YR
ANNUAL COST OF ELECT	@	$124	$130

5.4.3.5 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	113 Deg F	113 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	2795 GPM	2934 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf up to 1000 CF	
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	/KWH	
MAKE-UP: EVAPORATION RATE	28 GPM	29 GPM
BLOWDOWN RATE	7 GPM	7 GPM
MAKE-UP RATE	35 GPM	37 GPM
ANNUAL CONSUMPTION	4,715,833 GAL/YR	4,950,322 GAL/YR
WATER COST	$1,889	$1,983
SEWER COST	$680	$714
ANNUAL WATER COST -	$2,568	$2,696
FANS -		
QUANTITY -	5	5
RATING -	28 BHP	40 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	110 KW	157 KW

5.5 OPERATING AND MAINTENANCE

5.5.1 CHILLED WATER EQUIPMENT

STEAM DRIVEN EQUIPMENT:

CENTRIFUGAL CHILLERS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	724	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	36,483	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	49,252	MLB	
ANNUAL COST	@	$227,050		

CHILLED WATER PUMP

NUMBER OPERATING	@	1	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	0	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	na	MLB	
HEAT RETURNED	@	na	MMBTU	
ANNUAL HEAT CREDIT	@	na		
ANNUAL CHEM CREDIT	@	na	(90% CREDIT)	
ANNUAL WTR CREDIT	@	na	(99% CREDIT)	
ANNUAL SEWER CREDIT	@	na	(99% CREDIT)	

TOTAL ANNUAL STEAM COST = $227,050

ELECTRIC DRIVEN EQUIPMENT:

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	39	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	125	MKWh	
ANNUAL COST	@	$9,269		

HOTWELL PUMPS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	3	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	1.67	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$124		

COOLING TOWER

NUMBER OPERATING	@	5	CELLS	
DESIGN LOAD	@	28	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	148	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$10,983		

MISC EQUIPMENT

DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	42.91	MKWh	
ANNUAL COST	@	$3,175		

TOTAL ANNUAL ELEC. COST = $23,551

TOTAL ANNUAL ENERGY COST: $250,601

5.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

STEAM DRIVEN EQUIPMENT: FREE COOLING

CENTRIFUGAL CHILLERS - NOT RUNNING

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	724	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	36,483	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	1.7%		(CHILLER OFF-LINE
ANNUAL CONSUMPTION	@	0	MLB	DURING "FREE-
ANNUAL COST	@	$0		COOLING")

CHILLED WATER PUMP

NUMBER OPERATING	@	1	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	0	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	na	MLB
HEAT RETURNED	@	na	MMBTU
ANNUAL HEAT CREDIT	@	na	
ANNUAL CHEM CREDIT	@	na	(90% CREDIT)
ANNUAL WTR CREDIT	@	na	(99% CREDIT)
ANNUAL SEWER CREDIT	@	na	(99% CREDIT)

TOTAL ANNUAL STEAM COST = $0

ELECTRIC DRIVEN EQUIPMENT:

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	39	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	9.5%		
ANNUAL CONSUMPTION	@	51	MKWh	
ANNUAL COST	@	$3,809		

HOTWELL PUMPS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	3	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	1.67	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$124		

COOLING TOWER

NUMBER OPERATING	@	5	CELLS	
DESIGN LOAD	@	28	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	16	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$1,220		

MISC EQUIPMENT

DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	4.90	MKWh	
ANNUAL COST	@	$363		

TOTAL ANNUAL ELEC. COST = $5,516

TOTAL ANNUAL ENERGY COST: $5,516

5.5.3 O&M LABOR & MATERIALS

	QUANT	UNITS	RATE	ANNUAL
OPERATING LABOR (1)				
PLANT SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	1	EA	$28,000	$28,000
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	1	EA	$18,000	$18,000
TOTAL LABOR COST				$46,000
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	1000	MGAL	$.84	$840
TOWER MAKE-UP	4,716	MGAL		$2,568
MISC	500	MGAL	$.84	$420
CHEMICALS & OIL				
CHILLED WATER	4,073	MTH	$.40	$1,629
TOWER	4,716	MGAL	$.60	$2,829
LUBE OILS	1500	GAL	$6.00	$9,000
DISTRIBUTION	1.2	1000'	$1,000	$1,190
CHILLER/TURBINE	2	EA	$18,000	$36,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	286	HP	$10	$2,858
PIPING, VALVES & MISC	1	LOT	$15,000	$15,000
INSTRUMENTATION & ELECT	1	LOT	$20,000	$20,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	1	LOT	$12,000	$12,000
TOTAL MATERIALS COST				$129,335
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$175,335

(1) - Plant to be manned for day shift only; remotely operated for second and third shifts

5.5.4 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$10,000	
TELEPHONE	$3,600	
OFFICE EQUIPMENT	$2,000	
POSTAGE	$1,200	
EDP COST	$0	
MISC. COST	$3,600	
TOTAL G & A	$20,400	
PROPERTY INSURANCE	$14,817	$.70 /$100 CAPITAL
LIABILITY INSURANCE	$6,353	$6.50 /$1000 SALES
TAXES:		
PERSONAL PROPERTY TAXES	$50,000	(ESTIMATE)
REAL PROPERTY TAXES	na	
SALES/GRT	na	
LICENSE FEES/TAXES	$0	
TOTAL TAXES	$50,000	
TOTAL G&A AND TAXES	$85,217	

5.5.5 SUMMARY O & M COSTS

SUMMARY O & M COSTS

Ton-Hours Sold: 4,072,500

	Units	Units/T-HR	Cost	Cost/T-Hr
Steam	49,252 Mlbs	.01209	$227,050	.0558
Electricity	393 MKwh	.00010	$29,066	.0071
Water & Sewer	6,216 MGAL	.00153	$3,828	.0009
Chemicals	na	na	$13,458	.0033
			$273,404	

5.6 CAPITAL COST

5.6.1 SUMMARY & TOTAL

PHASE I

CHILLED WATER EQUIPMENT	$1,009,700	$354 $/TON (REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$928,000	$326 $/TON (REF SEC 6.3)
DISTRIBUTION SYSTEM	$179,000	$63 $/TON (REF SEC 6.4)
PLANT SITE	$0	$0 $/TON
TOTAL CAPITAL	$2,116,700	$743 $/TON
ENGINEERING & DESIGN	$120,000	
CONTINGENCY	$120,000	
TOTAL CHILLING SYSTEM COST	$2,356,700	$827 $/TON

NOTE: All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means Estimating Guide as commonly used by contractors

5.6.2 CHILLED WATER EQUIPMENT

PHASE I		QNTY	RATING	HP	DRV RPM	EQUIP COST
CENTR CHILLERS w/DRIVE	(TONS)	1	950	760	5400	$786,539
ABSORPTION CHILLER	(TONS)	2	950			incl above
COOLING TOWER; CELLS		5		75		$165,000
PUMPS:						
CW w/TURBINE DRV	(GPM)	0	6,816	NA	1750	$0
CW w/MOTOR DRV	(GPM)	3	3,408	153	1750	$30,200
CONDENSING WATER	(GPM)	3	1,467	41	1750	$24,000
CHILLER COND HTWL	(GPM)	2	84	3	1750	$4,000
CW PUMP COND HTWL	(GPM)	0	0	0	1750	$0
STEAM TURBINE DRIVES:						
CHILLER DRIVE		1	NA	760	5400	incl w/chlr
CW PUMP		0	NA	NA	5400	NA
STEAM SURFACE CONDENSER:						
CHILLER DRIVE	(LB/HR)	0	NA	NA	NA	NA
CW PUMP	(LB/HR)	0	NA	NA	NA	NA
TOTAL CHILLED WATER EQUIPMENT				965		$1,009,739

5.6.3 MISC EQUIPMENT & BUILDING

PHASE I	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	NA			$394,000
MISC EQUIPMENT	1	NA	NA	$13,000
ELEC: MCC, TRANS., ETC. (AMPS)	1	NA	NA	$130,000
INSTRUMENTS & CONTROLS	1	NA	NA	$100,000
TOTAL MISC EQUIPMENT				$637,000
BUILDING				
BUILDING & STRUCTURE (SQ FT)				$245,000
FOUNDATION & CONCRETE (SQ FT)				incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	3800			$12,000
MECHANICAL & PLUMBING (SQ FT)	3800			$34,000
TOTAL BUILDING				$291,000

5.6.4 DISTRIBUTION SYSTEM

PHASE I

CHILLED WATER DISTRIBUTION PIPE COST TABLE

						146.67	162.06	88.93						
PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	PIPE EXCAVAT	PIPE BED BACKFILL	PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	260	$71,110	0	$0
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	0	$0
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	510	$54,060	40	$13,477
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	180	$12,375	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	140	$9,940	60	$10,917
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											1090		100	

SUB-TOTAL COSTS: $147,485 $24,394

TOTAL COSTS: $171,879

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	165	$7,178	0	$0

SUB-TOTAL COSTS: $7,178 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $7,178

TOTAL DISTRIBUTION COST: $179,000

6.1 ECONOMIC SUMMARY

DESIGN CRITERIA:

INSTALLED CHILLING CAPACITY	4,800 TONS
BUILDING DEMAND LOAD	4,590 TONS
ANNUAL LOAD:	6,885 MTH
CHILLING PLANT LOAD FACTOR	17.1%
CHILLING PLANT DIVERSITY	105%

			Proposed $/T-HR	"Breakeven" REQ'D $/T-HR
A. ANNUAL REVENUE	$1,652,400		$.240	$.180
PRODUCTION COSTS:				
Steam Cost	$383,853		$.056	$.056
Condensate Credit	$0		$.007	$.007
Electric Cost	$47,909		$.007	$.007
Operating & Maintenance	$286,567		$.042	$.042
G&A, Taxes, Insurance	$125,316		$.018	$.018
B. TOTAL COST OF CHILLED WATER	$843,645		$.123	$.123
C. CASH BEFORE DEBT SERVICE	$808,755		$.117	$.058
PROJECT CAPITAL COST				
CHILLED WATER SYSTEM:				
CHILLED WATER EQUIPMENT	$1,652,900			
MISC EQUIPMENT & BUILDING	$1,352,500			
DISTRIBUTION SYSTEM	$554,000			
PLANT SITE LEASE	$0	(assumption)		
CAPITAL CONTRIBUTION	na			
TOTAL CAPITAL COST	$3,559,400			
ENGINEERING & CONTINGENCIES	$400,000			
D. TOTAL	$3,959,400			
E. PROJECT EQUITY @ 20%:	$791,880			
F. 80% Financing:				
Debt Service (11% @ 20yrs)	$398,157		$.058	$.058
CRF = .1257				
G. CASH AFTER DEBT SERVICE (C-F)	$410,598		$.060	($.000)
H. SIMPLE PAYBACK, YRS: (D÷C)	4.9			
I. CAPITAL:INCOME RATIO (D÷G)	9.6			
J. RETURN ON INVESTMENT:(G÷E)	51.9%			

6.2 PRICING SUMMARY

PHASE I & II:

PROJECTED CHILLER ANNUAL PRODUCTION:	6,196,500	TON-HRS
PROJECTED FREE-COOLING PRODUCTION:	688,500	TON-HRS
	6,885,000	TON-HRS
TOTAL PROJECT CAPITAL COST:	$3,959,400	
PROJECT EQUITY: 20%	$791,880	
AMOUNT FINANCED:	$3,167,520	

	"ACTIVE-COOLING "		"FREE-COOLING "	
		$/T-HR		$/T-HR
DEBT SERV; 11%, 20 YRS, CRF:.1257	$358,342	$.0520	$39,816	$.0520
RETURN ON EQUITY: 20%	$142,538	$.0207	$15,838	$.0207
ENERGY OPERATING COST:	$422,557	$.0682	$9,205 *	$.0134
FIXED OPERATING COSTS:	$605,192	$.0879	$67,244	$.0879
ANNUAL REVENUE REQUIRED:	$1,528,629		$568,123	
PRICE REQ'D/T-HR:		$.2288		$.1740
			DIFFERENCE:	$.0548

* Figure reflects no steam useage by the chillers

6.3 PROPOSED CUSTOMERS

6.3.1 COOLING LOADS: PHASE 1 & 2

I. TARGET LIST - Phase I & II BUILDING	INST TONS	SQUARE FOOTAGE	DEMAND TONS	TON-HRS	PRICE/ TON-HR	ANNUAL REVENUE
Municipal Building	550		275	412,500	$.24	$99,0
City Hall	440		220	330,000	$.24	$79,2
Court House East (Old P.O.)	1,000		500	750,000	$.24	$180,0
Court House West (Mitchell)	na		250	375,000	$.24	$90,0
Provident Bank	na		170	255,000	$.24	$61,2
Mercy Hospital	1,520		1,300	1,950,000	$.24	$468,0
Provident Building			1,875	2,812,500	$.24	$675,0
	3,510	0	4,590	6,885,000		$1,652,4
					AVG $/T-HR	$.24
EQUIVALENT FULL LOAD HOURS	1,500					

PLANT SIZING:

CENTRAL PLANT INST. TONNAGE:	2,850	CENTRIFUGAL:	1 @	950	Tons Each
		ABSORBERS:	2 @	950	Tons Each
	1,950	CENTRIFUGAL:	1 @	650	Tons Each
		ABSORBERS:	2 @	650	Tons Each
TOTAL:	4,800				

USING A CENTRAL PLANT SQ FT/TON FACTOR OF: 550 SQ FT/TON
CUSTOMER AREA SERVED BY 4800 TON PLANT: 2,640,000 SQ FT
UNDIVERSIFIED DEMAND TONNAGE @ 400 SQ FT/TON: 6,600 TONS

ANNUAL TON-HOURS: 6,885,000

ANNUAL REVENUE @ AVERAGE $/T-HR: $1,652,400

UNDIVERSIFIED PLANT/DEMAND CAPACITY: 1.05

6.4 FACILITY AND EQUIPMENT

6.4.1 DESIGN CRITERIA

6.4.1.1 EQUIPMENT CRITERIA

STEAM SUPPLY:

PRESSURE	130	PSIG
TEMPERATURE	355.6	°F
ENTHALPY	1193.50	BTU/LB
PRODUCTION COST:		
FUEL	incl	/MLB
CHEMICALS	incl	
WATER & SEWER	incl	
INCR. ELECTRIC	incl	
TOTAL	$4.61	/MLB

CHILLER STEAM CONDITIONS:

BACKPRESSURE STEAM TURBINE:

THEOR STM RATE	21.16	LB/HPH
EFFICIENCY	42%	
THEOR DELTA h	120.25	BTU
ACTUAL DELTA h	50.51	BTU

EXHAUST STEAM/ABSORBER INLET:

PRESSURE	15	PSIG
TEMPERATURE	250	°F
STM ENTHALPY	1142.99	BTU/LB

ABSORBER OUTLET:

PRESSURE	15	PSIG
TEMPERATURE	240	°F
COND. ENTHALPY	208.46	BTU/LB

CHILLERS:

CHILLED WATER SUPPLY:

PRESSURE	150	PSIG
TEMPERATURE	42	°F
ENTHALPY	10.04	BTU/LB
DENSITY	62.43	LB/CUFT

CHILLED WATER RETURN:

PRESSURE	140	PSIG
TEMPERATURE	52	°F
ENTHALPY	20.06	BTU/LB
DENSITY	62.41	LB/CUFT

CHILLED WATER SYSTEM:

TEMP RISE	10	°F
FLOW PER TON	2.39	GPM

ELECTRIC POWER

PRIMARY VOLTAGE AVAL	13800	VAC
AVG ELEC POWER COST	$.074	$/KWH

6.4.1.2 DISTRIBUTION PIPE SIZING CRITERIA

EQUIVALENT MAX TONS FOR 10 DEGREE RISE	MINIMUM FLOW GPM	MAXIMUM FLOW GPM	PIPE SIZE	MAX VEL FT/S	MAX HD LOSS/100'
0	0	0	NA	NA	NA
17	1	40	2	3.82	3.06
27	40	65	2.50	4.36	3.13
50	65	120	3	5.21	3.35
100	120	240	4	6.05	3.19
293	240	700	6	7.77	3.13
502	700	1200	8	7.70	2.20
753	1200	1800	10	7.32	1.52
1087	1800	2600	12	7.45	1.27
1255	2600	3000	14	7.12	1.04
1882	3000	4500	16	8.17	1.15
2509	4500	6000	18	8.61	1.11
2928	6000	7000	20	8.08	.86
4182	7000	10000	24	7.98	.68
7528	10000	18000	30	8.90	.63
10456	18000	25000	36	8.58	.47

6.4.2 PLANT SIZING

CHILLER SIZING:	OPERATING	RATING
TOTAL PEAK COOLING LOAD (TON)	1875 FIRM	1950
DIVERSITY FACTOR (CHILLED WTR)	105%	na
TOTAL SYSTEM PEAK LOAD (TON)	1875	1950
THREE CHILLERS @ TONS EACH =	625	650
COMPRESSOR RATING (HP/TON) =	.80	.80
STEAM TURBINE DRIVES - HP EACH =	500	520

6.4.3 CHILLING EQUIPMENT

6.4.3.1 CHILLERS

		OPERATING		RATING	
CENTRIFUGAL CHILLER DESIGN:					
OPEN DRIVE CENTRIFUGAL	@	625	TONS EA	650	TONS EA (PAR 4.2)
CHILLED WATER SUPPLY	@	42	°F	42	°F
CHILLED WATER RETURN	@	52	°F	52	°F
CONDENSING WTR SUPPLY	@	85	°F	85	°F
CONDENSING WTR RETURN	@	95	°F	95	°F
CONDENSING WTR FLOW	@	1755	GPM	1825	GPM
ABSORPTION CHILLER DESIGN:					
OPEN DRIVE CENTRIFUGAL	@	625	TONS EA	650	TONS EA
CHILLED WATER SUPPLY	@	42	°F	42	°F
CHILLED WATER RETURN	@	52	°F	52	°F
CONDENSING WTR SUPPLY	@	85	°F	85	°F
CONDENSING WTR RETURN	@	95	°F	95	°F
CONDENSING WTR FLOW	@	1755	GPM	1825	GPM
CENTRIFUGAL DRIVE:					
BACKPRESSURE STM TURBINE	@	500	HP	520	HP
THROTTLE STM CONDITIONS					
PRESSURE	@	130	PSIG	130	PSIG
TEMPERATURE	@	355.60	°F	355.60	°F
ENTHALPY	@	1193.5	BTU/LB	1193.5	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	250	°F	250	°F
STM ENTHALPY	@	1143.0	BTU/LB	1143.0	BTU/LB
ACTUAL TURBINE STM RATE	@	50.39	LB/HPH	50.39	LB/HPH
STEAM FLOW REQ'D	@	25,195	LB/HR	26,203	LB/HR
ABSORBER:					
THROTTLE STM CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	250.0	°F	250.0	°F
ENTHALPY	@	1143.0	BTU/LB	1143.0	BTU/LB
EXITING COND CONDITIONS					
PRESSURE	@	15	PSIG	15	PSIG
TEMPERATURE	@	240	°F	240	°F
COND ENTHALPY	@	208.5	BTU/LB	208.5	BTU/LB
CONDENSING WATER (ABSORBERS - SERIES FLOW w/CENTRIFUGAL)					
CONDENSING WTR FLOW	@	1755	GPM	1825	GPM
SUPPLY	@	85	°F	85	°F
RETURN	@	113	°F	113	°F
ANNUAL STEAM REQUIREMENTS					
CHILLER LOAD FACTOR	@	17.1%		17.1%	
ABSORPTION CLRS REQ'D	@	2		2	
CENTRIFUGAL CHLRS REQ'D	@	1		1	
ANNUAL MLBS STEAM	@	37,793	MLBS/YR	39,305	MLBS/YR
ANNUAL COST OF STM	@	$174,225		$181,194	

6.4.3.2 CHILLED WATER PUMPS

CHILLED WATER PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	4707	GPM	4896	GPM
PUMP EFFICIENCY	@	87%		87%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
DISTRIBUTION PIPING	@	20	FT	20	FT
IN-PLANT PIPING	@	50	FT	50	FT
CHILLERS	@	45	FT	45	FT
METERS/VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		140	FT	140	FT

DRIVES:

		MOTOR X TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	0	LB/HR	0	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	101	BHP EA	105	BHP EA

ANNUAL ENERGY REQUIREMENTS					
CW PUMP LOAD FACTOR	@	17.1%		17.1%	
STM DRIVERS REQUIRED	@	0		0	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2		2	
ANNUAL ELECT CONSUMPTION	@	226	MWH/YR	235	MWH/YR
ANNUAL COST OF ELECT	@	$16,699		$17,367	

6.4.3.3 CONDENSING WATER PUMPS

COND WTR PUMP DESIGN:		OPERATING		RATING	
VOLUME REQUIRED	@	1930	GPM TOTAL	2007	GPM TOTAL
PUMP EFFICIENCY	@	85%		85%	
NUMBER REQUIRED	@	2		2	
HEAD REQUIRED					
CHILLER COND'R	@	20	FT	20	FT
IN-PLANT PIPING	@	25	FT	25	FT
DRIVE STM COND'R	@	20	FT	20	FT
VALVES	@	10	FT	10	FT
CONTINGENCY	@	15	FT	15	FT
TOTAL		90	FT	90	FT

DRIVES:

		ELECTRIC MOTOR X CONDENSING TURBINE			
CONDENSING STM TURB EFF	@	NA		NA	
CONDENSING STM TURBINE	@	NA	BHP EA	NA	BHP EA
THROTTLE STM CONDITIONS					
PRESSURE	@	NA	PSIG	NA	PSIG
TEMPERATURE	@	NA	°F	NA	°F
ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
EXHAUST STM CONDITIONS					
PRESSURE	@	NA	" Hg	NA	" Hg
TEMPERATURE	@	NA	°F	NA	°F
STM ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
COND. ENTHALPY	@	NA	BTU/LB	NA	BTU/LB
ACTUAL STEAM RATE	@	NA	LB/HPH	NA	LB/HPH
FULL LOAD STEAM REQ'D	@	0	LB/HR	0	LB/HR
CONDENSING WATER					
CONDENSING WTR FLOW	@	0	GPM	0	GPM
SUPPLY	@	NA	°F	NA	°F
RETURN	@	NA	°F	NA	°F
ELEC MOTOR EFFICIENCY	@	95%		95%	
ELECTRIC MOTOR	@	27	BHP EA	28	BHP EA

ANNUAL REQUIREMENTS					
CONDENSING WTR LOAD FACT	@	25.7%		25.7%	
STM DRIVERS REQUIRED	@	0		2	
STM DRIVE CONSUMPTION	@	0	MLBS/YR	0	MLBS/YR
ANNUAL COST OF STM	@	$0		$0	
MOTOR DRIVES REQUIRED	@	2	(50% cap ea)	2	(50% cap ea)
ANNUAL ELECT CONSUMPTION	@	91	MWH/YR	95	MWH/YR
ANNUAL COST OF ELECT	@	$6,757		$7,027	

6.4.3.4 CONDENSER HOTWELL PUMPS

		OPERATING	RATING
PUMP DESIGN - CHLR DRV. HW:			
VOLUME REQUIRED	@	55 GPM	58 GPM
PUMP EFFICIENCY	@	64%	64%
NUMBER REQUIRED	@	1	1
PUMP DESIGN - CW PUMP DRV. HW:			
VOLUME REQUIRED	@	0 GPM	0 GPM
PUMP EFFICIENCY	@	42%	42%
NUMBER REQUIRED	@	0	0
HEAD REQUIRED			
CONDENSER VACUUM	@	30 FT	30 FT
IN-PLANT PIPING	@	20 FT	20 FT
VALVES	@	30 FT	30 FT
CONTINGENCY	@	10 FT	10 FT
TOTAL		90 FT	90 FT

ANNUAL ENERGY REQUIREMENTS			
CHL'R HOTWELL PUMPS	@	2 BHP EA	2 BHP EA
CHL'R HW LOAD FACT.	@	17.1%	17.1%
CW PUMP HOTWELL PUMPS	@	0 BHP	0 BHP
CW PUMP HW LOAD FACT.	@	17.1%	17.1%
MOTOR DRIVES REQUIRED	@	1	1
ANNUAL ELECT CONSUMPTION	@	1.15 MWH/YR	1.20 MWH/YR
ANNUAL COST OF ELECT	@	$85	$89

6.4.3.5 COOLING TOWER

COOLING TOWER:	OPERATING	RATING
Design Wet Bulb Temp -	78 Deg F	78 Deg F
Design Inlet Water Temp -	113 Deg F	113 Deg F
Design Outlet Water Temp	85 Deg F	85 Deg F
Design Flow -	1930 GPM	2007 GPM
Load Factor -	25.7%	25.7%
Water Cost: Sewer -	$.540 /100 cf	
Water Cost: 1ST BLOCK -	$.300 /100 cf	up to 1000 CF
Water Cost: REMAINDER -	$.300 /100 cf	
Avg Electricity Cost -	/KWH	
MAKE-UP: EVAPORATION RATE	19 GPM	20 GPM
BLOWDOWN RATE	5 GPM	5 GPM
MAKE-UP RATE	24 GPM	25 GPM
ANNUAL CONSUMPTION	3,256,791 GAL/YR	3,387,062 GAL/YR
WATER COST	$1,304	$1,356
SEWER COST	$470	$488
ANNUAL WATER COST -	$1,774	$1,845
FANS -		
QUANTITY -	2	2
RATING -	35 BHP	40 HP
MOTOR EFFICIENCY -	95%	95%
LOAD FACTOR -	17.1%	17.1%
PEAK CONSUMPTION -	55 KW	63 KW

6.5 OPERATING AND MAINTENANCE

6.5.1 CHILLED WATER EQUIPMENT

STEAM DRIVEN EQUIPMENT:

CHILLERS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	500	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	25,195	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	34,014	MLB	
ANNUAL COST	@	$156,803		

CHILLED WATER PUMP

NUMBER OPERATING	@	1	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	0	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		

CONDENSATE CREDIT

VOLUME RETURNED	@	na	MLB	
HEAT RETURNED	@	na	MMBTU	
ANNUAL HEAT CREDIT	@	na		
ANNUAL CHEM CREDIT	@	na	(90% CREDIT)	
ANNUAL WTR CREDIT	@	na	(99% CREDIT)	
ANNUAL SEWER CREDIT	@	na	(99% CREDIT)	

TOTAL ANNUAL STEAM COST = $156,803

ELECTRIC DRIVEN EQUIPMENT:

CONDENSING WTR PUMP

NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	27	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	87	MKWh	
ANNUAL COST	@	$6,401		

HOTWELL PUMPS

NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	1.15	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$85		

COOLING TOWER

NUMBER OPERATING	@	2	CELLS	
DESIGN LOAD	@	35	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	15.4%		
ANNUAL CONSUMPTION	@	74	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$5,491		

MISC EQUIPMENT

DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	23.1%		
ANNUAL CONSUMPTION	@	42.91	MKWh	
ANNUAL COST	@	$3,175		

TOTAL ANNUAL ELEC. COST = $15,153

TOTAL ANNUAL ENERGY COST: $171,956

6.5.2 CHILLED WATER EQUIPMENT - FREE COOLING

STEAM DRIVEN EQUIPMENT: FREE COOLING				
CHILLERS - NOT RUNNING				
NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	625	BHP	(REF PAR 4.3.1)
DESIGN FLOW	@	25,195	LB/HR	(REF PAR 4.3.1)
LOAD FACTOR	@	1.7%		(CHILLER OFF-LINE
ANNUAL CONSUMPTION	@	0	MLB	DURING "FREE-
ANNUAL COST	@	$0		COOLING")
CHILLED WATER PUMP				
NUMBER OPERATING	@	1	UNIT	
DESIGN LOAD	@	NA	BHP	(REF PAR 4.3.2)
DESIGN FLOW	@	0	LB/HR	(REF PAR 4.3.2)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	0	MLB	
ANNUAL COST	@	$0		
CONDENSATE CREDIT				
VOLUME RETURNED	@	na	MLB	
HEAT RETURNED	@	na	MMBTU	
ANNUAL HEAT CREDIT	@	na		
ANNUAL CHEM CREDIT	@	na	(90% CREDIT)	
ANNUAL WTR CREDIT	@	na	(99% CREDIT)	
ANNUAL SEWER CREDIT	@	na	(99% CREDIT)	
TOTAL ANNUAL STEAM COST	=	$0		
ELECTRIC DRIVEN EQUIPMENT:				
CONDENSING WTR PUMP				
NUMBER OPERATING	@	2	UNITS	
DESIGN LOAD	@	27	BHP	(REF PAR 4.3.3)
LOAD FACTOR	@	9.5%		
ANNUAL CONSUMPTION	@	36	MKWh	
ANNUAL COST	@	$2,631		
HOTWELL PUMPS				
NUMBER OPERATING	@	1	UNITS	
DESIGN LOAD	@	2	BHP	(REF PAR 4.3.4)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	1.15	MKWh	(REF PAR 4.3.4)
ANNUAL COST	@	$85		
COOLING TOWER				
NUMBER OPERATING	@	2	CELLS	
DESIGN LOAD	@	35	BHP	(REF PAR 4.3.5)
LOAD FACTOR	@	1.7%		
ANNUAL CONSUMPTION	@	8	MKWh	(REF PAR 4.3.5)
ANNUAL COST	@	$610		
MISC EQUIPMENT				
DESIGN LOAD	@	15	BHP	(ESTIMATED)
DESIGN LOAD	@	10	KWh	
LOAD FACTOR	@	2.6%		
ANNUAL CONSUMPTION	@	4.90	MKWh	
ANNUAL COST	@	$363		
TOTAL ANNUAL ELEC. COST	=	$3,689		
TOTAL ANNUAL ENERGY COST:		$3,689		

6.5.3 O&M LABOR & MATERIALS

OPERATING LABOR	QUANT	UNITS	RATE	ANNUAL
PLANT SUPERVISOR	0	EA	$40,000	$0
OPERATOR/MECHANIC	0	EA	$28,000	$0
MAINTENANCE LABOR				
CHIEF MECHANIC	0	EA	$25,000	$0
MECHANIC/ELECTRICIAN	0	EA	$18,000	$0
TOTAL LABOR COST				$0
OPERATING MATERIALS & EXPENSES				
WATER & SEWER				
CW MAKE-UP	600	MGAL	$.84	$504
TOWER MAKE-UP	3,257	MGAL		$1,774
MISC	350	MGAL	$.84	$294
CHEMICALS & OIL				
CHILLED WATER	6,885	MTH	$.40	$2,754
TOWER	3,257	MGAL	$.60	$1,954
LUBE OILS	1000	GAL	$6.00	$6,000
DISTRIBUTION	.6	1000'	$1,000	$565
CHILLER/TURBINE	2	EA	$18,000	$36,000
PUMP/TURBINE	0	EA	$12,000	$0
MOTORS & PUMPS	139	HP	$10	$1,387
PIPING, VALVES & MISC	1	LOT	$15,000	$15,000
INSTRUMENTATION & ELECT	1	LOT	$20,000	$20,000
CONTRACT SERVICES	1	LOT	$25,000	$25,000
BLD'G & GROUNDS	0	LOT	$12,000	$0
TOTAL MATERIALS COST				$111,232
TOTAL OPERATING LABOR, MATERIALS, & EXPENSES				$111,232

6.5.4 G&A, TAXES & OTHER

GENERAL & ADMINISTRATIVE:		
CLERICAL/SECRETARIAL	$0	
TELEPHONE	$0	
OFFICE EQUIPMENT	$0	
POSTAGE	$0	
EDP COST	$0	
MISC. COST	$0	
TOTAL G & A	$0	
PROPERTY INSURANCE	$10,099	$.70 /$100 CAPITAL
LIABILITY INSURANCE	$4,388	$6.50 /$1000 SALES
TAXES:		
PERSONAL PROPERTY TAXES	$30,000	(ESTIMATE)
REAL PROPERTY TAXES	na	
SALES/GRT	na	
LICENSE FEES/TAXES	$0	
TOTAL TAXES	$30,000	
TOTAL G&A AND TAXES	$40,099	

6.5.5 SUMMARY O & M COSTS

SUMMARY O & M COSTS

PHASE II:

Ton-Hours Sold: 2,812,500

	Units	Units/T-HR	Cost	Cost/T-Hr
Steam	34,014 Mlbs	.01209	$156,803	.0558
Electricity	255 MKwh	.00009	$18,842	.0067
Water & Sewer	4,207 MGAL	.00150	$2,572	.0009
Chemicals	na	na	$10,708	.0038
			$188,925	

PHASE I & II:

Ton-Hours Sold: 6,885,000

	Units	Units/T-HR	Cost	Cost/T-Hr
Steam	83,265 Mlbs	.01209	$383,853	.0558
Electricity	647 MKwh	.00009	$47,909	.0070
Water & Sewer	10,423 MGAL	.00151	$6,400	.0009
Chemicals	na	na	$24,167	.0035
			$462,329	

6.6 CAPITAL COST

6.6.1 SUMMARY & TOTAL

PHASE I & II

CHILLED WATER EQUIPMENT	$1,652,900	$344 $/TON (REF SEC 6.2)
MISC EQUIPMENT & BUILDING	$1,352,500	$282 $/TON (REF SEC 6.3)
DISTRIBUTION SYSTEM	$554,000	$115 $/TON (REF SEC 6.4)
PLANT SITE	$0	$0 $/TON
TOTAL CAPITAL	$3,559,400	$742 $/TON
ENGINEERING & DESIGN	$200,000	
CONTINGENCY	$200,000	
TOTAL CHILLING SYSTEM COST	$3,959,400	$825 $/TON

NOTE: All Phase II costs have been escalated based on a two year period between Phase I start-up and Phase II start-up.
- All major equipment costs based on actual vendor quotations
- Other costs derived from Richardson Engineering Services, Inc. Standard Estimating Guide and Means Estimating Guide as commonly used by contractors

6.6.2 CHILLED WATER EQUIPMENT

PHASE II		QNTY	RATING	HP	DRV RPM	EQUIP COST
CENTR CHILLERS w/DRIVE	(TONS)	1	650	520	5400	$538,000
ABSORPTION CHILLER	(TONS)	2	650			incl above
COOLING TOWER; CELLS		2		30		$50,000
PUMPS:						
CW w/TURBINE DRV	(GPM)	0	4,707	NA	1750	$0
CW w/MOTOR DRV	(GPM)	3	1,569	105	1750	$30,200
CONDENSING WATER	(GPM)	3	1,004	28	1750	$21,000
CHILLER COND HTWL	(GPM)	2	58	2	1750	$4,000
CW PUMP COND HTWL	(GPM)	0	0	0	1750	$0
STEAM TURBINE DRIVES:						
CHILLER DRIVE		1	NA	520	5400	incl w/chlr
CW PUMP		0	NA	NA	5400	NA
STEAM SURFACE CONDENSER:						
CHILLER DRIVE	(LB/HR)	1	356	NA	NA	NA
CW PUMP	(LB/HR)	0	NA	NA	NA	NA
TOTAL CHILLED WATER EQUIPMENT				464		$643,200

6.6.3 MISC EQUIPMENT & BUILDING

PHASE I	QNTY	RATING	HP	EQ COST
MISCELLANEOUS EQUIPMENT				
EQUIP INSTALL & PIPING WORK	1 LOT			$212,000
MISC EQUIPMENT	1 LOT	NA	NA	$9,000
ELEC: MCC, TRANS., ETC. (AMPS)	1 LOT	NA	NA	$50,000
INSTRUMENTS & CONTROLS	1 LOT	NA	NA	$20,000
TOTAL MISC EQUIPMENT				$291,000
BUILDING				
BUILDING & STRUCTURE (SQ FT)	1 LOT			$98,000
FOUNDATION & CONCRETE (SQ FT)	1 LOT			incl above
SITE & PAVING (SQ FT PAVING)	0			$0
ELEC; LIGHTS, RECEPT., SWITCHES	1 LOT			$10,500
MECHANICAL & PLUMBING (SQ FT)	1 LOT			$25,000
TOTAL BUILDING				$133,500

6.6.4 DISTRIBUTION SYSTEM

PHASE II

CHILLED WATER DISTRIBUTION PIPE COST TABLE

PIPE SIZE	PIPE COST	PIPE LABOR HUNG	PIPE LABOR BURIED	PIPE INSUL	EXCAV. FACTOR	146.67 PIPE EXCAVAT	162.06 PIPE BED BACKFILL	88.93 PIPE RESURFACE	TOTAL BURIED	TOTAL HUNG	IN BLDG LINEAL FT	IN BLDG COST	DISTR TRENCH FT	DISTR COST
48	514	471.25	249.76	45	1.30	190.67	210.67	115.61	2147.87	1030.25	0	$0	0	$0
42	400	333	176.49	40	1.20	176.00	194.47	106.72	1725.60	773	0	$0	0	$0
36	290	203	107.59	35	1.10	161.33	178.26	97.83	1320.08	528	0	$0	0	$0
30	192	130.45	69.14	30	1	146.67	162.06	88.93	999.46	352.45	0	$0	0	$0
24	172	75.50	40.02	26	.80	117.33	129.64	71.15	805.78	273.50	70	$19,145	242	$194,998
20	125	63.50	33.66	21	.67	97.78	108.04	59.29	635.43	209.50	0	$0	0	$0
18	101	56.50	29.95	19	.60	88.00	97.23	53.36	548.20	176.50	0	$0	0	$0
16	81	51	27.03	17	.53	78.22	86.43	47.43	470.56	149	0	$0	253	$119,051
14	65	46.50	24.65	15	.47	68.44	75.63	41.50	401.98	126.50	0	$0	0	$0
12	50.50	42.50	22.53	13	.40	58.67	64.82	35.57	336.92	106	0	$0	0	$0
10	39	36	19.08	11	.33	48.89	54.02	29.64	275.22	86	0	$0	0	$0
8	29	30.75	16.30	9	.27	39.11	43.21	23.72	217.84	68.75	0	$0	0	$0
6	21	42	22.26	8	.20	29.33	32.41	17.79	181.96	71	0	$0	0	$0
4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	0	$0	0	$0
											70		495	

SUB-TOTAL COSTS: $19,145 $314,050

TOTAL COSTS: $333,195

HP STEAM LINE

4	13	23.50	12.46	7	.13	19.56	21.61	11.86	114.53	43.50	165	$7,178	0	$0

SUB-TOTAL COSTS: $7,178 $0

NOTE: This estimate does NOT include any in-building piping other than that shown on the distribution map

TOTAL COSTS: $7,178

TOTAL DISTRIBUTION COST: $375,000

APPENDIX B

APPENDIX B

BROOKHAVEN NATIONAL LABORATORY

Baltimore Thermal Energy Corporation's (BTEC) Energy Economist and HVAC Engineer visited Brookhaven National Laboratories (BNL) on December 19, 1989. Purpose of the visit was to obtain information useful for estimating costs of installing a new district cooling system in a well developed metropolitan area, primarily costs involved in construction of the distribution system.

BTEC's employees net with Mike Piraino and John Strasser of BNL to discuss the application of their existing computer software to the analysis of this project.

The software program, entitled "District Heating and Cooling Technology Selection and Characterization", was thoroughly discussed and probed to determine its usefulness to this project. The preliminary assessment was that this program could not be used to benefit this project at this time. They did, however, assess the program as having a great deal of value for future projects when time is allotted for the large amounts of data which needs to be collected.

A great deal of work has gone into this program and BTEC's belief is that the future value of this software is quite high. Unfortunately, BNL has had a series of 4 different programmers work on this and some of the working files have been either lost or destroyed. BNL is unable to go forward with this project because the funding has not been allotted. It is BTEC's opinion that if additional funding is not provided, the already sunk costs to date will go to waste.

This program, with minor modifications, could be of substantial value to the dozens of cities in the U.S. that are currently investigating the potential of District Cooling. BTEC is currently doing a more detailed analysis of the program and plans to provide BNL with a critique and recommendations.