CHILLED WATER STUDY EEAP PROGRAM

FOR

Walter Reed Army Medical Center

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BOOK 1 of 2

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UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
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CHILLER STUDY

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The Energy Engineering Analysis Program (EEAP) Study for Walter Reed Army Medical Center (WRAMC) was to provide a thorough examination of the central chilled water plants on site. WRAMC is comprised of seventy-one (71) buildings located on a 113-acre site in Washington, D.C. There are two (2) central chilled water plants (Buildings 48 and 49) each with a primary chilled water distribution system. In addition to the two (2) central plants, three (3) buildings utilize their own independent chillers. Two (2) of the independent chillers (Buildings 7 and T-2), one of which is inoperative (T-2), are smaller air-cooled units, while the third (Building 54) has a 1,900-ton chilled water plant comprised of three (3) centrifugal chillers. Of the two (2) central chilled water plants, Building 48 houses six (6) chillers totalling 7,080 tons of cooling and Building 49 houses one (1) chiller with 660 tons of cooling. The total chiller cooling capacity available on site is 9,840 tons.

The chilled water systems were reviewed for alternative ways of conserving energy on site and reducing the peak-cooling load. Distribution systems were reviewed to determine which buildings were served by each of the chilled water plants and to determine chilled water usage on site. Evaluations were made of building exterior and interior composition in order to estimate cooling loads. Interviews with site personnel helped Entech better understand the chilled water plants, the distribution systems, and how each system was utilized.

The 1993-1994 October to September energy usage and costs at WRAMC are as follows:

Table 1.1
1993-1994 Energy Usage at WRAMC

Energy	Energy Unit Total	Energy Total	Cost
Electric Demand	180,139 kW	N/A	* N/A
Electric Usage	108,827,524 kWh	371,429 mmBtu	$6,704,900
Natural Gas	387,400 mcf	399,022 mmBtu	$1,466,900
Fuel Oil	1,055,866 gal	1,087,542 mmBtu	$739,100

* Electric Demand Cost is included in the Electric Usage Cost.

Five (5) of the six (6) chillers in Building 48 are twenty (20) to thirty-six (36) years old, while the expected normal service life is twenty-three (23) years. The sixth chiller was replaced last summer. All five (5) of the older chillers utilizes refrigerant which is no longer in production and does not meet current regulations. The single chiller in Building 49 is also twenty (20) years old and utilizes an out-of-production refrigerant. Of the three (3) chillers in Building 54, two (2) are forty-two (42) years old and one (1) is eleven (11) years old. All three (3) chillers in Building 54 utilize out-of-production refrigerants and do not meet current regulations. All the chillers in these three (3) buildings are in operable condition.

This study shows that the peak-cooling load at WRAMC is greater than what is available from the chilled water plants. Therefore, alternatives were developed based on the existing total site cooling capacity of 9,840 tons. To evaluate the alternatives based on a greater cooling tonnage than available would not meet the requirements of EEAP and would negatively impact the calculated energy savings. There are thirteen (13) alternatives developed and analyzed in this study. A summary of these alternatives can be found in Table 1.2 on the following page.

WALTER REED ARMY MEDICAL CENTER
ALTERNATIVE SUMMARY

TABLE 1.2

NO.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback (years)	LCCID SIR	Energy Savings			
							Elec. Demand (KW)	Elec. Usage (KWh)	Gas Usage (mcf)	Total (MMBTU)
1	Upgrade Existing Chilled Water Plants with New Chillers	$4,500,000	$524,800	$78,000	7.5	2.1	14,224	8,125,297	0	27,732
2	Convert Building 48 Chilled Water Distribution System to a Variable-Flow Primary/Secondary System	$1,450,000	$38,300	$0	38	0.4	347	842,418	0	2,875
3	Upgrade Existing Condenser and Chilled Water Free-Cooling Systems	$670,000	$164,000	$0	4.1	3.8	5,333	3,121,600	0	10,654
4	Upgrade Existing Building 48 Chilled Water Plant and Provide New Building 49 Chilled Water Plant	$11,100,000	$503,000	$78,000	19.1	0.8	13,223	7,871,314	0	26,865
5	Provide a New Central Chilled Water Plant Adjacent to the Central Heating Plant	$18,900,000	$526,000	$78,000	31.3	0.5	14,906	8,097,374	0	27,636
6	Chiller Type Comparison ** Two-Stage Steam Absorption Gas-Fired Absorption Gas Engine Driven Centrifugal Steam Turbine Driven Centrifugal	 $700,000 $800,000 $700,000 $900,000	 ($557,000) ($222,000) $3,000 ($435,000)	 ($500) ($500) ($500) ($1,000)	 N/A N/A 35.2 N/A	 N/A N/A 0 N/A	 11,714 11,706 12,415 12,415	 7,925,424 7,921,364 8,438,358 8,438,358	 (243,337) (149,530) (100,719) (223,222)	 (223,831) (127,130) (75,041) (201,342)
7	Chilled Water Storage	$1,230,000	$40,700	($2,000)	31.8	0.5	0	0	0	0
8	Reduce Outside Air Quantities in Buildings 1 and 40	N/A	$143,100	$0	N/A	N/A	35	267,343	34,823	36,815
9	Provide Unoccupied Space Temperature Setback in Buildings 1, 7, 11, 40, and 41	$83,600	$23,400	$0	5.1	3.5	0	239,400	1,700	2,570
10	Balance Hot Water Heating System and Reset Preheat Coil Set Points in Building 2	$30,000	$297,000	$0	0.1	191	0	2,186,053	54,523	63,674
11	Efficient Fluorescent Lighting in Buildings 1, 2, 7, 11, 40, 41, & 54	$4,300,000	$455,000	$0	9.5	1.6	12,100	8,439,200	0	28,803
12	Window Replacement in Buildings 1, 7, 11, 40, & 41	$6,600,000	$25,700	$0	257	0	133	329,000	0	1,123
13	Cogeneration	$5,600,000	$1,203,100	$227,700	5.7	2.4	38,500	28,360,000	(112,809)	(19,513)

** SAVINGS AND COSTS FOR EACH CHILLER TYPE ARE IN ADDITION TO OR SUBTRACTION FROM THE SAME VALUES FOR AN ELECTRIC CENTRIFUGAL CHILLER.

In summary, a total of five (5) alternatives are recommended for implementation out of the thirteen (13) analyzed in this report. Of the five (5) alternatives, only three (3) are considered to be eligible for ECIP designation. Alternatives No. 3, 1, and 11 have an SIR greater than 1.25 and a simple payback of less than ten (10) years. Alternatives No. 3 and 1 address the central chilled water systems. Alternative No. 3 will reduce the chiller requirements in the winter months by utilizing the cooling tower water to produce chilled water. Alternative No. 1 replaces nine (9) of the ten (10) centrifugal chillers with new more efficient chillers with the new environmentally-friendly refrigerants. This alternative will reduce the summer electric demand, electric usage, and maintenance costs. Alternative No. 11 reduces electric usage in several buildings by replacing the existing fluorescent lighting with new energy efficient lighting. These three (3) recommended alternatives are listed below:

Table 1.3
Recommended ECIP Projects

No.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback	SIR	Energy Savings (mmBtu)
3	Upgrade existing condenser and chilled water free-cooling systems.	$670,000	$164,000	$0	4.1	3.8	10,654
1	Upgrade existing chilled water plants with new chillers.	$4,500,000	$524,800	$78,000	7.5	2.1	27,732
11	Efficient fluorescent lighting in Buildings 1, 2, 7, 11, 40, 41, and 54.	$4,300,000	$455,000	$0	9.5	1.6	28,803

The remaining two (2) recommended alternatives are non-ECIP low cost/no cost (LC/NC) projects. Both projects have estimated construction costs less than $100,000 and simple payback of less than six (6) years. Alternative No. 10 should be implemented immediately since it has nearly a $300,000 in savings and only an estimated construction cost of $30,000.

Table 1.4
Recommended Non-ECIP LC/NC Projects

No.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback	SIR	Energy Savings (mmBtu)
10	Balance hot water heating system and reset preheat coil set points in Building 2.	$30,000	$297,000	$0	0.1	191	63,674
9	Provide unoccupied space temperature setback in Buildings 1, 7, 11, 40, and 41.	$83,600	$23,400	$0	5.1	3.5	2,570

The non-recommended alternatives are listed in Table 1.5 on the following page. Seven (7) of these alternatives have a high payback or an indefinite payback. Alternative No. 13, Cogeneration, falls within the ECIP eligibility requirements, but is not recommend for implementation. The outcome of this alternative indicates that a more detailed study is warranted to determine if this project is actually feasible. Due to the complexity of a cogeneration plant, a more detailed review of the total electrical usage, heating systems, and cooling systems should be performed.

WALTER REED ARMY MEDICAL CENTER
NON-RECOMMENDED ALTERNATIVE SUMMERY

TABLE 1.5

NO.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback (years)	LCCID SIR	Comments
2	Convert Building 48 Chilled Water Distribution System to a Variable-Flow Primary/Secondary System	$1,450,000	$38,300	$0	38	0.4	High construction cost and a low savings potential
4	Upgrade Existing Building 48 Chilled Water Plant and Provide New Building 49 Chilled Water Plant	$11,100,000	$503,000	$78,000	19.1	0.8	High construction cost and a low savings potential
5	Provide a New Central Chilled Water Plant Adjacent to the Central Heating Plant	$18,900,000	$526,000	$78,000	31.3	0.5	High construction cost and a low savings potential
6	Chiller Type Comparison **	$0	$0	$0	0	0	Alternate chiller types use more energy
	Two-Stage Steam Absorption	$700,000	($557,000)	($500)	N/A	N/A	
	Gas-Fired Absorption	$800,000	($222,000)	($500)	N/A	N/A	
	Gas Engine Driven Centrifugal	$700,000	$3,000	($500)	35.2	0	
	Steam Turbine Driven Centrifugal	$900,000	($435,000)	($1,000)	N/A	N/A	
7	Chilled Water Storage	$1,230,000	$40,700	($2,000)	31.8	0.5	High construction cost and a low savings potential
8	Reduce Outside Air Quantities in Buildings 1 and 40	N/A	$143,100	$0	N/A	N/A	Existing systems have no return air systems. New system cannot be defined within this project's scope
12	Window Replacement in Buildings 1, 7, 11, 40, & 41	$6,600,000	$25,700	$0	257	0	High construction cost and a low savings potential
13	Cogeneration	$5,600,000	$1,203,100	$227,700	5.7	2.4	Requires a more detailed study in order to determine actual feasibility

** SAVINGS AND COSTS FOR EACH CHILLER TYPE ARE IN ADDITION TO OR SUBTRACTION FROM THE SAME VALUES FOR AN ELECTRIC CENTRIFUGAL CHILLER.

2.0 METHODOLOGY

2.1 General

The intention of this report is to assess Walter Reed Army Medical Center's (WRAMC) current chilled water use, associated energy consumption, and to provide a long-range plan and recommendations to improve energy efficiency. Entech has developed a very thorough format which is adhered to during the development of an energy report. This format has permitted Entech to construct comprehensive reports in a smooth and timely process. Entech has employed the format in the preparation of over five-hundred (500) energy studies for commercial, industrial, and institutional clients.

The following is a listing of the components in Entech's methodology for completing energy studies:

1. Kickoff Meeting
2. Data Collection/Initial Review
3. Site Inspections
4. Model Existing Chilled Water Use and Energy Characteristics
5. Alternate Chiller Plant Opportunities
6. Draft Report Generation
7. Client Review
8. Final Report Generation

2.2 Kickoff Meeting

In order to initiate the process, Entech scheduled a kickoff meeting at WRAMC on October 17, 1994. Entech was represented by Messrs. Bill McMahon, Ed Caulkins, and Jack Fisher. Ms. Regina Larrabee, Energy Conservation Engineer, and Mr. Abas Keshavarz, Mechanical Engineer, represented WRAMC.

The purpose of the meeting was to introduce both parties and explain the process Entech was planning to follow during the study. In addition, WRAMC's expectations were noted and incorporated into the project.

2.3 Data Collection/Initial Review

Prior to the first site inspection, Entech requested electric, fuel oil, and gas billing data from WRAMC. Entech reviewed the data to determine the operating profiles of the Center.

2.4 Site Inspections

Entech performed site inspections of WRAMC throughout the course of the study. During each visit, Entech investigated the following:

1. Chilled Water Plants
2. Central Chilled Water Distribution
3. Buildings Utilizing Central Chilled Water

<u>Chilled Water Plants:</u> Entech visited each chilled water plant, recorded equipment information, and interviewed plant personnel relative to plant operations.

Buildings: Entech visited each of the buildings utilizing central chilled water and recorded building construction and function.

In addition to the above items, the following were also collected:

1. Operating Schedules
2. Chiller Operation Logs
3. Building Plans and Elevations
4. Building Photographs

Chilled water plant alternatives were developed after the site inspections were completed and data evaluated.

2.5 Model Existing Energy Consumption

2.5.1 General

Once the site investigation phase is complete, Entech models the existing operation of chilled water users at the facility. Entech uses in-house computer programs, purchased computer programs, and literature to assist in calculating current energy consumption and costs for chilled water equipment and systems. The two main computer models used to estimate energy use are as follows:

1. Electrical Model
2. Heat Gain Model

2.5.2 Electrical Model

Entech's electrical model is a computer spreadsheet used to identify electric loads related to the Center's chilled water production and to associate their contribution to overall electrical demand, usage, and cost. Loads have been identified from site investigations and drawings.

It is important to realize that the electric model is an approximation of the electricity used by each load. It shows general relationships and gives reasonable allocation of electrical demand, usage, and cost.

Demand (kW) and usage (kWh) estimates are then included in subsequent calculations of Chiller Plant Alternatives in Section 6.0.

A sample electric model is shown in Table 2.5.2.1 on the following page. A description of each column heading follows:

Connected Load: The total connected electric load expressed in kW.

Winter Demand: The average kW contributing to the billing demand each month. Winter months include December, January, February, and March.

Sam

						Winter Billing Months						Intermediate Billing Months				
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		
	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hr da
1																
2																
3	*AIR HANDLER #1*	2.2	1.9	1.9	1.9	10.0	660	6.0	264	6.0	264	10.0	660	6.0	264	
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33																
34																
	TOTALS	0	0	0	0		0		0		0		0		0	

Historical Billing Demand Averages

Dec	0	Apr	0	Jun	0
Jan	0	May	0	Jul	0
Feb	0	Nov	0	Aug	0
Mar	0			Sep	0
				Oct	0
Avg	0		0		0

0	Dec	0	Dec	0
0	Jan	0	Jan	0
0	Feb	0	Feb	0
0	Mar	0	Mar	0
0		0		0

0	Apr	0	Ap
0	May	0	Ma
0	Nov	0	No
0		0	

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.50	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.040	$0.034
Intermediate Incremental Usage Cost, $/kWh	$0.046	$0.047
On-Peak Incremental Usage Cost, $/kWh	$0.053	$0.062

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Sample Electric Model

Table 2.5.2.1

	Winter Billing Months						Intermediate Billing Months						Summer Billing Months							
	Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak			
er nd nth	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.
1.9	10.0	660	6.0	264	6.0	264	10.0	660	6.0	264	6.0	264	10.0	660	6.0	264	6.0	264	13	4,620
0		0		0		0		0		0		0		0		0		0	0	0

0
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0
0

0	Dec	0	Dec	0
0	Jan	0	Jan	0
0	Feb	0	Feb	0
0	Mar	0	Mar	0
0		0		0

0	Apr	0	Apr	0
0	May	0	May	0
0	Nov	0	Nov	0
0		0		0

0	Jun	0	Jun	0
0	Jul	0	Jul	0
0	Aug	0	Aug	0
0	Sep	0	Sep	0
0	Oct	0	Oct	0
0		0		0

Summer Billing Months														
Inter.		On-Peak		Non-Summer					Summer					
hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
														1
														2
6.0	264	6.0	264	13	4,620	1,848	1,848	$454	9	3,300	1,320	1,320	$416	3
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Jun	0	Jun	0
Jul	0	Jul	0
Aug	0	Aug	0
Sep	0	Sep	0
Oct	0	Oct	0
	0		0

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Intermediate Demand: The average contribution to billing demand in the intermediate months of April, May, and November.

Summer Demand: The average contribution to billing demand in the summer months of June, July, August, September, and October.

Winter Usage: The estimated full load equivalent off-peak, intermediate, and on-peak hours that the load operates in a day within the following schedules during the months of December through March.

Billing Period	Time of Day	Days/Mo
Off-Peak	12:00 a.m. to 8:00 a.m. 24 hrs. Saturday/Sunday	30
Intermediate	8:00 a.m. to 12:00 p.m. 8:00 p.m. to 12:00 a.m.	20
On-Peak	12:00 p.m. to 8:00 p.m.	30

The kWh/month, in the next column, is then calculated by multiplying (Connected Load) x (Hrs/Day) x 30.

Intermediate Usage: Same as winter usage except months are April, May, and November.

Summer Usage: Same as winter usage except months are June through October.

Non-Summer and Summer Totals per Year: The kW/month for each season is multiplied by the appropriate number of months/season to calculate kW/season for non-summer and summer. The kWh/season is calculated the same as kW. The non-summer and summer costs are calculated by multiplying kW and kWh by the appropriate incremental costs.

2.5.3 Heat Gain Model (EZDOE Method)

Once the site investigation phase is complete, Entech models the existing operation of all HVAC systems, within the buildings being served, by the central chilled water systems.

Entech utilizes Elite Software's CHVAC and EZDOE computer HVAC simulation program to assist in determining a cooling profile for the facility based upon individual building characteristics. The heat gain model will identify individual building peak-cooling loads along with the Center's block peak as a whole.

The heat gain calculations evaluate direct solar heat gain through glass; transmission heat gain through the building components including walls, roof, and glass; interior heat gains from lighting, people, and equipment; heat gains from outdoor air introduced by the mechanical systems; and infiltration of outdoor air.

EZDOE input data is complied utilizing information provided to Entech by WRAMC, limited available building plans, visual tours of each building, discussions with WRAMC personnel, and sound engineering judgement.

The output from the EZDOE program is used in conjunction with other Entech computer simulations to provide a heat gain model spreadsheet identifying individual chilled water user requirements, present and future chilled water plant requirements, and associated energy usage and energy costs. The following section provides detailed information regarding the EZDOE program.

2.5.4 EZDOE

General: Entech utilizes an hourly energy use simulation program known as EZDOE. This program is a PC version of the Department of Energy's simulation program known as DOE-2.1D. The program has the capability of calculating hour-by-hour energy use of all aspects of a building. This program will be used to substantiate estimates prepared by other modeling tools throughout this study. This section will provide a short overview of the program and its capabilities.

Energy Calculations: EZDOE calculates the annual energy consumption of HVAC systems based on U.S. Department of Energy standards. The program contains four (4) main simulation sections and are as follows:

1	Loads
2	Systems
3	Plants
4	Economics

Loads: This portion of the program allows the user to construct a database on the building. Some of the areas of input are listed below:

1	Exterior and Interior Wall Constructions
2	Roof Constructions
3	Window Details, Exterior Door Details
4	Schedules, Daily, Weekly, and Monthly
5	Luminaire Type and Load
6	People Occupancy Rates
7	Space/Area Definition
8	Miscellaneous Loads Such as DHW Usage
9	General Equipment Load
10	City/Weather References

Systems: This section simulates air-distribution systems which can be utilized within a building. Twenty-two (22) different air-handling systems are supported. In general, spaces defined under loads can be attached to systems. The following table lists some features which can be accessed:

1	Variable Air Volume
2	Preheating
3	Night Setback
4	Economizer
5	Reheating, Humidification
6	Baseboard Heating
7	System Scheduling

Plants: This section simulates the building's physical plants (boilers, chillers, water heaters, etc.) and various options. The program has the capability of sizing equipment based on loads or sizes which can be input manually. A wide variety of equipment can be simulated. The following table lists additional features which can be utilized:

1	Thermal Storage
2	Peak Shaving
3	Demand Limiting
4	Load Management

Economics: This portion provides a means to simulate utility tariffs and costs. Fuel consumption during specific time periods can also be generated. The following is a list of features which can be utilized:

1	Demand Costs
2	On/Off Peak Usage Costs
3	Demand Ratchets
4	Seasonal Rates

2.5.5 mmBtu/Unit

The following energy values have been used in the energy calculations in this report. These values are from the Institutional Conservation Program (ICP) as administered by DoE.

Table 2.5.5.1
mmBtu/Unit

Fuel Type	mmBtu/Unit
Natural Gas (mcf)	1,031,000
Distillate Fuel Oil (gal)	138,700
Residual Fuel Oil (gal)	149,700
Electricity (kWh)	3,413

2.6 Alternative Chiller Plant Opportunities

After the energy models have been finalized, Entech begins to analyze the alternatives which were developed following the site inspection. An alternative describes an idea for alternate chilled water production and associated energy costs. Each alternative write-up consists of the following sections:

1. Existing
2. Description
3. Construction Cost
4. Annual Energy Savings
5. Annual Operation and Maintenance Cost
6. Economics
7. Expected Service Life
8. Environmental Considerations
9. Advantages
10. Disadvantages

2.6.1 Existing

A general description of the existing condition is provided.

2.6.2 Description

A general description of the proposed alternatives is provided.

2.6.3 Construction Cost

The capital cost estimates prepared for this study are considered to be "conceptual" in nature. They are conceptual because they are based upon engineering design that is less than 1% of a complete detailed design effort for such a project.

The cost estimates are broken down into material, labor, and engineering components. Calculations or a spreadsheet are usually provided with each alternative.

The final results of a project can vary significantly from the "conceptual" cost estimate. The American Association of Cost Engineers (AACE) generally states that an accuracy range of plus or minus 20% from the total estimated cost is possible. Variations beyond this range are possible for the stated scope, but not likely.

Since it is not possible for the consultants to know the most likely variations that can occur in the future, nor can it control certain technologies, contractors, or general economic conditions, the costs estimated herein should not be construed as fixed or precise. Rather, they are estimates which will require a great deal of effort to manage until the final costs are realized.

2.6.4 Annual Energy Savings

This division of the alternative analysis compares the existing and proposed energy costs and notes increases or decreases in energy consumption.

2.6.5 Annual Operation and Maintenance Cost

The operation costs account for the necessary operator(s) cost required to run the chiller plant(s). Maintenance and maintenance supervision costs are also accounted for as a portion of overall plant operating costs.

2.6.6 Economics

Simple payback and savings to investment ratio (SIR) are calculated using LCCID. (Reference 2.7)

2.6.7 Expected Service Life

Service life is the median time during which a particular system or component remains in its original service application before replacement is required.

2.6.8 Environmental Considerations

Identifies any anticipated environmental impact, positive or negative, as a function of the proposed alternative.

2.6.9 Advantages

Identifies items of positive impact associated with the proposed alternative.

2.6.10 Disadvantages

Identifies items of negative impact associated with the proposed alternative.

2.7 Life Cycle Cost Analysis Summary

The life cycle costs were forecasted with Blast: LCCID Version 1.0, Level 80 Program. LCCID is an economic analysis computer program tailored to the needs of the Department of Defense (DoD).

It is intended to be used as a tool in evaluation and ranking of design alternatives for new and existing buildings. LCCID has built-in calculation procedures recognized as a standard for the DoD. The following is the specific criteria and other guidance embodied in LCCID according to the users' manual:

1. Office of Management and Budget (OMB) Circular A-94, March 27, 1972. OMB Circular A-94 has a new version (October 29, 1992) but a final decision on incorporating the new circular into tri-service criteria has not been determined.

2. Code of Federal Regulations, 10 CFR 436A, January 25, 1990. Annual fuel escalation rates are published by NIST (National Institute of Standards and Technology) under sanction by DoE.

3. Memorandum of Agreement on Criteria/Standards for Economic Analysis/Life Cycle Costing for MILCON Design, 18 March 1991. This memorandum obviated the need for separate criteria in the three services (Army, Air Force, and Navy) of the Department of Defense.

4. DoD Energy Conservation Investment Program (ECIP) Guidance. This guidance uses the memorandum from Item 3, as its basis, but also has some qualifying factors for energy conservation projects and specifies its own format.

The LCCID program is structured as shown on Table 2.7.1, ECIP Study LCCID Ready Reference, which can be found at the end of this section. This table was obtained from the LCCID program users' manual.

The following criteria was selected/entered into the LCCID Program to obtain the Life Cycle Cost Analysis Summaries prepared as part of each alternative:

1. Common criteria selected for all life cycle cost analysis summaries:

   A. Military Construction Army
   B. User Entry of Consumption Values
   C. ECIP Project
   D. Energy Escalation Rates for FY94 (only option available)
   E. English Units

2. Common criteria entered into all life cycle cost analysis summaries:

   A. ECIP Economic Life: Twenty-five years.
   B. Location: Washington, D.C.

C. Electric Usage Cost: Varies per project.

D. Project Number: #4130.02.

E. Fiscal Year: 1995.

F. Project Title: EEAP.

G. Installation Name: Walter Reed Medical Center.

H. Study Preparer: Entech Engineering, Inc.

I. Salvage Value: $0.

3. Criteria entered into life cycle cost analysis summaries from the alternative:

A. Discrete Portion Title: Alternative.

B. Construction Cost: Dollars.

C. Design Cost: Program default of 6% of construction cost.

D. Supervision, Inspection, and Overhead (SIOH): Program default of 5.5% of construction cost.

E. Energy Savings: mmBtu.

F. Demand Savings: Annual Dollars.

G. Annual Recurring Savings: Maintenance Savings Alternative Section.

H. Non-Recurring Savings: Maintenance Savings Alternative Section.

A sample Life Cycle Cost Analysis Summary Report is shown in Table 2.7.2 located at the end of this section. In this example, all the common criteria, noted in 2.7 Items 1 and 2, was selected or entered into this summary report.

In Part 1 of the summary report, a construction cost of $10,000 and a design cost of $600 (6%) was assumed. The SIOH was calculated by the program at $550 (5.5%).

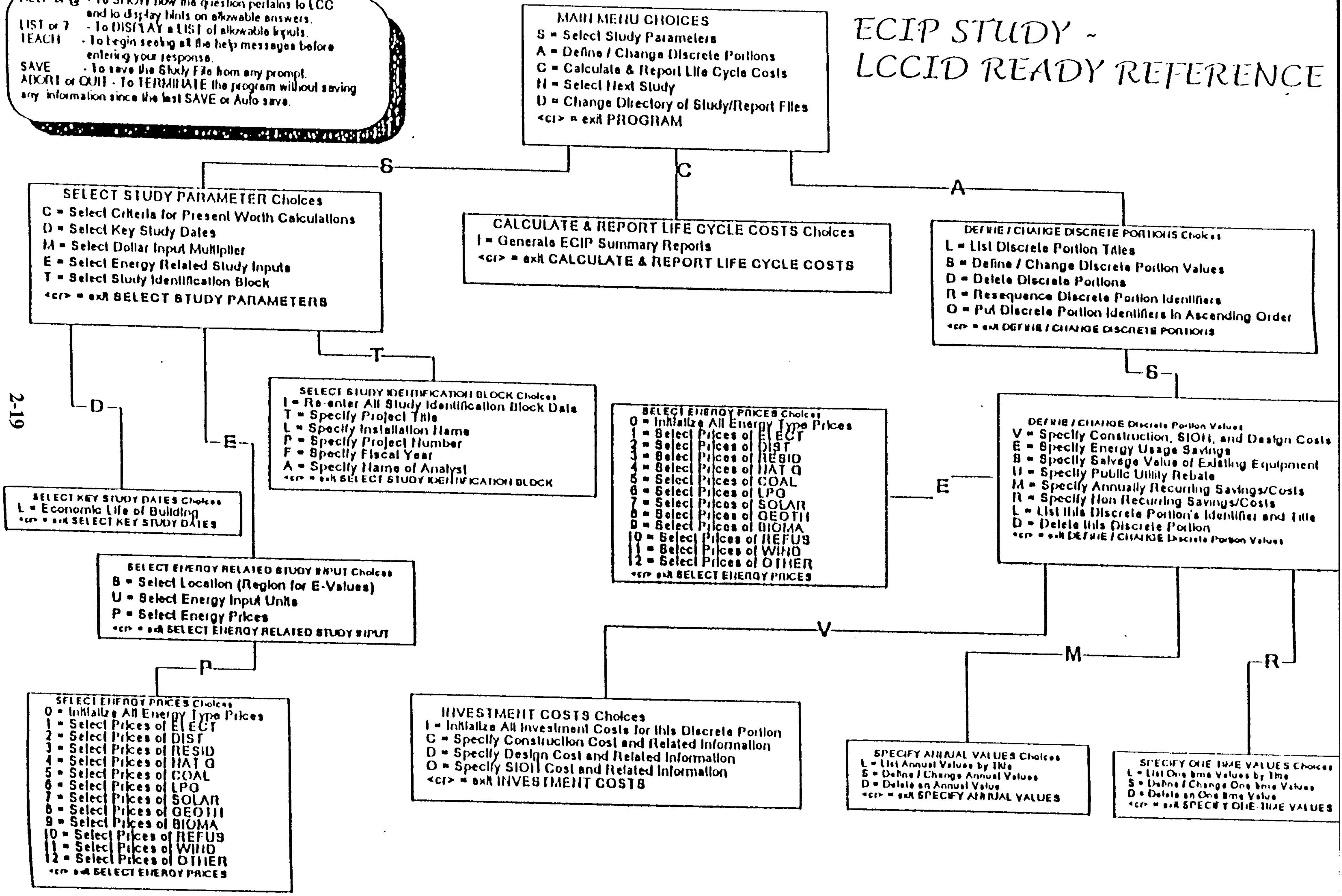
In Part 2 of the summary report, an electric energy saving of 500 mmBtu/yr was assumed. A $500/yr demand savings shown in "2 M" was also assumed.

In Part 3 of the summary report, a maintenance savings of $100/yr was also assumed. In the actual summary reports the above-assumed numbers would originate from an alternative. In this example, the program calculated a simple payback of 2.8 years and a savings to investment ratio of 6.50.

TABLE 2.7.1

ECIP STUDY ~ LCCID READY REFERENCE

HELP or ? - To SHOW how the question pertains to LCC and to display hints on allowable answers.
LIST or ? - To DISPLAY a LIST of allowable inputs.
TEACH - To begin seeing all the help messages before entering your response.
SAVE - To save the Study File from any prompt.
ABORT or QUIT - To TERMINATE the program without saving any information since the last SAVE or Auto save.



MAIN MENU CHOICES
S = Select Study Parameters
A = Define / Change Discrete Portions
C = Calculate & Report Life Cycle Costs
N = Select Next Study
D = Change Directory of Study/Report Files
<cr> = exit PROGRAM

SELECT STUDY PARAMETER Choices
C = Select Criteria for Present Worth Calculations
D = Select Key Study Dates
M = Select Dollar Input Multiplier
E = Select Energy Related Study Inputs
T = Select Study Identification Block
<cr> = exit SELECT STUDY PARAMETERS

CALCULATE & REPORT LIFE CYCLE COSTS Choices
I = Generate ECIP Summary Reports
<cr> = exit CALCULATE & REPORT LIFE CYCLE COSTS

DEFINE / CHANGE DISCRETE PORTIONS Choices
L = List Discrete Portion Titles
S = Define / Change Discrete Portion Values
D = Delete Discrete Portions
R = Resequence Discrete Portion Identifiers
O = Put Discrete Portion Identifiers in Ascending Order
<cr> = exit DEFINE / CHANGE DISCRETE PORTIONS

SELECT STUDY IDENTIFICATION BLOCK Choices
I = Re-enter All Study Identification Block Data
T = Specify Project Title
L = Specify Installation Name
P = Specify Project Number
F = Specify Fiscal Year
A = Specify Name of Analyst
<cr> = exit SELECT STUDY IDENTIFICATION BLOCK

SELECT KEY STUDY DATES Choices
L = Economic Life of Building
<cr> = exit SELECT KEY STUDY DATES

SELECT ENERGY PRICES Choices
0 = Initialize All Energy Type Prices
1 = Select Prices of ELECT
2 = Select Prices of DIST
3 = Select Prices of RESID
4 = Select Prices of NAT G
5 = Select Prices of COAL
6 = Select Prices of LPG
7 = Select Prices of SOLAR
8 = Select Prices of GEOTH
9 = Select Prices of BIOMA
10 = Select Prices of REFUS
11 = Select Prices of WIND
12 = Select Prices of OTHER
<cr> = exit SELECT ENERGY PRICES

DEFINE / CHANGE Discrete Portion Values
V = Specify Construction, SIOH, and Design Costs
E = Specify Energy Usage Savings
S = Specify Salvage Value of Existing Equipment
U = Specify Public Utility Rebate
M = Specify Annually Recurring Savings/Costs
R = Specify Non Recurring Savings/Costs
L = List this Discrete Portion's Identifier and Title
D = Delete this Discrete Portion
<cr> = exit DEFINE / CHANGE Discrete Portion Values

SELECT ENERGY RELATED STUDY INPUT Choices
S = Select Location (Region for E-Values)
U = Select Energy Input Units
P = Select Energy Prices
<cr> = exit SELECT ENERGY RELATED STUDY INPUT

SELECT ENERGY PRICES Choices
0 = Initialize All Energy Type Prices
1 = Select Prices of ELECT
2 = Select Prices of DIST
3 = Select Prices of RESID
4 = Select Prices of NAT G
5 = Select Prices of COAL
6 = Select Prices of LPG
7 = Select Prices of SOLAR
8 = Select Prices of GEOTH
9 = Select Prices of BIOMA
10 = Select Prices of REFUS
11 = Select Prices of WIND
12 = Select Prices of OTHER
<cr> exit SELECT ENERGY PRICES

INVESTMENT COSTS Choices
I = Initialize All Investment Costs for this Discrete Portion
C = Specify Construction Cost and Related Information
D = Specify Design Cost and Related Information
O = Specify SIOH Cost and Related Information
<cr> = exit INVESTMENT COSTS

SPECIFY ANNUAL VALUES Choices
L = List Annual Values by Title
S = Define / Change Annual Values
D = Delete an Annual Value
<cr> = exit SPECIFY ANNUAL VALUES

SPECIFY ONE TIME VALUES Choices
L = List One time Values by Time
S = Define / Change One time Values
D = Delete an One time Value
<cr> = exit SPECIFY ONE-TIME VALUES

TABLE 2.7.2

```
           LIFE CYCLE COST ANALYSIS SUMMARY            STUDY: SAMPLE
       ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)     LCCID  1.080
INSTALLATION & LOCATION: LETTERKENNY   REGION NOS.  3 CENSUS: 1
PROJECT NO. & TITLE: 4130.01   EEAP
FISCAL YEAR 1995   DISCRETE PORTION NAME: ECO #
ANALYSIS DATE:  08-14-95  ECONOMIC LIFE 25 YEARS PREPARED BY: DJB

1. INVESTMENT
A. CONSTRUCTION COST       $    10000.
B. SIOH                    $      550.
C. DESIGN COST             $     1200.
D. TOTAL COST (1A+1B+1C)   $    11750.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                  $    11750.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
            UNIT COST    SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
   FUEL     $/MBTU(1)   MBTU/YR(2)    SAVINGS(3)   FACTOR(4)  SAVINGS(5)

   A. ELECT $  7.27        500.       $    3635.      18.17   $    66048.
   B. DIST  $   .00          0.       $       0.      20.83   $        0.
   C. RESID $   .00          0.       $       0.      23.76   $        0.
   D. NAT G $   .00          0.       $       0.      22.78   $        0.
   E. COAL  $   .00          0.       $       0.      20.78   $        0.
   F. LPG   $   .00          0.       $       0.      18.87   $        0.
   M. DEMAND SAVINGS                  $     500.      17.22   $     8610.
   N. TOTAL                500.       $    4135.              $    74658.

3. NON ENERGY SAVINGS(+) / COST(-)

  A. ANNUAL RECURRING (+/-)                                   $      100.
      (1) DISCOUNT FACTOR (TABLE A)                   17.22
      (2) DISCOUNTED SAVING/COST (3A X 3A1)                   $     1722.

  B. NON RECURRING SAVINGS(+) / COSTS(-)
                          SAVINGS(+)    YR   DISCNT      DISCOUNTED
              ITEM         COST(-)      OC   FACTR       SAVINGS(+)/
                             (1)       (2)    (3)        COST(-)(4)

   d. TOTAL              $       0.                              0.

  C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$     1722.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$     4235.

5. SIMPLE PAYBACK PERIOD (1G/4)                                2.77 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $    76380.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=         6.50
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                   11.12 %
```

2.8 Draft Report/Client Review/Final Report

After the previous sections have been substantially completed, Entech proceeds to compile the information into the report format: Entech schedules a meeting with the client to present its findings. A copy of the report is supplied to the client for a more detailed review.

Entech then proceeds to incorporate the clients review comments and produce a final report.

3.0 FACILITY DESCRIPTION

3.1 General

The Walter Reed Army Medical Center (WRAMC) is a general and specialized medical care facility for both inpatient and outpatient care. WRAMC supports clinical research and development programs, medical and technical education programs for health care professionals, and serves as the primary clinical teaching facility for the uniformed services' medical students.

WRAMC is comprised of seventy-one (71) buildings located on a 113-acre site in Washington, D.C. Center focus of the WRAMC campus is Heaton Pavilion, a 1,150,000 square foot hospital facility. WRAMC also houses numerous primary support facilities for research, education, administration, and enlisted personnel housing. See Plate No. 1, page 3-21.

3.2 Chilled Water Production Systems

WRAMC incorporates two (2) central chilled water plants (Buildings 48 and 49), and two (2) primary chilled water distribution systems. The plants function independently of each other and are not cross connected. See Plate No. 2, page 3-22.

In addition to the chilled water plants, three (3) buildings utilize their own independent chillers, Buildings 7, 54, and T-2. Chillers for Buildings 7 and T-2 are air-cooled units while Building 54's units are water-cooled. The chiller for Building T-2 is presently inoperative.

These buildings are also valved into Building 48's distribution system. The BRAC Clinic, presently under construction, will also have its own dedicated chiller.

Buildings 7, T-2, and the BRAC Clinic all have independent chilled water pumps for building distribution. The BRAC Clinic is piped to utilize building distribution pumps as secondary pumps in a primary/secondary pumping arrangement when the building is valved into the central distribution system. Buildings 7 and T-2 are not piped for primary/secondary pumping.

Numerous buildings located within the Center utilize air-cooled DX equipment of varying sizes for air conditioning needs. Buildings utilizing central plant chilled water for building air conditioning systems are listed in Table 3.2.1, on the following three (3) pages.

Table 3.2.1
Facility Building Data

Building No.	Facility Name	Facility Function	Square Feet Gross/Net	Year Built	Chilled Water User Present/Future	Comments
1	Water Reed General Hospital	Administration	55,414/33,222	1908	YES/YES	
1A	A Wing	Administration	14,100/9,429	1915	YES/YES	
1B	A Wing	Administration	12,638/7,876	1915	YES/YES	
1C	F Wing	Administration	16,104/12,055	1928	YES/NO	
1D	D Wing	Administration	46,545/38,801	1928	YES/YES	
1E	E Wing	Administration	58,517/47,748	1928	YES/YES	
1F	C Wing	Administration	68,112/52,782	1928	YES/YES	
1G	E Wing	Administration	13,844/12,184	1944	YES/NO	
1J	E Wing	Administration	1,190/938	1944	YES/NO	
1K	E Wing	Administration	9,266/8,041	1953	YES/NO	
1L	F Wing	Administration	5,590/4,590	1953	YES/NO	
2	Heaton Pavilion	Hospital	*2,572,328 1,240,441	1977	YES/YES	
T-2	ADP	Automatic Data Processing Equip.	58,054/55,392	1972	YES/NO	Presently valved into the central system. Dedicated chiller is inoperable.
5	Magnetic Resonance Imaging	Patient Care	9,934/8,832	1993	YES/YES	

Note: * Includes Interstitial Equipment Levels

Table 3.2.1
Facility Building Data

Building No.	Facility Name	Facility Function	Square Feet Gross/Net	Year Built	Chilled Water User Present/Future	Comments
7	Outpatient Clinic	Psychiatry/Social Work	50,635/48,165	1910	YES/YES	Presently valved off the central system. Operates off its own dedicated chiller.
11	Delano Hall	Administration/ Personnel	130,083/81,044	1929 1931 1933	YES/YES	
14	Abrams Hall	Administration/Enlisted Men and Women's Barracks	300,000/176,326	1977	YES/YES	
16	Engineering Storage House	DPW	2,058/----	1920	NO/YES	Future renovation/ construction.
17	Guest House	Temporary Enlisted Men and Women's Housing	20,530/17,530	1920	YES/YES	
40	WRAIR	Administration	276,1182/218,289	1924 1932 1962	YES/YES	
41	Recreation Center	Physical Fitness/ Recreation	43,574/34,629	1927	YES/YES	
48	Air Conditioning Plant	DPW	19,256/----	1959	N/A	
49	Chilled Water Plant	DPW	1,232/----	1977	N/A	

Table 3.2.1
Facility Building Data

Building No.	Facility Name	Facility Function	Square Feet Gross/Net	Year Built	Chilled Water User Present/Future	Comments
53	AFIP	Conference Center	17,643/14,702	1954	YES/	Presently valved off system.
54	AFIP	Administration	355,703/348,959	1955 1972	YES/YES	Has its own dedicated chillers. Valved off the central system during summer months and into the central system during non-summer months.
91	Dentac	Administration	9,591/8,199	1955	NO/YES	Future renovation.
14A	Barracks Addition Bldg 14	Enlisted Men and Women's Barracks	10,100/----	Future	NO/YES	Future construction.
	Transient Lodging Facility	Transient Lodging	94,400/----	Future	NO/YES	Future construction.
	Physical Fitness Center	Physical Fitness/ Recreation	21,000/----	Future	NO/YES	Future construction.

3.3 Chilled Water Production Equipment and Operations

The present chilled water operational capability for WRAMC is 9,840 tons. Building 48 contains 7,080 tons of chilled water production capability, Building 49 — 660 tons, Building 54 — 1,900 tons, and Building 7 — 200 tons, as described previously. The inoperable chiller in Building 7 and the future chiller are not included in the total site chilled water production capability. See Table 3.3.1, on the following two (2) pages.

The chiller equipment rooms in Buildings 48, 49, and 54 house both chillers and associated electrical equipment. According to ASHRAE Standard 15-1992 this practice is acceptable for chillers utilizing refrigerants R-11, R-12, R-123, and R-134a.

Table 3.3.1
Facility Chiller Data

Chiller Design/ Manuf.	Model	Year Built	Refrig.	Volt.	Oper. Amps	Nom. Tons	Type	Flow GPM Chilled/ Cond.	Located (Building)	Comments
Carrier	30GB		R-22	460	401	175	Air cooled	400/----	T-2	Serves T-2 only, no longer operative.
Carrier				460		200	Air cooled		7	Serves 7 only.
York	HT-T2	1974	R-500	4160	151	1250	Water cooled	3,300/3,750	48	Serves chilled water central distribution system.
York	HT-T2	1974	R-500	4160	151	1250	Water cooled	3,300/3,750	48	Serves chilled water central distribution system.
Trane	CVHF	1994	R-123	4160	130	1280	Water cooled	3,300/3,750	48	Serves chilled water central distribution system.
Carrier	19C	1958	R-11	4160	130	1100	Water cooled	1,800/3,300	48	Serves chilled water central distribution system.
Carrier	19C	1958	R-11	4160	130	1100	Water cooled	1,800/3,300	48	Serves chilled water central distribution system.
Carrier	19C	1958	R-11	4160	130	1100	Water cooled	1,800/3,300	48	Serves chilled water central distribution system.

Table 3.3.1
Facility Chiller Data

Chiller Design/ Manuf.	Model	Year Built	Refrig.	Volt.	Oper. Amps	Nom. Tons	Type	Flow GPM Chilled/ Cond.	Located (Building)	Comments
Trane	CV6H	1976	R-11	4000	91	660	Water cooled	1,585/1,980	49	Serves chilled water central distribution system.
Carrier	17M	1952	R-11	2300	130	600	Water cooled	1,370/1,800	54	Serves 54 only.
Carrier	17M	1952	R-11	2300	130	600	Water cooled	1,370/1,800	54	Serves 54 only.
Trane	CVHE	1983	R-11	460	639	700	Water cooled	1,400/2,000	54	Serves 54 only.
Future				460		200	Air cooled		6	Building under construction. Will serve BRAC Clinic only.

Building 48: Building 48's chilled water plant was built in two (2) phases. The original building was constructed in 1958 and accommodated three (3) chillers. An addition was constructed in 1974 which added three (3) more chillers to the system. See Plate No. 3 and Plate No. 4, pages 3-23 and 3-24 respectively.

Building 48's chilled water system incorporates six (6) electric-driven, water-cooled, centrifugal chillers as shown below in Table 3.3.2. The overall chiller plant design is 42°F to 43°F leaving water temperature with a 10°F system rise.

Table 3.3.2
Chilled Water Plant 48
Chillers

Maintenance	Quantity	Tons/ea	Year
Carrier	3	1,100	1958
Trane	1	1,280	1994
York	2	1,250	1974

Cooling towers are field-fabricated, induced-draft, cross-flow type utilizing axial fans and ceramic fill. Table 3.3.3 on the following page, shows available information.

Table 3.3.3
Chilled Water Plant 48
Towers

Tons	Quantity	Fan hp
1,100	3	50 hp each
1,250	3	60 hp each

When the 1974 addition was built, the original three (3) condenser water pumps were replaced and three (3) new pumps added. Table 3.3.4 below, displays available information on the condenser pumps.

Table 3.3.4
Chilled Water Plant 48
Condenser Pumps

gpm	Quantity	hp
3,300	3	125
3,750	3	100

Building 48's chilled water distribution system consists of six (6) pumps. All six (6) pumps draw suction from a common central distribution chilled water return header and discharge into a common chiller return header. The chillers are piped into a common central distribution chilled water supply header.

This headered piping arrangement allows diverse pumping capability, matching any combination of pumps and chillers. The maximum chilled water design flow capacity is 15,300 gpm. Table 3.3.5 below, displays available information on the chilled water pumps.

Table 3.3.5
Chilled Water Plant 48
Chilled Water Pumps

gpm	Quantity	hp
1,800	3	125
3,300	3	100

A "free cooling" heat exchanger was installed in 1982. The heat exchanger is a plate and frame type rated for 2,765 gpm of chilled water flow, 51°F entering and 44.5°F leaving water temperature. The heat exchanger is piped into the chilled water and condenser water piping systems in a way to utilize Chiller #1 and either Cooling Towers #2 or #3. This system was intended to meet the plant's winter chilled water needs without the necessity to operate chillers. The system was noted as inadequately sized and no longer used by WRAMC personnel. It was noted that the heat exchanger was used once briefly in the winter of 1994, as identified by the chiller log sheets.

Building 48's chilled water central distribution system consists of four (4) independent chilled water loops which are served from the chilled water header system located within the building:

Loop #1 — 20" Supply and Return, serves Building 2

Loop #2 — 10" Supply and Return, serves Building 1 Complex and Building 7

Loop #3 — 12" Supply and Return, serves Buildings 1E, T-2, 40, and 41

Loop #4 — 10" Supply and Return, serves Buildings 53 and 54

With the exception of Building 2, Building 48's chilled water pumps serve as primary distribution pumps, supplying chilled water directly to building air conditioning equipment. A primary/secondary pumping arrangement was the design intent for Building 2, although as-built drawings indicate the system does not operate in that mode.

Three-way valves are widely used for control at individual building equipment. With the use of three-way valves, no pumping flow diversity exists within the central distribution system.

Building 49: Building 49's chilled water plant was constructed in 1976 in association with the construction of Abrams Hall, Building 14.

Building 49's chilled water system is composed of the following components:

Table 3.3.6
Chilled Water Plant 49
Components

Description	Fixtures
Chiller	Trane, 660 Ton, Centrifugal
Tower	650 Tons, 4-15 hp, Fans
Condenser Pump	1,980 gpm, 40 hp
Chilled Water Pump	1,585 gpm, 75 hp

Reference Plate No. 5, page 3-25, for more information.

The chiller is a Trane unit rated at 660 tons, built in 1976. The cooling tower is rated at 650 tons and has four (4) 15 hp centrifugal fans installed. The chilled water system design is 40°F leaving water temperature with a 14°F system rise.

The condenser water system consists of one (1) 1,980 gpm, 40 hp pump. The chilled water distribution system consists of one (1) 1,585 gpm, 75 hp pump. No standby pumping capability exists.

Building 49's chilled water system consists of two (2) independent chilled water loops:

Loop #5 — 6" Supply and Return, serves Building 14

Loop #6 — 6" Supply and Return, serves Buildings 11 and 17

Building 49's chilled water pump serves as the primary distribution pump. Three-way valves are used for control at individual building equipment. With the use of three-way valves, no pumping diversity exists within the central distribution system.

Within Building 14, the primary distribution pump is used for the main building air handler's chilled water coils. A secondary pumping arrangement supplies both chilled and heated water to fan coil units and radiation throughout the building. This secondary piping is arranged and valved in a manner to allow the secondary pumps to pump chilled water during the cooling season and heating water during the heating season.

Building 54: Building 54, the AFIP Building, was constructed in 1955 with an addition to the building constructed in 1972. The original Building 54 cooling system is comprised of two (2) electric-driven, water-cooled centrifugal chillers with an associated induced-draft, cross-flow type cooling tower. The building addition has a chiller installed, similar in type to the original building chillers, and a forced-draft cooling tower. See Plate No. 6, page 3-26. Table 3.3.7, on the following page, displays information on the chillers.

Table 3.3.7 Building 54 Chiller			
Manufacturer	Quantity	Tons/ea	Year
Carrier (original)	2	600	1952
Trane (addition)	1	700	1983

The original building and the addition's cooling systems are cross piped to operate as a single system. The original building has three (3) chilled water pumps and the addition has two (2) pumps. Pumps are piped in parallel with one (1) pump piped for standby operation. Table 3.3.8 below, displays information on the chilled water pumps.

Table 3.3.8 Building 54 Chilled Water Pumps		
gpm	Quantity	hp
960 (original)	3	40
1,400 (addition)	2	75

The original building condenser water system consists of three (3) pumps. Pumps are piped in parallel with one (1) pump piped for standby operation. The addition has one (1) condenser water pump. The condenser water systems are not cross piped between the original building and the addition. Table 3.3.9, on the following page, displays information on the condenser water pumps.

Table 3.3.9
Building 54
Condenser Water Pumps

gpm	Quantity	hp
1,200 (original)	3	50
2,000 (addition)	3	100

Building 54's chilled water distribution system is valved into Building 48's chilled water distribution system. During the non-summer months, chilled water from the central system is utilized to satisfy the building cooling needs. During this period, the Building 54's cooling system is supplied by Building 48's primary distribution pumps, while its own distribution pumps are shut off. During this same period, the addition utilizes its distribution pumps as secondary pumps in a primary/secondary pumping arrangement. All building chillers are shut off.

During the summer months, Building 54's cooling system is valved off the chilled water distribution system and functions as stand-alone. The original building's distribution pumps serve as primary pumps for the original building and as primary pumps for a primary/secondary pumping arrangement in the addition. The addition's chilled water distribution pumps always function as secondary pumps. The original building chillers are the primary building chilled water source; the addition's chiller is placed on-line when the two (2) original building chillers cannot satisfy cooling needs. The addition's chiller has an independent chilled water pump to supply building chilled water piping.

Maintenance Costs: Table 3.3.10 on the following page, summarizes operation and maintenance costs for Plants 48, 49, and Building 54. The costs are associated with the cooling systems only. Operation costs are for plant personnel while maintenance costs are for compressor repairs. This information has been provided by WRAMC and can be located in Section 11, Attachment J.

Table 3.3.10
Reported Operation & Maintenance Costs

Chilled Water Plant 49

	1992	1993	1994
In House Maintenance	$2,100	$6,200	$6,700
Contractual Maintenance	$6,800	$0	$0
Operations	$2,600	$700	$0

Chilled Water Plant 48

	1992	1993	1994
In House Maintenance	$49,400	$37,600	$32,500
Contractual Maintenance	$48,700	$1,600	$61,000
Operations	$165,700	$166,600	$170,900

Big diff.

Building 54

	1992	1993	1994
In House Maintenance	$9,800	$11,100	$9,600
Contractual Maintenance	$13,500	$5,000	$7,100
Operations	$300	$600	$100

Total All Chiller Plants

	1992	1993	1994
In House Maintenance	$61,300	$54,900	$48,800
Contractual Maintenance	$69,000	$6,600	$68,100
Operations	$168,600	$167,900	$171,000

3.4 Electrical

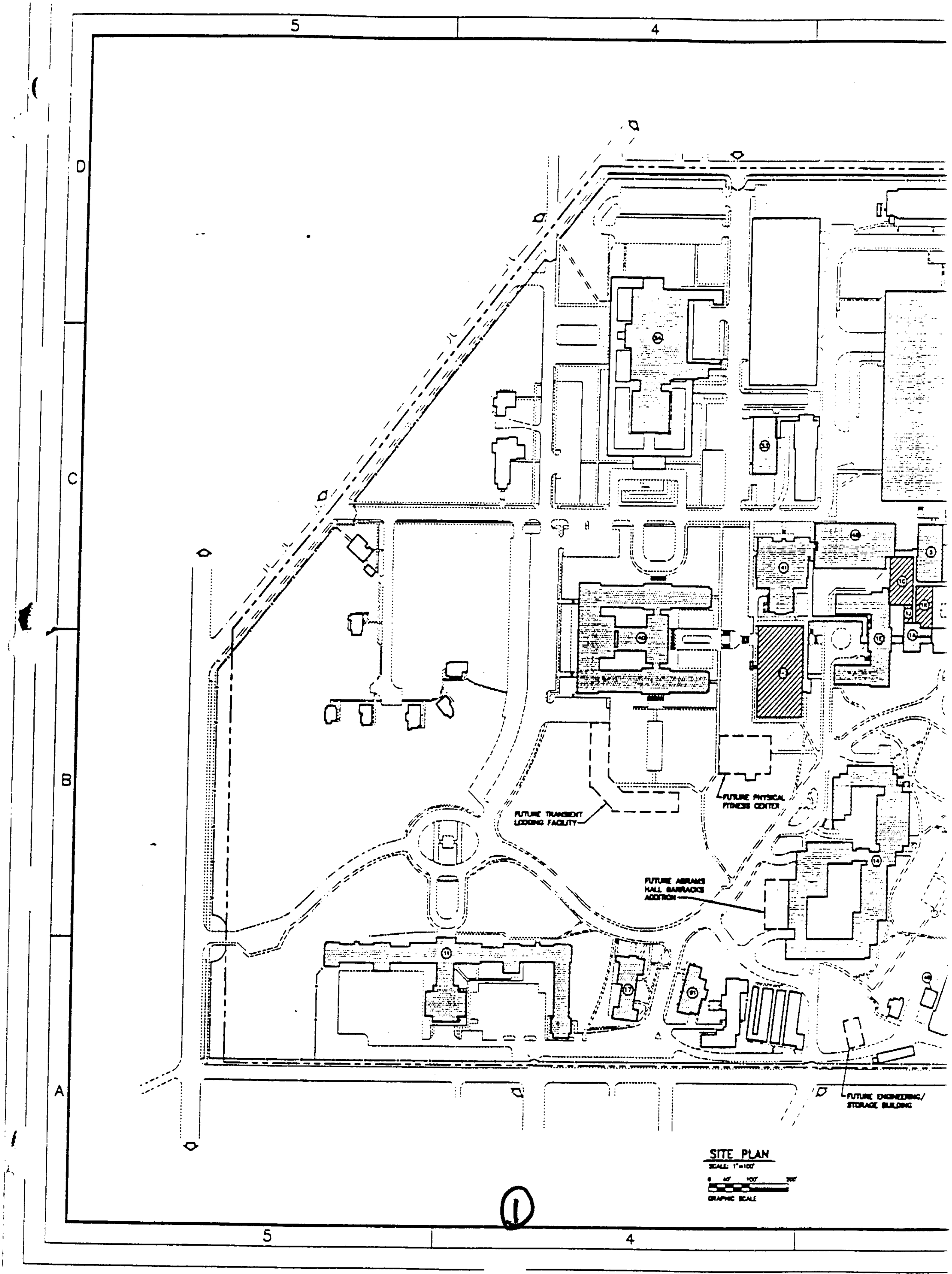
The chillers are fed from WRAMC's 13.2 kV electrical distribution system. The main distribution system feeds the entire facility, with the exception of Building 54. The distribution system consists of four (4) incoming 13.2 kV feeders from Potomac Electric Power Company (PEPCO), three (3) primary feeders and one (1) standby feeder. The PEPCO feeders are routed in underground ducts parallel to Aspen Street from a PEPCO manhole near the intersection of Aspen and Georgia Streets to the main switching station, Building 95. The switching station is located east of the central heating plant. The switchgear in the main switching station consists of three (3) incoming main breakers, an emergency tie system for the fourth feeder, utility metering, protective relaying, and three (3) distribution busses. Each distribution bus consists of five (5) feeder breakers.

The chillers for Buildings 48 and 49 are fed from distribution busses for the facility. Chillers #1, 2, and 3 and the ancillary motor loads for all six (6) chillers in Building 48 are fed from a 4.16 kV bus in Building 48. The ancillary 480-volt motors are fed from a 480-volt bus which is supplied power through parallel 1,000 kVA transformers. Chillers #4, 5, and 6 are fed from breaker 1A via a single 3,750 kVA transformer feeding a separate 4.16 kV bus. Reference Plates No. 7, 8, and 9, pages 6-27, 6-28, and 6-29 respectively, for more information.

The chiller in Building 49 is fed from breaker 1A via a 750 kVA step-down transformer. The ancillary 480-volt motors for the chiller are fed from a local 480-volt bus fed from a 225 kVA transformer.

The step-down transformers and the starters for the seven (7) chillers are located near the chillers in Buildings 48 and 49. The 13.2 kV feed to the transformers is routed via the underground cable in conduit distribution system.

The chiller in Building 54 is fed from Building 54's distribution system. Building 54 is fed from a separate PEPCO 13.2 kV feeder which enters the building from 14th Street.

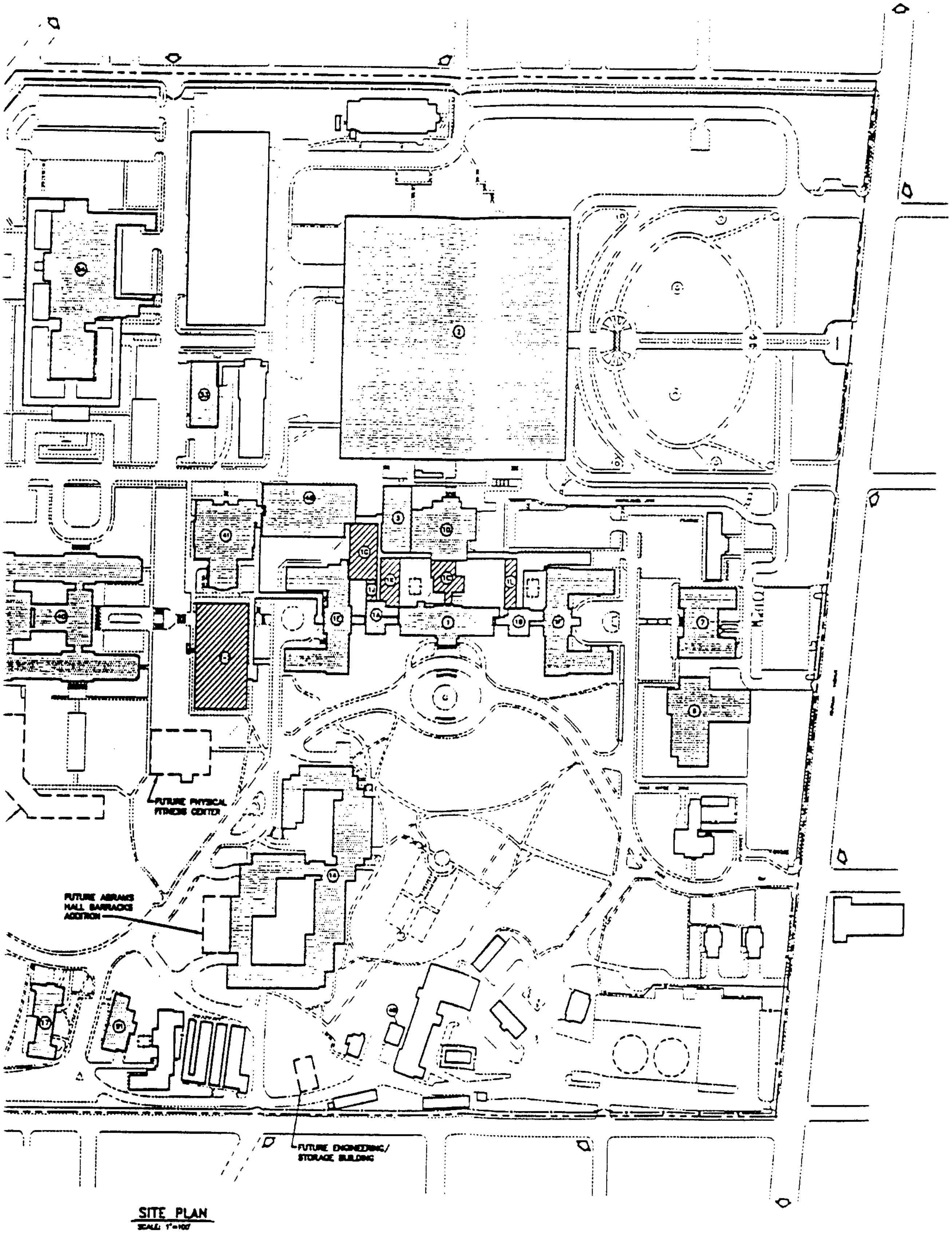


SITE PLAN

SCALE: 1"=100'

①

4 3 2

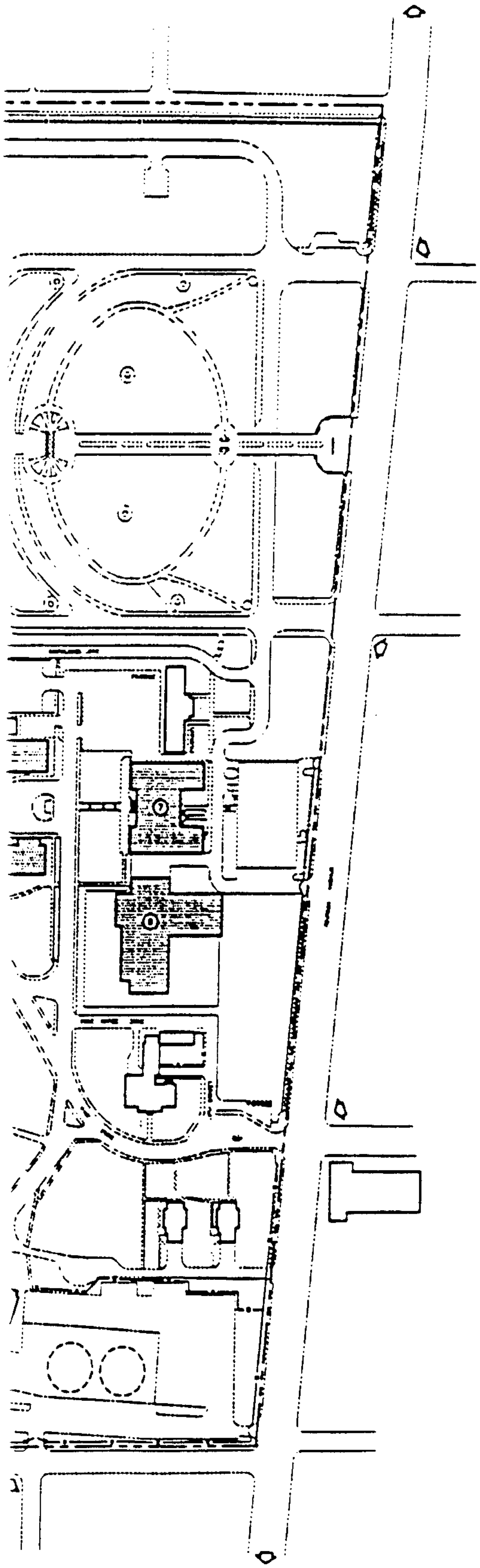


SITE PLAN

SCALE: 1"=100'

②

4 3 2



BLDG. LEGEND

▭	EXISTING BUILDING OR STRUCTURE
▭ ⓪	EXISTING BUILDING ADDRESSED, TO REMAIN
▨ ⓪	EXISTING BUILDING ADDRESSED, SLATED FOR DEMOLITION
⬚	FUTURE BUILDING ADDRESSED

BUILDING NO.	FACILITY NAME
1	WALTER REED GENERAL HOSPITAL
1A	A WING
1B	A WING
1C	F WING
1D	D WING
1E	E WING
1F	C WING
1G	E WING
1J	E WING
1H	E WING
1L	F WING
2	HEATON PAVILION
T-2	ADP
5	MAGNETIC RESONANCE IMAGING
6	BRAC CLINIC
7	OUTPATIENT CLINIC
11	DELANO HALL
14	ABRAMS HALL
16	ENGINEERING/ STORAGE HOUSE
17	GUEST HOUSE
40	WRAIR
41	RECREATION CENTER
48	AIR CONDITIONING PLANT
49	CHILLED WATER PLANT
83	AFIP
84	AFIP
91	DENTAC
	BARRACKS ADDITION BLDG 14
	TRANSIENT LODGING FACILITY
	PHYSICAL FITNESS CENTER

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-84-D-0037

MECHANICAL SITE PLAN – EXISTING
& FUTURE CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02

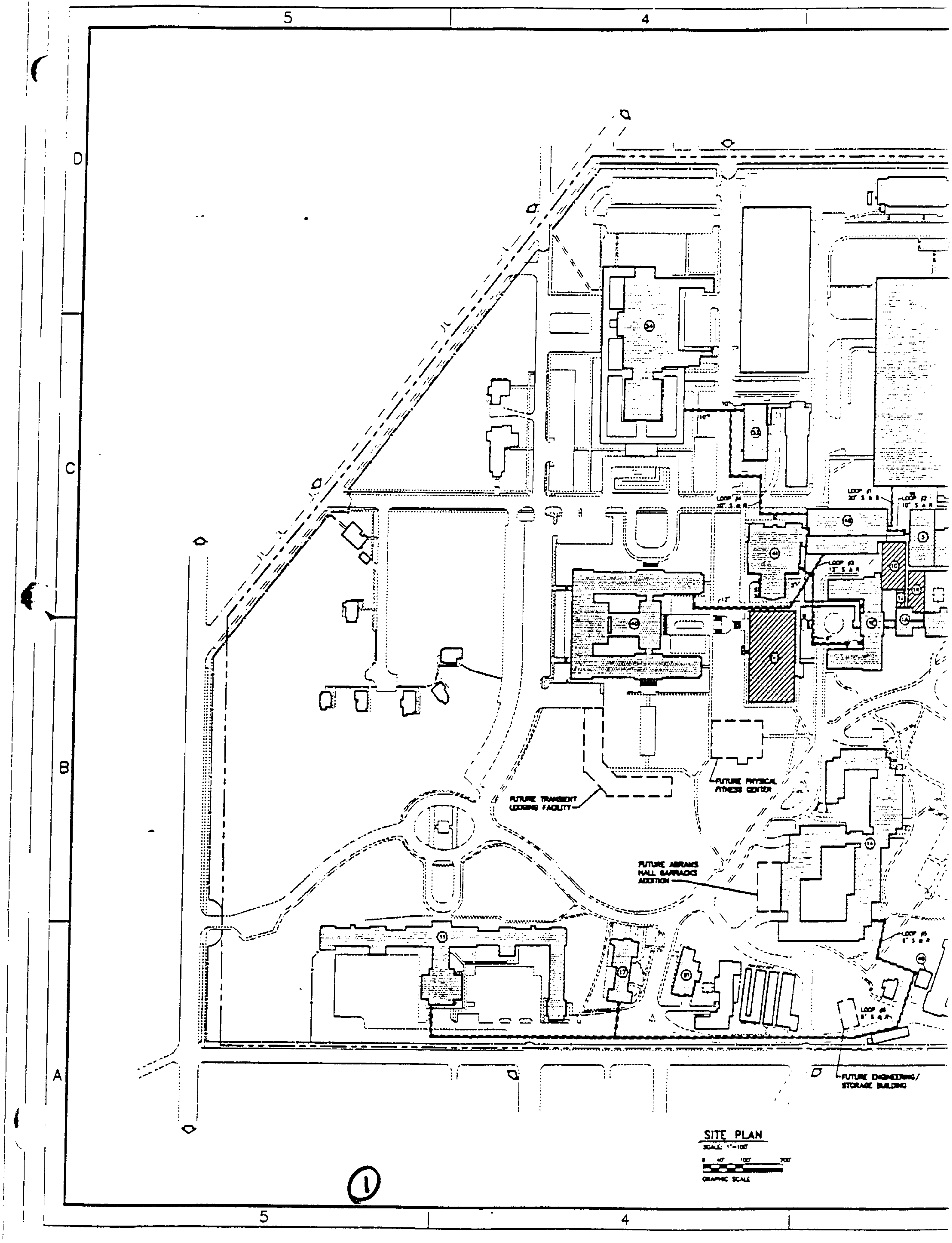
DRAWING NUMBER B-4130-02-01

PLATE 1

SCALE AS NOTED | DATE | SHEET M-1

CADD

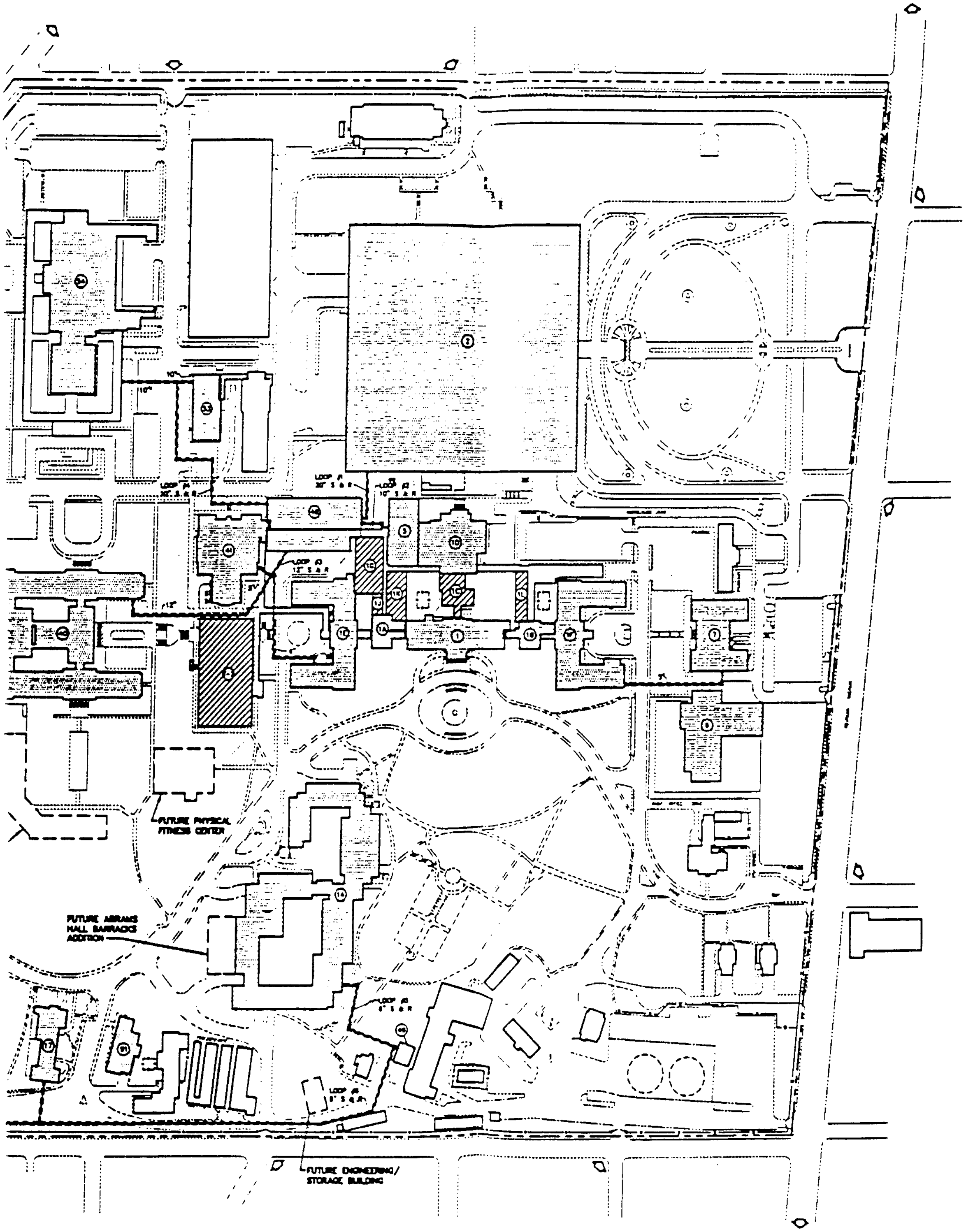
(3)



SITE PLAN

SCALE: 1"=100'

①



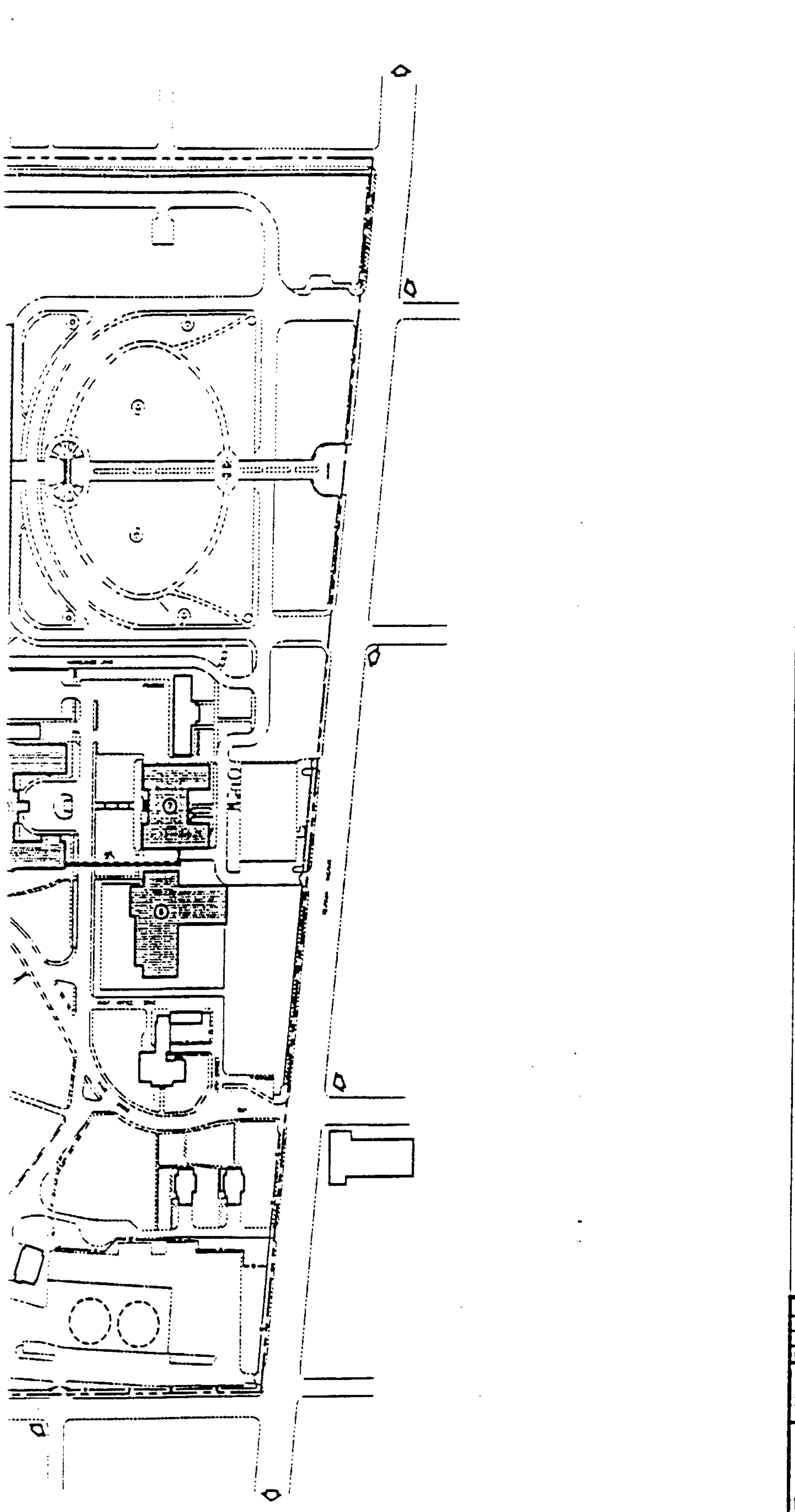
SITE PLAN

SCALE: 1"=100'

0 40' 100' 200'

GRAPHIC SCALE

②



BLDG. LEGEND

▭	EXISTING BUILDING OR STRUCTURE
ⓘ	EXISTING BUILDING ADDRESSED, TO REMAIN
▨	EXISTING BUILDING ADDRESSED, SLATED FOR DEMOLITION
⬚	FUTURE BUILDING ADDRESSED

BUILDING NO.	FACILITY NAME
1	WALTER REED GENERAL HOSPITAL
1A	A WING
1B	A WING
1C	F WING
1D	D WING
1E	E WING
1F	C WING
1G	E WING
1J	E WING
1K	E WING
1L	F WING
2	HEATON PAVILION
T-2	ADP
5	MAGNETIC RESONANCE IMAGING
6	BRAC CLINIC
7	OUTPATIENT CLINIC
11	DELANO HALL
14	ABRAMS HALL
16	ENGINEERING/ STORAGE HOUSE
17	GUEST HOUSE
40	WRAIR
41	RECREATION CENTER
48	AIR CONDITIONING PLANT
49	CHILLED WATER PLANT
53	AFIP
54	AFIP
91	DENTAC
	BARRACKS ADDITION BLDG 14
	TRANSIENT LODGING FACILITY
	PHYSICAL FITNESS CENTER

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL SITE PLAN-GENERAL CHILLED WATER MAP-EXISTING & FUTURE CONDITIONS

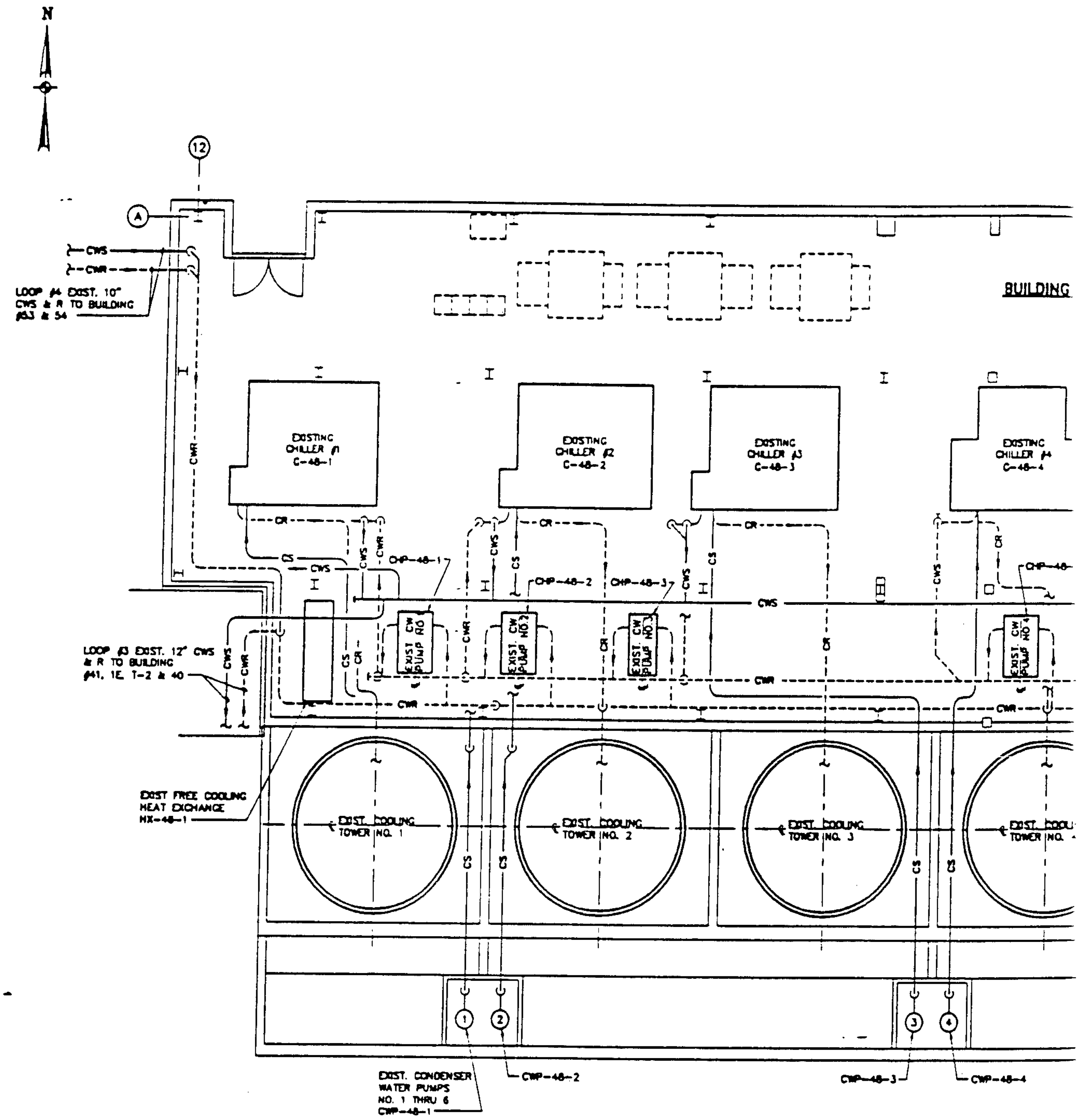
ENTECH Engineering Inc., Reading, PA. Job #4130.02

DRAWING NUMBER	PLATE
B-4130-02-02	2

SCALE: AS NOTED | DATE | SHEET M-2

CADD

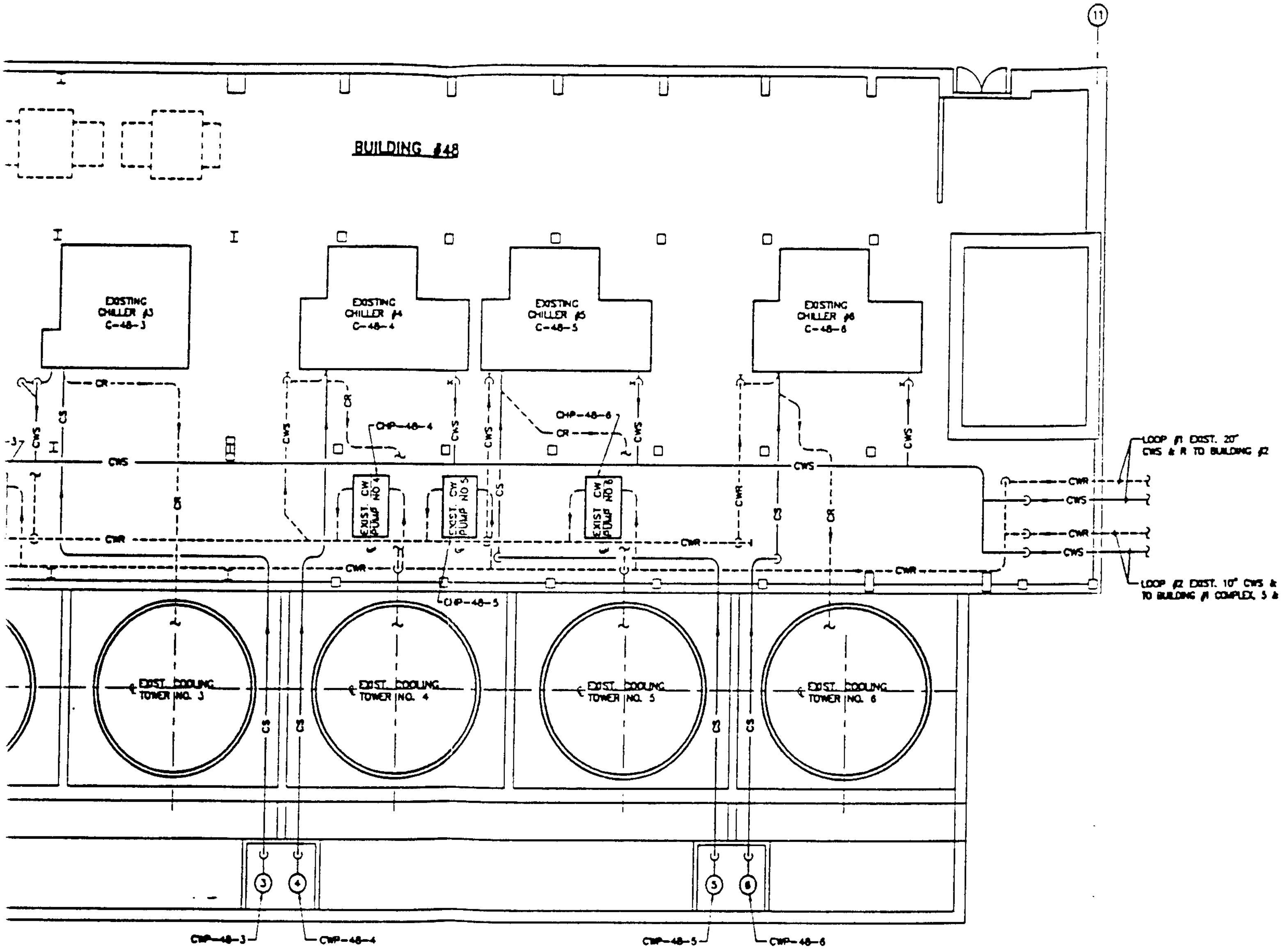
③



FLOOR PLAN – MECHANICAL EQUIPME

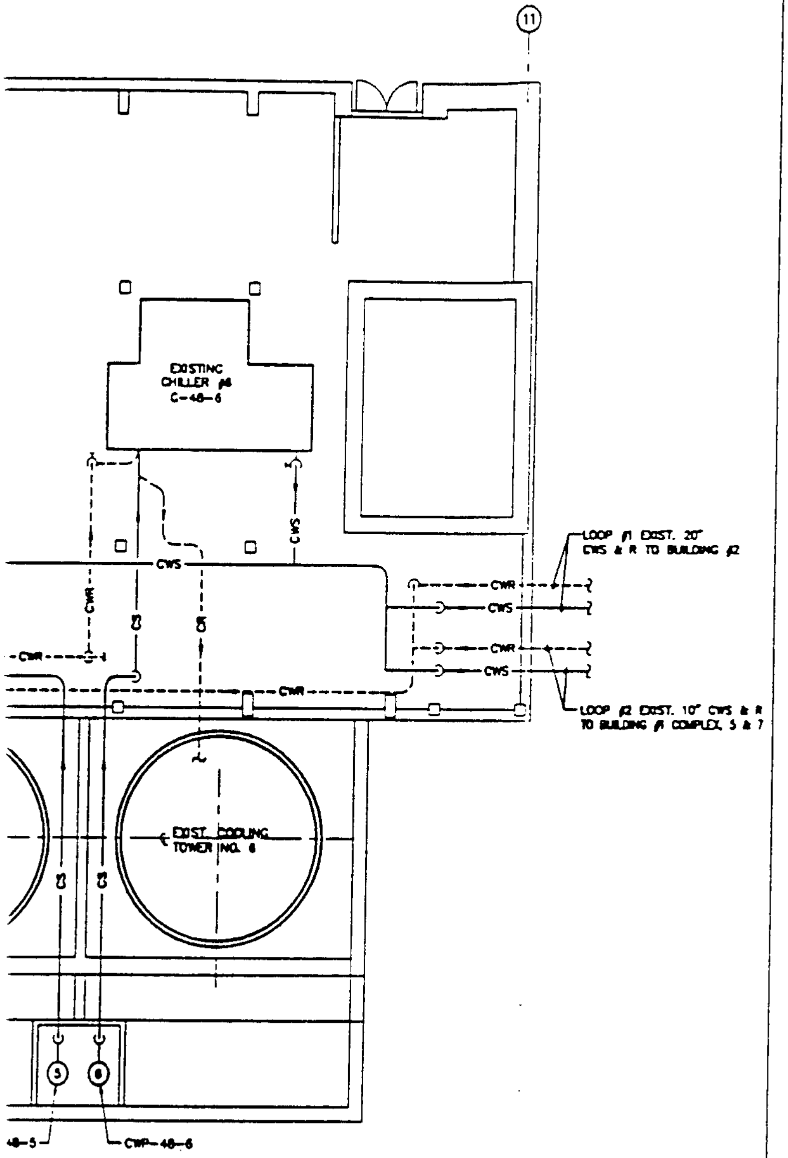
SCALE: NONE

①



FLOOR PLAN – MECHANICAL EQUIPMENT
SCALE: NONE

②



LEGEND

—— CWS ——	CHILLED WATER SUPPLY
---- CWR ----	CHILLED WATER RETURN
—— CS ——	CONDENSER WATER SUPPLY
---- CR ----	CONDENSER WATER RETURN
————	DIRECTION OF FLOW

GENERAL NOTES:

A. VALVING AND ASSOCIATED CONTROL APPURTENAUCES HAVE BEEN OMITED FROM DRAWING TO CLEARLY IDENTIFY IN SCHMATIC FORMAT THE SYSTEM FLOW AND THE AREAS IN WHICH THEY SERVE.

B. ANCILLARY EQUIPMENT NOT DIRECTLY RELATED TO THE PROCESS HAVE ALSO BEEN OMITED FROM THE DRAWINGS.

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL FLOOR PLAN-CHILLER BLDG. #48
EQUIP. LAYOUT-EXISTING CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02

DRAWING NUMBER B-4130-02-03

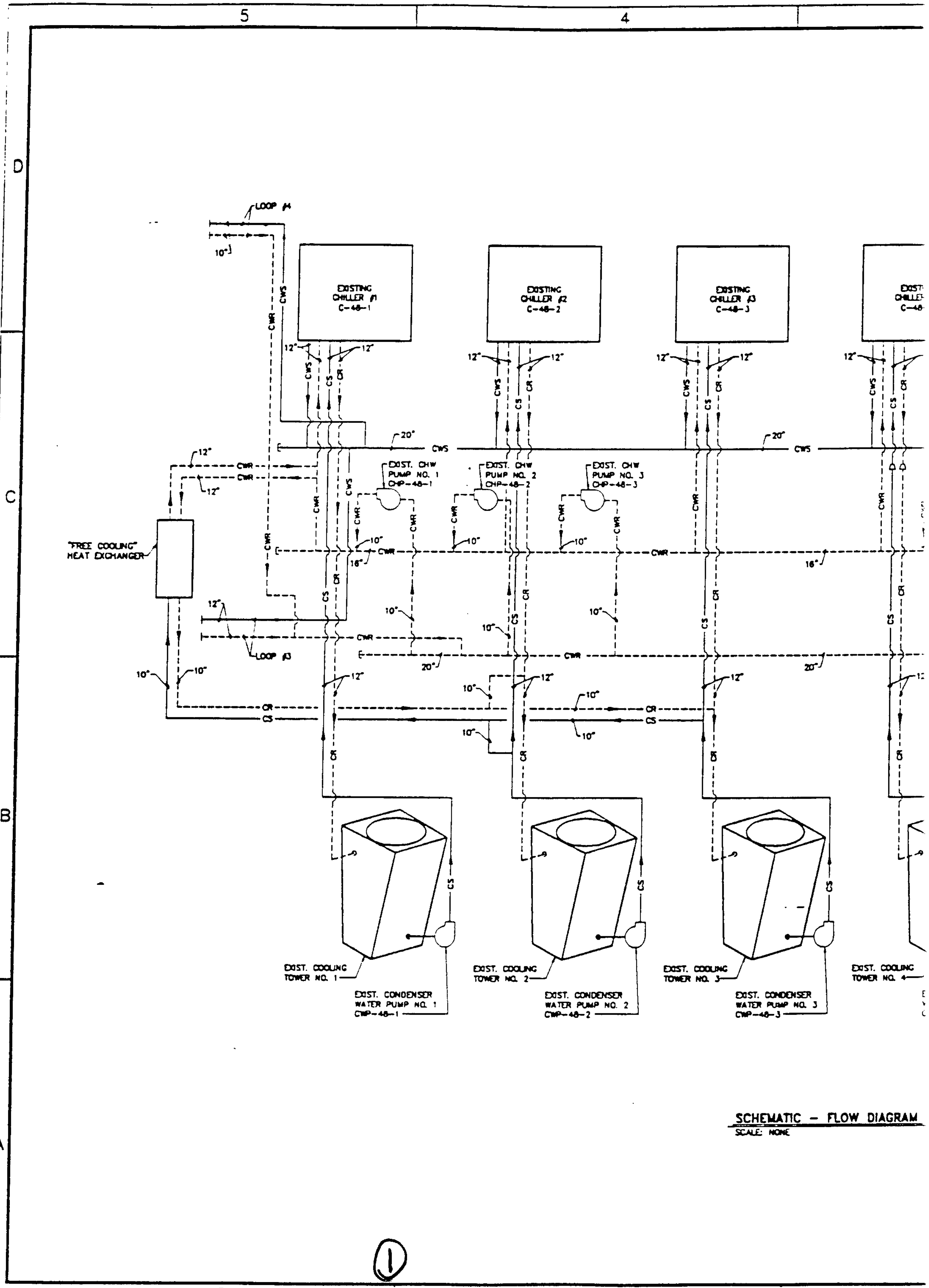
PLATE 3

SCALE AS NOTED

DATE

SHEET M-3

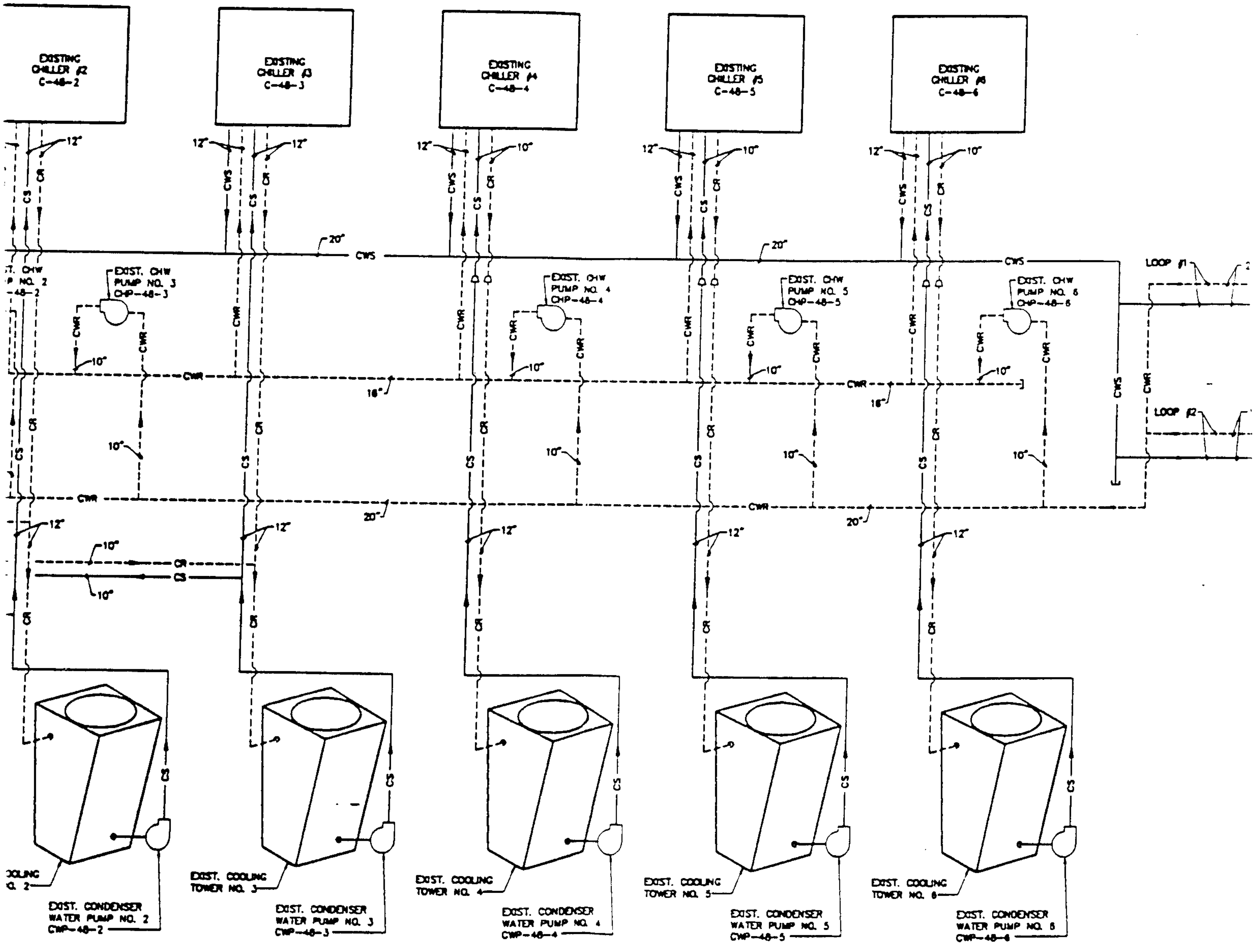
3



SCHEMATIC – FLOW DIAGRAM

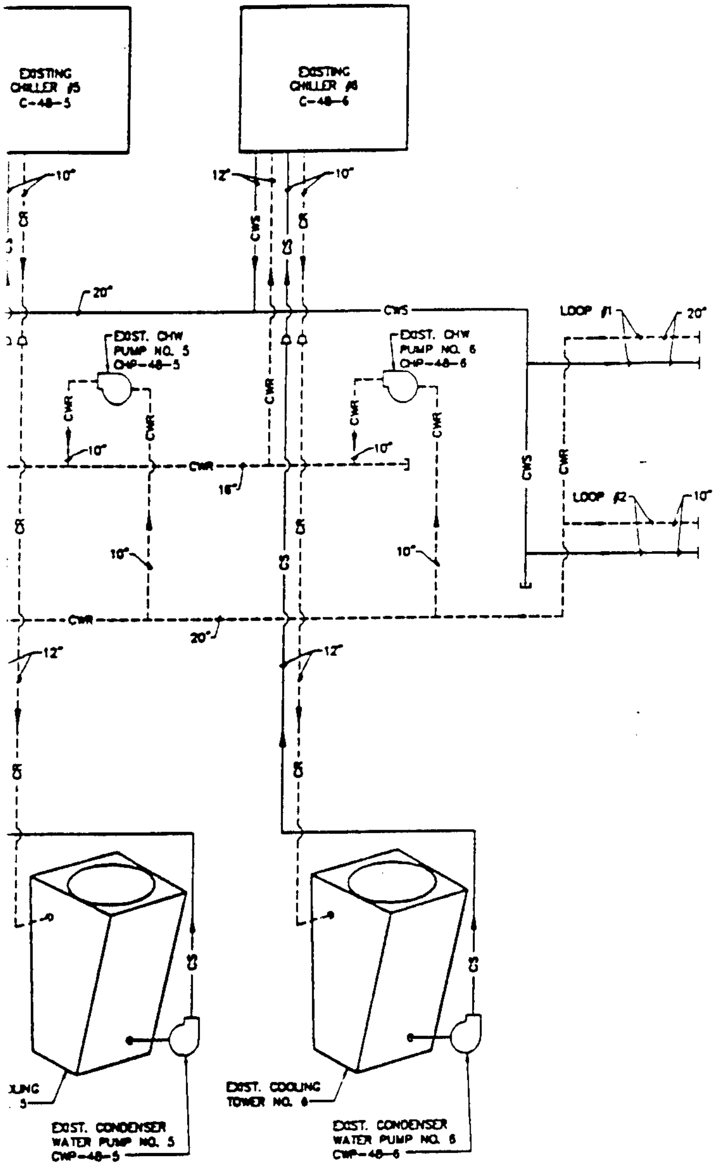
SCALE: NONE

①



SCHEMATIC – FLOW DIAGRAM
SCALE: NONE

②



LEGEND

----CHWS-----	CHILLED WATER SUPPLY
——CHWR——	CHILLED WATER RETURN
—— CS ——	CONDENSER WATER SUPPLY
---- CR ----	CONDENSER WATER RETURN
————	DIRECTION OF FLOW

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-EXIST. CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02

DRAWING NUMBER B-4130-02-04

PLATE 4

SCALE: AS NOTED

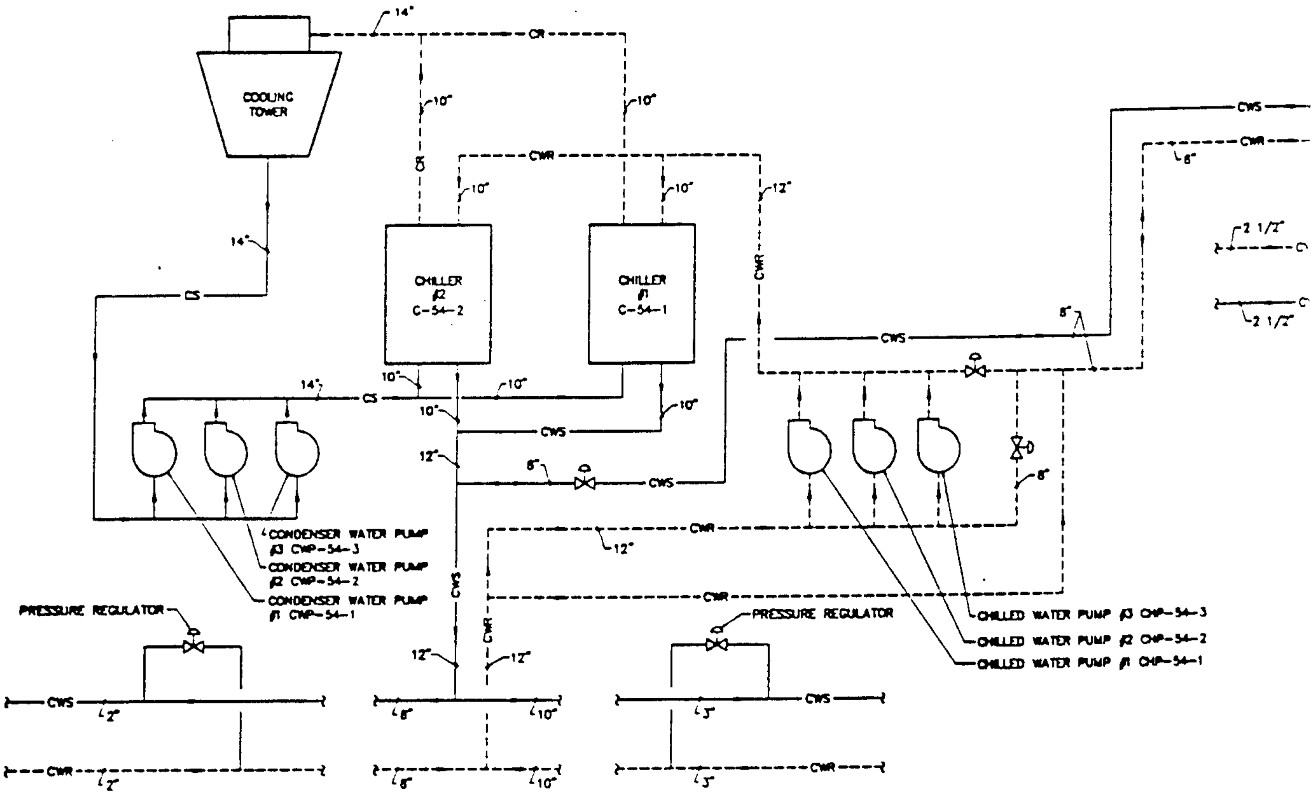
DATE .

SHEET M-4

3

D

C



B

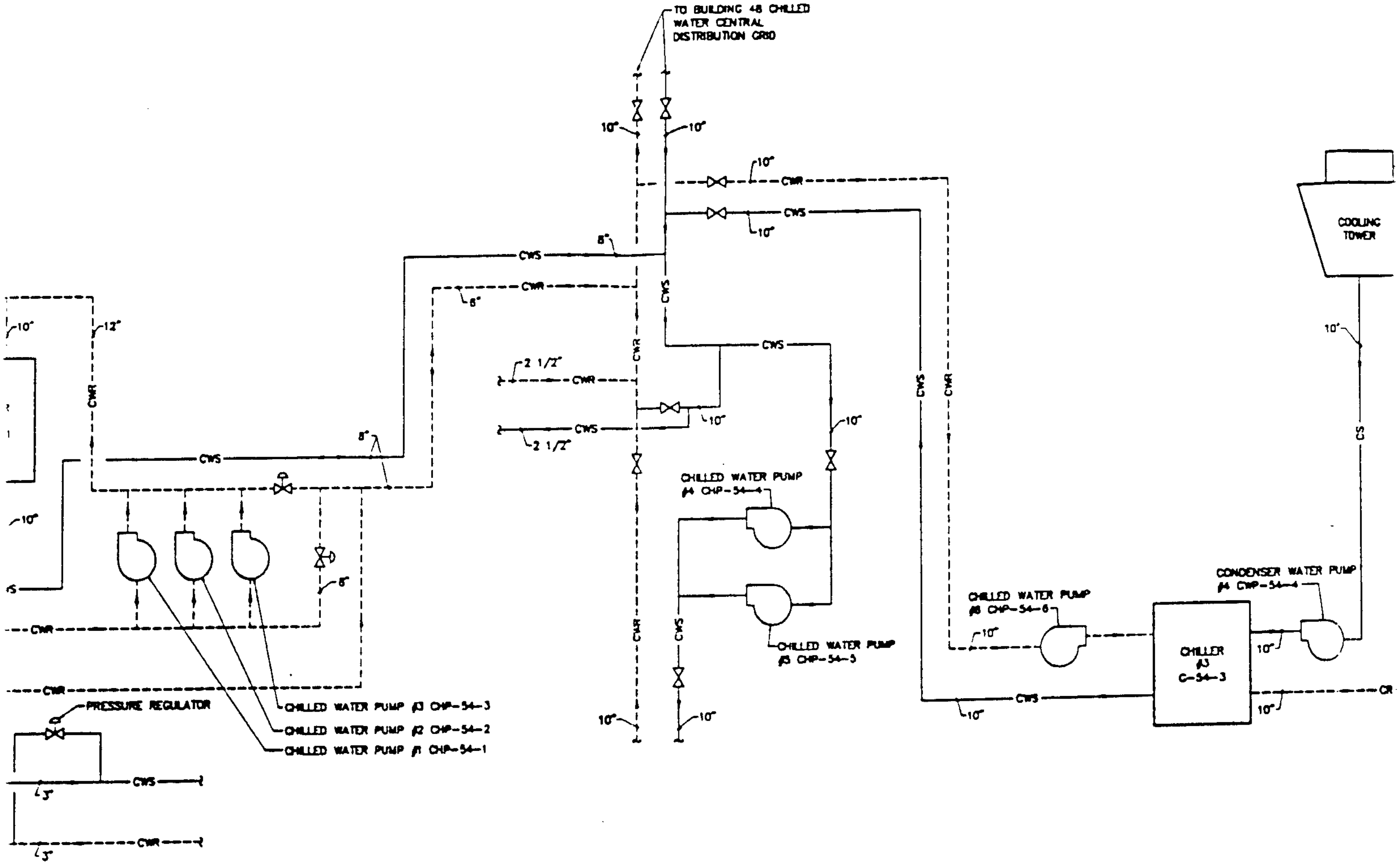
ORIGINAL BUILDING #54

SCHEMATIC – FLOW

SCALE: NONE

A

①

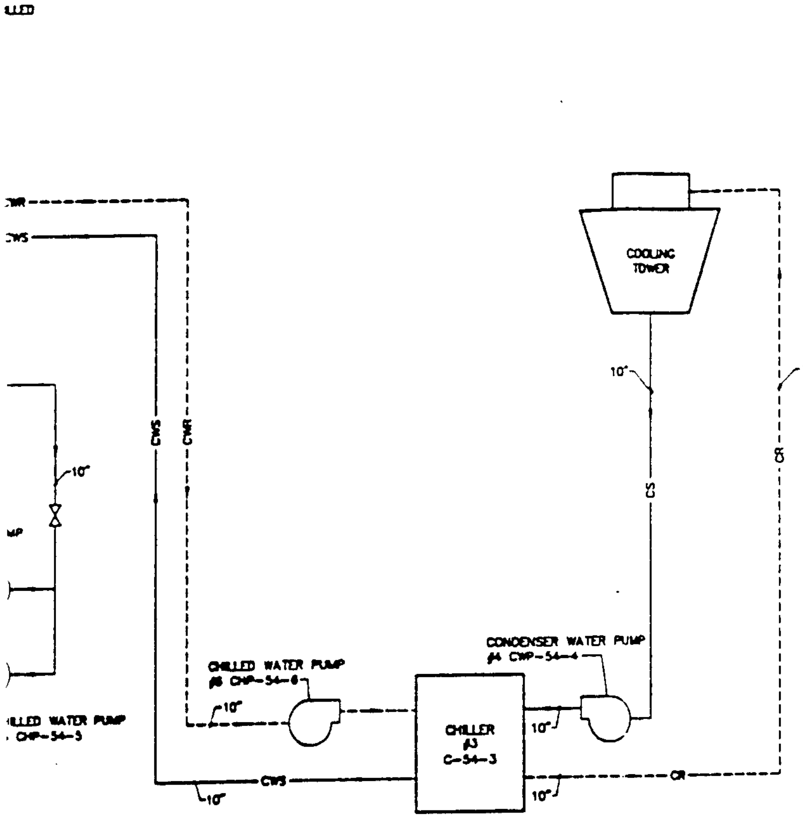


BUILDING #54 ADDITION

SCHEMATIC – FLOW DIAGRAM

SCALE: NONE

2



BUILDING #54 ADDITION

LEGEND

—— CWS —— CHILLED WATER SUPPLY
- - - - CWR - - - - CHILLED WATER RETURN
—— CS —— CONDENSER WATER SUPPLY
- - - - CR - - - - CONDENSER WATER RETURN
———— DIRECTION OF FLOW

GENERAL NOTES:

A. VALVING AND ASSOCIATED CONTROL APPURTENAUCES HAVE BEEN OMITED FROM DRAWING TO CLEARLY IDENTIFY IN SCHMATIC FORMAT THE SYSTEM FLOW AND THE AREAS IN WHICH THEY SERVE.

B. ANCILLARY EQUIPMENT NOT DIRECTLY RELATED TO THE PROCESS HAVE ALSO BEEN OMITED FROM THE DRAWINGS.

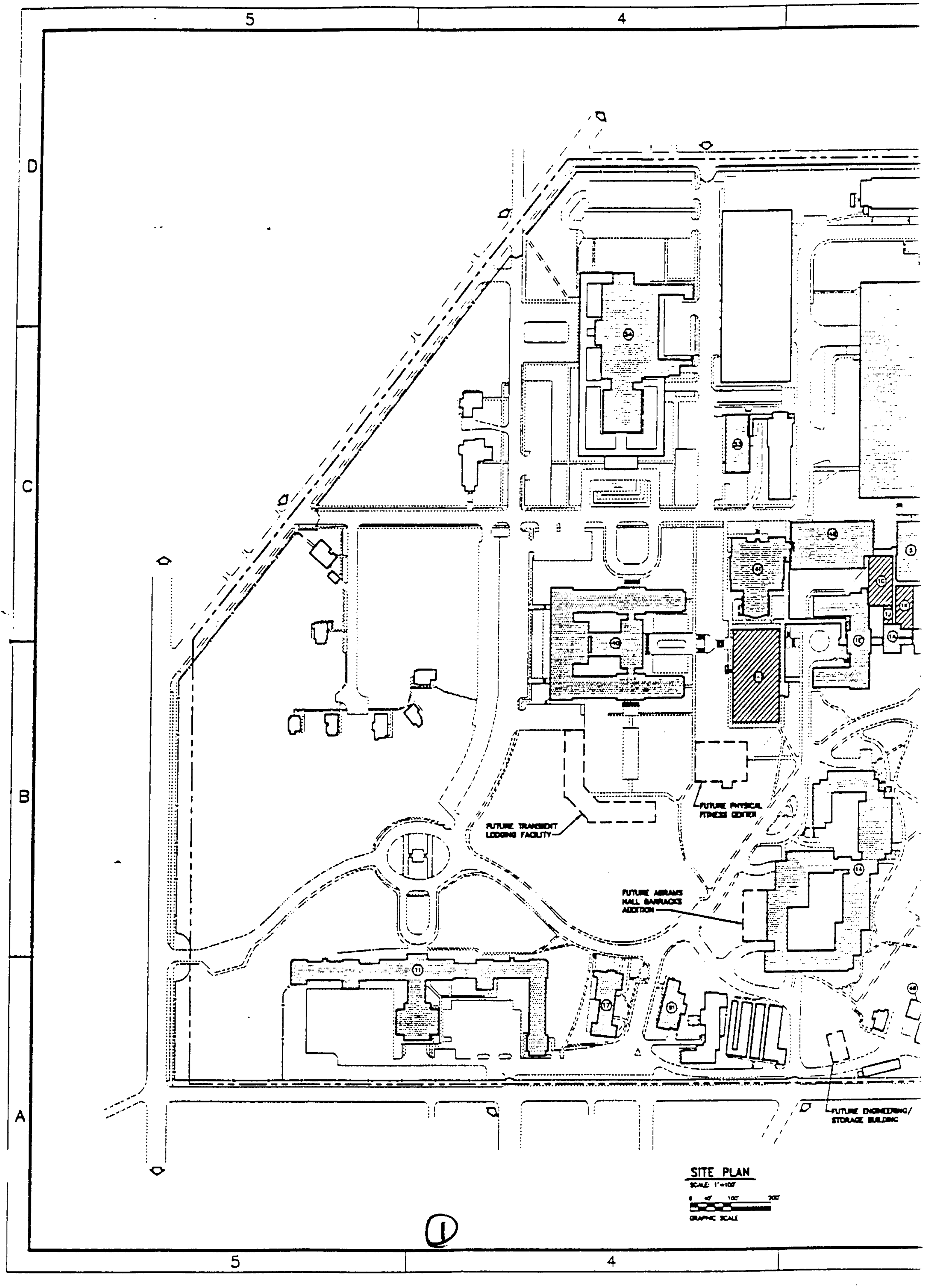
REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.
CHILLED WATER STUDY
EEAP PROGRAM
CONTRACT NO. DACA01-94-D-0037
MECHANICAL ROOM BLDG #54-CHILLED WATER SCHEMATIC-EXIST. CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02
DRAWING NUMBER B-4130-02-06
PLATE 6
SCALE: AS NOTED
DATE
SHEET M-6

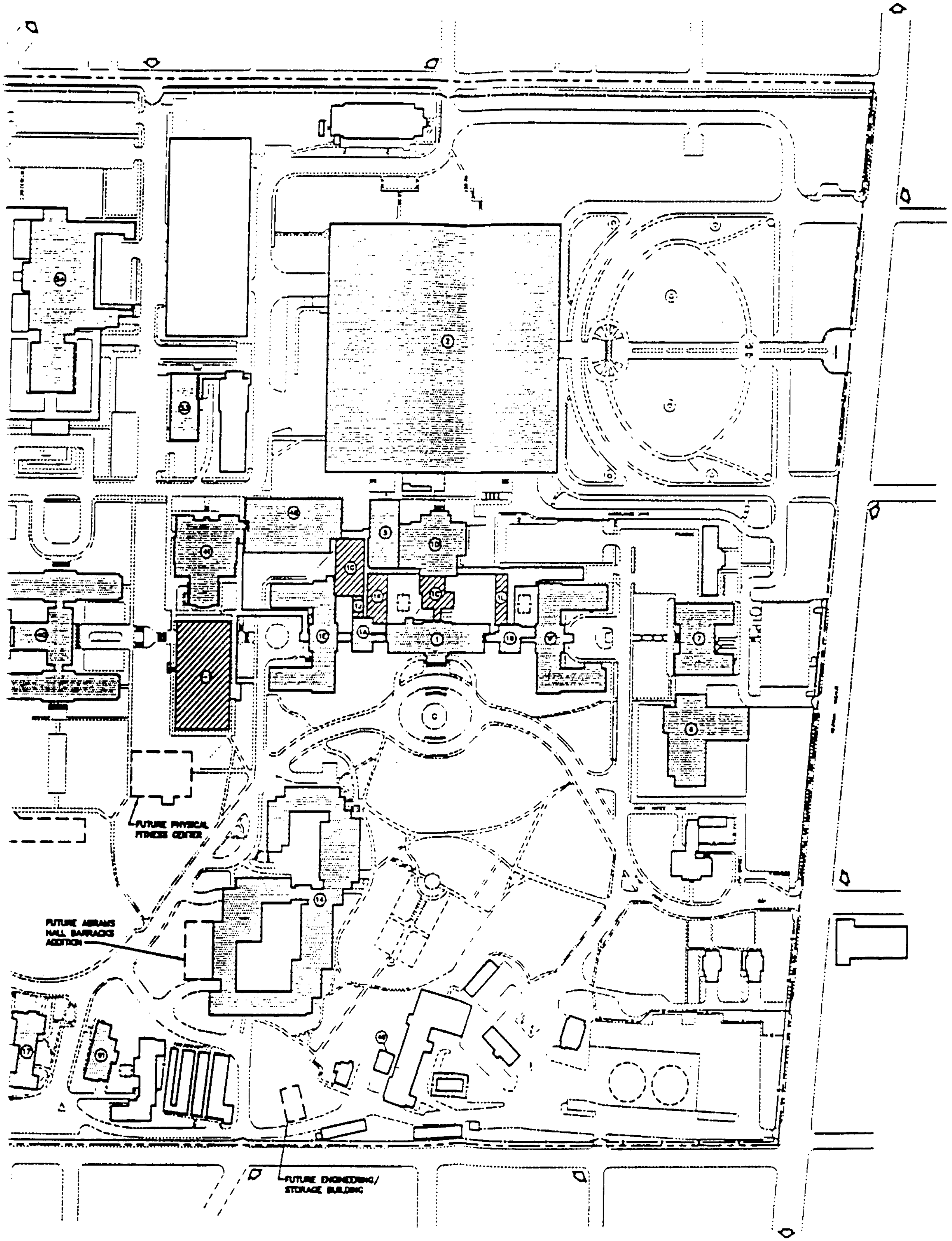
③



SITE PLAN

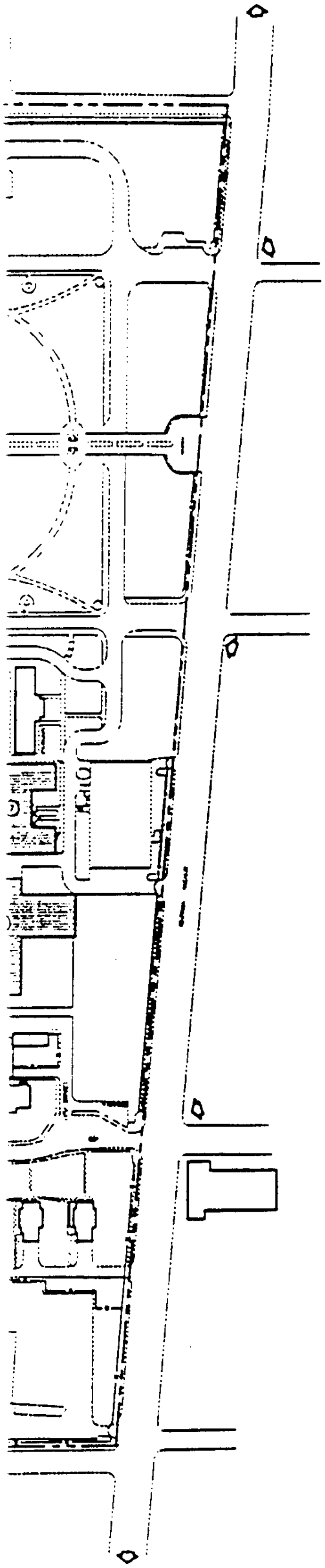
SCALE: 1"=100'

①



SITE PLAN
SCALE: 1"=100'
0 40' 100' 200'
GRAPHIC SCALE

②



BLDG. LEGEND

☐	EXISTING BUILDING OR STRUCTURE
ⓘ	EXISTING BUILDING ADDRESSED, TO REMAIN
▨	EXISTING BUILDING ADDRESSED, SLATED FOR DEMOLITION
⬚	FUTURE BUILDING ADDRESSED

BLDG/FAC NO.	FACILITY NAME
1	WALTER REED GENERAL HOSPITAL
1A	A WING
1B	A WING
1C	F WING
1D	D WING
1E	E WING
1F	C WING
1G	E WING
1J	E WING
1K	E WING
1L	F WING
2	HEATON PAVILION
1-2	AOP
3	MAGNETIC RESONANCE IMAGING
6	BRAC CLINIC
7	OUTPATIENT CLINIC
11	DELANO HALL
14	ABRAMS HALL
16	ENGINEERING/ STORAGE HOUSE
17	GUEST HOUSE
40	WRAIR
41	RECREATION CENTER
48	AIR CONDITIONING PLANT
49	CHILLED WATER PLANT
53	AFIP
54	AFIP
91	DENTAC
	BARRACKS ADDITION BLDG 14
	TRANSIENT LODGING FACILITY
	PHYSICAL FITNESS CENTER

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

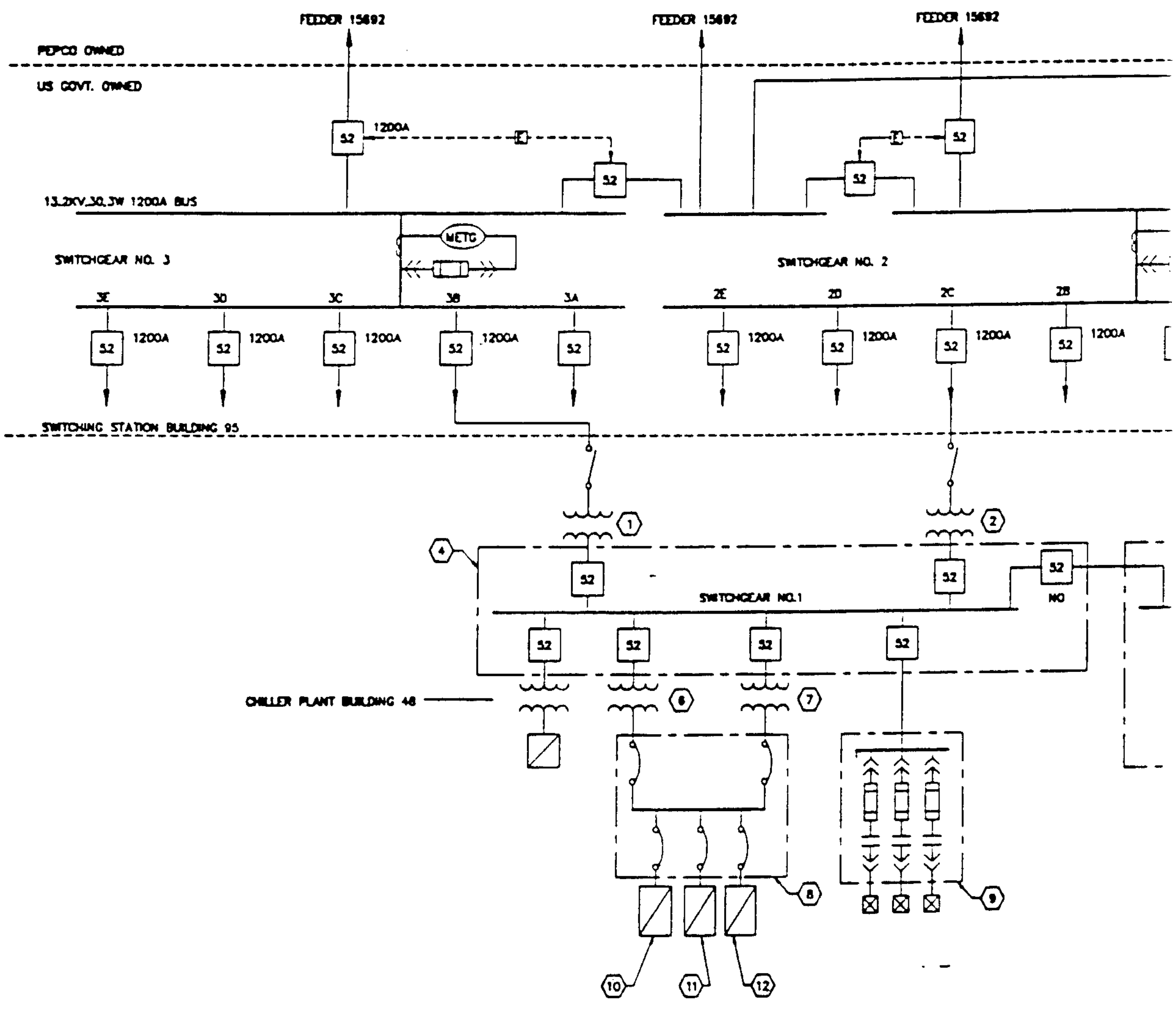
ELECTRICAL SITE PLAN – EXISTING & FUTURE CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02

DRAWING NUMBER	PLATE
B-4130-02-07	7

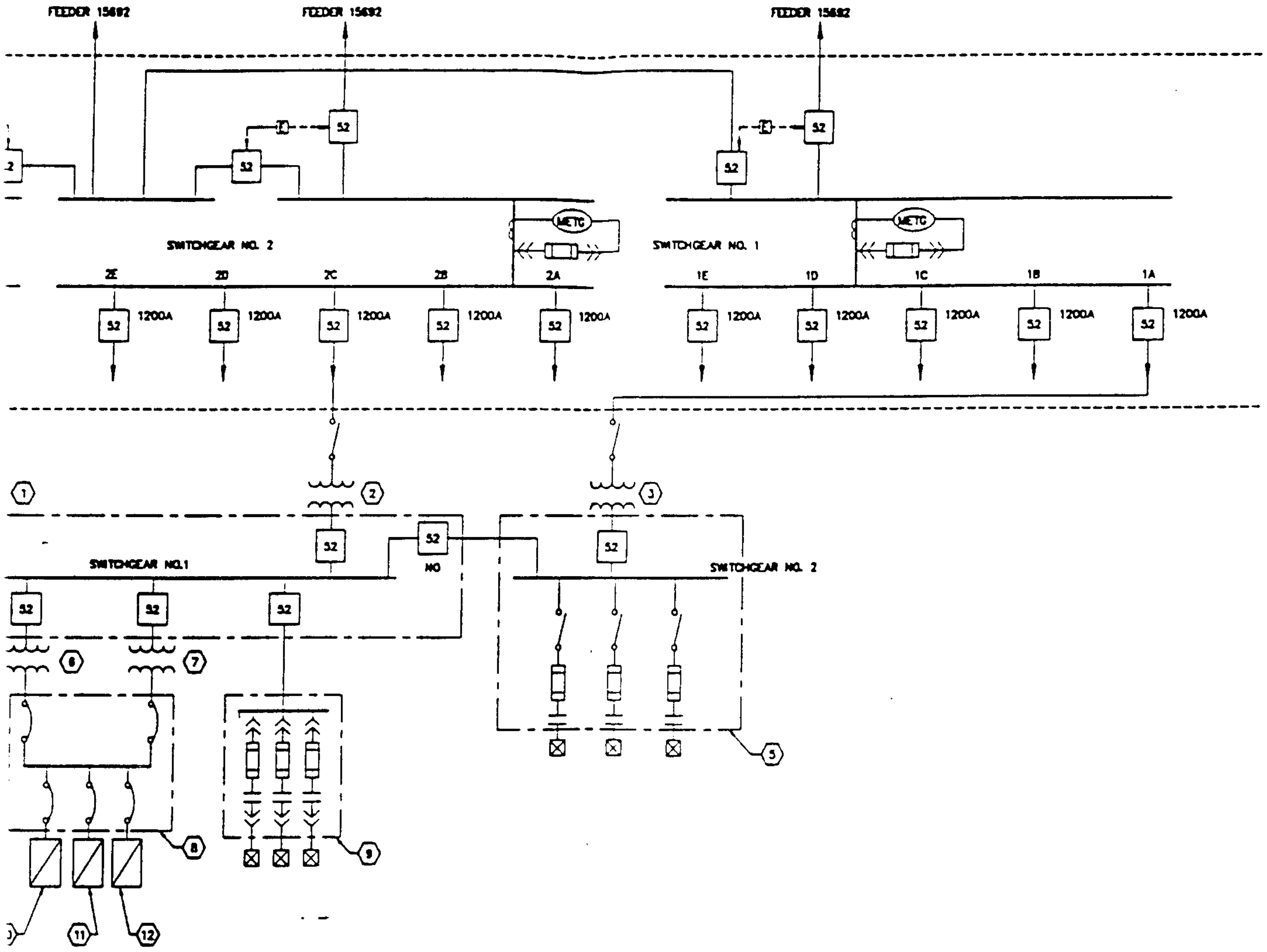
SCALE AS NOTED
DATE
SHEET E-1

3



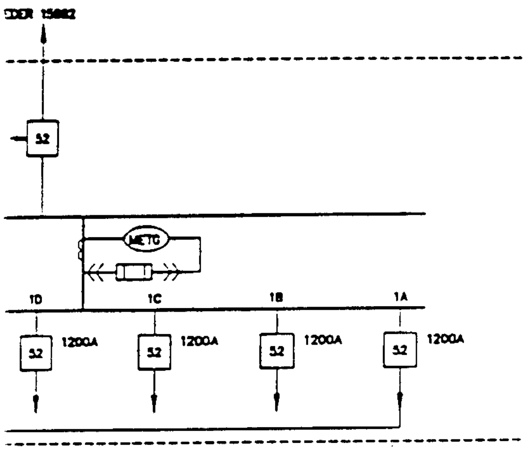
ELECTRICAL ELEMENTARY DIAGRAM

SCALE: NONE



ELECTRICAL ELEMENTARY DIAGRAM
SCALE: NONE

②



NO. 2

KEYED DRAWING NOTES:

- ① TRANSFORMER NO. 1 13.8KV – 4160V
- ② TRANSFORMER NO. 2 13.8KV – 4160V
- ③ TRANSFORMER NO. 3 13.8KV – 4160V
- ④ 5KV SWITCHGEAR
- ⑤ 5KV SWITCHGEAR/ STARTERS
- ⑥ TRANSFORMER NO. 4 4160V – 480V
- ⑦ TRANSFORMER NO. 5 4160V – 480V
- ⑧ 480V SWITCHGEAR
- ⑨ 5KV SWITCHGEAR/ STARTERS
- ⑩ 480V MCC-1
- ⑪ 480V MCC-2
- ⑫ 480V MCC-3

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.
CHILLED WATER STUDY
EEAP PROGRAM
CONTRACT NO. DACA01-94-D-0037
ELECTRICAL DIAGRAM-INCOMMING ELECTRIC SERVICE-BLDG. #48 & #95-EXIST. CONDITIONS

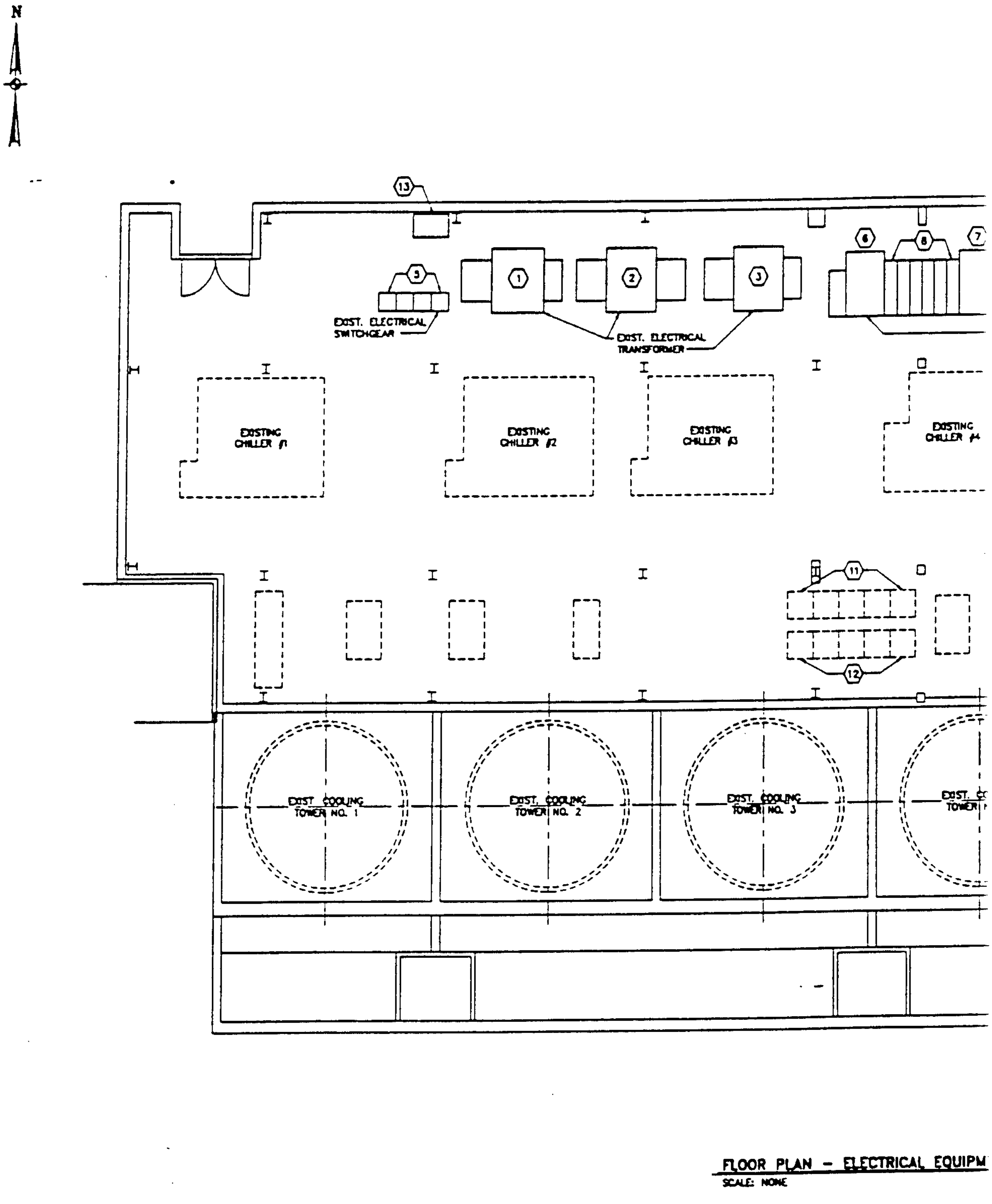
ENTECH Engineering Inc., Reading, PA. Job #4130.02

DRAWING NUMBER B-4130-02-08

PLATE 8

SCALE: AS NOTED | DATE | SHEET E-2

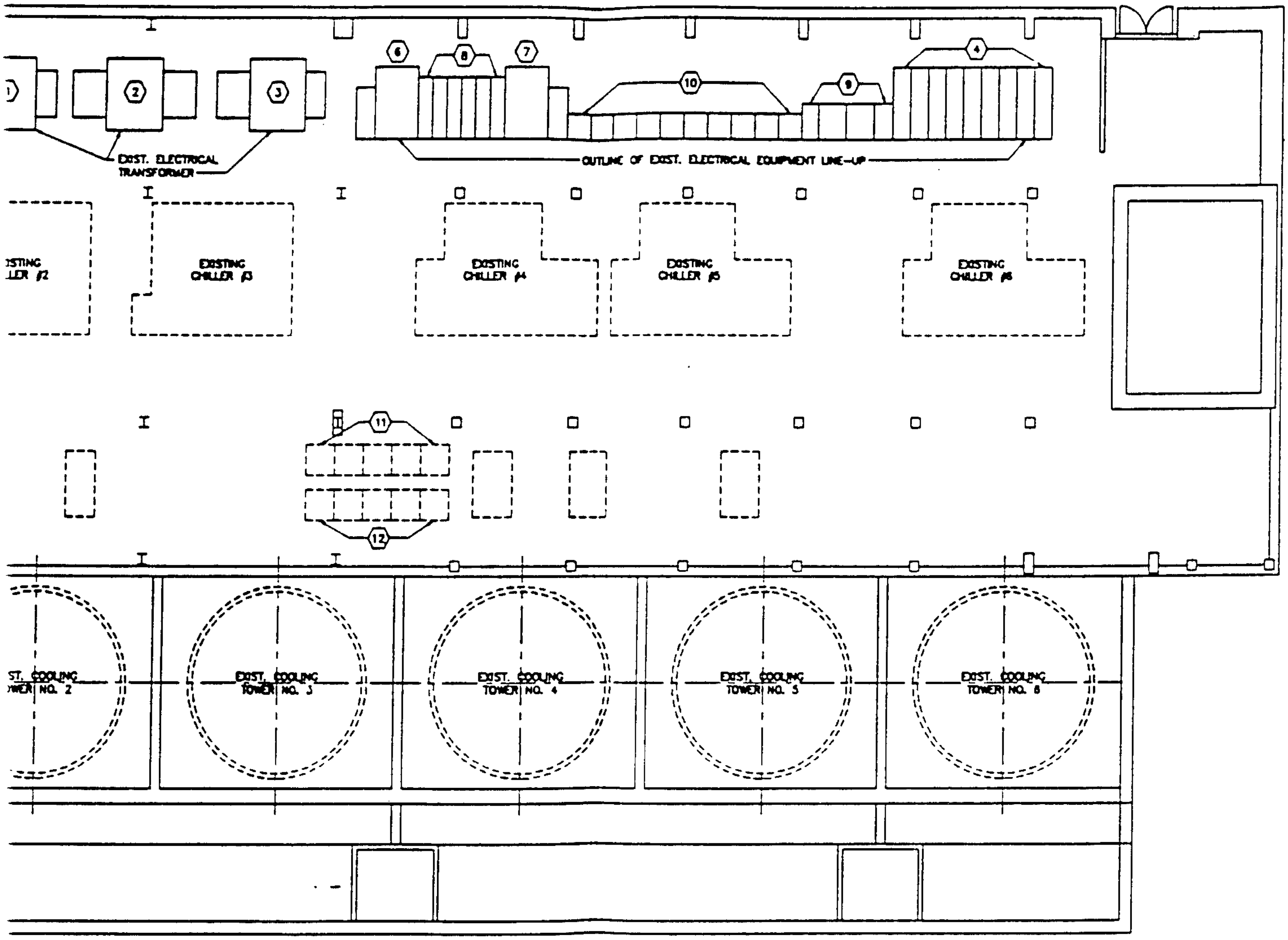
3



FLOOR PLAN – ELECTRICAL EQUIPM

SCALE: NONE

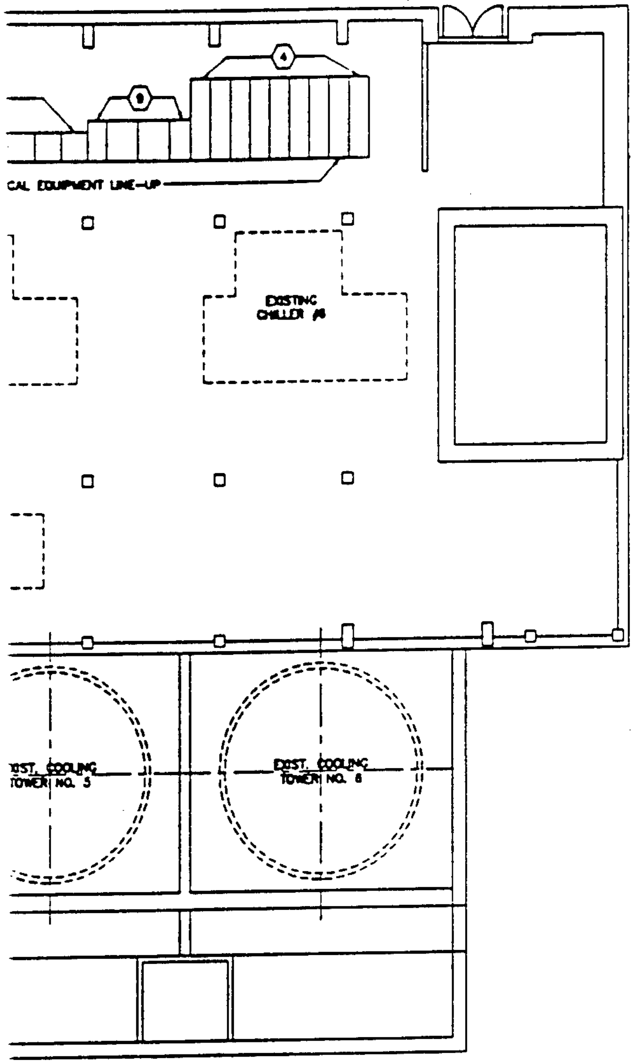
D



FLOOR PLAN – ELECTRICAL EQUIPMENT

SCALE: NONE

②



KEYED DRAWING NOTES:

1. TRANSFORMER NO. 1
13.8KV - 4160V
2. TRANSFORMER NO. 2
13.8KV - 4160V
3. TRANSFORMER NO. 3
13.8KV - 4160V
4. 5KV SWITCHGEAR
5. 5KV SWITCHGEAR/
STARTERS
6. TRANSFORMER NO. 4
4160V - 480V
7. TRANSFORMER NO. 5
4160V - 480V
8. 480V SWITCHGEAR
9. 5KV SWITCHGEAR/
STARTERS
10. 480V MCC-1
11. 480V MCC-2
12. 480V MCC-3
13. RESISTOR BANK

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.
CHILLED WATER STUDY
EEAP PROGRAM
CONTRACT NO. DACA01-94-D-0037
ELECTRICAL FLOOR PLAN-CHILLER BUILDING
#48-EQUIPMENT LAYOUT-EXIST. CONDITIONS

ENTECH Engineering Inc., Reading, PA. Job #4130.02
DRAWING NUMBER B-4130-02-09
PLATE 9
SCALE: AS NOTED
DATE .
SHEET E-3

3

4.0 BILLING HISTORY

4.1 General

The energy analysis for this report is based upon data during the twelve-month period from October 1993 through September 1994. The total energy cost for WRAMC during that period was approximately $8,900,000 and is distributed as follows:

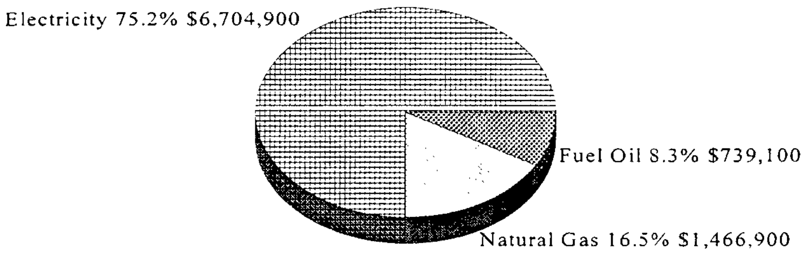
Table 4.1.1
Energy Cost Distribution

Electricity	$6,704,900
Natural Gas	$1,466,900
Fuel Oil	$739,100
Total	**$8,910,900**
Use	**$8,900,000**

The annual energy cost distribution is graphically shown below in Figure 4.1.2.

Walter Reed Army Medical Center

Energy Cost Distribution, Figure 4.1.2



4.2 Electricity

Potomac Electric Power Company (PEPCO) provides power to WRAMC under the GT-3A rate (General Service, Time Metered). This rate is available to customers taking service at voltages between 4.16 kV and 33 kV. Tables 4.2.1 and 4.2.2, on the following two pages, display the electric billing history for WRAMC during the past two years. Table 4.2.1 displays the electric bills for Building 54 and Table 4.2.2 displays the electric bills for the remainder of the Center.

4.2.1 Incremental Cost

Entech Engineering developed a Lotus spreadsheet computer program to determine the incremental cost for electricity. Using actual billing data, usage and demand are input into the program, and the bill is calculated. The computer calculation should match the utility's bill. The Center electric bill will be used for this calculation.

To calculate the incremental cost for billing demand, the electric bill is re-calculated using one less kW of demand. The cost difference between the actual bill and the bill calculated with one less kW is considered to be the incremental cost for demand ($/kW).

The same procedure is performed for usage (kWh). The bill is calculated using one less kWh, with the difference in the two costs being the incremental usage cost ($/kWh). For this facility, the incremental costs for electricity are as follows:

WALTER REED ARMY MEDICAL CENTER
ELECTRIC BILLING HISTORY
OCTOBER 1992–SEPTEMBER 1994
PEPCO RATE – GT 3A
ACCOUNT #0251124012
SERVICE #1 – BUILDING 54
TABLE 4.2.1

OCTOBER 1993–SEPTEMBER 1994

Month	# of Days	Max. Demand	On–Peak Demand	Off–Peak kWh	Interm kWh	On–Peak kWh	Total kWh	Cost $	$/kWh	Energy mmBtu	kWh Per Day
October	31	2,655	2,622	578,850	306,030	327,120	1,212,000	$62,698	$0.052	4,137	39,097
November	29	2,102	2,186	538,700	251,240	260,310	1,050,250	$48,970	$0.047	3,585	36,216
December	35	170	167	490,600	241,700	248,700	981,000	$499	$0.001	3,348	28,029
January	30	1,730	1,712	398,300	208,500	219,100	825,900	$42,902	$0.052	2,819	27,530
Feburary	29	1,752	1,722	408,000	212,400	223,100	843,500	$43,098	$0.051	2,879	29,086
March	31	1,728	1,728	441,400	225,600	232,700	899,700	$45,299	$0.050	3,071	29,023
April	29	2,129	2,129	392,000	225,200	233,700	850,900	$48,664	$0.057	2,904	29,341
May	29	2,186	2,186	455,100	249,700	263,900	968,700	$78,170	$0.081	3,306	33,403
June	33	3,303	3,303	836,800	383,900	405,700	1,626,400	$124,163	$0.076	5,551	49,285
July	31	3,128	3,128	878,600	442,200	460,900	1,781,700	$128,841	$0.072	6,081	57,474
August	31	2,974	2,974	758,100	368,700	388,800	1,515,600	$118,370	$0.078	5,173	48,890
September	33	2,844	2,844	839,900	391,800	401,200	1,632,900	$117,927	$0.072	5,573	49,482
TOTALS	371	26,701	26,701	7,016,350	3,506,970	3,665,230	14,188,550	$859,601	$0.061	48,426	38,244

OCTOBER 1992–SEPTEMBER 1993

Month	# of Days	Max. Demand	On–Peak Demand	Off–Peak kWh	Interm kWh	On–Peak kWh	Total kWh	Cost $	$/kWh	Energy mmBtu	kWh Per Day
October	29	2,306	2,306	398,324	210,512	225,119	833,955	$67,831	$0.081	2,846	28,757
November	29	1,685	1,674	399,981	212,016	223,632	835,629	$38,496	$0.046	2,852	28,815
December	33	1,712	1,712	459,534	231,905	239,903	931,342	$40,034	$0.043	3,179	28,222
January	34	1,746	1,746	507,884	218,510	226,248	952,642	$42,017	$0.044	3,251	28,019
Feburary	29	1,771	1,771	401,289	198,870	210,207	810,366	$38,246	$0.047	2,766	27,944
March	30	1,771	1,771	393,564	225,604	237,855	857,023	$40,249	$0.047	2,925	28,567
April	30	1,540	1,540	379,069	184,679	192,444	756,192	$35,506	$0.047	2,581	25,206
May *	0	0	0	0	0	0	0	$0	$0.000	0	0
June	54	5,471	5,471	1,230,027	679,551	718,459	2,628,037	$191,194	$0.073	8,969	48,667
July	32	3,075	3,075	939,390	405,040	424,960	1,769,390	$118,710	$0.067	6,039	55,293
August	29	2,946	2,936	774,290	418,250	435,710	1,628,250	$112,835	$0.069	5,557	56,147
September	31	2,997	2,997	798,350	385,560	397,750	1,581,660	$144,236	$0.091	5,398	51,021
TOTALS	360	27,020	26,999	6,681,702	3,370,497	3,532,287	13,584,486	$869,354	$0.064	46,364	37,735

* May's bill is included in June's bill.

what caused this

WALTER REED ARMY MEDICAL CENTER
ELECTRIC BILLING HISTORY
JANUARY 1992–DECEMBER 1993
PEPCO RATE – GT 3A
ACCOUNT #0251116018
SERVICE #2 – WRAMC
TABLE 4.2.2

OCTOBER 1993–SEPTEMBER 1994

Month	# of Days	Max. Demand	On–Peak Demand	Off–Peak kWh	Interm kWh	On–Peak kWh	Total kWh	Cost $	$/kWh	Energy mmBtu	kWh Per Day
October	29	12,261	12,236	3,638,782	1,682,325	1,647,867	6,968,974	$484,285	$0.069	23,785	240,309
November	38	257	257	4,807,000	1,994,000	2,100,000	8,901,000	$461,937	$0.052	30,379	234,237
December	30	11,940	11,930	3,432,000	1,716,000	1,767,000	6,915,000	$312,546	$0.045	23,601	230,500
January	29	12,690	12,690	3,495,000	1,538,000	1,621,000	6,654,000	$333,964	$0.050	22,710	229,448
Feburary	29	12,020	12,070	3,468,000	1,642,000	1,716,000	6,826,000	$335,241	$0.049	23,297	235,379
March	31	12,990	12,990	3,726,000	1,764,000	1,847,000	7,337,000	$360,659	$0.049	25,041	236,677
April	29	13,380	13,380	3,430,000	1,841,000	1,925,000	7,196,000	$379,777	$0.053	24,560	248,138
May	29	14,050	14,050	3,447,000	1,819,000	1,924,000	7,190,000	$547,850	$0.076	24,539	247,931
June	33	16,270	16,270	4,912,000	2,275,000	2,375,000	9,562,000	$656,577	$0.069	32,635	289,758
July	31	15,310	16,360	4,875,000	2,446,000	2,561,000	9,882,000	$690,727	$0.070	33,727	318,774
August	31	15,980	15,980	4,024,000	1,979,000	2,093,000	8,096,000	$634,384	$0.078	27,632	261,161
September	33	15,270	15,220	4,694,000	2,160,000	2,257,000	9,111,000	$647,330	$0.071	31,096	276,091
TOTALS	372	152,418	153,433	47,948,782	22,856,325	23,833,867	94,638,974	$5,845,277	$0.062	323,003	254,406

OCTOBER 1992–SEPTEMBER 1993

Month	# of Days	Max. Demand	On–Peak Demand	Off–Peak kWh	Interm kWh	On–Peak kWh	Total kWh	Cost $	$/kWh	Energy mmBtu	kWh Per Day
October	29	13,271	13,271	3,524,776	1,695,924	1,785,615	7,006,315	$464,703	$0.066	23,913	241,597
November	29	12,572	12,572	3,441,647	1,700,626	1,780,311	6,922,584	$308,268	$0.045	23,627	238,710
December	33	13,157	12,506	3,945,481	1,804,593	1,873,365	7,623,439	$319,815	$0.042	26,019	231,013
January	34	12,285	12,085	4,222,323	1,719,012	1,790,626	7,731,961	$327,602	$0.042	26,389	227,411
Feburary	29	12,158	12,158	3,318,478	1,633,620	1,709,046	6,661,144	$298,646	$0.045	22,734	229,695
March	30	12,158	12,158	3,337,204	1,819,938	1,854,464	7,011,606	$312,630	$0.045	23,931	233,720
April	30	12,989	12,989	3,777,345	1,795,853	1,889,171	7,462,369	$335,699	$0.045	25,469	248,746
May	30	14,576	14,576	3,558,914	1,899,539	2,003,588	7,462,041	$354,248	$0.047	25,468	248,735
June	30	16,139	16,139	4,211,725	2,121,670	2,231,843	8,565,238	$570,178	$0.067	29,233	285,508
July	32	17,109	17,109	5,464,387	2,375,138	2,465,009	10,304,534	$640,314	$0.062	35,169	322,017
August	29	16,290	16,290	4,341,565	2,313,370	2,407,001	9,061,936	$606,413	$0.067	30,928	312,481
September	30	16,360	16,327	4,608,000	2,206,027	2,251,999	9,066,026	$627,670	$0.069	30,942	302,201
TOTALS	365	169,064	168,180	47,751,845	23,085,310	24,042,038	94,879,193	$5,166,186	$0.054	323,823	259,943

Table 4.2.1.1
Incremental Costs

Incremental	Winter (Nov-May)	Summer (Jun-Oct)
Demand, $/kW	6.60	17.09
Off-Peak, $/kWh	0.035	0.033
Interm., $/kWh	0.044	0.045
On-Peak, $/kWh	0.051	0.060

The incremental costs will be used in calculations of the electric models as described in Section 2.0.

The use of incremental rates is reasonably accurate for calculating cost savings due to small changes in demand and usage (±25%) from existing levels. The use of incremental rates is less accurate in calculating cost savings with larger changes in demand and usage (>25%) and tends to underestimate savings slightly (usually < 2%). However, for the convenience of calculating the feasibility of various options, the use of incremental rates for demand and usage is either accurate or slightly conservative (savings not overestimated) and is therefore prudent.

Copies of the calculations of the incremental cost and monthly electric bills are included in the Section 11, Attachment D.

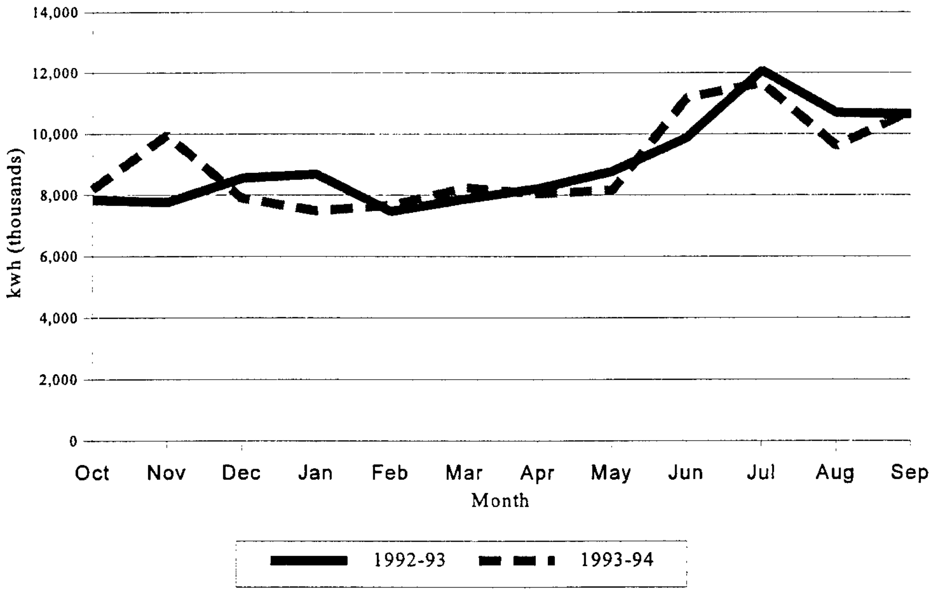
4.2.2 Electric Usage

Electric usage is measured in kilowatt hours (kWh). One kWh is equivalent to the usage of 1,000 watts of electricity for one hour. Figure 4.2.2.1 graphically shows electrical usage profile of WRAMC for the period of October 1992 through September 1994. The profile reflects both electric services (Building 54, remaining campus) added together.

The graph indicates that electric usage follows a cooling curve. This is evident from the increases seen during the summer.

Walter Reed Army Medical Center

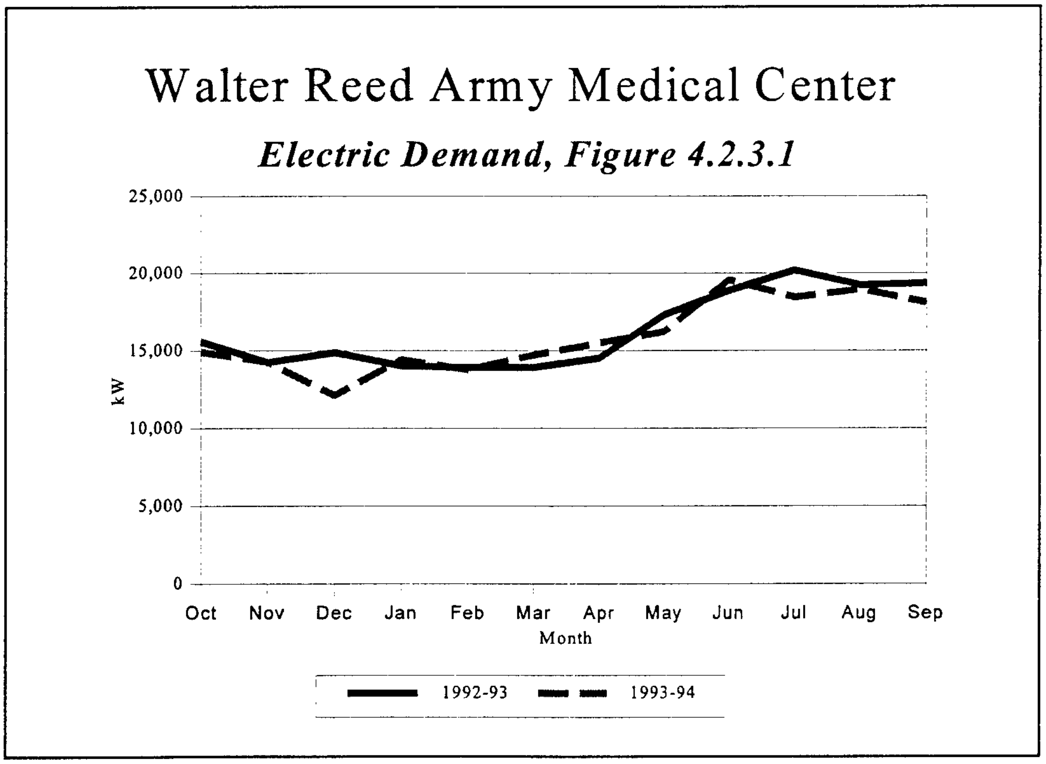
Electric Usage, Figure 4.2.2.1



4.2.3 Monthly Demand

Electrical demand is the highest rate of electrical energy used during a specified time interval (normally thirty minutes). The measurement of electric demand is expressed as kilowatts (1,000 watts). Electrical demand is not necessarily related to the amount of time the electrical components are in operation. The monthly billing demand profile for WRAMC during the past year is graphically shown in Figure 4.2.3.1. The profile reflects both electric services added together.

From Figure 4.2.3.1 it can be seen that the billed demand is fairly consistent during the winter months and increases as the warmer months are encountered.



Walter Reed Army Medical Center

Electric Demand, Figure 4.2.3.1

4.3 Natural Gas

WRAMC uses natural gas to produce steam at Building 15 Steam Boiler Plant for space heating, domestic hot water heating, and sterilizers during the course of a year. Natural gas is provided by Washington Gas Light Company under Rate Schedule #3 (Interruptible Gas Service). Table 4.3.2, on the following page, displays the gas billing history for the Medical Center from October 1992 to September 1994. Table 4.3.1, summarizes the gas consumption for the past two years.

Table 4.3.1
WRAMC Gas Usage Summary

Month	Usage (mcf)	Cost ($)	$ per mcf	mmBtu
Oct. 93-Sept. 94	387,400	$1,466,916	$3.79	399,022
Oct. 92-Sept. 93	490,800	$1,758,033	$3.58	505,524

Natural gas bills are included in Section 11, Attachment C. Figure 4.3.1, on page 4-10, graphically displays gas consumption for the past two years. The low gas usage in January and February of 1994 is the result of interruptions do to the severe weather.

WALTER REED ARMY MEDICAL CENTER
GAS BILLING HISTORY
OCTOBER 1992 – SEPTEMBER 1994
WASHINGTON GAS
TABLE 4.3.2

OCTOBER 1993 – SEPTEMBER 1994

Month	# of Days	Usage mcf	Cost $	$/mcf	Energy mcf x 1.03	mcf Per Day
October	29	29,400	$109,671	3.73	30,282	1,014
November	32	53,700	$200,121	3.73	55,311	1,678
December	30	42,200	$157,419	3.73	43,466	1,407
January	33	15,600	$57,041	3.66	16,068	473
February	30	23,300	$87,309	3.75	23,999	777
March	29	56,400	$216,153	3.83	58,092	1,945
April	31	41,300	$158,437	3.84	42,539	1,332
May	30	32,700	$122,746	3.75	33,681	1,090
June	29	21,000	$78,674	3.75	21,630	724
July	30	1,800	$6,724	3.74	1,854	60
August	30	43,800	$170,566	3.89	45,114	1,460
September	29	26,200	$102,055	3.90	26,986	903
TOTALS	362	387,400	$1,466,916	3.79	399,022	1,070

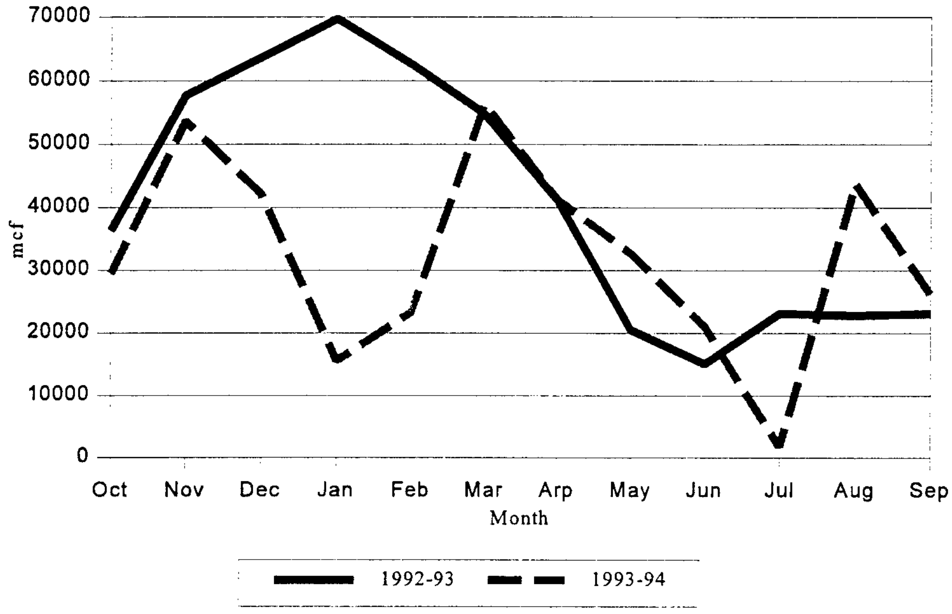
OCTOBER 1992 – SEPTEMBER 1993

Month	# of Days	Usage mcf	Cost $	$/mcf	Energy mcf x 1.03	mcf Per Day
October	29	36,300	$125,871	3.47	37,389	1,252
November	34	57,700	$199,488	3.46	59,431	1,697
December	30	63,700	$219,583	3.45	65,611	2,123
January	33	69,800	$254,561	3.65	71,894	2,115
February	30	62,600	$228,528	3.65	64,478	2,087
March	29	54,800	$200,841	3.66	56,444	1,890
April	28	41,300	$142,507	3.45	42,539	1,475
May	32	20,500	$74,381	3.63	21,115	641
June	29	15,100	$57,012	3.78	15,553	521
July	30	23,100	$86,094	3.73	23,793	770
August	31	22,800	$83,072	3.64	23,484	735
September	30	23,100	$86,095	3.73	23,793	770
TOTALS	365	490,800	$1,758,033	3.58	505,524	1,345

Fuel Oil < how was heating done w/o gas?

Walter Reed Army Medical Center

Natural Gas Usage, Figure 4.3.1



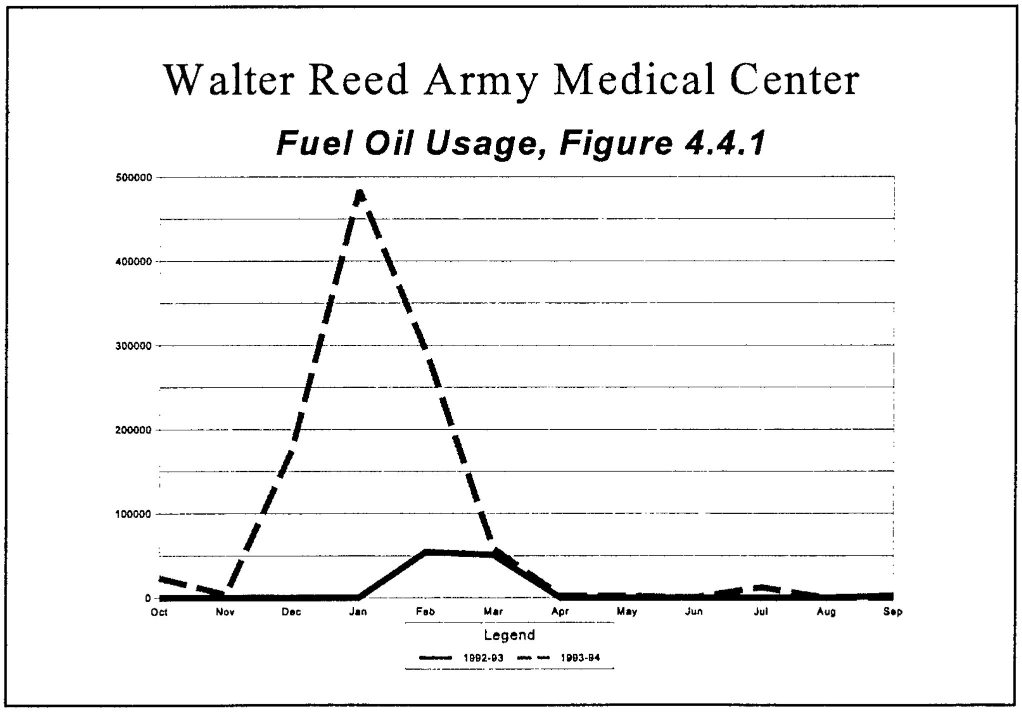
4.4 Fuel Oil

WRAMC uses No. 2 fuel oil as backup to natural gas to produce steam. The gas service is an interruptible service and fuel oil is used when gas is interrupted. Fuel oil was used extensively from January 1994 to February 1994 due to gas interruptions. Table 4.4.1 summarizes fuel oil use for the past two years. Table 4.4.2, on the following page, displays the fuel oil billing history from October 1992 to September 1994.

Table 4.4.1
WRAMC Fuel Oil Usage Summary

Month	Usage (gal)	Cost ($)	$ per gal	mmBtu
Oct. 93-Sept. 94	1,055,866	$739,106	$0.70	1,087,542
Oct. 92-Sept. 93	107,590	$75,313	$0.70	110,818

Fuel oil bills are included in Section 10, Attachment B. Figure 4.4.1 graphically displays fuel oil usage for the past two years.



WALTER REED ARMY MEDICAL CENTER
OIL BILLING HISTORY
OCTOBER 1992 – SEPTEMBER 1994

TABLE 4.4.2

OCTOBER 1993 – SEPTEMBER 1994

Month	# of Days	Usage gals	Cost $	$/gal	Energy mmBtu	gals Per Day
October	31	23,456	$16,419	0.70	3,253	757
November	30	3,285	$2,300	0.70	456	110
December	31	176,275	$123,392	0.70	24,448	5,686
January	31	484,065	$338,846	0.70	67,135	15,615
February	28	293,066	$205,146	0.70	40,645	10,467
March	31	58,605	$41,024	0.70	8,128	1,890
April	30	2,290	$1,603	0.70	318	76
May	31	2,213	$1,549	0.70	307	71
June	30	245	$172	0.70	34	8
July	31	12,366	$8,656	0.70	1,715	399
August	31	0	$0	0.00	0	0
September	30	0	$0	0.00	0	0
TOTALS	365	1,055,866	$739,106	0.70	1,087,542	2,893

OCTOBER 1992 – SEPTEMBER 1993

Month	# of Days	Usage gals	Cost $	$/gal	Energy mmBtu	gals Per Day
October	31	0	$0	0.00	0	0
November	30	0	$0	0.00	0	0
December	31	0	$0	0.00	0	0
January	31	0	$0	0.00	0	0
February	28	54,227	$37,959	0.70	7,521	1,937
March	31	50,914	$35,640	0.70	7,061	1,642
April	30	0	$0	0.00	0	0
May	31	0	$0	0.00	0	0
June	30	0	$0	0.00	0	0
July	31	0	$0	0.00	0	0
August	31	0	$0	0.00	0	0
September	30	2,449	$1,714	0.70	340	82
TOTALS	365	107,590	$75,313	0.70	110,818	295

Why are these different

5.0 ENERGY CALCULATIONS

5.1 General

In order to model the chilled water systems at WRAMC, Entech analyzed current operations using three (3) different methods. Chiller operation logs for Building 48, billing history for Building 54, and EZDOE HVAC simulation program for all buildings supplied with chilled water. Each of these methods will be detailed in the following subsections, culminating in the electric model which simulates the electric usage of the chilled water systems during an entire year at WRAMC. This information will be used as a basis for comparison in the chiller plant alternatives of Sections 6.0, 7.0, and 8.0.

5.2 Building 48 Estimated Cooling Usage

WRAMC maintains an hourly log of the operation of each of the six (6) chillers in Building 48. These six (6) chillers supply chilled water to a majority of the buildings on site. The logs document operating temperatures, pressures, and motor amperage as well as outside dry-bulb and wet-bulb temperatures. Entech reviewed the monthly logs and selected typical days during each month. These days represent an average load day which demand and usage could be used to estimate monthly and annual totals. The monthly chiller logs and Entech's calculations are located in Section 11, Attachment A. Tables 5.2.1 and 5.2.2, on the following page, displays monthly demand and usage at Building 48 for an entire year. Demand and usage will be separated between the different electric billing periods and used in the electric model for Service #2.

Table 5.2.1
Building 48
Cooling Estimate

Description	Unit	Quantity
Usage	kWh	18,338,690
Demand	kW	29,752

Table 5.2.2
Estimated Chiller Demand and Usage
Based on Chiller Logs, from Back-up Calcs

Month	Chiller kW	Chiller kWh
January	1,333	902,100
February	1,715	977,732
March	2,060	1,184,324
April	1,780	1,025,640
May	2,060	1,434,060
June	4,093	2,635,765
July	4,540	2,502,205
August	3,712	2,231,669
September	2,464	1,496,725
October	1,938	1,369,665
November	2,234	1,259,615
December	1,823	1,319,190
Totals	29,752	18,338,690

5.3 Building 54 Estimated Cooling Usage

As identified in Section 4.1, Building 54 has a separate electric service. Three (3) chillers located in two separate mechanical rooms provide cooling for the building (refer to Section 3.0). The following characteristics of this service allows it to provide an accurate estimate of chiller operation:

1. Chillers operate April through November only.
2. Electric meter only for one building (54).
3. Electric usage and demand constant from December through March.

These characteristics indicate that any increase in electric demand and usage during December through March averages is solely for the purpose of air conditioning. Using this logic, Tables 5.3.1 and 5.3.2 on the following two (2) pages were developed. These tables summarize the building's monthly demand and usage, respectively. The quantities on Tables 5.3.1 and 5.3.2 are from the October 1993 to September 1994 electric billing history (refer to Section 4.0). By comparing the electric usage and demand in the cooling months to the non-cooling months, the cooling system electric usage and demand can be determined. The annual cooling system demand for Building 54 is estimated to be 7,648 kW while usage is estimated at 3,651,853 kWh. These figures will be used to prepare the electric model for Building 54 later in this section.

TABLE 5.3.1

Walter Reed Medical Center

Estimated Electric Demand for Building 54 Cooling System

Based on 1993-94 Billing History

Months When Chiller Not Operational

Month	On-Peak kW
December *	1,700
January	1,712
February	1,722
March	1,728
Total kW	6,862
Average kW/Month	1,716

* Corrected Demand, Differs from Actual Billing.

Months When Chiller Operational

Month	On-Peak kW
April	2,129
May	2,186
June	3,303
July	3,128
August	2,974
September	2,844
October	2,622
November	2,186
Total kW	21,372
Average kW/Month	2,672

Cooling kW Calculated on Average Difference

kW Difference	956
Calculated Yearly Cooling Demand (kW)	7,648

TABLE 5.3.2
Walter Reed Medical Center
Estimated Electric Usage for Building 54 Cooling System
Based on 1993-94 Billing History

Months When Chiller Not Operational

Month	Days	Off-Peak kWh	Intermediate kWh	On-Peak kWh
December	35	490,600	241,700	248,700
January	30	398,300	208,500	219,100
February	29	408,000	212,400	223,100
March	31	441,400	225,600	232,700
Total kWh	125	1,738,300	888,200	923,600
Average kWh/Day		13,906	7,106	7,389

Months When Chiller Operational

Month	Days	Off-Peak kWh	Intermediate kWh	On-Peak kWh
April	29	392,000	225,200	233,700
May	29	455,100	249,700	263,900
June	33	836,800	383,900	405,700
July	31	878,600	442,200	460,900
August	31	758,100	368,700	388,800
September	33	839,900	391,800	401,200
October	31	578,850	306,030	327,120
November	29	538,700	251,240	260,310
Totals	246	5,278,050	2,618,770	2,741,630
Average kWh/Day		21,455	10,645	11,145

Cooling kWh Calculated on kWh/Day Difference

kWh/Day Difference	7,549	3,540	3,756
Calculated Cooling kWh (kWh/Day x 246 Days)	1,857,076	870,792	923,985
Total Cooling kWh			3,651,853

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5.4 EZDOE/CHVAC Load Simulation Programs

This study encompasses only the chilled water systems at WRAMC. In order to better model the central chilled water system, Entech needed to understand how all the buildings are presently operated in order to model the cooling systems at WRAMC.

Entech first utilized the CHVAC load program to identify the required airflow, water flow, and tonnage for each building. This program is described in Section 2.5.3. Table 5.4.1, on the following page, summarizes the CHVAC program results.

The CHVAC files were then imported into the EZDOE HVAC computer simulation program. This program is also described in Section 2.5.3. EZDOE's ~~predicted~~ cooling load and chiller energy was substantially different when compared to data retrieved from the chiller logs. Table 5.4.2, on page 5-8, displays this initial comparison. Refer to CHVAC and EZDOE program output in Section 11, Attachment F.

?

why

WALTER REED ARMY MEDICAL CENTER
CHVAC LOAD ANALYSIS
BUILDING HEAT GAINS
Table 5.4.1

ZONE #	Description	Year Built	Building #	Conditioned Space SF	Supply Air CFM	Ventilation Air CFM	% Outside Air CFM	(1) CFM/SF	(1) SF/TON	Zone (1) Tonnage	Total (1) Tonnage w/ OA	(1) GPM
1	Outpatient Clinic	1910	7	48180	52468	14835	28%	1.09	307	96.14	157.12	314.2
2	General Hospital	1928	1	227529	318596	247731	78%	1.40	150	583.8	1518.83	3037.7
3	Heaton Pavilion	1977	2	1299600	1321876	1000692	76%	1.02	209	2422.21	6212.57	12425.1
4	Delano Hall	1933	11	81225	109201	24672	23%	1.34	269	200.1	301.65	603.3
5	Admin/Computer	1972	T-2	55225	68428	9528	14%	1.24	339	125.39	162.81	325.6
6	Abrams Hall	1974	14	176400	166183	20530	12%	0.94	452	304.52	389.86	779.7
7	Guest House	1944	17	17424	27083	2400	9%	1.55	287	49.63	60.62	121.2
8	WRAIR Building	1962	40	218089	251659	193881	77%	1.15	182	461.14	1197.37	2394.7
9	Fitness Center Building	1944	41	34596	79787	7516	9%	2.31	196	146.2	176.08	352.2
10	AFIP Storage Building	1954	53	14641	14019	1500	11%	0.96	454	25.36	32.25	64.5
11	AFIP Path Lab Building	1955	54	348690	256802	197707	77%	0.74	286	470.56	1221.27	2442.5
12	MRI Building	1993	5	8836	10962	10962	100%	1.24	142	20.09	62.24	124.5
	BLOCK TOTALS or AVERAGES			2530435	2677064	1731954	65%	0.76	204	4905	12428	24856
1	Future Bldg. Addition – 14	–	14A	10404	7737	928	12%	0.74	571	15.62	18.21	36.4
2	Future Bldg. Addition – 16	–	16	324	412	75	18%	1.27	263	0.76	1.23	2.5
3	Future Bldg. Addition – Phy. Fittness	–	41	21025	25233	3750	15%	1.20	281	46.24	74.74	149.5
4	Future Bldg. Addition – Transient Housing	–	–	94249	56234	6748	12%	0.60	719	103.04	131.02	262.0
5	Future Bldg. Addition – BRAC Science	–	6	65536	62098	15525	25%	0.95	370	113.79	177.02	354.0
6	DENTAC Building–Renovation	1955	91	9604	10557	2200	21%	1.10	338	19.34	28.43	56.9
	BLOCK TOTALS or AVERAGES			201142	162271	29226	18%	0.81	468	299	430	860
	GRAND BLOCK TOTALS or AVERAGES			2731577	2839335	1761180	62.0%	0.8	335.7	5204	12858	25716

NOTES:
(1) Denotes zone peak loads
▨ Denotes block peak loads–Peak of all zones

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Table 5.4.2
EZDOE Comparison

	Chiller Logs		EZDOE Results	
Month	kW	kWh	kW	kWh
January	1,333	902,100	1,135	30,855
February	1,715	977,732	1,466	51,455
March	2,060	1,184,324	2,957	195,503
April	1,780	1,025,640	3,198	481,294
May	2,060	1,434,060	5,856	1,179,717
June	4,093	2,635,765	6,426	2,050,442
July	4,540	2,502,205	6,455	2,570,321
August	3,712	2,231,669	6,442	2,531,458
September	2,464	1,496,725	6,407	1,658,645
October	1,938	1,369,665	3,840	852,623
November	2,234	1,259,615	6,288	366,545
December	1,823	1,319,190	1,428	29,803
Totals	29,752	18,338,690	51,898	11,998,661

As can be seen in the table, EZDOE results are substantially different where EZDOE calculated small amounts of cooling required, the chiller logs indicate otherwise (winter and intermediate). EZDOE results appear more representative of a typical load profile while the chiller logs tend to show a more steady and flat load.

There must be a considerable internal load year-around.

During the progress meeting of March 22, 1995, Entech explained the conflict between the chiller logs and EZDOE. Through inquiries and discussions, WRAMC personnel identified some areas which could cause the difference to occur. These areas are as follows:

1. Reset of preheat coil to higher discharge temperature, in Heaton Pavilion, during the winter to avoid freezing problems due to improper heating water balancing.
2. Process loads which had not been identified.
3. Use of chilled water as condenser water for miscellaneous building and process stand-alone systems.

Utilizing the above information as a basis, Entech revised EZDOE to reflect these occurrences. A few variations were simulated by varying such factors as preheat temperature, discharge temperature, and operation schedules. A simulation representing a discharge temperature of 55°F and a preheat temperature of 60°F provided the closest match to the chiller logs. This comparison is shown in Table 5.4.3 on the following page.

Table 5.4.3
Revised EZDOE Comparison

	Chiller Logs		Revised EZDOE	
Month	kW	kWh	kW	kWh
January	1,333	902,100	1,906	1,098,723
February	1,715	977,732	1,906	1,017,541
March	2,060	1,184,324	1,906	1,206,854
April	1,780	1,025,646	1,906	1,237,009
May	2,060	1,434,060	1,906	1,351,609
June	4,093	2,635,765	3,039	1,900,800
July	4,540	2,502,205	4,255	2,243,950
August	3,712	2,231,669	4,210	2,265,370
September	2,464	1,496,725	3,019	1,746,114
October	1,938	1,369,665	1,906	1,296,553
November	2,234	1,259,615	1,906	1,146,808
December	1,823	1,319,190	1,906	1,105,302
Totals	29,752	18,338,696	29,763	17,616,633

For the purposes of this report, the revised simulation will be used to calculate proposed energy consumption for alternatives which require the detailed calculations the EZDOE can provide. Use of the revised simulation will provide a true representation of potential savings.

5.5 Miscellaneous Losses

An Entech computer program was used to estimate pipe losses within the chilled water central distribution systems and within the buildings served. Consideration was given to this information when determining chiller plant capacities. See Table 5.5.1 on the following page.

WALTER REED ARMY MEDICAL CENTER
ESTIMATED CHILLER WATER TEMPERATURE GAIN
TABLE 5.5.1

							Above Grade - Interior CW Piping										
ZONE NO.	Description	NO. FLRS.	Bldg. No.	Conditioned Space SF	GPM	Pipe Size In.	20	12	10	8	6	5	4	3	2 1/2	2	
						Factor (1)							0.0033	0.0046	0.0013	0.0266	
						Factor (2)	16.0	9.4	7.5	6.1	5.0	5.6	3.6	4.7	3.3	3.4	
1	Outpatient Clinic	3	7	48180	314	LF Pipe	0	0	0	0	0	80	159	222	60	1282	
2	General Hospital	4	1	227529	3037	LF Pipe	0	0	400	40	40	40	751	1047	284	6052	
3	Heaton Pavilion	8	2	1299600	14375	LF Pipe	100	60	720	720	720	720	4289	5978	1625	34569	
4	Delano Hall	3	11	81225	603	LF Pipe	0	0	0	0	40	40	268	374	102	2161	
5	Admin/Computer	2	T-2	55225	326	LF Pipe	0	0	0	0	0	0	182	254	69	1469	
6	Abrams Hall	3	14	176400	780	LF Pipe	0	0	0	0	40	40	582	811	221	4692	
7	Guest House	3	17	17424	121	LF Pipe	0	0	0	0	30	30	57	80	22	463	
8	WRAIR Building	5	40	218089	2829	LF Pipe	0	20	40	80	80	40	720	1003	273	5801	
9	Fitness Center Building	2	41	34596	352	LF Pipe	0	0	0	0	0	80	114	159	43	920	
10	AFIP Storage Building	1	53	14641	65	LF Pipe	0	0	20	0	0	0	48	67	18	389	
11	AFIP Path Lab Building	5	54	348690	2887	LF Pipe	0	0	560	80	80	40	1151	1604	436	9275	
12	MRI Building	4	5	8836	125	LF Pipe	0	0	0	0	0	0	190	41	11	235	
13	DENTAT Bldg - Renovation	1	91	9604	57	LF Pipe	0	0	0	0	0	0	0	0	128	255	
															0	0	
	SUB TOTALS			2540039	25871	TOTAL LF	100	80	1740	920	1030	1110	8511	11640	3291	67565	
						BTUH GAIN	1600	752	13050	5612	5150	6216	30641	54708	10860	229721	342908
																TONS	28.58

							Below Grade - Direct Burried CW Piping								
LOOP NO.	Description				GPM	Pipe Size In.	20" Pipe	12" Pipe	10" Pipe	8" Pipe	6" Pipe	5" Pipe	4" Pipe		
						Factor (1)	8.1	4.7	3.8	3.1	2.5	2.8	1.8		
1	Bldg#48 to Bldg#2					LF Pipe	160	0	0	0	0	0	0		
2	Bldg#48 to Bldg#1 & 7		N/A			LF Pipe	0	0	200	0	0	340	40		
3	Bldg#48 to Bldg#1E, 40 & 41		N/A			LF Pipe	0	640	0	0	410	60	40		
4	Bldg#48 to Bldg#53 & 54		N/A			LF Pipe	0	0	920	0	0	0	0		
5	Bldg#49 to Bldg#14		N/A			LF Pipe	0	0	0	0	300	0	0		
6	Bldg#48 to Bldg#11 & 17		N/A			LF Pipe	0	0	0	0	2040	0	0		
	TOTALS						160	640	1120	0	2750	400	80		
						BTUH GAIN	1296	3008	4256	0	6875	1120	144	16699	1.39 TONS

Notes:

1. Factor #1 is based on a typical floor using 25 ton ah units w/ 2" runouts and headers ranging from 2" thru 4"
2. Factor #2 is an average BTUH gain of averaged 30 deg delta T for both supply & return piping
3. Factor #3 is an average BTUH gain of averaged 15 deg delta T for both supply & return piping

TOTAL TONS 30

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5.6 Electric Model

An electric model, as described in Section 2.5.2, has been developed for Building 54 and WRAMC. Tables 5.6.1 and 5.6.2, pages 5-15 and 5-16, summarize Building 54 and WRAMC electric models respectively. These models represent the current operation of the chilled water systems in applicable buildings (i.e. equipment which is not operating displays "zeros"). The model is employed to approximate the contribution from all system electrical users to an annual electric cost for chilled water systems. As chiller plant alternatives are investigated, the electric model will be used to calculate energy costs and savings.

The models were prepared using the chiller logs from Building 48 and the electric billing history from Building 54. Each model is balanced to the actual electric bills from October 1993 to September 1994. At the bottom of each electric model is the actual electric billing quantities to which the model is balanced, and the incremental cost used in calculating the total model cost. The total costs do not balance because of varying electric rates throughout the year.

It is important to realize that the electric model is an approximation of the electricity used by each piece of equipment. It shows general relationships and gives a reasonable allocation of electrical demand, usage, and cost.

The annual cooling system cost for Building 54 is estimated to be $271,900.

Demand Cost = $117,000 ((6,363 kW x $17.09/kW) + (1,245 kW x $6.60/kW) = $116,961, use $117,000)

Off-Peak Usage = $61,400 ((1,676,093 kWh x $0.033/kWh) + (173,156 kWh x $0.035/kWh) = $61,372, use $61,400)

Intermediate Usage = $38,700 ((755,490 kWh x $0.045/kWh) + (105,924 kWh x $0.044/kWh) = $38,658, use $38,700)

On-Peak Usage = $54,800 ((817,290 kWh x $0.060/kWh) + (112,140 kWh x $0.051/kWh) = $54,757, use $54,800)

Total Electric Cost = $271,900 ($117,000 + $61,400 + $38,700 + $54,800 = $271,900)

The annual cooling system cost for Building 48 is estimated to be $1,535,700.

Demand Cost = $477,400 ((21,163 kW x $17.09/kW) + (17,532 kW x $6.60/kW) = $477,387, use $477,400)

Off-Peak Usage = $454,900 ((7,961,025 kWh x $0.033/kWh) + (5,490,279 kWh x $0.035/kWh) = $454,874, use $454,900)

Intermediate Usage = $266,300 ((3,355,300 kWh x $0.045/kWh) + (2,620,311 kWh x $0.044/kWh) = $266,282, use $266,300)

On-Peak Usage = $337,100 ((3,355,300 kWh x $0.060/kWh) + (2,661,683 kWh x $0.051/kWh) = $337,064, use $337,100)

Total Electric Cost = $1,535,700 ($477,400 + $454,900 + $266,300 + $337,100) = $1,535,700

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						Winter Billing Months						Intermediate Billing M			
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.	
No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo
1															
2	**Building #54**														
3	Chiller C-54-1	518	0	337	337	0.0	0	0.0	0	0.0	0	1.6	24,864	2.2	22,79
4	Chiller C-54-2	518	0	0	337	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
5	Chiller C-54-3	509	0	0	331	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
6	Pump CHWS-54-1	30	0	23	23	0.0	0	0.0	0	0.0	0	6.0	5,400	6.0	3,6
7	Pump CHWS-54-2	30	0	0	23	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
8	Pump CHWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
9	Pump CWS-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	6.0	6,660	6.0	4,44
10	Pump CWS-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
11	Pump CWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
12	Clg Tower CT-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	2.0	2,238	3.0	2,23
13	Clg Tower CT-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
14	Clg Tower CT-54-3	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
15	Subtotal	1,903	0	415	1,273		0		0		0		39,162		33,07
16	**Miscellaneous**														
17	Remainder Building Load	2,200	1,716	1,752	1,702	6.6	434,575	5.0	222,050	5.2	230,900	6.4	422,771	4.7	208,97
18			0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	
19	Subtotal	2,200	1,716	1,752	1,702		434,575		222,050		230,900		422,771		208,97
20	TOTALS	4,103	1,716	2,167	2,974		434,575		222,050		230,900		461,933		242,04

All Averages Based on Oct 93 - Sept 94

Historical Billing Demand Averages

Dec	1,700	Apl	2,129	Jun	3,303
Jan	1,712	May	2,186	Jul	3,128
Feb	1,722	Nov	2,186	Aug	2,974
Mar	1,728			Sep	2,844
				Oct	2,622
Avg	1,716	Avg	2,167	Avg	2,974
	0		0.075		-0.075

Historical Winter Usage Averages

490,600	Dec	241,700	Dec	248,700
398,300	Jan	208,500	Jan	219,100
408,000	Feb	212,400	Feb	223,100
441,400	Mar	225,600	Mar	232,700
434,575	Avg	222,050	Avg	230,900
-0.02		0.04		-0.12

Historical Intermediate U

392,000	Apl	225,20
455,100	May	249,70
538,700	Nov	251,24
461,933	Avg	242,0
-0.0288666		-0.00893

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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Electric Model
Electric Service #1 - Building 54
Walter Reed Army Medical Center
Table 5.6.1

Winter Billing Months					Intermediate Billing Months						Summer Billing Months								Non-Summer
eak	Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak				
Wh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.
0	0.0	0	0.0	0	1.6	24,864	2.2	22,792	2.4	24,864	4.8	74,592	3.5	36,260	3.9	40,404	1,010	74,592	68,376
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	74,592	3.5	36,260	3.9	40,404	0	0	0
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	73,296	3.5	35,630	3.9	39,702	0	0	0
0	0.0	0	0.0	0	6.0	5,400	6.0	3,600	6.0	3,600	8.0	7,200	6.0	3,600	6.0	3,600	68	16,200	10,800
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	7,200	6.0	3,600	6.0	3,600	0	0	0
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0
0	0.0	0	0.0	0	6.0	6,660	6.0	4,440	6.0	4,440	8.0	8,880	6.0	4,440	6.0	4,440	83	19,980	13,320
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	8,880	6.0	4,440	6.0	4,440	0	0	0
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0
0	0.0	0	0.0	0	2.0	2,238	3.0	2,238	3.0	2,238	6.0	6,714	6.0	4,476	6.0	4,476	84	6,714	6,714
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0
0		0		0		39,162		33,070		35,142		301,662		151,098		163,458	1,245	117,486	99,210
																		0	0
434,575	5.0	222,050	5.2	230,900	6.4	422,771	4.7	208,977	4.9	217,495	7.2	476,788	5.2	227,428	5.3	233,286	12,118	3,006,614	1,515,130
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0
434,575		222,050		230,900		422,771		208,977		217,495		476,788		227,428		233,286	12,118	3,006,614	1,515,130
434,575		222,050		230,900		461,933		242,047		252,637		778,450		378,526		396,744	13,363	3,124,100	1,614,340

Historical Winter Usage Averages

490,600	Dec	241,700	Dec	248,700
398,300	Jan	208,500	Jan	219,100
408,000	Feb	212,400	Feb	223,100
441,400	Mar	225,600	Mar	232,700
434,575	Avg	222,050	Avg	230,900
0.02		0.04		-0.12

Historical Intermediate Usage Averages

392,000	Apl	225,200	Apl	233,700
455,100	May	249,700	May	263,900
538,700	Nov	251,240	Nov	260,310
461,933	Avg	242,047	Avg	252,637
-0.0288666		-0.0089333		-0.1493333

Historical Summer Usage Averages

836,800	Jun	383,900	Jun	405,700
878,600	Jul	442,200	Jul	460,900
758,100	Aug	368,700	Aug	388,800
839,900	Sep	391,800	Sep	401,200
578,850	Oct	306,030	Oct	327,120
778,450	Avg	378,526	Avg	396,744
0.04		-0.08		0.14719999

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Summer Billing Months					Non-Summer					Summer					
eak	Inter.		On-Peak												
Wh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
															1
															2
74,592	3.5	36,260	3.9	40,404	1,010	74,592	68,376	74,592	$16,090	1,684	372,960	181,300	202,020	$61,358	3
74,592	3.5	36,260	3.9	40,404	0	0	0	0	$0	1,684	372,960	181,300	202,020	$61,358	4
73,296	3.5	35,630	3.9	39,702	0	0	0	0	$0	1,654	366,480	178,150	198,510	$60,292	5
7,200	6.0	3,600	6.0	3,600	68	16,200	10,800	10,800	$2,039	113	36,000	18,000	18,000	$5,001	6
7,200	6.0	3,600	6.0	3,600	0	0	0	0	$0	113	36,000	18,000	18,000	$5,001	7
13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	$9,335	8
8,880	6.0	4,440	6.0	4,440	83	19,980	13,320	13,320	$2,514	139	44,400	22,200	22,200	$6,167	9
8,880	6.0	4,440	6.0	4,440	0	0	0	0	$0	139	44,400	22,200	22,200	$6,167	10
13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	$9,335	11
6,714	6.0	4,476	6.0	4,476	84	6,714	6,714	6,714	$1,427	140	33,570	22,380	22,380	$5,848	12
6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	13
6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	14
301,662		151,098		163,458	1,245	117,486	99,210	105,426	$22,069	6,363	1,508,310	755,490	817,290	$241,559	15
						0	0	0	$0		0	0	0	$0	16
476,788	5.2	227,428	5.3	233,286	12,118	3,006,614	1,515,130	1,576,085	$332,256	8,508	2,383,940	1,137,140	1,166,429	$345,229	17
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	18
476,788		227,428		233,286	12,118	3,006,614	1,515,130	1,576,085	$332,256	8,508	2,383,940	1,137,140	1,166,429	$345,229	19
778,450		378,526		396,744	13,363	3,124,100	1,614,340	1,681,511	$354,326	14,871	3,892,250	1,892,630	1,983,719	$586,788	20

Historical Summer Usage Averages

836,800	Jun	383,900	Jun	405,700
878,600	Jul	442,200	Jul	460,900
758,100	Aug	368,700	Aug	388,800
839,900	Sep	391,800	Sep	401,200
578,850	Oct	306,030	Oct	327,120
778,450	Avg	378,526	Avg	396,744
0.04		-0.08		0.14719999

Model Yearly Totals	28,234	7,016,350	3,506,970	3,665,230	$941,113
Billing History Yearly Totals	28,234	7,016,350	3,506,970	3,665,230	$859,601

08-Aug-95

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Electric
Walter Ree

						Winter Billing Months						Intermediate Billing Months			
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.	
No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo
1															
2	**Building #48**														
3	Chiller C-48-1	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800
4	Chiller C-48-2	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800
5	Chiller C-48-3	1,088	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6	Chiller C-48-4	937	469	543	618	5.0	140,550	4.0	74,960	4.0	74,960	5.5	154,605	4.5	84,330
7	Chiller C-48-5	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
8	Chiller C-48-6	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
9	Pump CHWS-48-1	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880
10	Pump CHWS-48-2	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880
11	Pump CHWS-48-3	124	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
12	Pump CHWS-48-4	92	69	69	69	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040
13	Pump CHWS-48-5	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
14	Pump CHWS-48-6	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
15	Pump CWS-48-1	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440
16	Pump CWS-48-2	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440
17	Pump CWS-48-3	112	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
18	Pump CWS-48-4	93	70	70	70	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160
19	Pump CWS-48-5	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
20	Pump CWS-48-6	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
21	Clg Tower CT-48-1	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950
22	Clg Tower CT-48-2	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950
23	Clg Tower CT-48-3	45	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
24	Clg Tower CT-48-4	37	28	28	28	7.0	7,770	4.0	2,960	4.0	2,960	10.0	11,100	5.5	4,070
25	Clg Tower CT-48-5	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
26	Clg Tower CT-48-6	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
27	Subtotal	7,584	2,362	2,742	4,212		765,855		359,800		359,800		823,980		394,740
28	**Building #49**														
29	Chiller C-49-1	628	0	314	471	0.0	0	0.0	0	0.0	0	1.0	18,840	2.0	25,120
30	Pump CHWS-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720
31	Pump CHWS-49-1	56	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
32	Pump CWS-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720
33	Clg Tower CT-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	2.0	3,360	3.0	3,360
34	Subtotal	852	0	440	597		0		0		0		42,360		41,920
35	**Building #07**														
36	Chiller C-07-1	200.0	0.0	100.0	150.0	0.0	0	0.0	0	0.0	0	1.0	6,000	2.0	8,000
37	Pump CHWS-07-1	5.6	0.0	4.2	4.2	0.0	0	0.0	0	0.0	0	6.0	1,007	6.0	671
38	Subtotal	206	0	104	154		0		0		0		7,007		8,671
39	**Building #T-2**														
40	Chiller C-T2-1	319.0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
41	Pump CHWS-T2-1	11.2	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
42	Subtotal	330	0	0	0		0		0		0		0		0
43	**Miscellaneous**														
44	Remaining Electric Load	15000	10,058	10,047	10,250	6.1	2,764,395	4.4	1,305,200	4.6	1,377,950	6.7	3,021,986	4.8	1,439,335
45	Subtotal	15000	10,058	10,047	10,250		2,764,395		1,305,200		1,377,950		3,021,986		1,439,335
46	TOTALS	23,972	12,420	13,333	15,213		3,530,250		1,665,000		1,737,750		3,895,333		1,884,667

All Averages Based on Oct 93 - Sept 94

Historical Billing Demand Averages

Dec	11,930	Apl	13,380	Jun	16,270
Jan	12,690	May	14,050	Jul	16,360
Feb	12,070	Nov	12,570	Aug	15,980
Mar	12,990			Sep	15,220
				Oct	12,236
Avg	12,420	Avg	13,333	Avg	15,213
	-0.1		0.137083		0.08375

Historical Winter Usage Average

3,432,000	Dec	1,716,000	Dec	1,767,000
3,495,000	Jan	1,538,000	Jan	1,621,000
3,468,000	Feb	1,642,000	Feb	1,716,000
3,726,000	Mar	1,764,000	Mar	1,847,000
3,530,250	Avg	1,665,000	Avg	1,737,750
0		-0.0999999		0.02

Historical Intermediate Usage A

3,430,000	Apl	1,841,000	Apl
3,447,000	May	1,819,000	May
4,809,000	Nov	1,994,000	Nov
3,895,333	Avg	1,884,667	Avg
-0.0166666		0.0666666	

Winter Months: December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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Electric Model
Electric Service #2 - WRAMC
Walter Reed Army Medical Center
Table 5.6.2

	Winter Billing Months				Intermediate Billing Months						Summer Billing Months							Non-Summer		
	Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak					
Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On- KWI
,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	
,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
,550	4.0	74,960	4.0	74,960	5.5	154,605	4.5	84,330	4.5	84,330	8.0	224,880	5.0	93,700	5.0	93,700	3,504	1,026,015	552,830	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	
,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	
,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	483	202,860	77,280	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	
,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	
,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	488	205,065	78,120	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	
,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	
,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
,770	4.0	2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5	4,070	10.5	11,655	6.0	4,440	6.0	4,440	194	64,380	24,050	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	
855		359,800		359,800		823,980		394,740		394,740		1,583,700		667,820		667,820	17,674	5,535,360	2,623,420	2.
0	0.0	0	0.0	0	1.0	18,840	2.0	25,120	2.0	25,120	4.0	75,360	3.5	43,960	3.9	48,984	942	56,520	75,360	
0	0.0	0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
0	0.0	0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	
0	0.0	0	0.0	0	2.0	3,360	3.0	3,360	3.0	3,360	6.0	10,080	6.0	6,720	6.0	6,720	126	10,080	10,080	
0		0		0		42,360		41,920		41,920		115,680		64,120		69,144	1,320	127,080	125,760	
																		0	0	
0	0.0	0	0.0	0	1.0	6,000	2.0	8,000	2.0	8,000	4.0	24,000	3.5	14,000	3.9	15,600	300	18,000	24,000	
0	0.0	0	0.0	0	6.0	1,007	6.0	671	6.0	671	9.0	1,511	6.0	671	6.0	671	13	3,021	2,014	
0		0		0		7,007		8,671		8,671		25,511		14,671		16,271	313	21,021	26,014	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	
0		0		0		0		0		0		0		0		0	0	0	0	
395	4.4	1,305,200	4.6	1,377,950	6.7	3,021,986	4.8	1,439,335	5.1	1,537,669	6.0	2,703,466	4.5	1,361,854	4.8	1,433,538	70,374	20,123,539	9,538,806	10.
395		1,305,200		1,377,950		3,021,986		1,439,335		1,537,669		2,703,466		1,361,854		1,433,538	70,374	20,123,539	9,538,806	10.
250		1,665,000		1,737,750		3,895,333		1,884,667		1,983,000		4,428,356		2,108,465		2,186,773	89,680	25,807,000	12,314,000	12.

Model

Historical Winter Usage Average

,000	Dec	1,716,000	Dec	1,767,000
,000	Jan	1,538,000	Jan	1,621,000
000	Feb	1,642,000	Feb	1,716,000
000	Mar	1,764,000	Mar	1,847,000
250	Avg	1,665,000	Avg	1,737,750
0		-0.0999999		0.02

Historical Intermediate Usage Average

3,430,000	Apl	1,841,000	Apl	1,925,000
3,447,000	May	1,819,000	May	1,924,000
4,809,000	Nov	1,994,000	Nov	2,100,000
3,895,333	Avg	1,884,667	Avg	1,983,000
-0.0166666		0.00666666		0

Historical Summer Usage Average

4,912,000	Jun	2,275,000	Jun	2,375,000
4,875,000	Jul	2,446,000	Jul	2,561,000
4,024,000	Aug	1,979,000	Aug	2,093,000
4,694,000	Sep	2,160,000	Sep	2,257,000
3,636,782	Oct	1,682,325	Oct	1,647,867
4,128,356	Avg	2,108,465	Avg	2,186,773
0.03000000		0		0

Billing

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Summer Billing Months					Non-Summer					Summer					
-Peak	Inter.		On-Peak												
kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
															1
															2
261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	3
261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	4
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	5
224,880	5.0	93,700	5.0	93,700	3,504	1,026,015	552,830	552,830	$111,558	3,092	1,124,400	468,500	468,500	$139,142	6
224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	7
224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	8
39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	9
39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	10
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	11
28,980	6.0	11,040	6.0	11,040	483	202,860	77,280	77,280	$17,630	345	144,900	55,200	55,200	$16,474	12
28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	13
28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	14
35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	15
35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	16
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	17
29,295	6.0	11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821	349	146,475	55,800	55,800	$16,653	18
29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	19
29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	20
14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	21
14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	22
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	23
11,655	6.0	4,440	6.0	4,440	194	64,380	24,050	24,050	$5,820	139	58,275	22,200	22,200	$6,625	24
11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	25
11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	26
1,583,700		667,820		667,820	17,674	5,535,360	2,623,420	2,623,420	$559,608	21,062	7,918,500	3,339,100	3,339,100	$971,867	27
															28
75,360	3.5	43,960	3.9	48,984	942	56,520	75,360	75,360	$15,355	2,355	376,800	219,800	244,920	$77,268	29
15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	30
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	31
15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	32
10,080	6.0	6,720	6.0	6,720	126	10,080	10,080	10,080	$2,142	210	50,400	33,600	33,600	$8,780	33
115,680		64,120		69,144	1,320	127,080	125,760	125,760	$25,107	2,985	578,400	320,600	345,720	$105,271	34
						0	0	0	$0		0	0	0	$0	35
24,000	3.5	14,000	3.9	15,600	300	18,000	24,000	24,000	$4,890	750	120,000	70,000	78,000	$24,608	36
1,511	6.0	671	6.0	671	13	3,021	2,014	2,014	$380	21	7,553	3,357	3,357	$960	37
25,511		14,671		16,271	313	21,021	26,014	26,014	$5,270	771	127,553	73,357	81,357	$25,568	38
															39
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	40
0	0.0	0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	41
0		0		0	0	0	0	0	$0	0	0	0	0	$0	42
															43
2,703,466	4.5	1,361,854	4.8	1,433,538	70,374	20,123,539	9,538,806	10,124,806	$2,104,864	51,248	13,517,329	6,809,268	7,167,690	$2,058,370	44
2,703,466		1,361,854		1,433,538	70,374	20,123,539	9,538,806	10,124,806	$2,104,864	51,248	13,517,329	6,809,268	7,167,690	$2,058,370	45
4,428,356		2,108,465		2,186,773	89,680	25,807,000	12,314,000	12,900,000	$2,694,849	76,066	22,141,782	10,542,325	10,933,867	$3,161,076	46

Model Yearly Totals	165,716	47,918,782	22,856,325	23,833,867	$5,855,925
Billing History Yearly Totals	165,716	47,948,782	22,856,325	23,833,867	$5,845,277

Historical Summer Usage Average

4,912,000	Jun	2,275,000	Jun	2,375,000
4,875,000	Jul	2,446,000	Jul	2,561,000
4,024,000	Aug	1,979,000	Aug	2,093,000
4,694,000	Sep	2,160,000	Sep	2,257,000
3,636,782	Oct	1,682,325	Oct	1,647,867
4,428,356	Avg	2,108,465	Avg	2,186,773
03000000		0		0

08-Aug-95

3

5.7 Future Chiller Plant Loads

Future planning at WRAMC identifies several planned construction and renovation projects through the year 2005. This construction includes new facilities, additions to existing facilities, and several buildings to be demolished as identified below:

New Buildings — BRAC Building (currently under construction)

— Physical Fitness
— Transient Housing
— Building 16

Additions — Building 14

Renovations — Building 91

Demolition — Building T-2
— Building 1-C
— Building 1-G
— Building 1-J
— Building 1-K
— Building 1-L

This planned construction will add a net increase of 250 tons of chilled water capacity. In addition, the current site capacity has a shortage of approximately 3,100 tons. This results in an overall chilled water capacity deficiency of approximately 3,350 tons. Future loads due to construction beyond the year 2005 are not currently identified.

does it get hot. ?

6.0 CHILLER PLANT ALTERNATIVES

6.1 General

This section of the report evaluates various alternatives for upgrading and/or replacing the central chilled water systems. These alternatives have been developed to meet several overall objectives as follows:

1. Energy efficiency.
2. Ability to phase-in, while minimizing impact on existing building function.
3. Overall serviceability and operation by plant operators.

Each alternative will be described in the following format:

Existing:	Generally describes the existing conditions, energy usage, and energy cost.
Description:	Generally describes the alternative and its critical components. Estimates the amount of energy usage and cost to operate the proposed system.
Construction Cost:	Summarizes the construction cost estimates prepared for the work necessary to implement the alternative. The costs are broken down into material, labor, and engineering.
Annual Energy Savings:	Compares the existing energy usage and costs with the proposed energy usage and costs.

Annual Operation and Maintenance Cost:	An estimate of the average annual operation and maintenance costs during the expected equipment service life of the proposed system.
Economics:	Studies the payback for installing the proposed system.
Expected Life:	The average expected service life of the equipment.
Environmental Considerations:	A discussion of the environmental impact of the alternative.
Advantages:	A list of advantages that can be expected for the type of system described.
Disadvantages:	A list of the disadvantages associated with the system.

6.1.1 Assumptions

In order to remain consistent, the following assumptions were established for each alternative analyzed:

1. New chillers will be sized to match existing tonnage.
2. Deficiencies in meeting peak cooling loads will not be addressed.

6.2 Existing Conditions

6.2.1 Chilled Water Plant Operations

All chillers have factory-packaged controls installed. Once an individual chiller is activated, these controls maintain a constant leaving chilled water temperature. The chillers are manually activated along with associated chilled water pumps, cooling towers, and condenser water pumps. Chillers and chilled water pumps are placed on- and off-line as the cooling needs of buildings dictate. Refer to Section 3.0 for a more detailed description of the chilled water systems.

6.2.2 Deficiencies

Chiller Plants

Building 48's chilled water system can no longer meet peak cooling load demands for the buildings on its distribution system. During the warmer months, Building 54 is valved-off the central distribution system, and an independent building chilled water system is activated to meet its cooling needs.

Building 2, Heaton Pavilion, is the most critical chilled water user on Building 48's chilled water system. During peak cooling load demands, with Building 54 valved-off the system, it is necessary to shed additional load by trimming chilled water usage within Buildings 1, T-2, 40, and 41. Calculated cooling loads and chiller operating log sheets concur with this deficiency. See Table 5.4.1, in Section 5.0.

Calculated cooling loads and existing chiller operating log sheets indicate Building 49's system is lightly loaded.

Building 48's and 49's distribution systems are not cross connected. Thus, spare chiller capacity at Building 49 cannot be utilized to alleviate the deficit within Building 48's system.

Building 54's and 7's chilled water systems appear to be adequate to meet their cooling demands.

Presently, as new buildings are added to WRAMC, independent chilled water systems are constructed to meet their cooling needs.

The majority of existing chillers utilize refrigerants R-11 and R-500. Production of R-11 and R-500 is not permitted beyond 1996. Refrigerant R-123 is an acceptable alternative for existing R-11 chillers and R-134a for existing R-500 chillers. No production of R-123 is permitted beyond 2030, R-134a does not have production limits at this writing. Refer to Section 9.0 for more information.

Chilled Water Central Distribution Systems

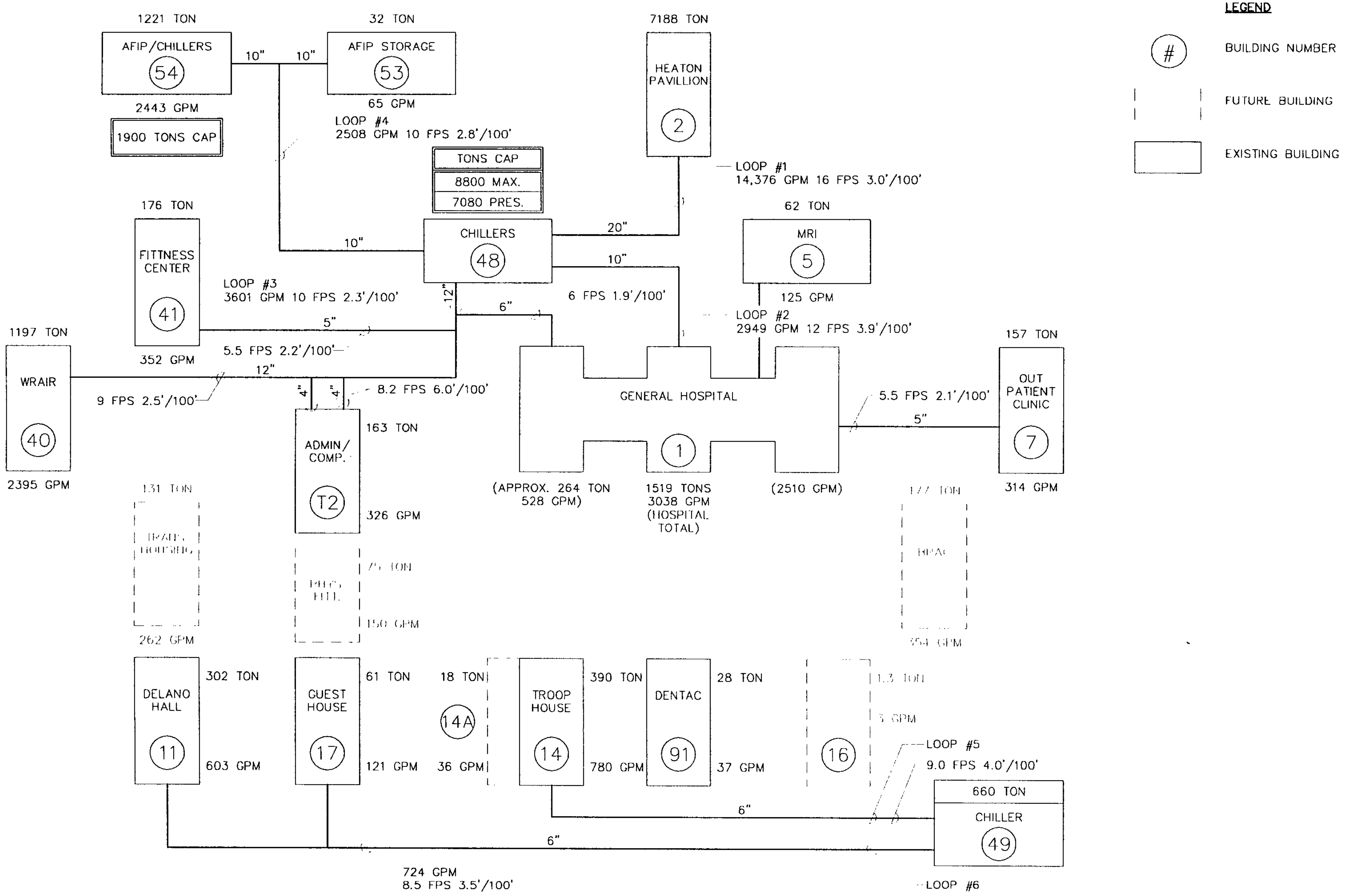
Building 48's distribution system provides chilled water to Buildings 1, 2, T-2, 5, 7, 40, 41, 53, and 54. See Figure 6.2.2.1 on page 6-6. Individual building chilled water loops are undersized, or marginal in size at best, as shown in Table 6.2.2.2 on the following page.

Table 6.2.2.2 Chilled Water Loops				
System Loop	Building	Supply & Return	Condition	Comment
#1	2	20"	Undersized	Difficulty in cooling upper floors.
#2	1, 5, 7	10"	Marginal	Affects all floors.
#3	1E, T-2, 40, 41	12"	Adequate	
#4	53, 54	10"	Adequate	
#5	14, 91	6"	Adequate	
#6	11, 17	6"	Adequate	

Current building chilled water loops have no additional capacity for future expansion. See Plate 2, Section 3.0.

Building 48 "Chilled Water Logs" (refer to Section 11, Attachment A) indicate the daily chilled water makeup requirements. Leaks within the chilled water distribution system account for the required makeup water. In general, during the summer months, the chilled water system loses an average in the range of 16,000 gal/month, or 500-600 gal/day. During the intermediate and winter months, losses average within the range of 29,000 gal/month or 900-1,000 gal/day. The makeup water requirements equate to less than 1% of the plant's chilled water production capability.

WALTER REED ARMY MEDICAL CENTER
CHILLED WATER
CENTRAL DISTRIBUTION SYSTEMS
FIGURE 6.2.2.1



Physical Constraints

To meet Building 48's present and future chilled water production capacity, an addition to the existing building would be required. Site limitations and existing structures limit the size of any addition. Any addition would not be adequate in size to house additional refrigeration equipment needed to meet chilled water demands.

Existing structures and site limitation would also preclude an addition to Building 49. See Site Plan, Plate 1, Section 3.0.

Two (2) 600-ton chillers which serve Building 54 are forty-three years old. Chillers are housed in an equipment room located in the basement level. There were no provisions provided for adequate access to the exterior of the building to remove and replace these chillers. Loss of both of these chillers must be assumed by the central chilled water plant in Building 48.

Maintenance

A total of twelve (12) chillers presently exist at WRAMC. A thirteenth chiller is being installed for the BRAC Clinic. Three (3) chillers are air cooled and the remaining nine (9) are water-cooled, electric centrifugal units. Associated with these thirteen (13) chillers are nine (9) cooling towers, eleven (11) condenser water pumps, and sixteen (16) chilled water pumps. See Section 3.0 for more details on equipment.

Chillers, and their appurtenances, are located in six (6) separate buildings located around WRAMC.

electric demand

In addition to the systems identified, numerous air-cooled DX cooling units are incorporated to supplement building cooling requirements.

A majority of the chilled water production equipment is of an age where its useful service life is past or approaching the point of replacement. Service and maintenance becomes excessive and replacement parts costly or non-existent. Several major pieces of chilled water production equipment are due for major overhaul work. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) lists estimated service life for centrifugal chillers at twenty-three years and for base-mounted pumps, conventional cooling towers, and air-cooled DX cooling equipment at twenty years. The original building cooling towers for Building 54 are deteriorated and need to be rebuilt.

In general, the equipment at WRAMC appears to be well maintained, although maintenance costs are high due to the quantity, age, and location of equipment throughout the site.

6.3 Alternative No. 1

— Upgrade Existing Chilled Water Plants with New Chillers

6.3.1 Existing

A description of existing chilled water plants is provided in Section 3.4. As shown in Table 6.3.1 on the following page, the existing chillers (Buildings 48, 49, and 54) are estimated to use 22,554,695 kWh/yr and require 39,343 kW of demand per year. The estimated annual cost to operate the chillers is $1,457,400.

6.3.2 Description

Upgrade existing chilled water plants in Buildings 48, 49, and 54, with new higher-efficiency chillers. Chillers would be replaced on a one-for-one basis while reusing existing pumps and chilled water piping.

Plant operations would remain similar to existing. The current practice of manual plant changeover for summer and winter seasons and manual placement of equipment on and off line would still occur to satisfy cooling loads.

Future buildings would continue to be built with independent chillers. This is required because many sections of the existing distribution system mains are undersized for current chilled water flow needs. In addition, the central chilled water plant buildings are not physically large enough to add any cooling equipment.

WALTER REED ARMY MEDICA NTER
ALTERNATE No. 1
UPGRADE EXISTING CHILLED WATER PLANTS with NEW CHILLERS
TABLE 6.3.1

EXISTING (From Electric Model)

				Non-Summer					Summer				
Building #	Chiller	Chiller Tonnage	Chiller KW/Ton	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $
48	Chiller #1	1250	0.87	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277
48	Chiller #2	1250	0.87	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277
48	Chiller #3	1280	0.73	0	0	0	0	$0	0	0	0	0	$0
48	Chiller #4	1100	0.85	3,504	1,026,015	552,830	552,830	$111,558	3,092	1,124,400	468,500	468,500	$139,142
48	Chiller #5	1100	0.85	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142
48	Chiller #6	1100	0.85	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142
49	Chiller #1	660	0.95	942	56,520	75,360	75,360	$15,355	2,355	376,800	219,800	244,920	$77,268
54	Chiller #1	600	0.86	1,010	74,592	68,376	74,592	$16,090	1,684	372,960	181,300	202,020	$61,358
54	Chiller #2	600	0.86	0	0	0	0	$0	1,684	372,960	181,300	202,020	$61,358
54	Chiller #3	700	0.73	0	0	0	0	$0	1,654	366,480	178,150	198,510	$60,292
	Totals			15,510	3,996,807	2,132,726	2,138,942	$445,178	23,833	7,473,600	3,362,850	3,449,770	$1,012,255
											GRAND TOTAL KW		39,343
											GRAND TOTAL KWh		22,554,695
											GRAND TOTAL COST		$1,457,433

Typical Calculation:
Chiller #1 Demand Reduction – Exist Demand KW x Exist KW/Ton ÷ Proposed KW/Ton = Proposed Demand KW
Chiller #1 Usage Reduction – Exist Usage KWh x Exist KW/Ton ÷ Proposed KW/Ton = Proposed Usage KWh

PROPOSED

				Non-Summer					Summer				
Building #	Chiller	Chiller Tonnage	Chiller KW/Ton	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $
48	Chiller #1	1250	0.55	3,178	897,600	453,959	453,959	$95,515	2,270	825,379	378,299	378,299	$105,750
48	Chiller #2	1250	0.55	3,178	897,600	453,959	453,959	$95,515	2,270	825,379	378,299	378,299	$105,750
48	Chiller #3	1280	0.55	0	0	0	0	$0	0	0	0	0	$0
48	Chiller #4	1100	0.55	2,268	663,892	357,714	357,714	$72,185	2,001	727,553	303,147	303,147	$90,033
48	Chiller #5	1100	0.55	0	0	0	0	$0	2,001	727,553	303,147	303,147	$90,033
48	Chiller #6	1100	0.55	0	0	0	0	$0	2,001	727,553	303,147	303,147	$90,033
49	Chiller #1	660	0.55	545	32,722	43,629	43,629	$8,890	1,363	218,147	127,253	141,796	$44,734
54	Chiller #1	600	0.55	646	47,704	43,729	47,704	$10,290	1,077	238,521	115,948	129,199	$39,241
54	Chiller #2	600	0.55	0	0	0	0	$0	1,077	238,521	115,948	129,199	$39,241
54	Chiller #3	700	0.55	0	0	0	0	$0	1,246	276,115	134,223	149,562	$45,426
	Totals			9,814	2,539,518	1,352,989	1,356,964	$282,394	15,305	4,804,722	2,159,409	2,215,795	$650,239
											GRAND TOTAL KW		25,119
											GRAND TOTAL KWh		14,429,398
											GRAND TOTAL COST		$932,634

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During the field survey, it was confirmed that all but one of the large electric centrifugal chillers is using R-11 or R-500 refrigerant, and range in age from twelve to forty-three years old. Replacement machines would be equivalently sized and use new HFC-134a or HCFC-123. See Section 9.0 for a more detailed discussion concerning refrigerants.

The new chillers will be electric centrifugal type and have an efficiency of 0.55 kW/ton (Federal Specification). The existing chillers have efficiencies ranging from 0.73 kW/ton to 0.95 kW/ton. Table 6.3.1, on page 6-10, shows existing and proposed electric energy consumption. The proposed numbers are estimated by using the ratio of the existing efficiency to the new chiller efficiency. By installing new more efficient chillers, demand will be lowered to 25,119 kW/yr and the usage to 14,429,398 kWh/yr. The annual cost for operation of the new chillers will be $932,600.

6.3.3 Construction Cost

The estimated cost to replace the chillers in each of the chiller plants as described above is $4,500,000. An itemized cost estimate is included at the end of this alternative.

Material	$2,600,000
Labor	1,500,000
SIOH	200,000
Design Fee	200,000
Total	**$4,500,000**

6.3.4 Annual Energy Savings

The estimated annual energy savings is $524,800 per year ($1,457,400 - $932,600). The cost figure reflects the annual cost savings with the implementation of new chillers. All quantities are calculated on cooling loads previously established in Section 5.0.

Savings Summary

	Existing	Proposed	Savings
Electric Demand (kW)	39,343	25,119	14,224
Electric Usage (kWh)	22,554,695	14,429,398	8,125,297
Cost ($)	$1,457,400	$932,600	$524,800

6.3.5 Annual Operation and Maintenance Cost

This alternative would require the same number of operators which currently are used to operate and maintain the chiller plants. Maintenance costs will be lowered by eliminating the older chillers. Recurring maintenance savings are estimated at $78,000 per year. Currently, all chillers require compressor repairs each year. It is estimated that the new chillers will require maintenance, on average, every three years or ⅓ the cost.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	0
Maintenance	$117,000	$39,000	$78,000

6.3.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 27,732 mmBtu
(8,125,297 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $18.92/mmBtu
($524,800 ÷ 27,732 mmBtu)

Construction $ = $4,100,000
($2,600,000 + $1,500,000)

SIOH $ = $200.000

Design $ = $200,000

Maintenance = $78,000

Simple Payback (Years)	7.5
Savings to Investment Ratio (SIR)	21

6.3.7 Expected Service Life

Twenty to twenty-five years.

6.3.8 Environmental Considerations

The replacement of old chillers will provide new refrigerants which are environmentally acceptable and available during normal service life of the chillers.

6.3.9 Advantages

- Minimal disruption to the hospital (Building 2) which can not be shut down.
- More efficient operation (lower kW/ton).
- Reduced maintenance and operations expenses, no major overhauls required for a substantial time period.

6.3.10 Disadvantages

- No improvement in system deficiencies.
- System cooling diversity will not improve.
- No future growth capabilities.

ALTERNATE NO. 1
UPGRADE EXISTING CHILLED WATER PLANTS WITH NEW CHILLERS

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1									1
2	BLDG 48 CHILLER #1	1250	TON	$220	$275,000	$80	$100,000	$375,000	2
3	BLDG 48 CHILLER #2	1250	TON	$220	$275,000	$80	$100,000	$375,000	3
4	BLDG 48 CHILLER #4	1100	TON	$220	$242,000	$80	$88,000	$330,000	4
5	BLDG 48 CHILLER #5	1100	TON	$220	$242,000	$80	$88,000	$330,000	5
6	BLDG 48 CHILLER #6	1100	TON	$220	$242,000	$80	$88,000	$330,000	6
7	BLDG 49 CHILLER #1	660	TON	$220	$145,200	$80	$52,800	$198,000	7
8	BLDG 54 CHILLER #1, assemble in place	600	TON	$230	$138,000	$160	$96,000	$234,000	8
9	BLDG 54 CHILLER #2, assemble in place	600	TON	$230	$138,000	$160	$96,000	$234,000	9
10	BLDG 54 CHILLER #3	700	TON	$220	$154,000	$80	$56,000	$210,000	10
11					$0		$0	$0	11
12	DEMOLITION BLDG 48	5	EA		$0	$10,000	$50,000	$50,000	12
13	DEMOLITION BLDG 49	1	EA		$0	$10,000	$10,000	$10,000	13
14	DEMOLITION BLDG 54	3	EA		$0	$10,000	$30,000	$30,000	14
15					$0		$0	$0	15
16	BLDG 54 ADDITIONAL PIPING 12" w/insulation	1600	LF	$70	$112,000	$70	$112,000	$224,000	16
17	BLDG 54 VENTILATION SYSTEM	1	EA	$10,000	$10,000	$15,000	$15,000	$25,000	17
18	BLDG 48 VENTILATION SYSTEM	1	EA	$15,000	$15,000	$20,000	$20,000	$35,000	18
19	BLDG 49 VENTILATION SYSTEM	1	EA	$5,000	$5,000	$10,000	$10,000	$15,000	19
20	BREATHING APPARATUS	5	EA	$500	$2,500	$100	$500	$3,000	20
21					$0		$0	$0	21
22	REFRIGERANT SENSORS AND ALARMS	4	EA	$1,500	$6,000	$1,000	$4,000	$10,000	22
23					$0		$0	$0	23
24	VALVE AND PIPE FOR CHILLERS	9	EA	$2,500	$22,500	$3,000	$27,000	$49,500	24
25					$0		$0	$0	25
26	ELECTRICAL REQUIREMENTS BLDG 48	5	EA	$5,000	$25,000	$5,000	$25,000	$50,000	26
27	ELECTRICAL REQUIREMENTS BLDG 49	1	EA	$5,000	$5,000	$5,000	$5,000	$10,000	27
28	ELECTRICAL REQUIREMENTS BLDG 54	3	EA	$5,000	$15,000	$5,000	$15,000	$30,000	28
29					$0		$0	$0	29
30	CONCRETE WORK	9	EA	$1,000	$9,000	$1,200	$10,800	$19,800	30
1					$0		$0	$0	31
32	REBUILD 1200 TON TOWER IN BLDG 54	1200	TON	$10	$12,000	$25	$30,000	$42,000	32
33					$0		$0	$0	33
34	RIGGING	9	EA		$0	$5,000	$45,000	$45,000	34
35					$0		$0	$0	35
36	ARCH MODIFICATIONS FOR CHILLERS	1	LOT	$10,000	$10,000	$10,000	$10,000	$20,000	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59	CONTINGENCY				$499,800		$315,900	$815,700	59
60					$0		$0	$0	60
61	**TOTALS>>>>>>>>**				**$2,600,000**		**$1,500,000**	**$4,100,000**	61

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        LIFE CYCLE COST ANALYSIS SUMMARY              STUDY: WALTER1
     ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)     LCCID  1.080
INSTALLATION & LOCATION:               REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: ALT#1
ANALYSIS DATE:  08-14-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST        $  4100000.
B. SIOH                     $   200000.
C. DESIGN COST              $   200000.
D. TOTAL COST (1A+1B+1C)    $  4500000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                 $  4500000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST   SAVINGS     ANNUAL $     DISCOUNT   DISCOUNTED
    FUEL     $/MBTU(1)   MBTU/YR(2)  SAVINGS(3)   FACTOR(4)  SAVINGS(5)

    A. ELECT $ 18.92       27732.    $  524689.      15.61   $  8190402.
    B. DIST  $   .00           0.    $       0.      17.56   $        0.
    C. RESID $   .00           0.    $       0.      19.97   $        0.
    D. NAT G $  3.67           0.    $       0.      20.96   $        0.
    E. COAL  $   .00           0.    $       0.      17.58   $        0.
    F. LPG   $   .00           0.    $       0.      16.12   $        0.
    M. DEMAND SAVINGS                $       0.      14.74   $        0.
    N. TOTAL               27732.    $  524689.              $  8190402.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                 $    78000.
       (1) DISCOUNT FACTOR (TABLE A)                 14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                 $  1149720.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                                SAVINGS(+)   YR   DISCNT     DISCOUNTED
               ITEM              COST(-)     OC   FACTR      SAVINGS(+)/
                                   (1)      (2)    (3)       COST(-)(4)

    d. TOTAL                    $      0.                          0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$  1149720.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$   602689.

5. SIMPLE PAYBACK PERIOD (1G/4)                                7.47 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                     $  9340122.

7. SAVINGS TO INVESTMENT RATIO          (SIR)=(6 / 1G)=        2.08
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                    6.93 %
```

6.4 Alternative No. 2

— Convert Building 48 Chilled Water Distribution System to a Variable-Flow Primary/Secondary System

6.4.1 Existing

A description of existing chilled water distribution system is provided in Section 3.4. As shown in Table 6.4.1, on the following page, the chilled water pumps in Building 48 are estimated to use 3,119,100 kWh/yr and 4,215 kW per year of demand. The estimated annual cost to operate the pumps is $181,200.

6.4.2 Description

Revise the chilled water piping system in Building 48 to a variable-flow primary/secondary system.

The existing system is a common pressurized header arrangement. The net result is that the primary chiller flow is also the secondary distribution flow. Consequently, the chiller flow becomes dependant on downstream flow requirements rather than actual overall system cooling loads. This method of operation requires the chilled water plant to operate more primary pumps than chillers which results in higher pressure drops through chillers and excess pumping horsepower. These problems are primarily due to flow requirements at remote sections of the distribution loop which have no secondary pumps.

WALTER REED ARMY MEDICAL CENTER
ALTERNATE No. 2
CONVERT BLDG 48 DISTRIBUTION SYSTEM TO A VARIABLE FLOW PRIMARY/SECONDARY SYSTEM
TABLE 6.4.1

EXISTING (From Electric Model)

				Non-Summer					Summer				
Building #	Pump	Pump HP	Pump Connected KW	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $
48	CHWS-48-1	125	124	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204
48	CHWS-48-2	125	124	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204
48	CHWS-48-3	125	124	0	0	0	0	$0	465	195,300	74,400	74,400	$22,204
48	CHWS-48-4	100	92	483	202,860	77,280	77,280	$17,630	345	144,900	55,200	55,200	$16,474
48	CHWS-48-5	100	92	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474
48	CHWS-48-6	100	92	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474
Totals				1,785	749,700	285,600	285,600	$65,153	2,430	1,020,600	388,800	388,800	$116,033

GRAND TOTAL KW	4,215
GRAND TOTAL KWh	3,119,100
GRAND TOTAL COST	$181,185

PROPOSED

				Non-Summer					Summer				
Building #	Pump	Pump HP	Pump Connected KW	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $	Demand KW	Off-Peak KWh/Yr	Inter KWh/Yr	On-Peak KWh/Yr	Cost $
48	PRIMARY #1	50	38	200	83,790	31,920	31,920	$7,282	143	59,850	22,800	22,800	$6,804
48	PRIMARY #2	50	38	200	83,790	31,920	31,920	$7,282	143	59,850	22,800	22,800	$6,804
48	PRIMARY #3	50	38	0	0	0	0	$0	143	59,850	22,800	22,800	$6,804
48	PRIMARY #4	50	38	200	83,790	31,920	31,920	$7,282	143	59,850	22,800	22,800	$6,804
48	PRIMARY #5	50	38	0	0	0	0	$0	143	59,850	22,800	22,800	$6,804
48	PRIMARY #6	50	38	0	0	0	0	$0	143	59,850	22,800	22,800	$6,804
48	SEC LOOP#1	75	56	190	52,920	20,720	20,720	$5,077	266	75,600	28,000	28,000	$9,981
48	SEC LOOP#1	75	56	190	52,920	20,720	20,720	$5,077	266	75,600	28,000	28,000	$9,981
48	SEC LOOP#1	75	56	190	52,920	20,720	20,720	$5,077	266	75,600	28,000	28,000	$9,981
48	SEC LOOP#2	75	56	168	47,880	19,040	19,040	$4,593	266	71,400	28,000	28,000	$9,842
48	SEC LOOP#3	100	75	225	64,125	25,500	35,985	$6,687	356	101,250	37,500	37,500	$13,367
48	SEC LOOP#4	50	37	30	4,440	1,776	1,776	$519	0	0	0	0	$0
Totals				1,592	526,575	204,236	214,721	$48,876	2,276	758,550	286,300	286,300	$93,977

GRAND TOTAL KW	3,868
GRAND TOTAL KWh	2,276,682
GRAND TOTAL COST	$142,854

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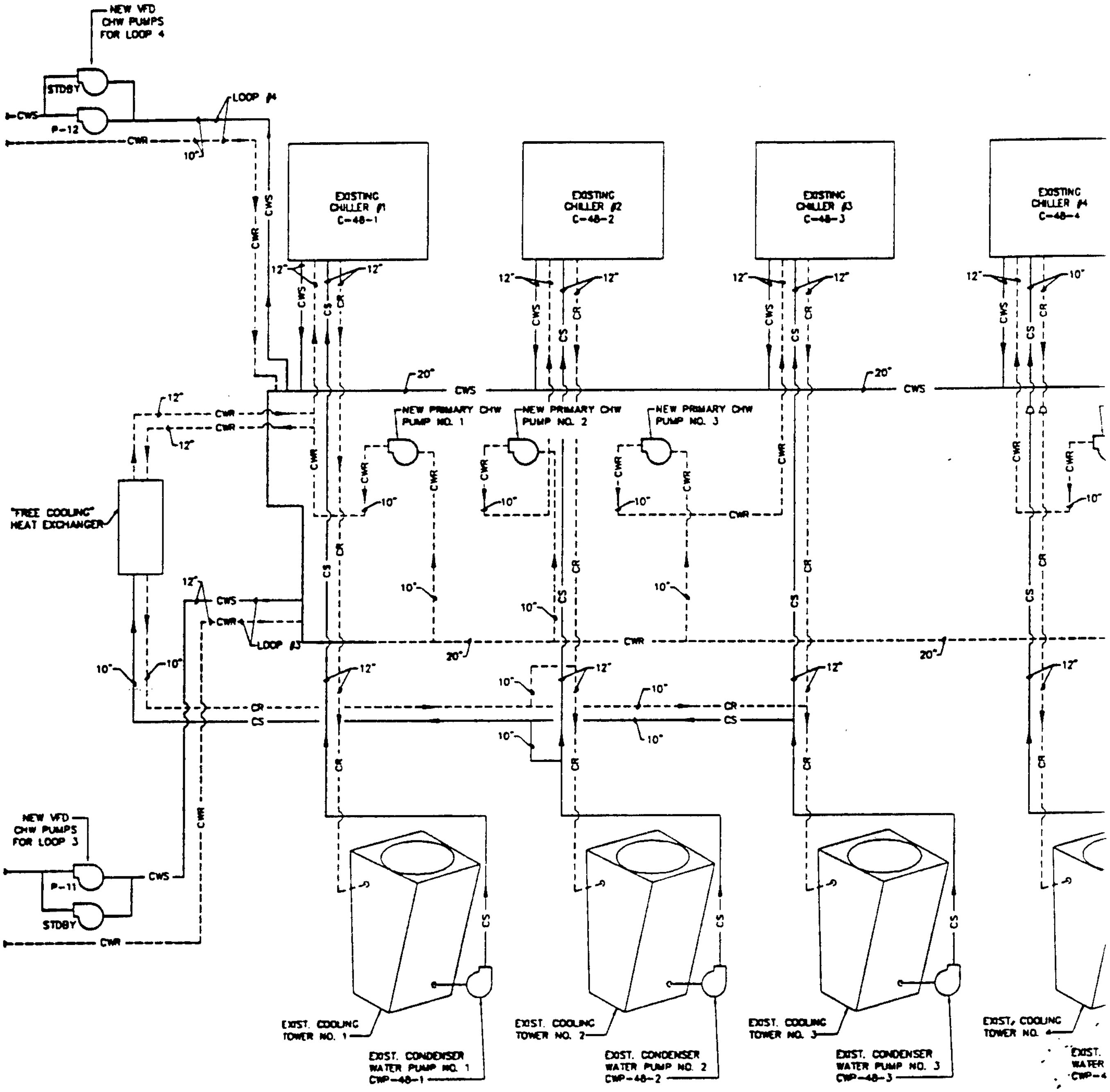
In order to alleviate this problem, a primary/secondary distribution system will be installed with new low-head primary pumps. One (1) primary pump will operate when the respective chiller operates. The primary loop will be located in Building 48 and flow will vary by the number of pumps and chillers operating at full flow to meet the required load.

A set of secondary pumps for each of the four (4) piping loops leaving Building 48 will be installed. Each secondary pump will have at least one (1) operating pump and one (1) standby pump. The secondary pumps shall each have a variable-frequency drive which will vary the pump flow based on system pressure. In Buildings 1, 5, 7, 40, 41, and T-2, 90% of the existing 3-way control valves will be changed to 2-way control valves. In Building 2 and parts of Building 54, most control valves are currently 2-way control valves.

The proposed electric costs shown in Table 6.4.1, page 6-18, were calculated using the electric model. The primary pump costs were derived by using the same operating hours as the existing pumps and altering the pump connected loads. The secondary pump cost was also calculated using the electric model and EZDOE building load profiles. Loop #1's secondary pump demand costs were derived by using 40%, 60%, and 95% of the connected pump load for the winter intermediate and summer periods respectively. Loop #1's usage costs were derived by using 30%, 60%, and 85% of the

5 4

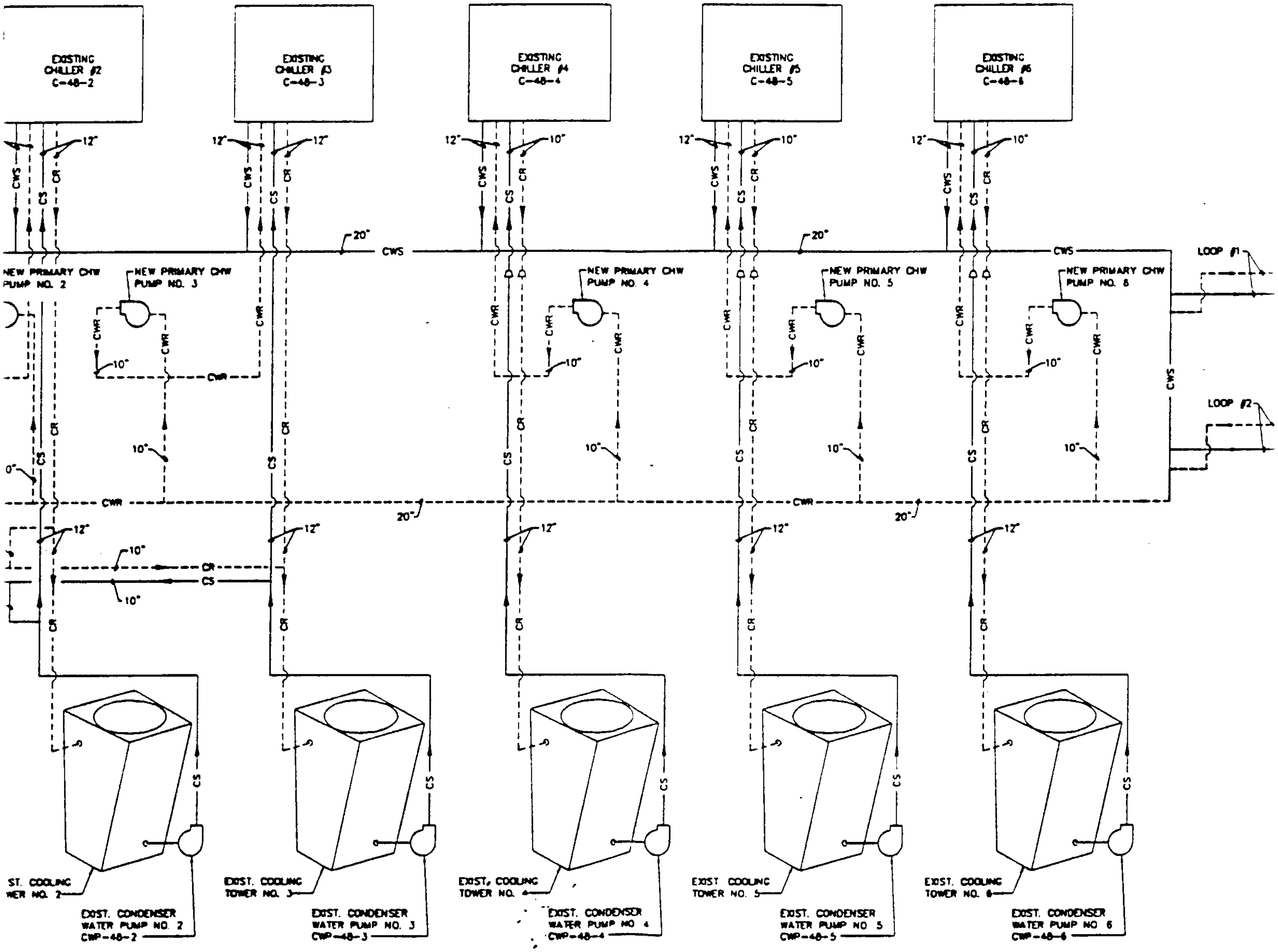


ALTERNATE #2
SCHEMATIC – FLOW DIAGRAM

SCALE: NONE

①

5 4

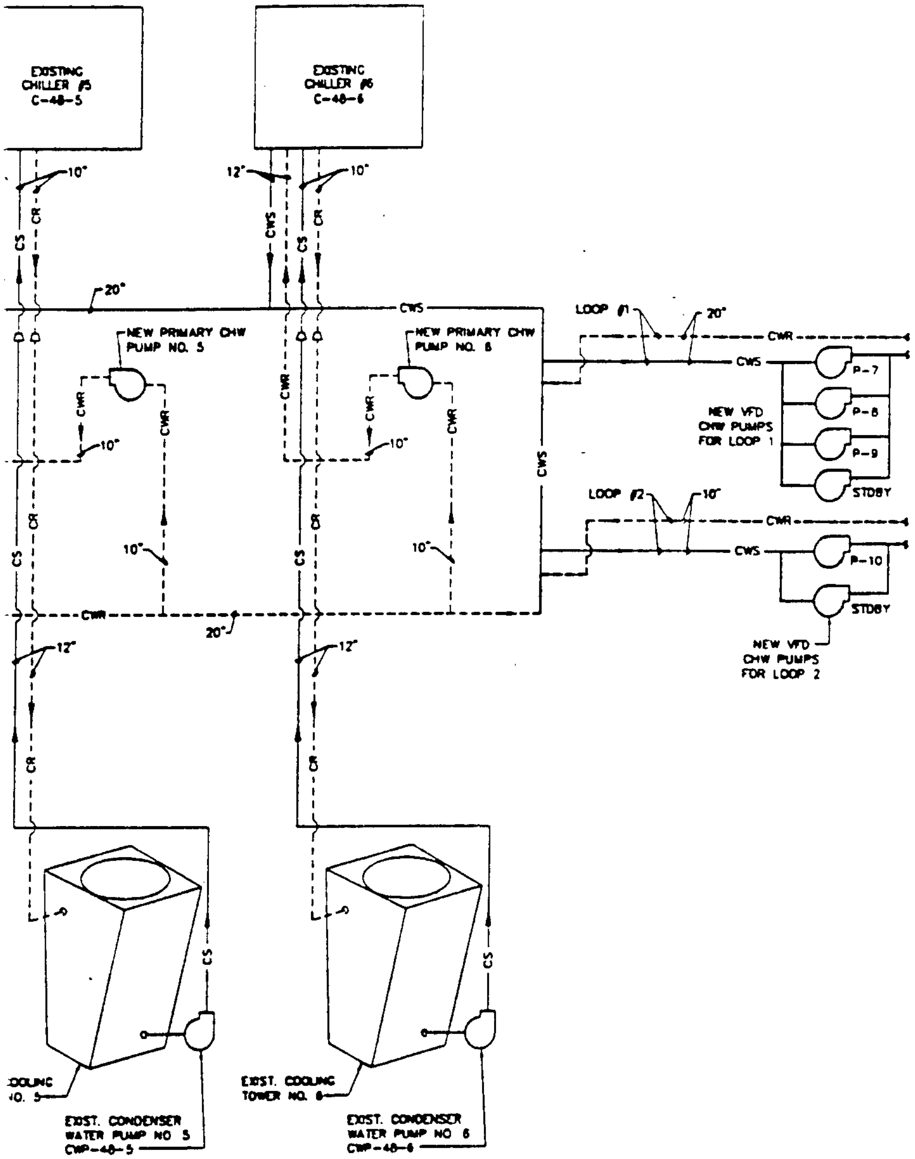


ALTERNATE #2
SCHEMATIC – FLOW DIAGRAM
SCALE: NONE

②

LEGEND

- ——— CWS ——— CHILLED WATER SUPPLY
- - - - - CWR - - - - CHILLED WATER RETURN
- ——— CS ——— CONDENSER WATER SUPPLY
- - - - - CR - - - - CONDENSER WATER RETURN
- ——————— DIRECTION OF FLOW



REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-ALTERNATE NO. 2

ENTECH Engineering Inc., Reading, PA Job #4130.02

DRAWING NUMBER B-4130-02-10

PLATE 10

SCALE NONE

DATE

SHEET M-10

③

primary pump hours per day for the winter, intermediate, and summer periods, respectively.

Electric demand for Loops #2 and #3 was derived by using 30%, 60%, and 95% of the connected pump load for the three periods. The secondary pumps, for Loops #2 and #3, usage costs were derived by using 30%, 50%, and 80% of the primary pump hours per day for the three periods. Loop #4 only operates in the winter since Buildings 54 and 53 are cooled in the intermediate and summer periods by their own chillers. The costs for Loop #4 were derived by using 20% of the connected load for demand and 10% of the primary pump hours per day for the usage.

By providing a primary/secondary chilled water distribution system in Building 48, demand is estimated to be lowered to 3,868 kW and usage lowered to 2,276,682 kWh, for an annual estimated operating cost of $142,900.

6.4.3 Construction Cost

The estimated cost to convert the chilled water distribution system to a variable-flow primary/secondary system is $1,450,000. An itemized cost estimate is included at the end of this alternative.

Material	$ 850,000
Labor	450,000
SIOH	70,000
Design Fee	80,000
Total	**$1,450,000**

6.4.4 Annual Energy Savings

The estimated annual energy saving is $38,300 per year ($181,200 - $142,900). The cost figure reflects the annual cost savings with the implementation of the new variable-flow primary/secondary system. All numbers are calculated on the cooling loads previously established in Section 5.0.

Savings Summary

	Existing	Proposed	Savings
Electric Demand (kW)	4,215	3,868	347
Electric Usage (kWh)	3,119,100	2,276,682	842,418
Cost ($)	$181,200	$142,900	$38,300

6.4.5 Annual Operation and Maintenance Cost

Maintenance costs are estimated to remain relatively constant.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	0
Maintenance	$117,000	$117,000	0

6.4.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 2,875 mmBtu
(842,418 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $13.32/mmBtu
($38,300 ÷ 2,875 mmBtu)

Construction $ = $1,300,000
($850,000 + $550,000)

SIOH $ = $70,000

Design $ = $80,000

Maintenance = $-0-

Simple Payback (Years)	38
Savings to Investment Ratio (SIR)	0.4

6.4.7 Expected Service Life

Fifteen to twenty years.

6.4.8 Environmental Considerations

None.

6.4.9 Advantages

- Reduced pumping energy.
- Improves distribution deficiencies.
- Allows for better load diversity.

6.4.10 Disadvantages

- Requires modifications to existing individual building chilled water pumping and control-valve systems.
- Some disruption to the hospital (Building 2) which cannot be shut down.

ALTERNATE NO. 2
BUILDING 48 CENTRAL DISTRIBUTION SYSTEM TO A VARIABLE FLOW PRIMARY/SECONDARY SYSTEM

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1									1
2	PRIMARY PUMP P-1, 50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	2
3	PRIMARY PUMP P-2, 50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	3
4	PRIMARY PUMP P-3, 50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	4
5	PRIMARY PUMP P-4,50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	5
6	PRIMARY PUMP P-5,50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	6
7	PRIMARY PUMP P-6,50 HP	1	EA	$6,500	$6,500	$600	$600	$7,100	7
8	SECONDARY LOOP #1 PUMP P-7, 75 HP	2	EA	$9,700	$19,400	$800	$1,600	$21,000	8
9	SECONDARY LOOP #1 PUMP P-8, 75 HP	1	EA	$9,700	$9,700	$800	$800	$10,500	9
10	SECONDARY LOOP #1 PUMP P-9, 75 HP	1	EA	$9,700	$9,700	$800	$800	$10,500	10
11	SECONDARY LOOP #2 PUMP P-10, 75 HP	2	EA	$9,700	$19,400	$800	$1,600	$21,000	11
12	SECONDARY LOOP #3 PUMP P-11, 125 HP	2	EA	$10,700	$21,400	$1,100	$2,200	$23,600	12
13	SECONDARY LOOP #4 PUMP P-12, 50 HP	2	EA	$6,500	$13,000	$600	$1,200	$14,200	13
14					$0		$0	$0	14
15	PRIMARY PIPING 20" w/insulation	300	LF	$95	$28,500	$100	$30,000	$58,500	15
16	SECONDARY PIPING 20" w/insulation	600	LF	$95	$57,000	$100	$60,000	$117,000	16
17	SECONDARY PIPING 12" w/insulation	600	LF	$70	$42,000	$50	$30,000	$72,000	17
18	SECONDARY PIPING 10" w/insulstion	1200	LF	$62	$74,400	$60	$72,000	$146,400	18
19					$0		$0	$0	19
20	VALVES NEW FOR PUMPS 10"	42	EA	$550	$23,100	$190	$7,980	$31,080	20
21	VALVES NEW FOR PUMPS 12"	6	EA	$850	$5,100	$250	$1,500	$6,600	21
22					$0		$0	$0	22
23	ELECTRICAL REQUIREMENTS BLDG 48	16	EA	$5,000	$80,000	$5,000	$80,000	$160,000	23
24					$0		$0	$0	24
25	VARIABLE FREQUENCY DRIVE 75 HP	6	EA	$20,000	$120,000	$2,000	$12,000	$132,000	25
26	VARIABLE FREQUENCY DRIVE 125 HP	2	EA	$25,000	$50,000	$2,000	$4,000	$54,000	26
27	VARIABLE FREQUENCY DRIVE 50 HP	2	EA	$14,000	$28,000	$2,000	$4,000	$32,000	27
28	PRESSURE SENSORS	4	EA	$500	$2,000	$500	$2,000	$4,000	28
29	CONTROLS	60	PTS	$750	$45,000	$750	$45,000	$90,000	29
30					$0		$0	$0	30
	CONCRETE PADS FOR PUMPS	10	EA	$100	$1,000	$400	$4,000	$5,000	31
32					$0		$0	$0	32
33	REPLACE 3WAY W/2WAY VALVES BLDG 1	32	EA	$300	$9,600	$150	$4,800	$14,400	33
34	REPLACE 3WAY W/2WAY VALVES BLDG 5	3	EA	$300	$900	$150	$450	$1,350	34
35	REPLACE 3WAY W/2WAY VALVES BLDG 7	5	EA	$300	$1,500	$150	$750	$2,250	35
36	REPLACE 3WAY W/2WAY VALVES BLDG 40	20	EA	$300	$6,000	$150	$3,000	$9,000	36
37	REPLACE 3WAY W/2WAY VALVES BLDG 41	3	EA	$300	$900	$150	$450	$1,350	37
38	REPLACE 3WAY W/2WAY VALVES BLDG T2	11	EA	$300	$3,300	$150	$1,650	$4,950	38
39					$0		$0	$0	39
40	DEMOLITION OF PUMPS	6	EA		$0	$600	$3,600	$3,600	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59	CONTINGENCY				$140,100		$71,020	$211,120	59
60					$0		$0	$0	60
61	**TOTALS>>>>>>>>**				**$850,000**		**$450,000**	**$1,300,000**	61

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          LIFE CYCLE COST ANALYSIS SUMMARY             STUDY: WALTER1
     ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID  1.080
INSTALLATION & LOCATION:               REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: ALT#2
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST      $  1300000.
B. SIOH                   $    70000.
C. DESIGN COST            $    80000.
D. TOTAL COST (1A+1B+1C)  $  1450000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                  $  1450000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST   SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
    FUEL     $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)   FACTOR(4)  SAVINGS(5)

    A. ELECT $ 13.32       2875.      $   38295.      15.61   $   597785.
    B. DIST  $   .00          0.      $       0.      17.56   $        0.
    C. RESID $   .00          0.      $       0.      19.97   $        0.
    D. NAT G $   .00          0.      $       0.      20.96   $        0.
    E. COAL  $   .00          0.      $       0.      17.58   $        0.
    F. LPG   $   .00          0.      $       0.      16.12   $        0.
    M. DEMAND SAVINGS                 $       0.      14.74   $        0.
    N. TOTAL               2875.      $   38295.              $   597785.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                  $        0.
       (1) DISCOUNT FACTOR (TABLE A)                  14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                  $        0.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                            SAVINGS(+)   YR   DISCNT     DISCOUNTED
               ITEM           COST(-)    OC   FACTR      SAVINGS(+)/
                                 (1)    (2)    (3)       COST(-)(4)

    d. TOTAL                $      0.                           0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$        0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    38295.

5. SIMPLE PAYBACK PERIOD (1G/4)                                 37.86 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $   597785.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=            .41
    (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                     -1.37 %
```

6.5 Alternative No. 3

— Upgrade Condenser Water and Chilled Water Free-Cooling Systems

6.5.1 Existing

A description of Building 48's chilled water and free-cooling systems is provided in Section 3.4. As shown in Table 6.5.1 page 6-29, Building 48's free-cooling system is not adequately sized and operated to meet winter loads. The system is currently not in use. During the winter, one to three chillers in Building 48 must operate to provide adequate cooling. Energy usage for Building 48's chilled water system (chillers, pumps, and cooling towers) is estimated at 5,941,820 kWh/yr of usage and 9,448 kW of demand during this period. The estimated annual winter operating cost for the system in Building 48 is $306,300.

6.5.2 Description

Upgrade the existing chilled water "free-cooling" system in Building 48 with new plate and frame heat exchangers. This system uses condenser water circulation through the cooling tower to cool central distribution chilled water. A similar system currently exists but has limited use due to capacity constraints.

The current plate and frame heat exchanger would be replaced with two (2) larger capacity units. Piping would be upgraded to allow additional flow capacity using two (2) condenser water pumps, two

(2) cooling towers, and two (2) chilled water pumps. The installation would allow two chillers to be shut down during periods of low load. A third chiller would still need to operate to meet higher loads.

Table 6.5.1 shows the existing and proposed electric costs. The proposed quantities are estimated by shutting down Chillers #1 and #2 and increasing the usage of Cooling Towers #1 and #2. By adding the plate and frame heat exchangers in Building 48, the chilled water is estimated to use 2,820,220 kWh/yr and 4,115 kW of demand during the winter months. The annual cost will be $142,300.

WALTER REED ARMY M[illegible]L CENTER
ALTERNATE No. 3
CONDENSER WATER/CHILLED WATER FREE COOLING SYSTEM
TABLE 6.5.1

EXISTING

BLDG	Description	Total Connected Load (kW)	Winter Demand kW/Month	Winter Billing Months Off-Peak		Inter.		On-Peak		Demand kW/Yr.	Winter Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $
				hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo					
48	Chiller C-48-1	1,088	653	6.0	195,840	4.5	97,920	4.5	97,920	2,611	783,360	391,680	391,680	$81,861
48	Chiller C-48-2	1,088	653	6.0	195,840	4.5	97,920	4.5	97,920	2,611	783,360	391,680	391,680	$81,861
48	Chiller C-48-3	1,088	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-4	937	469	5.0	140,550	4.0	74,960	4.0	74,960	1,874	562,200	299,840	299,840	$60,530
48	Chiller C-48-5	937	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-6	937	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-1	124	93	10.5	39,060	6.0	14,880	6.0	14,880	372	156,240	59,520	59,520	$13,578
48	Pump CHWS-48-2	124	93	10.5	39,060	6.0	14,880	6.0	14,880	372	156,240	59,520	59,520	$13,578
48	Pump CHWS-48-3	124	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-4	92	69	10.5	28,980	6.0	11,040	6.0	11,040	276	115,920	44,160	44,160	$10,074
48	Pump CHWS-48-5	92	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-6	92	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-1	112	84	10.5	35,280	6.0	13,440	6.0	13,440	336	141,120	53,760	53,760	$12,264
48	Pump CWS-48-2	112	84	10.5	35,280	6.0	13,440	6.0	13,440	336	141,120	53,760	53,760	$12,264
48	Pump CWS-48-3	112	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-4	93	70	10.5	29,295	6.0	11,160	6.0	11,160	279	117,180	44,640	44,640	$10,184
48	Pump CWS-48-5	93	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-6	93	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-1	45	34	7.0	9,450	4.0	3,600	4.0	3,600	135	37,800	14,400	14,400	$3,582
48	Clg Tower CT-48-2	45	34	7.0	9,450	4.0	3,600	4.0	3,600	135	37,800	14,400	14,400	$3,582
48	Clg Tower CT-48-3	45	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-4	37	28	7.0	7,770	4.0	2,960	4.0	2,960	111	31,080	11,840	11,840	$2,945
48	Clg Tower CT-48-5	37	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-6	37	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
	TOTALS	7,428	2,362		765,855		359,800		359,800	9,448	3,063,420	1,439,200	1,439,200	$306,303
											Total KWH/Yr.		5,941,820	

Winter Months, December, January, February, March

	Winter
Incremental Demand Cost, $/kW	$6.60
Off-Peak Incremental Usage Cost, $/kWh	$0.035
Intermediate Incremental Usage Cost, $/kWh	$0.044
On-Peak Incremental Usage Cost, $/kWh	$0.051

PROPOSED

BLDG	Description	Total Connected Load (kW)	Winter Demand kW/Month	Winter Billing Months Off-Peak		Inter.		On-Peak		Demand kW/Yr.	Winter Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $
				hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo					
48	Chiller C-48-1	1,088	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-2	1,088	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-3	1,088	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-4	937	469	5.0	140,550	4.0	74,960	4.0	74,960	1,874	562,200	299,840	299,840	$60,530
48	Chiller C-48-5	937	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Chiller C-48-6	937	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-1	124	93	10.5	39,060	6.0	14,880	6.0	14,880	372	156,240	59,520	59,520	$13,578
48	Pump CHWS-48-2	124	93	10.5	39,060	6.0	14,880	6.0	14,880	372	156,240	59,520	59,520	$13,578
48	Pump CHWS-48-3	124	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-4	92	69	10.5	28,980	6.0	11,040	6.0	11,040	276	115,920	44,160	44,160	$10,074
48	Pump CHWS-48-5	92	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CHWS-48-6	92	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-1	112	84	10.5	35,280	6.0	13,440	6.0	13,440	336	141,120	53,760	53,760	$12,264
48	Pump CWS-48-2	112	84	10.5	35,280	6.0	13,440	6.0	13,440	336	141,120	53,760	53,760	$12,264
48	Pump CWS-48-3	112	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-4	93	70	10.5	29,295	6.0	11,160	6.0	11,160	279	117,180	44,640	44,640	$10,184
48	Pump CWS-48-5	93	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Pump CWS-48-6	93	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-1	45	34	10.5	14,175	6.0	5,400	6.0	5,400	135	56,700	21,600	21,600	$4,928
48	Clg Tower CT-48-2	45	34	10.5	14,175	6.0	5,400	6.0	5,400	135	56,700	21,600	21,600	$4,928
48	Clg Tower CT-48-3	45	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-4	37	28	7.0	7,770	4.0	2,960	4.0	2,960	111	31,080	11,840	11,840	$2,945
48	Clg Tower CT-48-5	37	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
48	Clg Tower CT-48-6	37	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
	TOTALS	7,428	1,029		375,855		164,600		164,600	4,115	1,503,420	658,400	658,400	$142,327
											Total KWH/Yr.		2,820,220	

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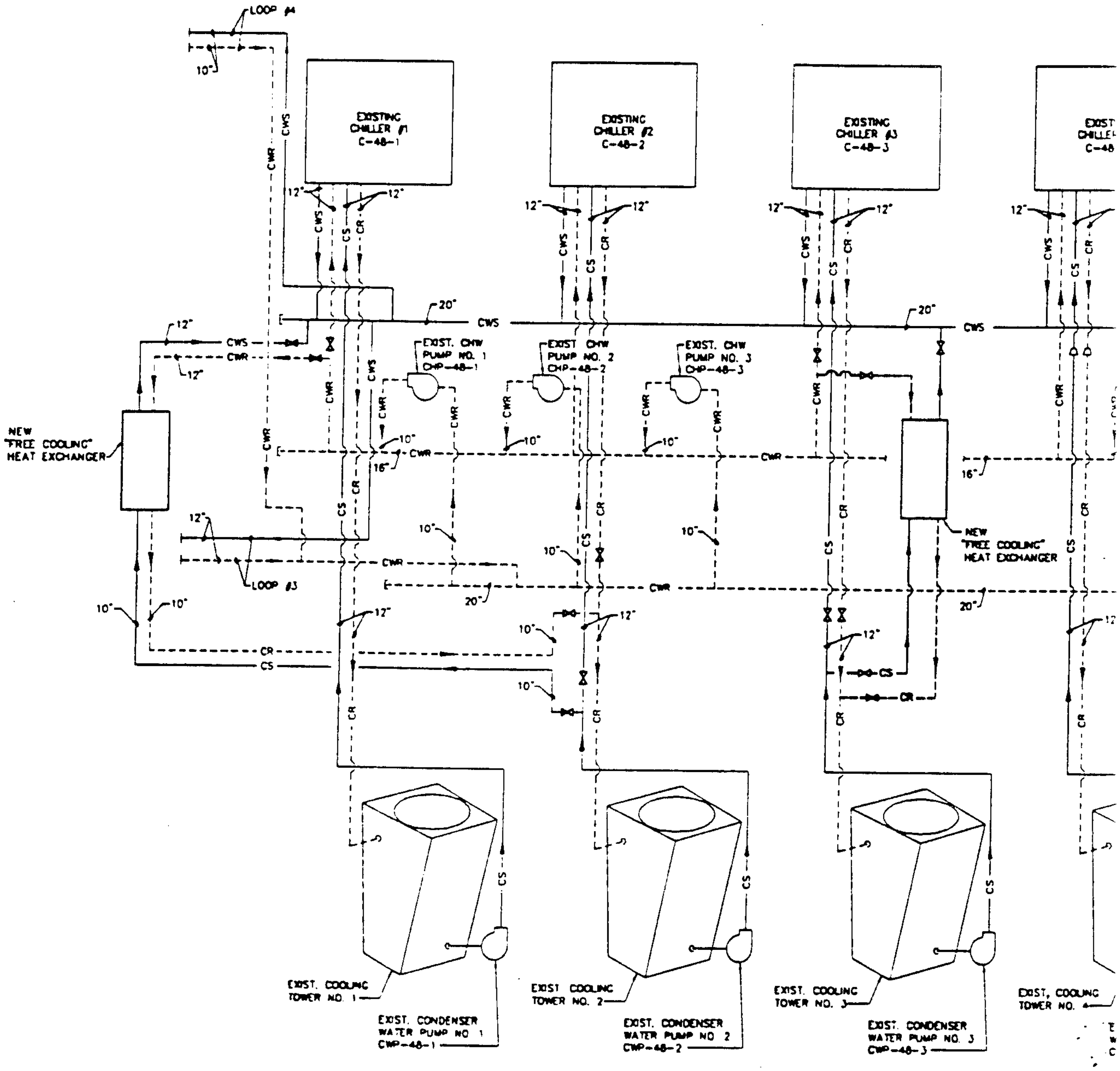
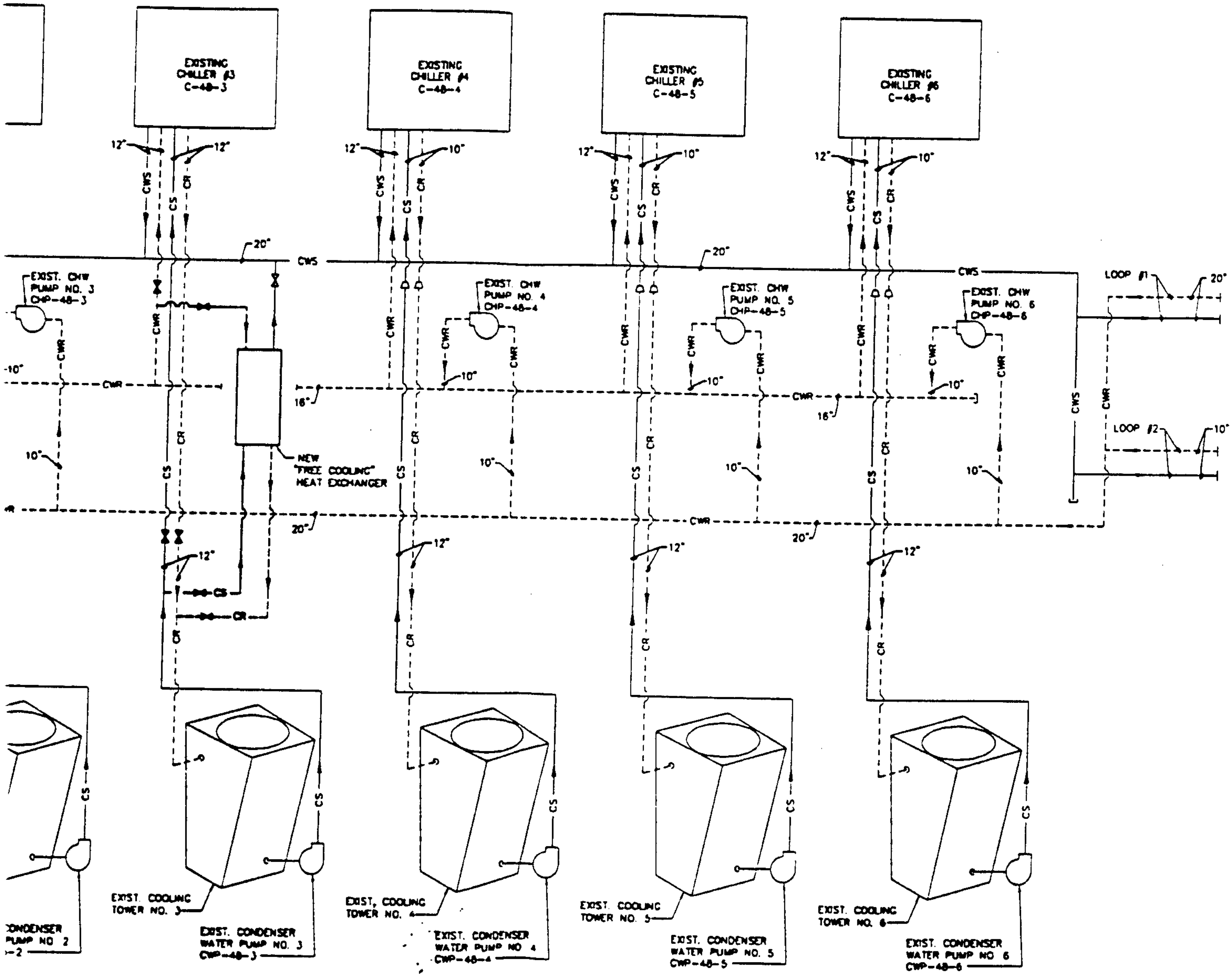


ALTERNATE #3
SCHEMATIC - FLOW DIAGRAM

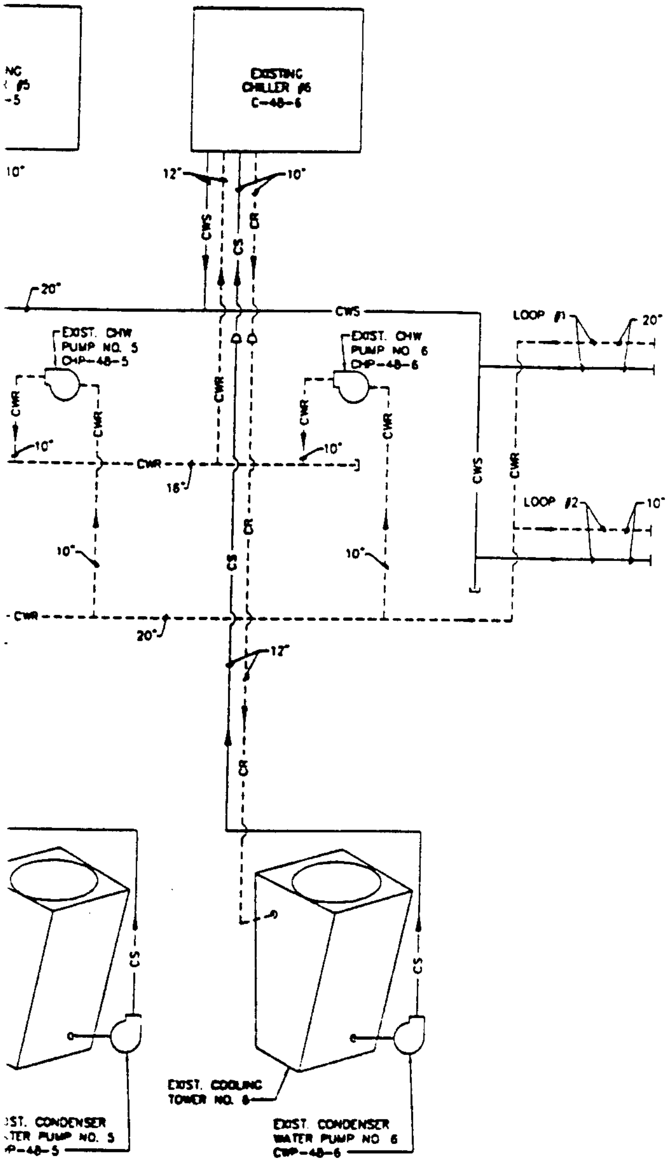
SCALE: NONE

①



ALTERNATE #3
SCHEMATIC – FLOW DIAGRAM
SCALE: NONE

Ⓠ



LEGEND

—— CWS ——	CHILLED WATER SUPPLY
- - - - CWR - - - -	CHILLED WATER RETURN
—— CS ——	CONDENSER WATER SUPPLY
- - - - CR - - - -	CONDENSER WATER RETURN
————	DIRECTION OF FLOW

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-ALTERNATE #3

ENTECH Engineering Inc., Reading, PA Job #4130.02

DRAWING NUMBER B-4130-02-11

11

SCALE NONE

DATE

SHEET M-11

③

6.5.3 Capital Cost Estimate

The estimated cost to provide free waterside cooling is $670,000. An itemized cost estimate is included at the end of this alternative.

Material	$370,000
Labor	230,000
SIOH	30,000
Design Fee	40,000
Total	**$670,000**

6.5.4 Annual Energy Savings

The estimated annual energy savings is $164,000 per year ($306,300 - $142,300). This figure reflects the annual cost savings with the implementation of new plate and frame heat exchangers, controls, and piping. All numbers are calculated on the previously established cooling loads in Section 5.0.

Savings Summary

	Existing	Proposed	Savings
Electric Demand (kW)	9,448	4,115	5,333
Electric Usage (kWh)	5,941,820	2,820,220	3,121,600
Cost ($)	$306,300	$142,300	$164,000

6.5.5 Annual Operation and Maintenance Cost

This alternative does not impact the number of plant operations. Maintenance costs are minimal because there are few moving parts or complicated pieces of equipment.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	0
Maintenance	$117,000	$117,000	0

6.5.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 10,654 mmBtu (3,121,600 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $15.39/mmBtu ($164,000 ÷ 10,654 mmBtu)

Construction $ = $600,000 ($370,000 + $230,000)

SIOH $ = $30,000

Design $ = $40,000

Maintenance = $-0-

Simple Payback (Years)	4.1
Savings to Investment Ratio (SIR)	3.8

6.5.7 Expected Service Life

Twenty years.

6.5.8 Environmental Consideration

None.

6.5.9 Advantages

- Provides chilled water cooling without using electric chillers during low-load winter periods.
- Reduce winter chilled operation cost.

6.5.10 Disadvantages

- Requires freeze protection controls for the cooling towers.
- Requires operator attention to avoid freeze damage to systems.

ALTERNATE NO. 3
UPGRADE CONDENSER WATER/CHILLED WATER FREE COOLING SYSTEM

				MATERIAL		LABOR			
	DESCRIPTION	QUAN.	UNITS	$/UNIT	TOTAL	$/UNIT	TOTAL	LINE TOTAL	#
1									1
2	PLATE & FRAME HTXGHR	2	EA	$50,000	$100,000	$20,000	$40,000	$140,000	2
3	2-WAY CONTROL VALVES	8	EA	$750	$6,000	$300	$2,400	$8,400	3
4	PIPING 12" w/insulation	2000	LF	$65	$130,000	$45	$90,000	$220,000	4
5	MANUAL SHUT-OFF VALVES 12"	8	EA	$500	$4,000	$250	$2,000	$6,000	5
6	BALANCE VALVES 12"	2	EA	$2,000	$4,000	$500	$1,000	$5,000	6
7	CONTROLS	30	PTS	$750	$22,500	$750	$22,500	$45,000	7
8	ELECTRICAL REQUIREMENTS BLDG 48	1	LOT	$2,000	$2,000	$3,000	$3,000	$5,000	8
9	EXIST HEAT EXCHANGER DEMOLITION	1	EA		$0	$3,000	$3,000	$3,000	9
10					$0		$0	$0	10
11					$0		$0	$0	11
12					$0		$0	$0	12
13					$0		$0	$0	13
14					$0		$0	$0	14
15					$0		$0	$0	15
16					$0		$0	$0	16
17					$0		$0	$0	17
18					$0		$0	$0	18
19					$0		$0	$0	19
20					$0		$0	$0	20
21					$0		$0	$0	21
22					$0		$0	$0	22
23					$0		$0	$0	23
24					$0		$0	$0	24
25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
					$0		$0	$0	30
					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
35					$0		$0	$0	35
36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59	CONTINGENCY				$101,500		$66,100	$167,600	59
60					$0		$0	$0	60
	TOTALS>>>>>>>>>				**$370,000**		**$230,000**	**$600,000**	61

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ENTECH ENGINEERING INC. 19-Jun-95

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                 LIFE CYCLE COST ANALYSIS SUMMARY            STUDY: WALTER1
            ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID  1.080
INSTALLATION & LOCATION:                   REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR       DISCRETE PORTION NAME: ALT#3
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST       $    600000.
B. SIOH                    $     30000.
C. DESIGN COST             $     40000.
D. TOTAL COST (1A+1B+1C)   $    670000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $         0.
F. PUBLIC UTILITY COMPANY REBATE       $         0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                   $    670000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST    SAVINGS      ANNUAL $      DISCOUNT    DISCOUNTED
    FUEL     $/MBTU(1)    MBTU/YR(2)   SAVINGS(3)    FACTOR(4)   SAVINGS(5)

    A. ELECT $ 15.39       10654.      $  163965.       15.61    $  2559495.
    B. DIST  $   .00           0.      $        0.      17.56    $         0.
    C. RESID $   .00           0.      $        0.      19.97    $         0.
    D. NAT G $   .00           0.      $        0.      20.96    $         0.
    E. COAL  $   .00           0.      $        0.      17.58    $         0.
    F. LPG   $   .00           0.      $        0.      16.12    $         0.
    M. DEMAND SAVINGS                  $        0.      14.74    $         0.
    N. TOTAL               10654.      $  163965.                $  2559495.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                     $         0.
       (1) DISCOUNT FACTOR (TABLE A)                    14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                     $         0.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                                SAVINGS(+)   YR    DISCNT      DISCOUNTED
                 ITEM            COST(-)     OC    FACTR       SAVINGS(+)/
                                   (1)      (2)     (3)        COST(-)(4)

    d. TOTAL                 $       0.                               0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$         0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    163965.

5. SIMPLE PAYBACK PERIOD (1G/4)                                   4.09 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                     $  2559495.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=            3.82
    (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                      10.25 %
```

6.6 Alternative No. 4

— Upgrade Existing Building 48 Chilled Water Plant and Provide New Building 49 Chilled Water Plant

6.6.1 Existing

A description of the existing chilled water distribution system is provided in Section 3.4. As shown in Table 6.6.1 page 6-40, the existing chilled water systems (chillers, pumps, and towers) at WRAMC are estimated to use 34,042,924 kWh/yr and 56,376 kW of demand per year. The estimated annual cost to operate all these systems is $2,174,000.

6.6.2 Description

Upgrade Building 48's chilled water plant with new 0.55 kW/ton (Federal Specification) chillers and a primary/secondary variable-flow distribution system. Building 48's system would supply Buildings 1, 2, 5, and 7. A new Building 49 chilled water plant would be constructed with a chilled water production capacity to satisfy the remaining WRAMC chilled water requirements. The chillers in Buildings 54 and 7 will be eliminated.

There are currently eleven (11) chillers serving twelve (12) buildings at the Center and are distributed as follows:

Building	Chillers	Tons
Building 48	6	7,080
Building 54	3	1,900
Building 7	1	200
Building 49	1	660
Totals	11	9,840

Buildings 1, 2, 5, and 7 require 70% of the total center cooling capacity, while Buildings 54, 53, 12, 40, 41, T2, 14, 17, and 11 requires the remaining 30% of the capacity.

Building 48 will have six (6) chillers, three (3) at 1,200 tons and three (3) at 1,100 tons. The existing chilled water distribution system would be modified to a variable-flow primary/secondary system as detailed in Alternative 2. The existing chilled water distribution headers, within Building 48 and central distribution system to Buildings 1, 2, 5, and 7, would be reused. Refer to Plate 12, page 6-40.

Provide new low-head primary pumps. One (1) primary pump per chiller will operate when the respective chiller operates. The primary loop will be in Building 48 with variable flow by the number of pumps and chillers operating at full flow to meet the required load. Provide two (2) sets of secondary pumps, one for each loop to Building 2 and Buildings 1, 5, and 7 respectively. Each secondary pump set will have at least one (1) operating pump and one (1) standby pump. The secondary pump shall have a variable-frequency drive which will vary the flow based on system pressure.

In Buildings 1, 5, and 7, 90% of the existing 3-way control valves will be changed to 2-way control valves. In Building 2, most control valves are currently 2-way control valves. The existing cooling towers and condenser pumps will be reused with the new chillers.

A new Building 49 chilled water plant would be constructed on the east side of the central heating plant, Building 15. This option would require a new structure and new distribution system. The new chiller plant will have three (3) chillers at 1,000 tons each.

Each chiller will have a cooling tower, condenser water pump, and chilled water pump dedicated to it. The chilled water distribution system will be variable-volume primary/secondary pumping system. Two (2) variable-volume primary pumps will be provided to distribute chilled water to each building. Refer to Plate 13, page 6-41.

In addition, all buildings except Building T-2, will require system modifications to provide secondary chilled water pumps with variable-frequency drives. In each building, 90% of the existing 3-way control valves will be changed to 2-way control valves. In

Building T-2, which has an existing building pump, the pump will be modified to be a variable frequency-driven pump. This overall change would result in a variable-flow primary/secondary chilled water pumping system.

The new chillers will be electric centrifugal type and have an efficiency of 0.55 kW/ton (Federal Specifications). Secondary pump operation will take into account the use of variable-frequency drives. Operating hours are estimated based on the existing electric model. Table 6.6.2 page 6-41, shows proposed electric usage estimated at 26,171,610 kWh and demand at 43,153 kW, for a total annual cost of $1,671,000.

WALTER REE
AI
UPGRADE BUILDING 48 CHILLED WATER PLAN

EXISTIN

No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	Winter Billing Months						Intermediate Billing Mont			
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.	
						hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo
1															
2	**Building #48**														
3	Chiller C-48-1	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800
4	Chiller C-48-2	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800
5	Chiller C-48-3	1,088	0	0	718	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6	Chiller C-48-4	937	469	543	618	5.0	140,550	4.0	74,960	4.0	74,960	5.5	154,605	4.5	84,330
7	Chiller C-48-5	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
8	Chiller C-48-6	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
9	Pump CHWS-48-1	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880
10	Pump CHWS-48-2	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880
11	Pump CHWS-48-3	124	0	0	93	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
12	Pump CHWS-48-4	92	69	69	69	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040
13	Pump CHWS-48-5	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
14	Pump CHWS-48-6	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
15	Pump CWS-48-1	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440
16	Pump CWS-48-2	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440
17	Pump CWS-48-3	112	0	0	84	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
18	Pump CWS-48-4	93	70	70	70	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160
19	Pump CWS-48-5	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
20	Pump CWS-48-6	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
21	Clg Tower CT-48-1	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950
22	Clg Tower CT-48-2	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950
23	Clg Tower CT-48-3	45	0	0	34	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
24	Clg Tower CT-48-4	37	28	28	28	7.0	7,770	4.0	2,960	4.0	2,960	10.0	11,100	5.5	4,070
25	Clg Tower CT-48-5	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
26	Clg Tower CT-48-6	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
27	Subtotal	7,584	2,362	2,742	5,141		765,855		359,800		359,800		823,980		394,740
28	**Building #49**														
29	Chiller C-49-1	628	0	314	471	0.0	0	0.0	0	0.0	0	1.0	18,840	2.0	25,120
30	Pump CHWS-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720
31	Pump CHWS-49-1	56	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
32	Pump CWS-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720
33	Clg Tower CT-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	2.0	3,360	3.0	3,360
34	Subtotal	852	0	440	597		0		0		0		42,360		41,920
35	**Building #T-2**														
36	Pump CHWS-07-1	11.2	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
37	Subtotal		0.0	0.0	0.0		0		0		0		0		0
38	**Building #07**														
39	Chiller C-07-1	200.0	0.0	100.0	150.0	0.0	0	0.0	0	0.0	0	1.0	6,000	2.0	8,000
40	Pump CHWS-07-1	5.6	0.0	4.2	4.2	0.0	0	0.0	0	0.0	0	6.0	1,007	6.0	671
41	Subtotal	206	0	104	154		0		0		0		7,007		8,671
42	**Building #54**														
43	Chiller C-54-1	518	0	337	337	0.0	0	0.0	0	0.0	0	1.6	24,864	2.2	22,792
44	Chiller C-54-2	518	0	0	337	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
45	Chiller C-54-3	509	0	0	331	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
46	Pump CHWS-54-1	30	0	23	23	0.0	0	0.0	0	0.0	0	6.0	5,400	6.0	3,600
47	Pump CHWS-54-2	30	0	0	23	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
48	Pump CHWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
49	Pump CWS-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	6.0	6,660	6.0	4,440
50	Pump CWS-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
51	Pump CWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
52	Clg Tower CT-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	2.0	2,238	3.0	2,238
53	Clg Tower CT-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
54	Clg Tower CT-54-3	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
55	Subtotal	1,903	0	415	1,273		0		0		0		39,162		33,070
56	TOTALS	10,544	2,362	3,701	7,165		765,855		359,800		359,800		912,509		478,401

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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WALTER REED ARMY MEDICAL CENTER
ALTERNATE NO. 4
BUILDING 48 CHILLED WATER PLANT AND PROVIDE NEW BUILDING 49 CHILLED WATER PLANT
Table 6.6.1
EXISTING ELECTRIC MODEL

Months			Intermediate Billing Months						Summer Billing Months						Non-Summer				
r.	On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Demand	Off-Peak	Inter	On-Peak	Cost
Wh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	kW/Yr.	KWH/Yr.	KWH/Yr.	KWH/Yr.	$
97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,08
97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	261,120	5.5	119,680	5.5	119,680	0	0	0	0	$0
74,960	4.0	74,960	5.5	154,605	4.5	84,330	4.5	84,330	8.0	224,880	5.0	93,700	5.0	93,700	3,504	1,026,015	552,830	552,830	$111,55
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0
14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,76
14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,76
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	39,060	6.0	14,880	6.0	14,880	0	0	0	0	$0
11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	483	202,860	77,280	77,280	$17,63
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0
13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,46
13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,46
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	35,280	6.0	13,440	6.0	13,440	0	0	0	0	$0
11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	14,175	6.0	5,400	6.0	5,400	0	0	0	0	$0
2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5	4,070	10.5	11,655	6.0	4,440	6.0	4,440	194	64,380	24,050	24,050	$5,82
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0
359,800		359,800		823,980		394,740		394,740		1,933,335		821,220		821,220	17,674	5,535,360	2,623,420	2,623,420	$559,60
0	0.0	0	1.0	18,840	2.0	25,120	2.0	25,120	4.0	75,360	3.5	43,960	3.9	48,984	942	56,520	75,360	75,360	$15,35
0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,80
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,80
0	0.0	0	2.0	3,360	3.0	3,360	3.0	3,360	6.0	10,080	6.0	6,720	6.0	6,720	126	10,080	10,080	10,080	$2,14
0		0		42,360		41,920		41,920		115,680		64,120		69,144	1,320	127,080	125,760	125,760	$25,10
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
0		0		0		0		0		0		0		0	0	0	0	0	$0
0	0.0	0	1.0	6,000	2.0	8,000	2.0	8,000	4.0	24,000	3.5	14,000	3.9	15,600	300	18,000	24,000	24,000	$4,890
0	0.0	0	6.0	1,007	6.0	671	6.0	671	9.0	1,511	6.0	671	6.0	671	13	3,021	2,014	2,014	$380
0		0		7,007		8,671		8,671		25,511		14,671		16,271	313	21,021	26,014	26,014	$5,270
0	0.0	0	1.6	24,864	2.2	22,792	2.4	24,864	4.8	74,592	3.5	36,260	3.9	40,404	1,010	74,592	68,376	74,592	$16,090
0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	74,592	3.5	36,260	3.9	40,404	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	73,296	3.5	35,630	3.9	39,702	0	0	0	0	$0
0	0.0	0	6.0	5,400	6.0	3,600	6.0	3,600	8.0	7,200	6.0	3,600	6.0	3,600	68	16,200	10,800	10,800	$2,039
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	7,200	6.0	3,600	6.0	3,600	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0
0	0.0	0	6.0	6,660	6.0	4,440	6.0	4,440	8.0	8,880	6.0	4,440	6.0	4,440	83	19,980	13,320	13,320	$2,514
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	8,880	6.0	4,440	6.0	4,440	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0
0	0.0	0	2.0	2,238	3.0	2,238	3.0	2,238	6.0	6,714	6.0	4,476	6.0	4,476	84	6,714	6,714	6,714	$1,427
0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0
0		0		39,162		33,070		35,142		301,662		151,098		163,458	1,245	117,486	99,210	105,426	$22,069
59,800		359,800		912,509		478,401		480,473		2,376,188		1,051,109		1,070,093	20,551	5,800,947	2,874,404	2,880,620	$612,054

Model Yearly Totals

Total Yearly Demand	
Total Yearly Usage	
Total Yearly Cost	

②

ER

ILDING 49 CHILLED WATER PLANT

illing Months													
iter.	On-Peak		Non-Summer					Summer					
kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
													1
													2
119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	3
119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	4
119,680	5.5	119,680	0	0	0	0	$0	3,590	1,305,600	598,400	598,400	$167,277	5
93,700	5.0	93,700	3,504	1,026,015	552,830	552,830	$111,558	3,092	1,124,400	468,500	468,500	$139,142	6
93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	7
93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	8
14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	9
14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	10
14,880	6.0	14,880	0	0	0	0	$0	465	195,300	74,400	74,400	$22,204	11
11,040	6.0	11,040	483	202,860	77,280	77,280	$17,630	345	144,900	55,200	55,200	$16,474	12
11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	13
11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	14
13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	15
13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	16
13,440	6.0	13,440	0	0	0	0	$0	420	176,400	67,200	67,200	$20,055	17
11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821	349	146,475	55,800	55,800	$16,653	18
11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	19
11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	20
5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	21
5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	22
5,400	6.0	5,400	0	0	0	0	$0	169	70,875	27,000	27,000	$8,058	23
4,440	6.0	4,440	194	64,380	24,050	24,050	$5,820	139	58,275	22,200	22,200	$6,625	24
4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	25
4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	26
821,220		821,220	17,674	5,535,360	2,623,420	2,623,420	$559,608	25,706	9,666,675	4,106,100	4,106,100	$1,189,461	27
													28
43,960	3.9	48,984	942	56,520	75,360	75,360	$15,355	2,355	376,800	219,800	244,920	$77,268	29
6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	30
0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	31
6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	32
6,720	6.0	6,720	126	10,080	10,080	10,080	$2,142	210	50,400	33,600	33,600	$8,780	33
64,120		69,144	1,320	127,080	125,760	125,760	$25,107	2,985	578,400	320,600	345,720	$105,271	34
													35
0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	36
0		0	0	0	0	0	$0	0	0	0	0	$0	37
													38
14,000	3.9	15,600	300	18,000	24,000	24,000	$4,890	750	120,000	70,000	78,000	$24,608	39
671	6.0	671	13	3,021	2,014	2,014	$380	21	7,553	3,357	3,357	$960	40
14,671		16,271	313	21,021	26,014	26,014	$5,270	771	127,553	73,357	81,357	$25,568	41
													42
36,260	3.9	40,404	1,010	74,592	68,376	74,592	$16,090	1,684	372,960	181,300	202,020	$61,358	43
36,260	3.9	40,404	0	0	0	0	$0	1,684	372,960	181,300	202,020	$61,358	44
35,630	3.9	39,702	0	0	0	0	$0	1,654	366,480	178,150	198,510	$60,292	45
3,600	6.0	3,600	68	16,200	10,800	10,800	$2,039	113	36,000	18,000	18,000	$5,001	46
3,600	6.0	3,600	0	0	0	0	$0	113	36,000	18,000	18,000	$5,001	47
6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	$9,335	48
4,440	6.0	4,440	83	19,980	13,320	13,320	$2,514	139	44,400	22,200	22,200	$6,167	49
4,440	6.0	4,440	0	0	0	0	$0	139	44,400	22,200	22,200	$6,167	50
6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	$9,335	51
4,476	6.0	4,476	84	6,714	6,714	6,714	$1,427	140	33,570	22,380	22,380	$5,848	52
4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	53
4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	54
151,098		163,458	1,245	117,486	99,210	105,426	$22,069	6,363	1,508,310	755,490	817,290	$241,559	55
1,051,109		1,070,093	20,551	5,800,947	2,874,404	2,880,620	$612,054	35,826	11,880,938	5,255,547	5,350,467	$1,561,858	56
						Model Yearly Totals		56,376	17,681,886	8,129,951	8,231,087	$2,173,912	

Total Yearly Demand	**56,376 KW**
Total Yearly Usage	**34,042,924 KWh**
Total Yearly Cost	**$2,174,000**

23-May-95

③

WALTER REED

ALT

UPGRADE BUILDING 48 CHILLED WATER PLANT

PROPOSED

No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	Winter Billing Months						Intermediate Billing Months				
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		
						hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day
1																
2	**Building #48**															
3	Chiller C-48-1	660	330	409	436	6.0	118,800	4.5	59,400	4.5	59,400	6.5	128,700	5.0	66,000	5.
4	Chiller C-48-2	660	330	409	436	6.0	118,800	4.5	59,400	4.5	59,400	6.5	128,700	5.0	66,000	5.
5	Chiller C-48-3	660	0	0	436	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
6	Chiller C-48-4	605	303	393	399	5.0	90,750	4.0	48,400	4.0	48,400	5.5	99,825	4.5	54,450	4.
7	Chiller C-48-5	605	0	0	399	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
8	Chiller C-48-6	605	0	0	399	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
9	Pump CHWS-48-1 PRIM	37	28	28	28	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6
10	Pump CHWS-48-2 PRIM	37	28	28	28	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6
11	Pump CHWS-48-3 PRIM	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
12	Pump CHWS-48-4 PRIM	37	28	28	28	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6
13	Pump CHWS-48-5 PRIM	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
14	Pump CHWS-48-6 PRIM	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
15	Pump CHWS-48-7 SEC	56	39	45	50	5.5	9,232	3.0	3,357	3.0	3,357	7.5	12,589	4.0	4,476	4
16	Pump CHWS-48-8 SEC	56	39	45	50	5.5	9,232	3.0	3,357	3.0	3,357	7.5	12,589	4.0	4,476	4
17	Pump CHWS-48-9 SEC	56	39	45	50	5.5	9,232	3.0	3,357	3.0	3,357	7.5	12,589	4.0	4,476	4
18	Pump CHWS-48-10 SEC	56	34	39	50	2.0	3,357	1.0	1,119	1.0	1,119	5.5	9,232	3.0	3,357	3
19	Pump CWS-48-1	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6
20	Pump CWS-48-2	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6
21	Pump CWS-48-3	112	0	0	84	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
22	Pump CWS-48-4	93	70	70	70	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6
23	Pump CWS-48-5	93	0	0	70	0.0	0	0.0	0	0.0	8,489	0.0	3,578	0.0	6,017	0
24	Pump CWS-48-6	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
25	Clg Tower CT-48-1	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5
26	Clg Tower CT-48-2	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5
27	Clg Tower CT-48-3	45	0	0	34	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0
28	Clg Tower CT-48-4	37	28	28	28	7.0	7,770	4.0	2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5
29	Clg Tower CT-48-5	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
30	Clg Tower CT-48-6	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
31	Subtotal	5,104	1,530	1,802	3,520		521,176		240,018		248,507		581,005		274,690	
32	**Building #49**															
33	Chiller C-49-1	550	165	385	495	1.5	24,750	2.5	27,500	2.5	27,500	3.0	49,500	3.0	33,000	3.0
34	Chiller C-49-2	550	0	0	495	0.0	0	0.0	0	0.0	0	3.0	49,500	3.0	33,000	3.0
35	Chiller C-49-3	550	0	0	495	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
36	Pump CHWS-49-1	30	22	22	22	8.0	7,162	6.0	3,581	6.0	3,581	8.0	7,162	6.0	3,581	6.0
37	Pump CHWS-49-2	30	0	22	22	0.0	0	0.0	0	0.0	0	8.0	7,162	6.0	3,581	6.0
38	Pump CHWS-49-3	30	0	0	22	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
39	Pump CHWS-49-4 PRIM	75	11	31	60	2.1	4,700	1.2	1,790	1.2	1,790	4.4	9,847	2.5	3,730	2.5
40	Pump CHWS-49-5 PRIM	75	11	31	60	2.1	4,700	1.2	1,790	1.2	1,790	4.4	9,847	2.5	3,730	2.5
41	Pump CWS-49-1	75	56	56	56	8.0	17,904	6.0	8,952	6.0	8,952	8.0	17,904	6.0	8,952	6.0
42	Pump CWS-49-2	75	0	56	56	0.0	0	0.0	0	0.0	0	8.0	17,904	6.0	8,952	6.0
43	Pump CWS-49-3	75	0	0	56	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
44	Clg Tower CT-49-1	37	19	28	34	4.0	4,476	2.5	1,865	2.5	1,865	6.0	6,714	4.0	2,984	4.0
45	Clg Tower CT-49-2	37	0	28	34	0.0	0	0.0	0	0.0	0	6.0	6,714	4.0	2,984	4.0
46	Clg Tower CT-49-3	37	0	0	34	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
47	Bldg 54: P-1 Original	30	1	12	25	0.5	448	0.3	179	0.3	179	3.9	3491.28	2.2	1,313	2.2
48	Bldg 54: P-2 Original	30	1	12	25	0.5	448	0.3	179	0.3	179	3.9	3491.28	2.2	1,313	2.2
49	Bldg 54: P-3 Addition	56	3	22	48	0.5	839	0.3	336	0.3	336	3.9	6546.15	2.2	2,462	2.2
50	Bldg T-2: P-5	11	4	7	10	4.2	1,410	2.4	537	2.4	537	6.3	2114.91	3.6	806	3.6
51	Bldg 11: P-7	11	1	6	9	1	336	0.6	134	0.6	134	5.3	1779.21	3.1	694	3.1
52	Bldg 14: P-8	15	1	7	11	1	448	0.6	179	0.6	179	4.7	2103.72	2.7	806	2.7
53	Bldg 17: P-9	1	0	0	1	1	34	0.6	13	0.6	13	4.2	140.994	2.4	54	2.4
54	Bldg 40: P-10	45	10	20	39	2.1	2,820	1.2	1,074	1.2	1,074	4.7	6311.16	2.7	2,417	2.7
55	Bldg 41: P-11	2	0	1	1	2.1	141	1.2	54	1.2	54	3.2	214.848	1.8	81	1.8
56	Bldg 53: P-12	1	0	0	1	0	0	0	0	0	0	4.2	93.996	2.4	36	2.4
57	Subtotal	2,426	308	747	2,111		70,613		48,164		48,164		208,541		114,474	
58	TOTALS	7,530	1,838	2,549	5,631		591,789		288,182		296,671		789,546		389,164	

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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WALTER REED ARMY MEDICAL CENTER
ALTERNATE NO. 4
E BUILDING 48 CHILLED WATER PLANT AND PROVIDE NEW BUILDING 49 CHILLED WATER PLANT
Table 6.6.2
PROPOSED ELECTRIC MODEL

ing Months			Intermediate Billing Months						Summer Billing Months										
ter.	On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Non-Summer				
kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $
59,400	4.5	59,400	6.5	128,700	5.0	66,000	5.0	66,000	8.0	158,400	5.5	72,600	5.5	72,600	2,548	861,300	435,600	435,600	$88,
59,400	4.5	59,400	6.5	128,700	5.0	66,000	5.0	66,000	8.0	158,400	5.5	72,600	5.5	72,600	2,548	861,300	435,600	435,600	$88,
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	158,400	5.5	72,600	5.5	72,600	0	0	0	0	
48,400	4.0	48,400	5.5	99,825	4.5	54,450	4.5	54,450	8.0	145,200	5.0	60,500	5.0	60,500	2,390	662,475	356,950	356,950	$72,
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	145,200	5.0	60,500	5.0	60,500	0	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	145,200	5.0	60,500	5.0	60,500	0	0	0	0	
4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,
4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,750	6.0	4,476	6.0	4,476	0	0	0	0	
4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	10.5	11,750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,750	6.0	4,476	6.0	4,476	0	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,750	6.0	4,476	6.0	4,476	0	0	0	0	
3,357	3.0	3,357	7.5	12,589	4.0	4,476	4.0	4,476	8.5	14,267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,
3,357	3.0	3,357	7.5	12,589	4.0	4,476	4.0	4,476	8.5	14,267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,
3,357	3.0	3,357	7.5	12,589	4.0	4,476	4.0	4,476	8.5	14,267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,
1,119	1.0	1,119	5.5	9,232	3.0	3,357	3.0	3,357	8.0	13,428	4.5	5,036	4.5	5,036	252	41,123	14,547	14,547	$4,
13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,
13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	35,280	6.0	13,440	6.0	13,440	0	0	0	0	
11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	488	205,065	78,120	78,120	$17,
0	0.0	8,489	0.0	3,578	0.0	6,017	0.0	8,489	10.5	29,295	6.0	11,160	6.0	11,160	0	10,734	18,051	59,423	$4,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	0	
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	14,175	6.0	5,400	6.0	5,400	0	0	0	0	
2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5	4,070	10.5	11,655	6.0	4,440	6.0	4,440	194	64,380	24,050	24,050	$5,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	
240,018		248,507		581,005		274,690		277,162		1,308,742		551,297		551,297	11,528	3,827,717	1,784,142	1,825,514	$381,
27,500	2.5	27,500	3.0	49,500	3.0	33,000	3.0	33,000	6.0	99,000	4.0	44,000	4.0	44,000	1,815	247,500	209,000	209,000	$40,4
0	0.0	0	3.0	49,500	3.0	33,000	3.0	33,000	6.0	99,000	4.0	44,000	4.0	44,000	0	148,500	99,000	99,000	$14,
0	0.0	0	0.0	0	0.0	0	0.0	0	5.0	82,500	4.0	44,000	4.0	44,000	0	0	0	0	
3,581	6.0	3,581	8.0	7,162	6.0	3,581	6.0	3,581	10.5	9,400	6.0	3,581	6.0	3,581	157	50,131	25,066	25,066	$5,
0	0.0	0	8.0	7,162	6.0	3,581	6.0	3,581	10.5	9,400	6.0	3,581	6.0	3,581	67	21,485	10,742	10,742	$2,
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	9,400	6.0	3,581	6.0	3,581	0	0	0	0	
1,790	1.2	1,790	4.4	9,847	2.5	3,730	2.5	3,730	8.6	19,247	4.9	7,311	4.9	7,311	139	48,341	18,352	18,352	$4,
1,790	1.2	1,790	4.4	9,847	2.5	3,730	2.5	3,730	8.6	19,247	4.9	7,311	4.9	7,311	139	48,341	18,352	18,352	$4,
8,952	6.0	8,952	8.0	17,904	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	392	125,328	62,664	62,664	$12,9
0	0.0	0	8.0	17,904	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	168	53,712	26,856	26,856	$5,5
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	23,499	6.0	8,952	6.0	8,952	0	0	0	0	
1,865	2.5	1,865	6.0	6,714	4.0	2,984	4.0	2,984	10.5	11,750	6.0	4,476	6.0	4,476	159	38,046	16,412	16,412	$3,9
0	0.0	0	6.0	6,714	4.0	2,984	4.0	2,984	10.5	11,750	6.0	4,476	6.0	4,476	84	20,142	8,952	8,952	$2,1
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,750	6.0	4,476	6.0	4,476	0	0	0	0	
179	0.3	179	3.9	3491.28	2.2	1,313	2.2	1,313	8.5	7,609	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,1
179	0.3	179	3.9	3491.28	2.2	1,313	2.2	1,313	8.5	7,609	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,1
336	0.3	336	3.9	6546.15	2.2	2,462	2.2	2,462	8.5	14,267	4.9	5,483	4.9	5,483	78	22,995	8,728	8,728	$2,1
537	2.4	537	6.3	2114.91	3.6	806	3.6	806	8.9	2,988	5.1	1,141	5.1	1,141	38	11,984	4,566	4,566	$1,1
134	0.6	134	5.3	1779.21	3.1	694	3.1	694	8.8	2,954	5	1,119	5	1,119	21	6,680	2,618	2,618	$6
179	0.6	179	4.7	2103.72	2.7	806	2.7	806	7.9	3,536	4.5	1,343	4.5	1,343	26	8,102	3,133	3,133	$7
13	0.6	13	4.2	140.994	2.4	54	2.4	54	6.3	211	3.6	81	3.6	81	2	557	215	215	$
1,074	1.2	1,074	4.7	6311.16	2.7	2,417	2.7	2,417	8.9	11,951	5.1	4,566	5.1	4,566	100	30,213	11,548	11,548	$2,8
54	1.2	54	3.2	214.848	1.8	81	1.8	81	5.3	356	3.1	139	3.1	139	4	1,209	457	457	$1
0	0	0	4.2	93.996	2.4	36	2.4	36	7.9	177	4.5	67	4.5	67	1	282	107	107	$
48,164		48,164		208,541		114,474		114,474		504,597		217,435		217,435	3,472	908,077	536,078	536,078	$105,6
288,182		296,671		789,546		389,164		391,636		1,813,338		768,731		768,731	15,000	4,735,793	2,320,220	2,361,592	$487,

Model Yearly Totals

Total Yearly Demand
Total Yearly Usage
Total Yearly Cost

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L CENTER

NEW BUILDING 49 CHILLED WATER PLANT

DEL

Summer Billing Months					Non-Summer					Summer					
	Inter.		On-Peak												
Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
															1
															2
,400	5.5	72,600	5.5	72,600	2,548	861,300	435,600	435,600	$88,342	2,178	792,000	363,000	363,000	$101,473	3
,400	5.5	72,600	5.5	72,600	2,548	861,300	435,600	435,600	$88,342	2,178	792,000	363,000	363,000	$101,473	4
,400	5.5	72,600	5.5	72,600	0	0	0	0	$0	2,178	792,000	363,000	363,000	$101,473	5
,200	5.0	60,500	5.0	60,500	2,390	662,475	356,950	356,950	$72,869	1,997	726,000	302,500	302,500	$89,841	6
,200	5.0	60,500	5.0	60,500	0	0	0	0	$0	1,997	726,000	302,500	302,500	$89,841	7
,200	5.0	60,500	5.0	60,500	0	0	0	0	$0	1,997	726,000	302,500	302,500	$89,841	8
,750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,148	140	58,748	22,380	22,380	$6,679	9
,750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,148	140	58,748	22,380	22,380	$6,679	10
750	6.0	4,476	6.0	4,476	0	0	0	0	$0	140	58,748	22,380	22,380	$6,679	11
750	6.0	4,476	6.0	4,476	196	82,247	31,332	31,332	$7,148	140	58,748	22,380	22,380	$6,679	12
,750	6.0	4,476	6.0	4,476	0	0	0	0	$0	140	58,748	22,380	22,380	$6,679	13
,750	6.0	4,476	6.0	4,476	0	0	0	0	$0	140	58,748	22,380	22,380	$6,679	14
267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,086	252	71,336	27,975	27,975	$9,594	15
267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,086	252	71,336	27,975	27,975	$9,594	16
267	5.0	5,595	5.0	5,595	291	74,693	26,856	26,856	$7,086	252	71,336	27,975	27,975	$9,594	17
428	4.5	5,036	4.5	5,036	252	41,123	14,547	14,547	$4,483	252	67,140	25,178	25,178	$9,162	18
280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	19
280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	20
280	6.0	13,440	6.0	13,440	0	0	0	0	$0	420	176,400	67,200	67,200	$20,055	21
295	6.0	11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821	349	146,475	55,800	55,800	$16,653	22
295	6.0	11,160	6.0	11,160	0	10,734	18,051	59,423	$4,201	349	146,475	55,800	55,800	$16,653	23
295	6.0	11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	24
175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	25
175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	26
175	6.0	5,400	6.0	5,400	0	0	0	0	$0	169	70,875	27,000	27,000	$8,058	27
655	6.0	4,440	6.0	4,440	194	64,380	24,050	24,050	$5,820	139	58,275	22,200	22,200	$6,625	28
655	6.0	4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	29
655	6.0	4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	30
742		551,297		551,297	11,528	3,827,717	1,784,142	1,825,514	$381,658	17,599	6,543,709	2,756,483	2,756,483	$806,133	31
															32
000	4.0	44,000	4.0	44,000	1,815	247,500	209,000	209,000	$40,497	2,475	495,000	220,000	220,000	$81,733	33
000	4.0	44,000	4.0	44,000	0	148,500	99,000	99,000	$14,603	2,475	495,000	220,000	220,000	$81,733	34
500	4.0	44,000	4.0	44,000	0	0	0	0	$0	2,475	412,500	220,000	220,000	$79,010	35
400	6.0	3,581	6.0	3,581	157	50,131	25,066	25,066	$5,170	112	46,998	17,904	17,904	$5,343	36
400	6.0	3,581	6.0	3,581	67	21,485	10,742	10,742	$2,216	112	46,998	17,904	17,904	$5,343	37
400	6.0	3,581	6.0	3,581	0	0	0	0	$0	112	46,998	17,904	17,904	$5,343	38
47	4.9	7,311	4.9	7,311	139	48,341	18,352	18,352	$4,351	302	96,234	36,554	36,554	$12,177	39
47	4.9	7,311	4.9	7,311	139	48,341	18,352	18,352	$4,351	302	96,234	36,554	36,554	$12,177	40
99	6.0	8,952	6.0	8,952	392	125,328	62,664	62,664	$12,924	280	117,495	44,760	44,760	$13,358	41
99	6.0	8,952	6.0	8,952	168	53,712	26,856	26,856	$5,539	280	117,495	44,760	44,760	$13,358	42
99	6.0	8,952	6.0	8,952	0	0	0	0	$0	280	117,495	44,760	44,760	$13,358	43
750	6.0	4,476	6.0	4,476	159	38,046	16,412	16,412	$3,937	168	58,748	22,380	22,380	$7,157	44
750	6.0	4,476	6.0	4,476	84	20,142	8,952	8,952	$2,109	168	58,748	22,380	22,380	$7,157	45
750	6.0	4,476	6.0	4,476	0	0	0	0	$0	168	58,748	22,380	22,380	$7,157	46
09	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,147	127	38,046	14,622	14,622	$4,958	47
09	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,147	127	38,046	14,622	14,622	$4,958	48
67	4.9	5,483	4.9	5,483	78	22,995	8,728	8,728	$2,151	238	71,336	27,416	27,416	$9,297	49
88	5.1	1,141	5.1	1,141	38	11,984	4,566	4,566	$1,104	48	14,939	5,707	5,707	$1,905	50
54	5	1,119	5	1,119	21	6,680	2,618	2,618	$623	45	14,771	5,595	5,595	$1,840	51
36	4.5	1,343	4.5	1,343	26	8,102	3,133	3,133	$754	56	17,680	6,714	6,714	$2,245	52
11	3.6	81	3.6	81	2	557	215	215	$52	3	1,057	403	403	$135	53
51	5.1	4,566	5.1	4,566	100	30,213	11,548	11,548	$2,813	195	59,755	22,828	22,828	$7,696	54
56	3.1	139	3.1	139	4	1,209	457	457	$112	6	1,779	694	694	$227	55
77	4.5	67	4.5	67	1	282	107	107	$26	3	884	336	336	$112	56
97		217,435		217,435	3,472	908,077	536,078	536,078	$105,626	10,554	2,522,983	1,087,175	1,087,175	$377,778	57
38		768,731		768,731	15,000	4,735,793	2,320,220	2,361,592	$487,284	28,153	9,066,691	3,843,657	3,843,657	$1,183,911	58

Model Yearly Totals	43,153	13,802,485	6,163,877	6,205,249	$1,671,195

Total Yearly Demand	**43,153 KW**
Total Yearly Usage	**26,171,610 KWh**
Total Yearly Cost	**$1,671,000**

23-May-95

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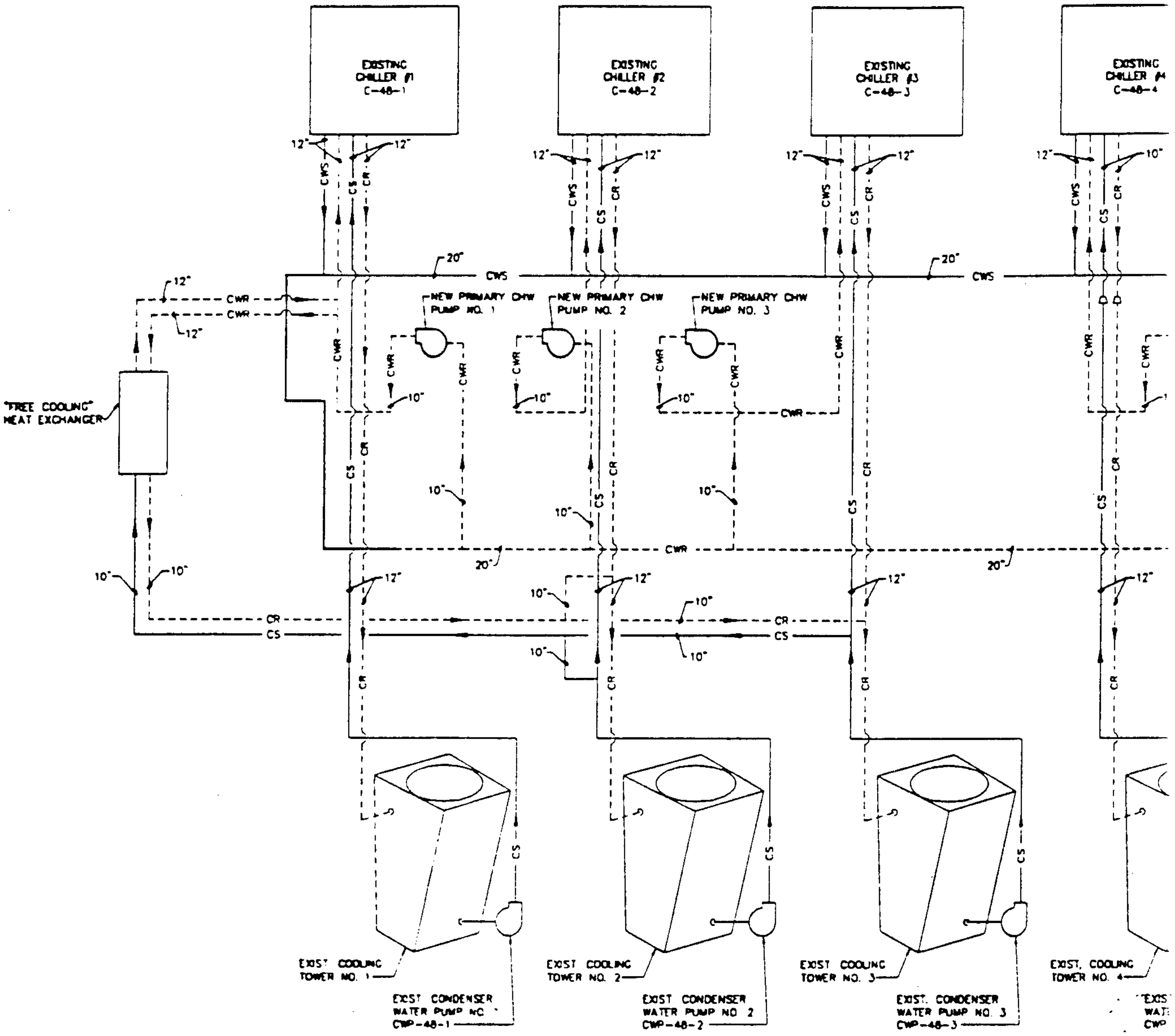
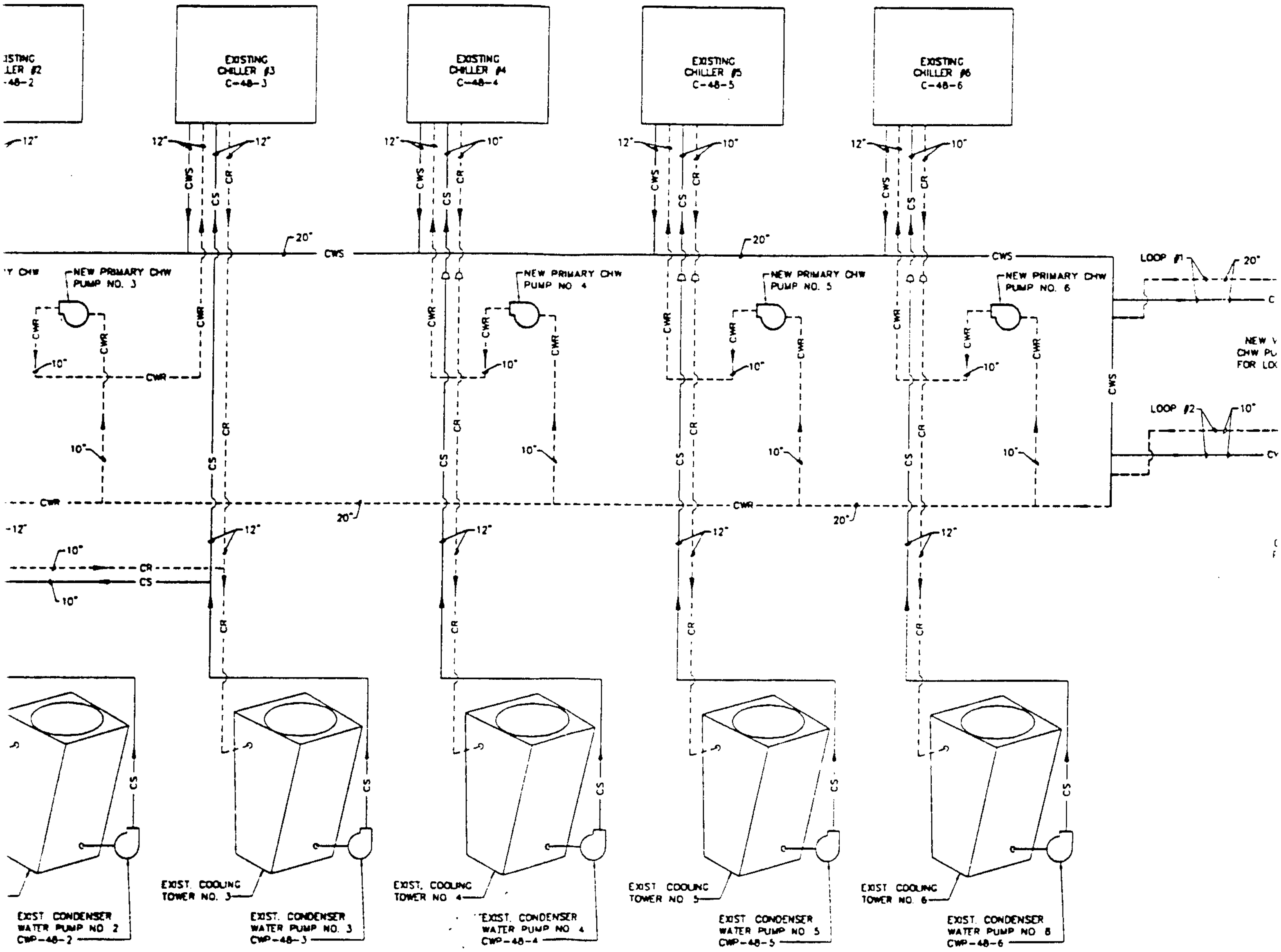


ALTERNATE #4 - BUILDING 48
SCHEMATIC - FLOW DIAGRAM
SCALE: NONE

A

①

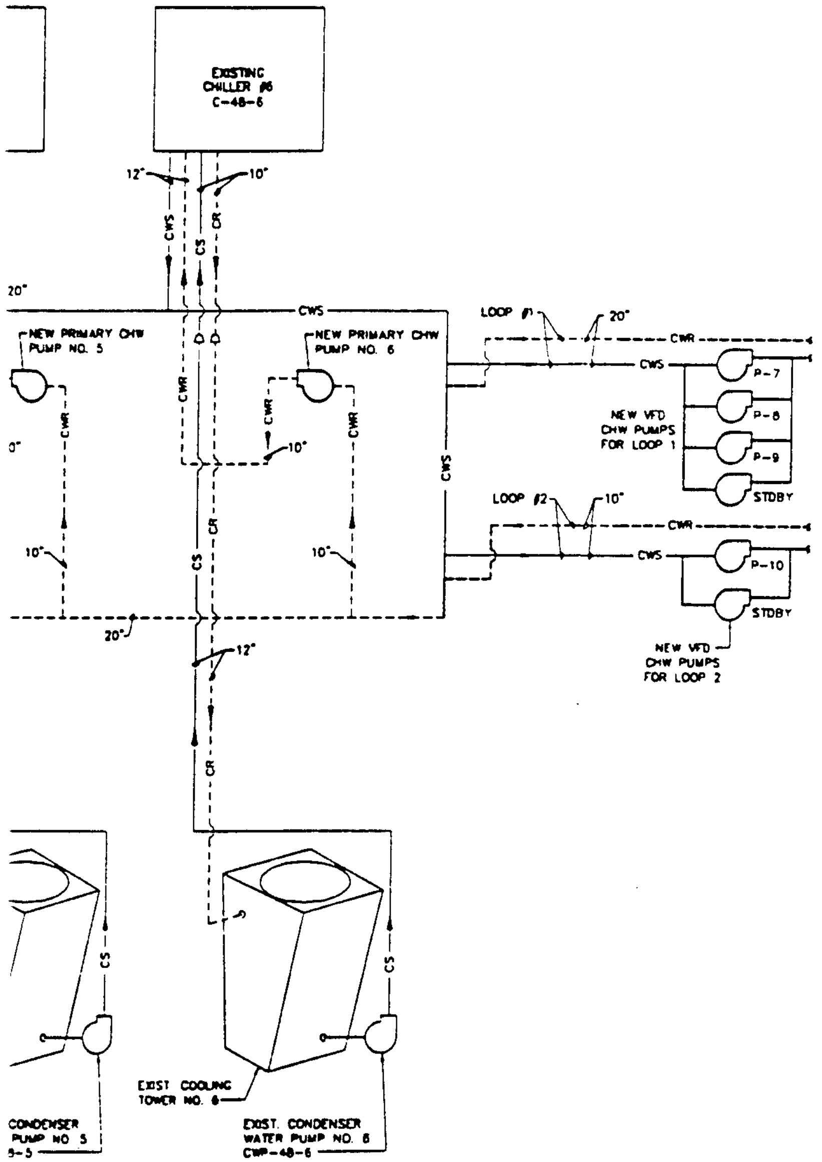


ALTERNATE #4 - BUILDING 48
SCHEMATIC - FLOW DIAGRAM
SCALE: NONE

②

LEGEND

——— CWS ———	CHILLED WATER SUPPLY
- - - - CWR - - - -	CHILLED WATER RETURN
——— CS ———	CONDENSER WATER SUPPLY
- - - - CR - - - -	CONDENSER WATER RETURN
———→———	DIRECTION OF FLOW



REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-ALTERNATE NO. 4

ENTECH Engineering Inc., Reading, PA Job #4130.02

DRAWING NUMBER B-4130-02-12

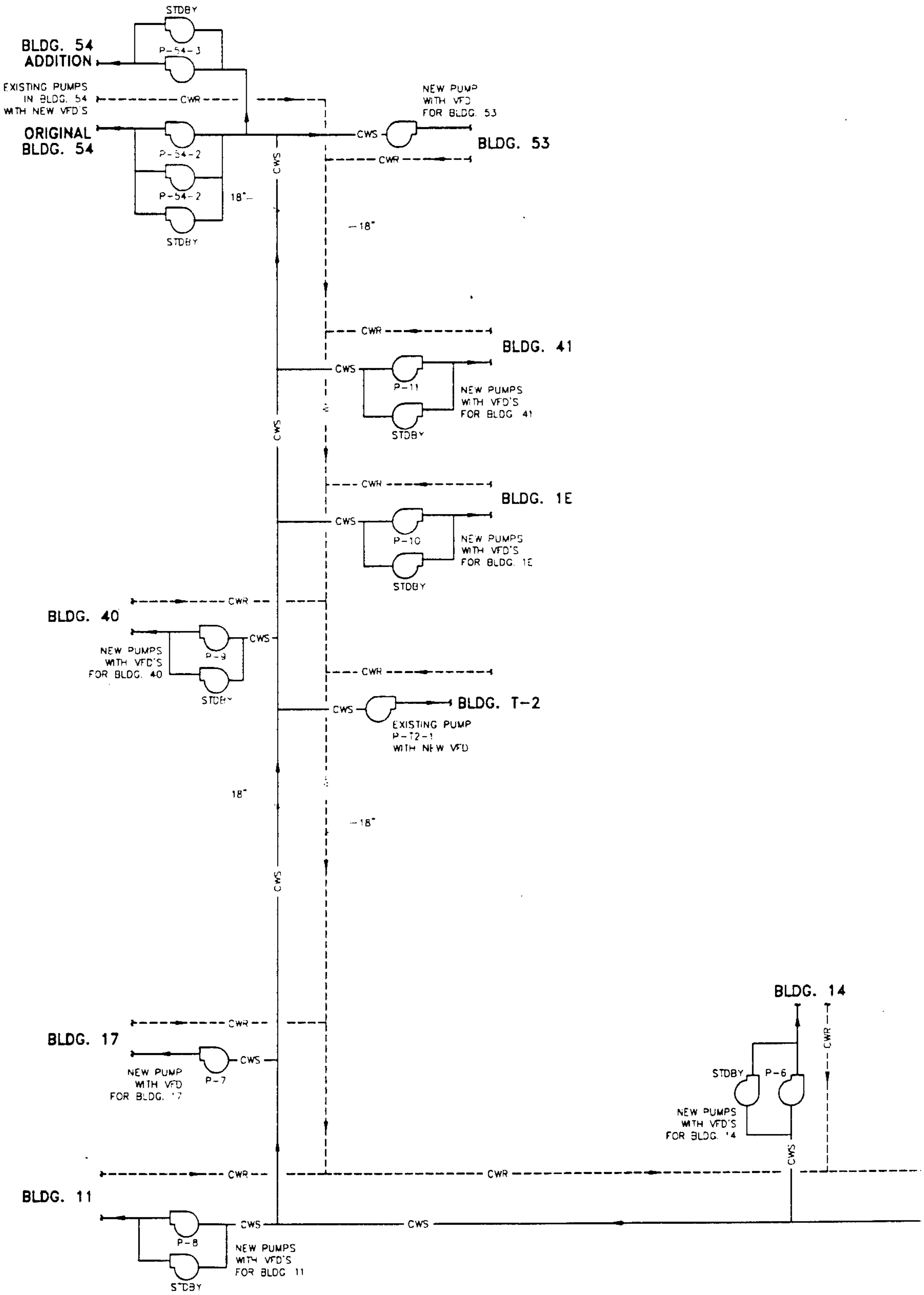
PLATE 12

SCALE NONE

DATE

SHEET M-12

3



ALTERNATE #4 – BUILDING 49 SCHEMATIC – FLOW DIAGRAM

SCALE: NONE

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3

_DG. 53

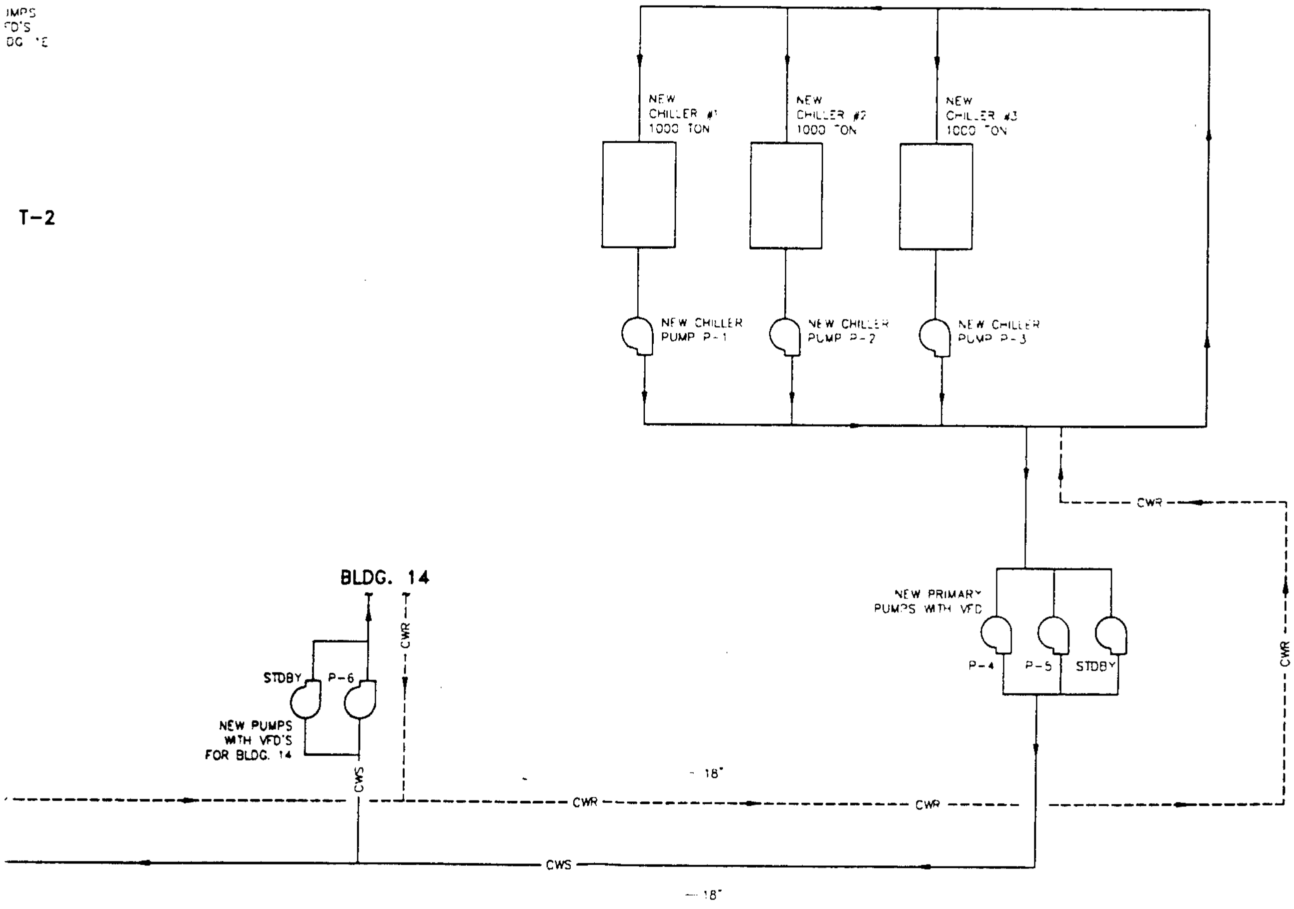
BLDG. 41

JMPS
FD'S
DG 41

BLDG. 1E

JMPS
FD'S
DG 1E

T-2



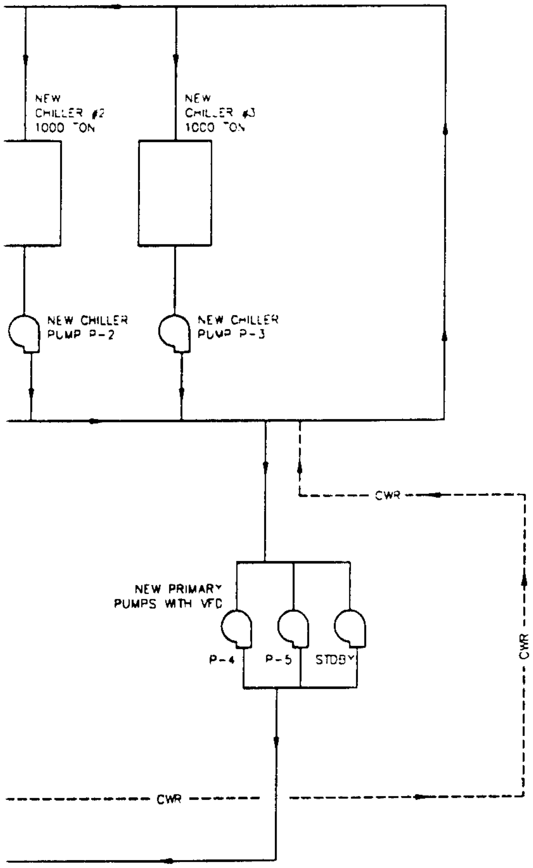
ALTERNATE #4 - BUILDING 49
SCHEMATIC - FLOW DIAGRAM

SCALE: NONE

②

LEGEND

—— CWS ——	CHILLED WATER SUPPLY
- - - - CWR - - - -	CHILLED WATER RETURN
—— CS ——	CONDENSER WATER SUPPLY
- - - - CR - - - -	CONDENSER WATER RETURN
——→——	DIRECTION OF FLOW



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REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.

CHILLED WATER STUDY
EEAP PROGRAM

CONTRACT NO. DACA01-94-D-0037

MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-ALTERNATE NO. 4

ENTECH Engineering
Inc., Reading, PA.
Job #4130.02

B-4130-02-13 | 13

NONE | M-13

6.6.3 Construction Cost

The estimated cost to provide new chillers in Building 48, construct a new Building 49 chilled water plant, install a new chilled water central distribution system and convert the chilled water distribution system to a variable-flow primary/secondary system is $11,100,000. An itemized cost estimate is included at the end of this section.

Material	$ 6,300,000
Labor	3,700,000
SIOH	500,000
Design Fee	600,000
Total	**$11,100,000**

6.6.4 Annual Energy Savings

The estimated annual energy savings is $503,000 per year ($2,174,000 - $1,671,000). The cost figure reflects the annual cost savings with the implementation of two chiller plants and a variable flow-primary/secondary system. All numbers are calculated on the cooling loads previously established in Section 5.0.

Savings Summary

	Existing	Proposed	Savings
Electric Demand (kW)	56,376	43,153	13,223
Electric Usage (kWh)	34,042,924	26,171,610	7,871,314
Cost ($)	$2,174,000	$1,671,000	$503,000

6.6.5 Annual Operation and Maintenance Cost

Maintenance costs will also be reduced with the addition of new equipment to replace existing chillers. It is estimated that compressor repairs will be ⅓ of the existing levels.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	0
Maintenance	$117,000	$39,000	$78,000

6.6.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 26,865 mmBtu
(7,871,314 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $18.72/mmBtu
($503,000 ÷ 26,865 mmBtu)

Construction $ = $10,000,000
($6,300,000 + $3,700,000)

SIOH $ = $500,000

Design $ = $600,000

Maintenance = $78,000

Simple Payback (Years)	19.1
Savings to Investment Ratio (SIR)	0.8

6.6.7 Expected Service Life

Service life depends on equipment type; therefore, it can be from twenty to thirty-five years.

6.6.8 Environmental Consideration

The replacement of old chillers will provide new refrigerants which are environmentally acceptable and available during the normal service life of the chillers.

6.6.9 Advantages

- Minimal disruption to the hospital (Building 2) which cannot be shut down.
- Will allow new construction to occur while existing plants remain on line.
- More efficient operation (lower kW/ton).
- Reduced maintenance and operation expenses, no major overhauls required for a substantial time period.
- Reduced pumping energy.
- Reduced chiller energy.
- Improves some distribution deficiencies.
- Allows for load diversity of connected chilled water demand.

6.6.10 Disadvantages

- Capital costs.
- Significant site work required.
- Building interface coordination.
- Building tie-in to avoid service interruption.
- Requires modifications to existing individual building's chilled water pumping and control valve systems.

ALTERNATE NO. 4
UPGRADE BLDG 48 CHILLED WATER PLANT AND PROVIDE NEW BLDG 49 CHILLED WATER PLANT

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1	**BLDG 48**								1
2	BLDG 48 CHILLER 5 @ 1200 TON EACH	6000	TON	$220	$1,320,000	$80	$480,000	$1,800,000	2
3	DEMOLITION BLDG 48 CHILLERS	5	EA		$0	$10,000	$50,000	$50,000	3
4	RIGGING CHILLERS	5	EA		$0	$5,000	$25,000	$25,000	4
5	BLDG 48 VENTILATION SYSTEM	1	EA	$15,000	$15,000	$20,000	$20,000	$35,000	5
6	BREATHING APPARATUS	2	EA	$500	$1,000	$100	$200	$1,200	6
7	REFRIGERANT SENSORS AND ALARMS	2	EA	$1,500	$3,000	$1,000	$2,000	$5,000	7
8	PRIMARY PUMP BLDG 48, 50 HP	6	EA	$6,500	$39,000	$600	$3,600	$42,600	8
9	SECONDARY PUMP BLDG 48, 75 HP	4	EA	$9,700	$38,800	$800	$3,200	$42,000	9
10	SECONDARY PUMP BLDG 48, 75 HP	2	EA	$9,700	$19,400	$800	$1,600	$21,000	10
11	PRIMARY PIPING BLDG 48, 20" w/insulation	300	LF	$95	$28,500	$100	$30,000	$58,500	11
12	SECONDARY PIPING BLDG 48, 20" w/insulatio	600	LF	$95	$57,000	$100	$60,000	$117,000	12
13	SECONDARY PIPING BLDG 48, 10" w/insulatio	600	LF	$62	$37,200	$60	$36,000	$73,200	13
14	VALVES FOR PUMPS BLDG 48, 10"	36	EA	$350	$12,600	$190	$6,840	$19,440	14
15	VARIABLE FREQUENCY DRIVE 75 HP	6	EA	$20,000	$120,000	$2,000	$12,000	$132,000	15
16	REPLACE 3WAY W/2WAY VALVES BLDG 1	32	EA	$300	$9,600	$150	$4,800	$14,400	16
17	REPLACE 3WAY W/2WAY VALVES BLDG 5	3	EA	$300	$900	$150	$450	$1,350	17
18	REPLACE 3WAY W/2WAY VALVES BLDG 7	5	EA	$300	$1,500	$150	$750	$2,250	18
19	PRESSURE SENSORS	2	EA	$500	$1,000	$500	$1,000	$2,000	19
20	**BLDG 49**								20
21	BLDG 49 CHILLER 3 @ 1000 TON EACH	3000	TON	$220	$660,000	$80	$240,000	$900,000	21
22	DEMOLITION BLDG 49 CHILLER & SYSTEM	3	EA		$0	$10,000	$30,000	$30,000	22
23	DEMOLITION BLDG 54 CHILLERS	3	EA		$0	$10,000	$30,000	$30,000	23
24	DEMOLITION BLDG 54 CLG TOWER & PUM	3	EA		$0	$5,000	$15,000	$15,000	24
25	RIGGING CHILLERS	3	EA		$0	$5,000	$15,000	$15,000	25
26	BLDG 49 VENTILATION SYSTEM	1	EA	$10,000	$10,000	$15,000	$15,000	$25,000	26
27	BREATHING APPARATUS	2	EA	$500	$1,000	$100	$200	$1,200	27
28	REFRIGERANT SENSORS AND ALARMS	2	EA	$1,500	$3,000	$1,000	$2,000	$5,000	28
29	COOLING TOWERS BLDG 49, 3 TOTAL	3	EA	$120,000	$360,000	$20,000	$60,000	$420,000	29
30	CONDENSER PUMPS BLDG 49, 30 HP, 1 stdby	7	EA	$11,000	$77,000	$100	$700	$77,700	30
1	CHILLER PUMPS BLDG 49, 40 HP, 1 stdby	4	EA	$1,500	$6,000	$1,000	$4,000	$10,000	31
32	PRIMARY PUMP BLDG 49, 100 HP, 1 stdby	3	EA	$10,400	$31,200	$900	$2,700	$33,900	32
33	CONCRETE PADS CHILLERS	3	EA	$500	$1,500	$500	$1,500	$3,000	33
34	CONCRETE PADS PUMPS	9	EA	$100	$900	$400	$3,600	$4,500	34
35					$0		$0	$0	35
36	CHILLER LOOP PIPING BLDG 49, 18" w/insulat	500	LF	$90	$45,000	$85	$42,500	$87,500	36
37	CHILLER LOOP PIPING BLDG 49, 10" w/insulat	750	LF	$62	$46,500	$60	$45,000	$91,500	37
38	PRIMARY PIPING BLDG 49, 18" w/insulation	300	LF	$90	$27,000	$85	$25,500	$52,500	38
39	CONDENSER WATER PIPING BLDG 49, 12"	1250	LF	$70	$87,500	$50	$62,500	$150,000	39
40	VALVES FOR PUMPS BLDG 49, 10"	9	EA	$550	$4,950	$190	$1,710	$6,660	40
41	VALVES FOR PUMPS BLDG 49, 12"	18	EA	$850	$15,300	$250	$4,500	$19,800	41
42	VARIABLE FREQUENCY DRIVE 100 HP	3	EA	$22,000	$66,000	$2,000	$6,000	$72,000	42
43	3WAY TO 2WAY VALVES BLDG 54,40,41,T2	76	EA	$300	$22,800	$150	$11,400	$34,200	43
44	VARIABLE FREQUENCY DRIVE 75 HP	1	EA	$20,000	$20,000	$2,000	$2,000	$22,000	44
45	VARIABLE FREQUENCY DRIVE 40 HP	2	EA	$12,500	$25,000	$2,000	$4,000	$29,000	45
46	3WAY TO 2WAY VALVES BLDG 17,14,11	155	EA	$300	$46,500	$150	$23,250	$69,750	46
47	SECONDARY PUMP BLDG 17 & 41, 3 HP	3	EA	$1,600	$4,800	$250	$750	$5,550	47
48	VARIABLE FREQUENCY DRIVE 3 HP	3	EA	$3,500	$10,500	$2,000	$6,000	$16,500	48
49	VARIABLE FREQUENCY DRIVE 15 HP	1	EA	$5,500	$5,500	$2,000	$2,000	$7,500	49
50	SECONDARY PUMP BLDG 14, 20 HP	2	EA	$2,700	$5,400	$540	$1,080	$6,480	50
51	VARIABLE FREQUENCY DRIVE 20 HP	2	EA	$7,000	$14,000	$2,000	$4,000	$18,000	51
52	SECONDARY PUMP BLDG 11, 15 HP	2	EA	$2,000	$4,000	$470	$940	$4,940	52
53	VARIABLE FREQUENCY DRIVE 15 HP	2	EA	$5,500	$11,000	$2,000	$4,000	$15,000	53
54	SECONDARY PUMP BLDG 40, 60 HP	2	EA	$6,500	$13,000	$600	$1,200	$14,200	54
55	VARIABLE FREQUENCY DRIVE 60 HP	2	EA	$17,000	$34,000	$2,000	$4,000	$38,000	55
56	VALVES FOR BLDG PUMPS	30	EA	$500	$15,000	$300	$9,000	$24,000	56
57	PRIMARY CAMPUS DIST PIPING 14" w/insulati	9000	LF	$100	$900,000	$100	$900,000	$1,800,000	57
58	BLDG 15 ADDITION	18500	SF	$50	$925,000	$32	$592,000	$1,517,000	58
59	CONTROLS FOR 48 AND NEW 49/15	300	PTS	$750	$225,000	$750	$225,000	$450,000	59
60	PRESSURE SENSORS	10	EA	$500	$5,000	$500	$5,000	$10,000	60
61	CONTINGENCY				$866,150		$559,530	$1,425,680	61
	TOTALS>>>>>>>>				**$6,300,000**		**$3,700,000**	**$10,000,000**	

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ENTECH ENGINEERING INC. 31-Jul-95

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          LIFE CYCLE COST ANALYSIS SUMMARY              STUDY: WALTER1
     ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)       LCCID  1.080
INSTALLATION & LOCATION:                REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: ALT#4
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST       $ 10000000.
B. SIOH                    $   500000.
C. DESIGN COST             $   600000.
D. TOTAL COST (1A+1B+1C)   $ 11100000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                 $ 11100000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST    SAVINGS       ANNUAL $      DISCOUNT    DISCOUNTED
   FUEL      $/MBTU(1)   MBTU/YR(2)    SAVINGS(3)    FACTOR(4)   SAVINGS(5)

   A. ELECT $ 18.72       26865.       $  502913.       15.61     $  7850469.
   B. DIST  $   .00           0.       $       0.       17.56     $        0.
   C. RESID $   .00           0.       $       0.       19.97     $        0.
   D. NAT G $   .00           0.       $       0.       20.96     $        0.
   E. COAL  $   .00           0.       $       0.       17.58     $        0.
   F. LPG   $   .00           0.       $       0.       16.12     $        0.
   M. DEMAND SAVINGS                   $       0.       14.74     $        0.
   N. TOTAL               26865.       $  502913.                 $  7850469.

3. NON ENERGY SAVINGS(+) / COST(-)

  A. ANNUAL RECURRING (+/-)                                       $    78000.
      (1) DISCOUNT FACTOR (TABLE A)                     14.74
      (2) DISCOUNTED SAVING/COST (3A X 3A1)                       $  1149720.

  B. NON RECURRING SAVINGS(+) / COSTS(-)
                                SAVINGS(+)   YR   DISCNT      DISCOUNTED
                ITEM             COST(-)     OC   FACTR       SAVINGS(+)/
                                   (1)      (2)    (3)        COST(-)(4)

   d. TOTAL                   $       0.                              0.

  C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$  1149720.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$   580913.

5. SIMPLE PAYBACK PERIOD (1G/4)                                  19.11 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                       $  9000188.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=              .81
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                       2.02 %
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6.7 Alternative No. 5

— Provide a New Central Chilled Water Plant Adjacent to the Central Heating Plant

6.7.1 Existing

A description of the existing chilled water distribution system is provided in Section 3.4. As shown in Table 6.7.1, on the following page, the existing chilled water systems (chillers, pumps, and towers) at WRAMC are estimated to use 34,042,924 kWh/yr and require 56,376 kW of demand per year. The estimated annual cost to operate all these systems is $2,174,000.

6.7.2 Description

Replace existing central chilled water plants in Buildings 48, 49, 54 and 7 with a new single chilled water plant. This new plant would be located on the east side of the Center's heating plant, Building 15. This option would require a new structure, new chilled water distribution system, and relocation of the electric service substation in Building 95.

The construction of this plant would provide a single chilled water plant which could supply the entire site with chilled water year round. This would reduce the need for summer isolation of remote buildings from the system and provide for more efficient operation using overall campus load diversity.

WALTER REED AR
ALTER
PROVIDE A NEW CENTRAL CHILLED WATER PL
Tab
EXISTING EL

No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	Winter Billing Months Off-Peak hrs/day	Winter Billing Months Off-Peak kWh/Mo	Winter Billing Months Inter. hrs/day	Winter Billing Months Inter. kWh/Mo	Winter Billing Months On-Peak hrs/day	Winter Billing Months On-Peak kWh/Mo	Intermediate Billing Months Off-Peak hrs/day	Intermediate Billing Months Off-Peak kWh/Mo	Intermediate Billing Months Inter. hrs/day	Intermediate Billing Months Inter. kWh/Mo	On-Pe hrs/day
1																
2	**Building #48**															
3	Chiller C-48-1	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0
4	Chiller C-48-2	1,088	653	805	718	6.0	195,840	4.5	97,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0
5	Chiller C-48-3	1,088	0	0	718	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	Chiller C-48-4	937	469	543	618	5.0	140,550	4.0	74,960	4.0	74,960	5.5	154,605	4.5	84,330	4.5
7	Chiller C-48-5	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
8	Chiller C-48-6	937	0	0	618	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
9	Pump CHWS-48-1	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0
10	Pump CHWS-48-2	124	93	93	93	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0
11	Pump CHWS-48-3	124	0	0	93	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
12	Pump CHWS-48-4	92	69	69	69	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0
13	Pump CHWS-48-5	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
14	Pump CHWS-48-6	92	0	0	69	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
15	Pump CWS-48-1	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0
16	Pump CWS-48-2	112	84	84	84	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0
17	Pump CWS-48-3	112	0	0	84	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
18	Pump CWS-48-4	93	70	70	70	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0
19	Pump CWS-48-5	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
20	Pump CWS-48-6	93	0	0	70	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
21	Clg Tower CT-48-1	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5
22	Clg Tower CT-48-2	45	34	34	34	7.0	9,450	4.0	3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5
23	Clg Tower CT-48-3	45	0	0	34	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
24	Clg Tower CT-48-4	37	28	28	28	7.0	7,770	4.0	2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5
25	Clg Tower CT-48-5	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
26	Clg Tower CT-48-6	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
27	**Subtotal**	7,584	2,362	2,742	5,141		765,855		359,800		359,800		823,980		394,740	
28	**Building #49**															
29	Chiller C-49-1	628	0	314	471	0.0	0	0.0	0	0.0	0	1.0	18,840	2.0	25,120	2.0
30	Pump CHWS-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720	6.0
31	Pump CHWS-49-1	56	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
32	Pump CWS-49-1	56	0	42	42	[illegible]	0	0.0	0	0.0	0	6.0	10,080	6.0	6,720	6.0
33	Clg Tower CT-49-1	56	0	42	42	0.0	0	0.0	0	0.0	0	2.0	3,360	3.0	3,360	3.0
34	**Subtotal**	852	0	440	597		0		0		0		42,360		41,920	
35	**Building #T-2**															
36	Pump CHWS-07-1	11.2	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
37	**Subtotal**		0.0	0.0	0.0		0		0		0		0		0	
38	**Building #07**															
39	Chiller C-07-1	200.0	0.0	100.0	150.0	0.0	0	0.0	0	0.0	0	1.0	6,000	2.0	8,000	2.0
40	Pump CHWS-07-1	5.6	0.0	4.2	4.2	0.0	0	0.0	0	0.0	0	6.0	1,007	6.0	671	6.0
41	**Subtotal**	206	0	104	154		0		0		0		7,007		8,671	
42	**Building #54**															
43	Chiller C-54-1	518	0	337	337	0.0	0	0.0	0	0.0	0	1.6	24,864	2.2	22,792	2.4
44	Chiller C-54-2	518	0	0	337	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
45	Chiller C-54-3	509	0	0	331	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
46	Pump CHWS-54-1	30	0	23	23	0.0	0	0.0	0	0.0	0	6.0	5,400	6.0	3,600	6.0
47	Pump CHWS-54-2	30	0	0	23	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
48	Pump CHWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
49	Pump CWS-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	6.0	6,660	6.0	4,440	6.0
50	Pump CWS-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
51	Pump CWS-54-3	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
52	Clg Tower CT-54-1	37	0	28	28	0.0	0	0.0	0	0.0	0	2.0	2,238	3.0	2,238	3.0
53	Clg Tower CT-54-2	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
54	Clg Tower CT-54-3	37	0	0	28	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
55	**Subtotal**	1,903	0	415	1,273		0		0		0		39,162		33,070	
56	TOTALS	10,544	2,362	3,701	7,165		765,855		359,800		359,800		912,509		478,401	

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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WALTER REED ARMY MEDICAL CENTER
ALTERNATE NO. 5
E A NEW CENTRAL CHILLED WATER PLANT ADJACENT TO THE CENTRAL HEATING PLANT
Table 6.7.1
EXISTING ELECTRIC MODEL

Months			Intermediate Billing Months						Summer Billing Months										
	On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Non-Summer				
/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $
7,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087
7,920	4.5	97,920	6.5	212,160	5.0	108,800	5.0	108,800	8.0	261,120	5.5	119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	261,120	5.5	119,680	5.5	119,680	0	0	0	0	$0
4,960	4.0	74,960	5.5	154,605	4.5	84,330	4.5	84,330	8.0	224,880	5.0	93,700	5.0	93,700	3,504	1,026,015	552,830	552,830	$111,558
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	224,880	5.0	93,700	5.0	93,700	0	0	0	0	$0
4,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762
4,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	10.5	39,060	6.0	14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	39,060	6.0	14,880	6.0	14,880	0	0	0	0	$0
1,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	10.5	28,980	6.0	11,040	6.0	11,040	483	202,860	77,280	77,280	$17,630
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	28,980	6.0	11,040	6.0	11,040	0	0	0	0	$0
3,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462
3,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	10.5	35,280	6.0	13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	35,280	6.0	13,440	6.0	13,440	0	0	0	0	$0
1,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	10.5	29,295	6.0	11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	29,295	6.0	11,160	6.0	11,160	0	0	0	0	$0
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079
3,600	4.0	3,600	10.0	13,500	5.5	4,950	5.5	4,950	10.5	14,175	6.0	5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	14,175	6.0	5,400	6.0	5,400	0	0	0	0	$0
2,960	4.0	2,960	10.0	11,100	5.5	4,070	5.5	4,070	10.5	11,655	6.0	4,440	6.0	4,440	194	64,380	24,050	24,050	$5,820
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	11,655	6.0	4,440	6.0	4,440	0	0	0	0	$0
9,800		359,800		823,980		394,740		394,740		1,933,335		821,220		821,220	17,674	5,535,360	2,623,420	2,623,420	$559,608
0	0.0	0	1.0	18,840	2.0	25,120	2.0	25,120	4.0	75,360	3.5	43,960	3.9	48,984	942	56,520	75,360	75,360	$15,355
0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
0	0.0	0	6.0	10,080	6.0	6,720	6.0	6,720	9.0	15,120	6.0	6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805
0	0.0	0	2.0	3,360	3.0	3,360	3.0	3,360	6.0	10,080	6.0	6,720	6.0	6,720	126	10,080	10,080	10,080	$2,142
0		0		42,360		41,920		41,920		115,680		64,120		69,144	1,320	127,080	125,760	125,760	$25,107
0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	$0
0		0		0		0		0		0		0		0	0	0	0	0	$0
0	0.0	0	1.0	6,000	2.0	8,000	2.0	8,000	4.0	24,000	3.5	14,000	3	15,600	300	18,000	24,000	24,000	$4,890
0	0.0	0	6.0	1,007	6.0	671	6.0	671	9.0	1,511	6.0	671	6	671	13	3,021	2,014	2,014	$380
0		0		7,007		8,671		8,671		25,511		14,671		16,271	313	21,021	26,014	26,014	$5,270
0	0.0	0	1.6	24,864	2.2	22,792	2.4	24,864	4.8	74,592	3.5	36,260	3.9	40,404	1,010	74,592	68,376	74,592	$16,090
0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	74,592	3.5	36,260	3.9	40,404	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	4.8	73,296	3.5	35,630	3.9	39,702	0	0	0	0	$0
0	0.0	0	6.0	5,400	6.0	3,600	6.0	3,600	8.0	7,200	6.0	3,600	6.0	3,600	68	16,200	10,800	10,800	$2,039
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	7,200	6.0	3,600	6.0	3,600	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0
0	0.0	0	6.0	6,660	6.0	4,440	6.0	4,440	8.0	8,880	6.0	4,440	6.0	4,440	83	19,980	13,320	13,320	$2,514
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	8,880	6.0	4,440	6.0	4,440	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	13,440	6.0	6,720	6.0	6,720	0	0	0	0	$0
0	0.0	0	2.0	2,238	3.0	2,238	3.0	2,238	6.0	6,714	6.0	4,476	6.0	4,476	84	6,714	6,714	6,714	$1,427
0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0
0	0.0	0	0.0	0	0.0	0	0.0	0	6.0	6,714	6.0	4,476	6.0	4,476	0	0	0	0	$0
0		0		39,162		33,070		35,142		301,662		151,098		163,458	1,245	117,486	99,210	105,426	$22,069
,800		359,800		912,509		478,401		480,473		2,376,188		1,051,109		1,070,093	20,551	5,800,947	2,874,404	2,880,620	$612,054

Model Yearly Totals

Total Yearly Demand
Total Yearly Usage
Total Yearly Cost

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HE CENTRAL HEATING PLANT

ng Months													
.	On-Peak		Non-Summer					Summer					
Wh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
													1
													2
119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	3
119,680	5.5	119,680	5,027	1,419,840	718,080	718,080	$151,087	3,590	1,305,600	598,400	598,400	$167,277	4
119,680	5.5	119,680	0	0	0	0	$0	3,590	1,305,600	598,400	598,400	$167,277	5
93,700	5.0	93,700	3,504	1,026,015	552,830	552,830	$111,558	3,092	1,124,400	468,500	468,500	$139,142	6
93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	7
93,700	5.0	93,700	0	0	0	0	$0	3,092	1,124,400	468,500	468,500	$139,142	8
14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	9
14,880	6.0	14,880	651	273,420	104,160	104,160	$23,762	465	195,300	74,400	74,400	$22,204	10
14,880	6.0	14,880	0	0	0	0	$0	465	195,300	74,400	74,400	$22,204	11
11,040	6.0	11,040	483	202,860	77,280	77,280	$17,630	345	144,900	55,200	55,200	$16,474	12
11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	13
11,040	6.0	11,040	0	0	0	0	$0	345	144,900	55,200	55,200	$16,474	14
13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	15
13,440	6.0	13,440	588	246,960	94,080	94,080	$21,462	420	176,400	67,200	67,200	$20,055	16
13,440	6.0	13,440	0	0	0	0	$0	420	176,400	67,200	67,200	$20,055	17
11,160	6.0	11,160	488	205,065	78,120	78,120	$17,821	349	146,475	55,800	55,800	$16,653	18
11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	19
11,160	6.0	11,160	0	0	0	0	$0	349	146,475	55,800	55,800	$16,653	20
5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	21
5,400	6.0	5,400	236	78,300	29,250	29,250	$7,079	169	70,875	27,000	27,000	$8,058	22
5,400	6.0	5,400	0	0	0	0	$0	169	70,875	27,000	27,000	$8,058	23
4,440	6.0	4,440	194	64,380	24,050	24,050	$5,820	139	58,275	22,200	22,200	$6,625	24
4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	25
4,440	6.0	4,440	0	0	0	0	$0	139	58,275	22,200	22,200	$6,625	26
821,220		821,220	17,674	5,535,360	2,623,420	2,623,420	$559,608	25,706	9,666,675	4,106,100	4,106,100	$1,189,461	27
													28
43,960	3.9	48,984	942	56,520	75,360	75,360	$15,355	2,355	376,800	219,800	244,920	$77,268	29
6,720	6.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	30
0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	31
6,720	5.0	6,720	126	30,240	20,160	20,160	$3,805	210	75,600	33,600	33,600	$9,612	32
6,720	6.0	6,720	126	10,080	10,080	10,080	$2,142	210	50,400	33,600	33,600	$8,780	33
64,120		69,144	1,320	127,080	125,760	125,760	$25,107	2,985	578,400	320,600	345,720	$105,271	34
													35
0	0.0	0	0	0	0	0	$0	0	0	0	0	$0	36
0		0	0	0	0	0	$0	0	0	0	0	$0	37
													38
14,000	3	15,600	300	18,000	24,000	24,000	$4,890	750	120,000	70,000	78,000	$24,608	39
671	6.0	671	13	3,021	2,014	2,014	$380	21	7,553	3,357	3,357	$960	40
14,671		16,271	313	21,021	26,014	26,014	$5,270	771	127,553	73,357	81,357	$25,568	41
													42
36,260	3.9	40,404	1,010	74,592	68,376	74,592	$16,090	1,684	372,960	181,300	202,020	$61,358	43
36,260	3.9	40,404	0	0	0	0	$0	1,684	372,960	181,300	202,020	$61,358	44
35,630	3.9	39,702	0	0	0	0	$0	1,654	366,480	178,150	198,510	$60,292	45
3,600	6.0	3,600	68	16,200	10,800	10,800	$2,039	113	36,000	18,000	18,000	$5,001	46
3,600	6.0	3,600	0	0	0	0	$0	113	36,000	18,000	18,000	$5,001	47
6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	• $9,335	48
4,440	6.0	4,440	83	19,980	13,320	13,320	$2,514	139	44,400	22,200	22,200	$6,167	49
4,440	6.0	4,440	0	0	0	0	$0	139	44,400	22,200	22,200	$6,167	50
6,720	6.0	6,720	0	0	0	0	$0	210	67,200	33,600	33,600	$9,335	51
4,476	6.0	4,476	84	6,714	6,714	6,714	$1,427	140	33,570	22,380	22,380	$5,848	52
4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	53
4,476	6.0	4,476	0	0	0	0	$0	140	33,570	22,380	22,380	$5,848	54
51,098		163,458	1,245	117,486	99,210	105,426	$22,069	6,363	1,508,310	755,490	817,290	$241,559	55
51,109		1,070,093	20,551	5,800,947	2,874,404	2,880,620	$612,054	35,826	11,880,938	5,255,547	5,350,467	$1,561,858	56
						Model Yearly Totals		56,376	17,681,886	8,129,951	8,231,087	$2,173,912	

Total Yearly Demand	56,376 KW
Total Yearly Usage	34,042,924 KWh
Total Yearly Cost	$2,174,000

23-May-95

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WALTER REED
ALT
PROVIDE A NEW CENTRAL CHILLED WATER

PROPOSE

No.	Description	Total Connected Load (kW)	Winter Demand kW/Month	Inter Demand kW/Month	Summer Demand kW/Month	Winter Billing Months						Intermediate Billing Months			
						Off-Peak		Inter.		On-Peak		Off-Peak		Inter.	
						hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo
1															
2	**New CHW Plant**														
3	Chiller C-1	908	590	408	662	2.0	54,450	2 0	36,300	2.0	36,300	6.5	176,963	5.0	90,750
4	Chiller C-2	908	590	408	662	2.0	54,450	2.0	36,300	2.0	36,300	6.5	176,963	5.0	90,750
5	Chiller C-3	908	0	408	662	0.0	0	0.0	0	0.0	0	6.5	176,963	5.0	90,750
6	Chiller C-4	908	0	408	662	0.0	0	0.0	0	0.0	0	6.5	176,963	5.0	90,750
7	Chiller C-5	908	0	0	662	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
8	Chiller C-6	908	0	0	662	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
9	Pump CHWS-1	56	42	42	42	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714
10	Pump CHWS-2	56	42	42	42	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714
11	Pump CHWS-3	56	0	42	42	0.0	0	0.0	0	0.0	0	10.5	17,624	6.0	6,714
12	Pump CHWS-4	56	0	42	42	0.0	0	0.0	0	0.0	0	10.5	17,624	6.0	6,714
13	Pump CHWS-5	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
14	Pump CHWS-6	56	0	0	42	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
15	Pump CHWS-7 PRIM	112	22	51	92	2.1	7,050	1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266
16	Pump CHWS-8 PRIM	112	22	51	92	2.1	7,050	1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266
17	Pump CHWS-9 PRIM	112	22	51	92	2.1	7,050	1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266
18	Pump CHWS-10 PRIM	112	22	51	92	2.1	7,050	1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266
19	Pump CWS-1	75	56	56	56	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952
20	Pump CWS-2	75	56	56	56	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952
21	Pump CWS-3	75	0	56	56	0.0	0	0.0	0	0.0	0	10.5	23,499	6.0	8,952
22	Pump CWS-4	75	0	56	56	0.0	0	0.0	0	0.0	0	10.5	23,499	6.0	8,952
23	Pump CWS-5	75	0	0	56	0.0	0	0 0	0	0.0	0	0.0	0	0.0	0
24	Pump CWS-6	75	0	0	56	0.0	0	0 0	0	0.0	0	0.0	0	0.0	0
25	Clg Tower CT-1	90	31	45	63	6.0	16,114	3 0	5,371	3.0	5,371	8.0	21,485	5.0	8,952
26	Clg Tower CT-2	90	31	45	63	6.0	16,114	3 0	5,371	3.0	5,371	8 0	21,485	5.0	8,952
27	Clg Tower CT-3	90	0	45	63	0.0	0	0 0	0	0.0	0	8.0	21,485	5.0	8,952
28	Clg Tower CT-4	90	0	45	63	0.0	0	0 0	0	0.0	0	8.0	21,485	5.0	8,952
29	Clg Tower CT-5	90	0	0	63	0.0	0	0 0	0	0.0	0	0.0	0	0.0	0
30	Clg Tower CT-6	90	0	0	63	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
31	**Secondary Pumps**														
32	Bldg 54: P-1 Original	30	1	12	25	0.5	448	0.3	179	0.3	179	3.9	3,491	2.2	1,313
33	Bldg 54: P-2 Original	30	1	12	25	0.5	448	0.3	179	0.3	179	3.9	3,491	2.2	1,313
34	Bldg 54: P-3 Addition	56	3	22	48	0.5	839	0.3	336	0.3	336	3 9	6,546	2.2	2,462
35	Bldg 7: P-4	6	1	3	5	1.5	252	0.8	90	0.8	90	4.9	822	2.8	313
36	Bldg T-2: P-5	11	4	7	10	4.2	1,410	2.4	537	2.4	537	6.3	2,115	3.6	806
37	Bldg 1: P-6	56	11	25	48	2.1	3,525	1.2	1,343	1.2	1,343	4.7	7,889	2.7	3,021
38	Bldg 11: P-7	11	1	6	9	1.0	336	0.6	134	0.6	134	5.3	1,779	3.1	694
39	Bldg 14: P-8	15	1	7	11	1.0	448	0.6	179	0 6	179	4 7	2,104	2.7	806
40	Bldg 17: P-9	1	0	0	1	1.0	34	0.6	13	0.6	13	4.2	141	2.4	54
41	Bldg 40: P-10	45	10	20	39	2.1	2,820	1.2	1,074	1.2	1,074	4 7	6,311	2.7	2,417
42	Bldg 41: P-11	2	0	1	1	2.1	141	1.2	54	1.2	54	3.2	215	1.8	81
43	Bldg 53: P-12	1	0	0	1	0.0	0	0.0	0	0.0	0	4.2	94	2.4	36
44	Bldg 5: P-13	1	0	1	1	2.1	70	1.2	27	1.2	27	4.6	154	2.6	58
45															
46	TOTALS	7,477	1,563	2,525	5,528		262,342		129,562		129,562		1,057,890		499,910

Winter Months, December, January, February, March
Intermediate Months: April, May, November
Summer Months: June, July, August, September, October

	Winter	Summer
Incremental Demand Cost, $/kW	$6.60	$17.09
Off-Peak Incremental Usage Cost, $/kWh	$0.035	$0.033
Intermediate Incremental Usage Cost, $/kWh	$0.044	$0.045
On-Peak Incremental Usage Cost, $/kWh	$0.051	$0.060

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WALTER REED ARMY MEDICAL CENTER
ALTERNATE NO. 5
PROVIDE A NEW CENTRAL CHILLED WATER PLANT ADJACENT TO THE CENTRAL HEATING PLANT
Table 6.7.2
PROPOSED ELECTRIC MODEL

Winter Billing Months				Intermediate Billing Months						Summer Billing Months									
Inter.		On-Peak		Off-Peak		Inter.		On-Peak		Off-Peak		Inter.		On-Peak			Non-Summer		
hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.
2.0	36,300	2.0	36,300	6.5	176,963	5.0	90,750	5.0	90,750	8.0	217,800	5.5	99,825	5.5	99,825	3,585	748,688	417,450	417,450
2.0	36,300	2.0	36,300	6.5	176,963	5.0	90,750	5.0	90,750	8.0	217,800	5.5	99,825	5.5	99,825	3,585	748,688	417,450	417,450
0.0	0	0.0	0	6.5	176,963	5.0	90,750	5.0	90,750	8.0	217,800	5.5	99,825	5.5	99,825	1,225	530,888	272,250	272,250
0.0	0	0.0	0	6.5	176,963	5.0	90,750	5.0	90,750	8.0	217,800	5.5	99,825	5.5	99,825	1,225	530,888	272,250	272,250
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	217,800	5.5	99,825	5.5	99,825	0	0	0	0
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.0	217,800	5.5	99,825	5.5	99,825	0	0	0	0
6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	294	123,370	46,998	46,998
6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	294	123,370	46,998	46,998
0.0	0	0.0	0	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	126	52,873	20,142	20,142
0.0	0	0.0	0	10.5	17,624	6.0	6,714	6.0	6,714	10.5	17,624	6.0	6,714	6.0	6,714	126	52,873	20,142	20,142
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	17,624	6.0	6,714	6.0	6,714	0	0	0	0
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	17,624	6.0	6,714	6.0	6,714	0	0	0	0
1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266	2.8	6,266	8.6	28,870	4.9	10,966	4.9	10,966	244	76,540	29,542	29,542
1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266	2.8	6,266	8.6	28,870	4.9	10,966	4.9	10,966	244	76,540	29,542	29,542
1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266	2.8	6,266	8.6	28,870	4.9	10,966	4.9	10,966	244	76,540	29,542	29,542
1.2	2,686	1.2	2,686	4.8	16,114	2.8	6,266	2.8	6,266	8.6	28,870	4.9	10,966	4.9	10,966	244	76,540	29,542	29,542
6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	392	164,493	62,664	62,664
6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	392	164,493	62,664	62,664
0.0	0	0.0	0	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	168	70,497	26,856	26,856
0.0	0	0.0	0	10.5	23,499	6.0	8,952	6.0	8,952	10.5	23,499	6.0	8,952	6.0	8,952	168	70,497	26,856	26,856
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	23,499	6.0	8,952	6.0	8,952	0	0	0	0
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	10.5	23,499	6.0	8,952	6.0	8,952	0	0	0	0
3.0	5,371	3.0	5,371	8.0	21,485	5.0	8,952	5.0	8,952	9.0	24,170	6.0	10,742	6.0	10,742	260	128,909	48,341	48,341
3.0	5,371	3.0	5,371	8.0	21,485	5.0	8,952	5.0	8,952	9.0	24,170	6.0	10,742	6.0	10,742	260	128,909	48,341	48,341
0.0	0	0.0	0	8.0	21,485	5.0	8,952	5.0	8,952	9.0	24,170	6.0	10,742	6.0	10,742	134	64,454	26,856	26,856
0.0	0	0.0	0	8.0	21,485	5.0	8,952	5.0	8,952	9.0	24,170	6.0	10,742	6.0	10,742	134	64,454	26,856	26,856
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	9.0	24,170	6.0	10,742	6.0	10,742	0	0	0	0
0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	9.0	24,170	6.0	10,742	6.0	10,742	0	0	0	0
0.3	179	0.3	179	3.9	3,491	2.2	1,313	2.2	1,313	8.5	7,609	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655
0.3	179	0.3	179	3.9	3,491	2.2	1,313	2.2	1,313	8.5	7,609	4.9	2,924	4.9	2,924	42	12,264	4,655	4,655
0.3	336	0.3	336	3.9	6,546	2.2	2,462	2.2	2,462	8.5	14,267	4.9	5,483	4.9	5,483	78	22,995	8,728	8,728
0.8	90	0.8	90	4.9	822	2.8	313	2.8	313	8.8	1,477	5.0	560	5.0	560	12	3,474	1,298	1,298
2.4	537	2.4	537	6.3	2,115	3.6	806	3.6	806	8.9	2,988	5.1	1,141	5.1	1,141	38	11,984	4,566	4,566
1.2	1,343	1.2	1,343	4.7	7,889	2.7	3,021	2.7	3,021	8.9	14,939	5.1	5,707	5.1	5,707	120	37,766	14,435	14,435
0.6	134	0.6	134	5.3	1,779	3.1	694	3.1	694	8.8	2,954	5.0	1,119	5.0	1,119	21	6,680	2,618	2,618
0.6	179	0.6	179	4.7	2,104	2.7	806	2.7	806	7.9	3,536	4.5	1,343	4.5	1,343	26	8,102	3,133	3,133
0.6	13	0.6	13	4.2	141	2.4	54	2.4	54	6.3	211	3.6	81	3.6	81	2	557	215	215
1.2	1,074	1.2	1,074	4.7	6,311	2.7	2,417	2.7	2,417	8.9	11,951	5.1	4,566	5.1	4,566	100	30,213	11,548	11,548
1.2	54	1.2	54	3.2	215	1.8	81	1.8	81	5.3	356	3.1	139	3.1	139	4	1,209	457	457
0.0	0	0.0	0	4.2	94	2.4	36	2.4	36	7.9	177	4.5	67	4.5	67	1	282	107	107
1.2	27	1.2	27	4.6	154	2.6	58	2.6	58	9.4	316	5.4	121	5.4	121	2	745	282	282
	129,562		129,562		1,057,890		499,910		499,910		1,882,433		827,439		827,439	13,830	4,223,037	2,017,977	2,017,977

Model Yearly Tot

Total Yearly Dem

Total Yearly Usag

Total Yearly Cost

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TO THE CENTRAL HEATING PLANT

mer Billing Months				Non-Summer					Summer					
Inter.		On-Peak												
rs/ ay	kWh/Mo	hrs/ day	kWh/Mo	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	Demand kW/Yr.	Off-Peak KWH/Yr.	Inter KWH/Yr.	On-Peak KWH/Yr.	Cost $	No.
														1
														2
5.5	99,825	5.5	99,825	3,585	748,688	417,450	417,450	$89,520	3,312	1,089,000	499,125	499,125	$144,954	3
5.5	99,825	5.5	99,825	3,585	748,688	417,450	417,450	$89,520	3,312	1,089,000	499,125	499,125	$144,954	4
5.5	99,825	5.5	99,825	1,225	530,888	272,250	272,250	$52,531	3,312	1,089,000	499,125	499,125	$144,954	5
5.5	99,825	5.5	99,825	1,225	530,888	272,250	272,250	$52,531	3,312	1,089,000	499,125	499,125	$144,954	6
5.5	99,825	5.5	99,825	0	0	0	0	$0	3,312	1,089,000	499,125	499,125	$144,954	7
5.5	99,825	5.5	99,825	0	0	0	0	$0	3,312	1,089,000	499,125	499,125	$144,954	8
6.0	6,714	6.0	6,714	294	123,370	46,998	46,998	$10,721	210	88,121	33,570	33,570	$10,019	9
6.0	6,714	6.0	6,714	294	123,370	46,998	46,998	$10,721	210	88,121	33,570	33,570	$10,019	10
6.0	6,714	6.0	6,714	126	52,873	20,142	20,142	$4,595	210	88,121	33,570	33,570	$10,019	11
6.0	6,714	6.0	6,714	126	52,873	20,142	20,142	$4,595	210	88,121	33,570	33,570	$10,019	12
6.0	6,714	6.0	6,714	0	0	0	0	$0	210	88,121	33,570	33,570	$10,019	13
6.0	6,714	6.0	6,714	0	0	0	0	$0	210	88,121	33,570	33,570	$10,019	14
4.9	10,966	4.9	10,966	244	76,540	29,542	29,542	$7,095	459	144,351	54,831	54,831	$18,362	15
4.9	10,966	4.9	10,966	244	76,540	29,542	29,542	$7,095	459	144,351	54,831	54,831	$18,362	16
4.9	10,966	4.9	10,966	244	76,540	29,542	29,542	$7,095	459	144,351	54,831	54,831	$18,362	17
4.9	10,966	4.9	10,966	244	76,540	29,542	29,542	$7,095	459	144,351	54,831	54,831	$18,362	18
6.0	8,952	6.0	8,952	392	164,493	62,664	62,664	$14,295	280	117,495	44,760	44,760	$13,358	19
6.0	8,952	6.0	8,952	392	164,493	62,664	62,664	$14,295	280	117,495	44,760	44,760	$13,358	20
6.0	8,952	6.0	8,952	168	70,497	26,856	26,856	$6,127	280	117,495	44,760	44,760	$13,358	21
6.0	8,952	6.0	8,952	168	70,497	26,856	26,856	$6,127	280	117,495	44,760	44,760	$13,358	22
6.0	8,952	6.0	8,952	0	0	0	0	$0	280	117,495	44,760	44,760	$13,358	23
6.0	8,952	6.0	8,952	0	0	0	0	$0	280	117,495	44,760	44,760	$13,358	24
6.0	10,742	6.0	10,742	260	128,909	48,341	48,341	$10,818	313	120,852	53,712	53,712	$14,983	25
6.0	10,742	6.0	10,742	260	128,909	48,341	48,341	$10,818	313	120,852	53,712	53,712	$14,983	26
6.0	10,742	6.0	10,742	134	64,454	26,856	26,856	$5,693	313	120,852	53,712	53,712	$14,983	27
6.0	10,742	6.0	10,742	134	64,454	26,856	26,856	$5,693	313	120,852	53,712	53,712	$14,983	28
6.0	10,742	6.0	10,742	0	0	0	0	$0	313	120,852	53,712	53,712	$14,983	29
6.0	10,742	6.0	10,742	0	0	0	0	$0	313	120,852	53,712	53,712	$14,983	30
														31
4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,147	127	38,046	14,622	14,622	$4,958	32
4.9	2,924	4.9	2,924	42	12,264	4,655	4,655	$1,147	127	38,046	14,622	14,622	$4,958	33
4.9	5,483	4.9	5,483	78	22,995	8,728	8,728	$2,151	238	71,336	27,416	27,416	$9,297	34
5.0	560	5.0	560	12	3,474	1,298	1,298	$322	23	7,385	2,798	2,798	$929	35
5.1	1,141	5.1	1,141	38	11,984	4,566	4,566	$1,104	48	14,939	5,707	5,707	$1,905	36
5.1	5,707	5.1	5,707	120	37,766	14,435	14,435	$3,487	238	74,693	28,535	28,535	$9,525	37
5.0	1,119	5.0	1,119	21	6,680	2,618	2,618	$623	45	14,771	5,595	5,595	$1,840	38
4.5	1,343	4.5	1,343	26	8,102	3,133	3,133	$754	56	17,680	6,714	6,714	$2,245	39
3.6	81	3.6	81	2	557	215	215	$52	3	1,057	403	403	$135	40
5.1	4,566	5.1	4,566	100	30,213	11,548	11,548	$2,813	195	59,755	22,828	22,828	$7,696	41
3.1	139	3.1	139	4	1,209	457	457	$112	6	1,779	694	694	$227	42
4.5	67	4.5	67	1	282	107	107	$26	3	884	336	336	$112	43
5.4	121	5.4	121	2	745	282	282	$69	5	1,578	604	604	$202	44
														45
	827,439		827,439	13,830	4,223,037	2,017,977	2,017,977	$430,790	27,639	9,412,163	4,137,197	4,137,197	$1,217,351	46

Model Yearly Totals	41,468	13,635,200	6,155,174	6,155,174	$1,648,141

Total Yearly Demand	**41,470 KW**
Total Yearly Usage	**25,945,549 KWh**
Total Yearly Cost	**$1,648,000**

23-May-95

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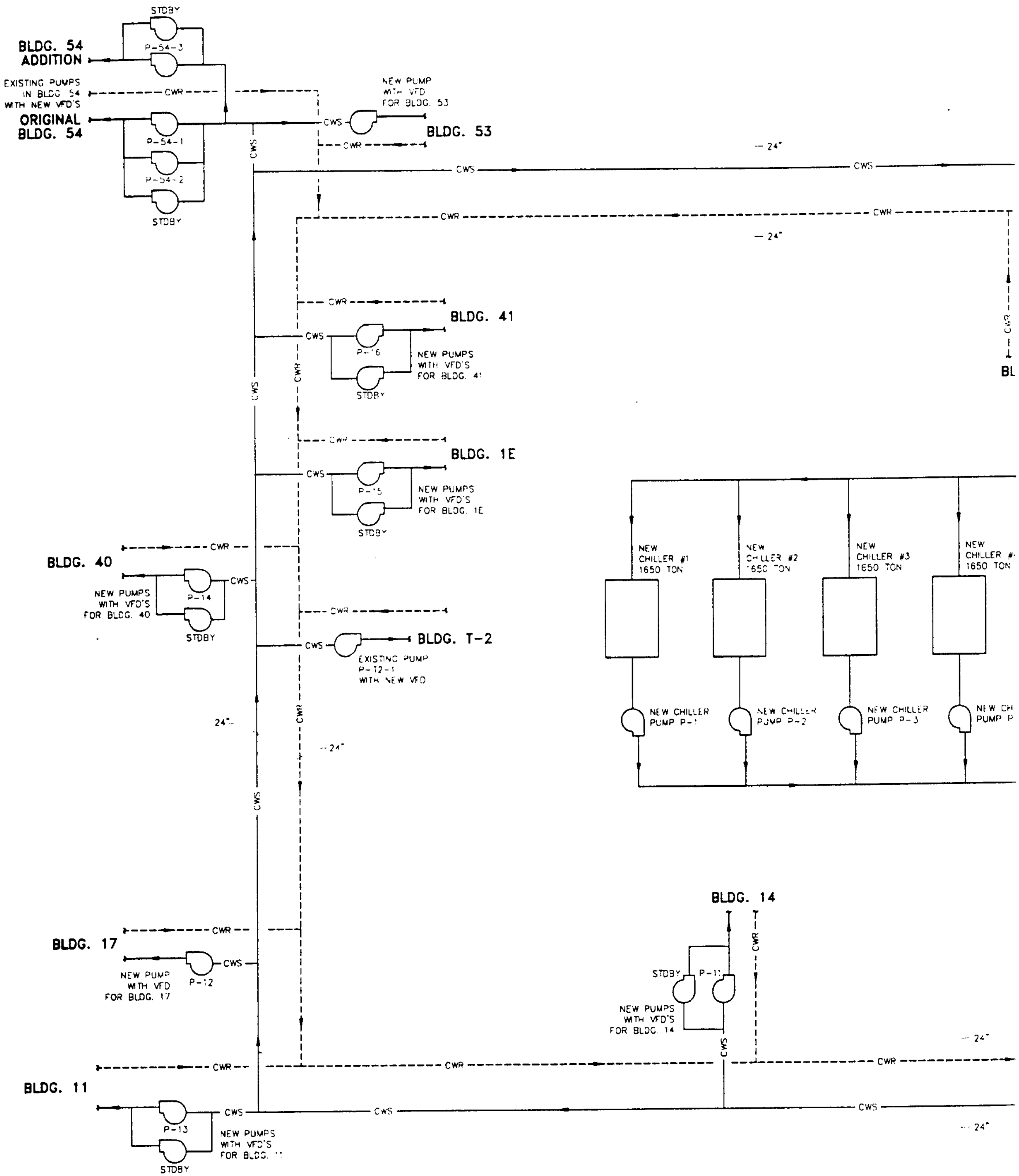
The present central chilled water systems will not accommodate any future growth, and in some cases, are undersized for existing loads. The new plant will be sized based on the existing capacity in Buildings 48, 49, 54, and 7 for a total of 9,840 tons. The provisions for a new plant would require a new distribution system throughout the site. Consideration will be given to phased building tie-ins and coordinated to minimize service interruptions.

The new plant will house six (6) 1,650-ton chillers. The chillers will be electric centrifugal with an efficiency rating of 0.55 kW/ton (federal specification). Each chiller will have a new cooling tower, condenser water pump, and chilled water pump dedicated to it. The chilled water system will be variable-volume primary/secondary pumping system. Four (4) variable-volume primary pumps will provide chilled water to each building. Refer to Plate 14, page 6-52.

In addition, all buildings except Buildings 2, 7, and T-2, would require system modifications in order to provide secondary chilled water pumps with variable-frequency drives. In each building, except Building 2, 90% of the existing 3-way control valves will be changed to 2-way control valves. In Buildings 2 and 7, the existing building pumps will be modified to provide variable-frequency drives. This overall change would result in a variable-flow primary/secondary chilled water pumping system.

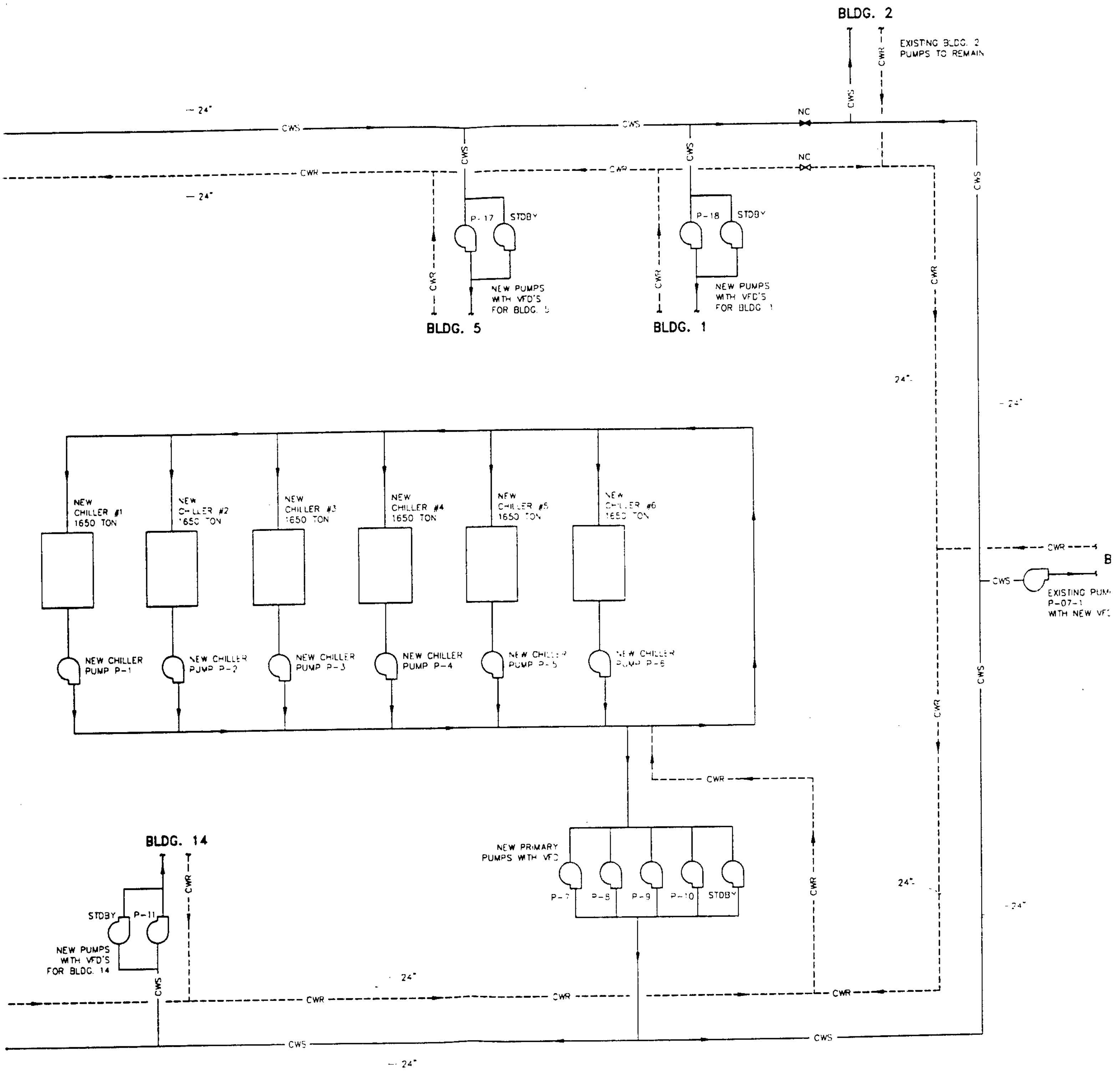
The new plant, as shown in Table 6.7.2 page 6-52, will have an estimated electric usage of 25,945,500 kWh/yr and demand of 41,470 kW/yr. The total operating cost will be $1,648,000.



ALTERNATE #5
SCHEMATIC – FLOW DIAGRAM

SCALE: NONE

①

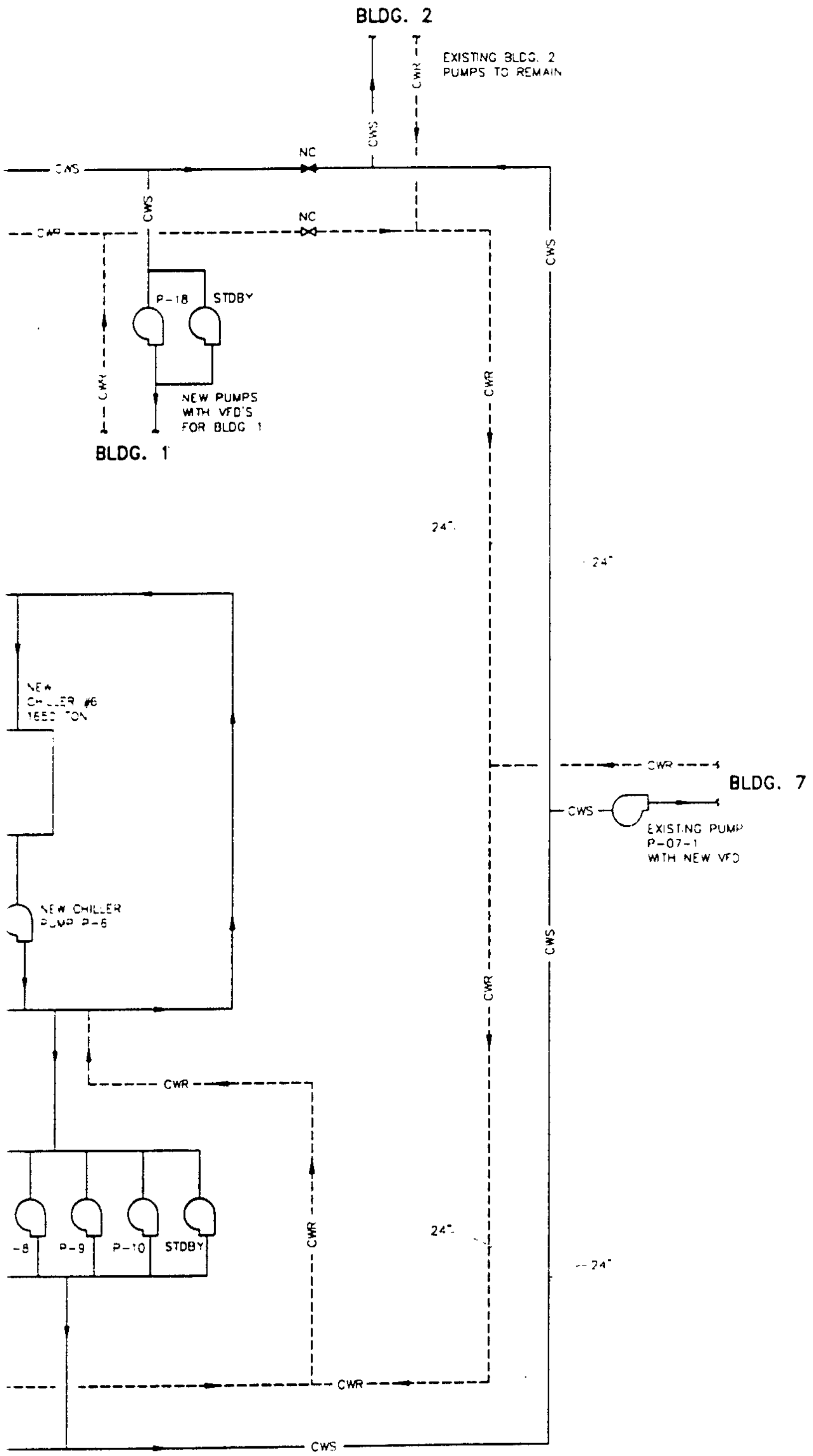


ALTERNATE #5

SCHEMATIC – FLOW DIAGRAM

SCALE: NONE

②



LEGEND

—— CWS ——	CHILLED WATER SUPPLY
- - - - CWR - - - -	CHILLED WATER RETURN
—— CS ——	CONDENSER WATER SUPPLY
- - - - CR - - - -	CONDENSER WATER RETURN
——→——	DIRECTION OF FLOW

REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

WALTER REED ARMY MEDICAL CENTER WASHINGTON, D.C.
CHILLED WATER STUDY
EEAP PROGRAM
CONTRACT NO. DACA01-94-D-0037
MECHANICAL-CHILLER BLDG. #48-CHILLED & CONDENSER WATER SCHEMATIC-ALTERNATE NO. 5

ENTECH Engineering
Inc., Reading, PA.
Job #4130.02

B-4130-02-14
14

NONE
M-14

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6.7.3 Capital Cost Estimate

The estimated construction cost for a new central chilled water plant with a variable-flow primary/secondary distribution system is $18,900,000. An itemized cost estimate is included at the end of this section.

Material	$10,300,000
Labor	6,700,000
SIOH	900,000
Design Fee	1,000,000
Total	**$18,900,000**

6.7.4 Annual Energy Savings

The estimated annual energy savings is $526,000 per year ($2,174,000 - $1,648,000). The cost figure reflects the annual cost savings with the implementation of a new chilled water plant and distribution system. All numbers are calculated on the previously established cooling loads in Section 5.0.

Savings Summary			
	Existing	Proposed	Savings
Electric Demand (kW)	56,376	41,470	14,906
Electric Usage (kWh)	34,042,924	25,945,550	8,097,374
Cost ($)	$2,174,000	$1,648,000	$526,000

6.7.5 Annual Operation and Maintenance Cost

Maintenance costs will also be reduced with the addition of new equipment to replace the existing. It is estimated that the maintenance cost will be ⅓ of existing costs.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	$0
Maintenance	$117,000	$39,000	$78,000

6.7.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 27,636 mmBtu (8,097,374 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $19.03/mmBtu ($526,000 ÷ 27,636 mmBtu)

Construction $ = $17,000,000 ($10,300,000 + $6,700,000)

SIOH $ = $900,000

Design $ = $1,000,000

Maintenance = $78,000

Simple Payback (Years)	31.3
Savings to Investment Ratio (SIR)	0.5

6.7.7 Expected Service Life

Service life depends on equipment type; therefore, it can be from twenty to thirty-five years.

6.7.8 Environmental Consideration

The replacement of old chillers will provide new refrigerants which are environmentally acceptable and available during the normal service life of the chillers.

6.7.9 Advantages

- Will allow for new construction to occur while existing plants remain on line.
- More efficient operation (lower kW/ton).
- Reduced maintenance and operation expenses, no major overhauls required for a substantial time period.
- Reduced pumping energy.
- Reduced chiller energy.
- Improves site distribution deficiencies.
- Allows for load diversity of connected chilled water demand.

6.7.10 Disadvantages

- Capital costs.
- Significant site work required.
- Building interface coordination.
- Building tie-in to avoid service interruption.
- Requires modifications to existing individual building chilled water pumping and control valve systems.

ALTERNATE NO. 5
PROVIDE NEW CENTRAL CHILLED WATER PLANT ADJACENT TO EXISTING CENTRAL HEATING PLANT

				MATERIAL		LABOR		LINE	
	DESCRIPTION	QUAN.	UNITS	$/UNIT	TOTAL	$/UNIT	TOTAL	TOTAL	#
1	CHILLERS 6 @ 1650 TON EACH	9900	TON	$200	$1,980,000	$80	$792,000	$2,772,000	1
2	RIGGING CHILLERS	6	EA	$5,000	$30,000	$5,000	$30,000	$60,000	2
3	BLDG VENTILATION SYSTEM	1	EA	$15,000	$15,000	$20,000	$20,000	$35,000	3
4	BREATHING APPARATUS	2	EA	$500	$1,000	$100	$200	$1,200	4
5	REFRIGERANT SENSORS AND ALARMS	2	EA	$1,500	$3,000	$1,000	$2,000	$5,000	5
6	DEMOLITION BLDG 48 CHILLERS	6	EA		$0	$10,000	$60,000	$60,000	6
7	DEMOLITION BLDG 49 CHILLER & SYSTEM	3	EA		$0	$10,000	$30,000	$30,000	7
8	DEMOLITION BLDG 54 CHILLERS	3	EA		$0	$10,000	$30,000	$30,000	8
9	DEMOLITION BLDG 54 CLG TOWER & PUMI	3	EA		$0	$5,000	$15,000	$15,000	9
10	COOLING TOWERS , 6 TOTAL	6	EA	$150,000	$900,000	$25,000	$150,000	$1,050,000	10
11	CONDENSER PUMPS , 40 HP, 2 stdby	14	EA	$14,000	$196,000	$900	$12,600	$208,600	11
12	CHILLER PUMPS, 75 HP, 1 stdby	7	EA	$9,700	$67,900	$800	$5,600	$73,500	12
13	PRIMARY PUMP, 150 HP, 1stdby	5	EA	$16,900	$84,500	$1,100	$5,500	$90,000	13
14	VARIABLE FREQUENCY DRIVE 150 HP	4	EA	$27,000	$108,000	$2,000	$8,000	$116,000	14
15	CONCRETE PADS CHILLERS	6	EA	$500	$3,000	$500	$3,000	$6,000	15
16	CONCRETE PADS PUMPS	16	EA	$100	$1,600	$400	$6,400	$8,000	16
17					$0		$0	$0	17
18	CHILLER LOOP PIPING, 24" w/insulation	1000	LF	$120	$120,000	$122	$122,000	$242,000	18
19	CHILLER LOOP PIPING, 14" w/insulation	1500	LF	$70	$105,000	$70	$105,000	$210,000	19
20	PRIMARY PIPING, 24" w/insulation	500	LF	$120	$60,000	$122	$61,000	$121,000	20
21	PRIMARY PIPING, 16" w/insulation	1000	LF	$85	$85,000	$85	$85,000	$170,000	21
22	CONDENSER WATER PIPING, 16"	2500	LF	$85	$212,500	$85	$212,500	$425,000	22
23	VALVES FOR PUMPS , 14"	18	EA	$3,100	$55,800	$600	$10,800	$66,600	23
24	VALVES FOR PUMPS , 16"	30	EA	$4,700	$141,000	$750	$22,500	$163,500	24
25	PRIMARY BELOW GRND DIST PIPING 24"	18000	LF	$150	$2,700,000	$150	$2,700,000	$5,400,000	25
26	SECONDARY PUMP BLDG 1, 75 HP	2	EA	$9,700	$19,400	$800	$1,600	$21,000	26
27	VARIABLE FREQUENCY DRIVE 75 HP	2	EA	$20,000	$40,000	$2,000	$4,000	$44,000	27
28	REPLACE 3WAY W/2WAY VALVES BLDG 1	32	EA	$300	$9,600	$150	$4,800	$14,400	28
29	SECONDARY PUMP BLDG 5, 3 HP	2	EA	$1,600	$3,200	$250	$500	$3,700	29
30	VARIABLE FREQUENCY DRIVE 3 HP	2	EA	$3,500	$7,000	$2,000	$4,000	$11,000	30
1	REPLACE 3WAY W/2WAY VALVES BLDG 5	3	EA	$300	$900	$150	$450	$1,350	31
32	VARIABLE FREQUENCY DRIVE 7.5 HP, 7	1	EA	$4,600	$4,600	$2,000	$2,000	$6,600	32
33	REPLACE 3WAY W/2WAY VALVES BLDG 7	5	EA	$300	$1,500	$150	$750	$2,250	33
34	VARIABLE FREQUENCY DRIVE 75 HP, 54	1	EA	$20,000	$20,000	$2,000	$2,000	$22,000	34
35	VARIABLE FREQUENCY DRIVE 40 HP, 54	2	EA	$12,500	$25,000	$2,000	$4,000	$29,000	35
36	REPLACE 3WAY W/2WAY VALVES BLDG 54	42	EA	$300	$12,600	$150	$6,300	$18,900	36
37	SECONDARY PUMP BLDG 40, 60 HP	2	EA	$8,000	$16,000	$700	$1,400	$17,400	37
38	VARIABLE FREQUENCY DRIVE 60 HP	2	EA	$17,000	$34,000	$2,000	$4,000	$38,000	38
39	REPLACE 3WAY W/2WAY VALVES BLDG 40	20	EA	$300	$6,000	$150	$3,000	$9,000	39
40	SECONDARY PUMP BLDG 41, 3 HP	2	EA	$1,600	$3,200	$250	$500	$3,700	40
41	VARIABLE FREQUENCY DRIVE 3 HP	2	EA	$3,500	$7,000	$2,000	$4,000	$11,000	41
42	REPLACE 3WAY W/2WAY VALVES BLDG 41	3	EA	$300	$900	$150	$450	$1,350	42
43	VARIABLE FREQUENCY DRIVE 15 HP, T-2	1	EA	$5,500	$5,500	$2,000	$2,000	$7,500	43
44	REPLACE 3WAY W/2WAY VALVES BLDG T2	11	EA	$300	$3,300	$150	$1,650	$4,950	44
45	SECONDARY PUMP BLDG 17, 3 HP	1	EA	$1,600	$1,600	$250	$250	$1,850	45
46	VARIABLE FREQUENCY DRIVE 3 HP	1	EA	$3,500	$3,500	$2,000	$2,000	$5,500	46
47	REPLACE 3WAY W/2WAY VALVES BLDG 17	75	EA	$300	$22,500	$150	$11,250	$33,750	47
48	SECONDARY PUMP BLDG 14, 20 HP	2	EA	$2,700	$5,400	$540	$1,080	$6,480	48
49	VARIABLE FREQUENCY DRIVE 20 HP	2	EA	$7,000	$14,000	$2,000	$4,000	$18,000	49
50	REPLACE 3WAY W/2WAY VALVES BLDG 14	75	EA	$300	$22,500	$150	$11,250	$33,750	50
51	SECONDARY PUMP BLDG 11, 15 HP	2	EA	$2,000	$4,000	$470	$940	$4,940	51
52	VARIABLE FREQUENCY DRIVE 15 HP	2	EA	$5,500	$11,000	$2,000	$4,000	$15,000	52
53	REPLACE 3WAY W/2WAY VALVES BLDG 11	5	EA	$300	$1,500	$150	$750	$2,250	53
54	VALVES FOR BLDG PUMPS	40	EA	$750	$30,000	$300	$12,000	$42,000	54
55	PRESSURE SENSORS	12	EA	$500	$6,000	$500	$6,000	$12,000	55
56	CONTROLS	300	PTS	$750	$225,000	$750	$225,000	$450,000	56
57			EA		$0		$0	$0	57
58	BLDG 15 ADDITION	30500	SF	$50	$1,525,000	$32	$976,000	$2,501,000	58
59			EA		$0		$0	$0	59
60			EA		$0		$0	$0	60
61	CONTINGENCY				$1,339,000		$908,980	$2,247,980	61
	TOTALS>>>>>>>>>				**$10,300,000**		**$6,700,000**	**$17,000,000**	

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            LIFE CYCLE COST ANALYSIS SUMMARY              STUDY: WALTER1
       ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)       LCCID  1.080
INSTALLATION & LOCATION:                   REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR       DISCRETE PORTION NAME: ALT#5
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST       $ 17000000.
B. SIOH                    $   900000.
C. DESIGN COST             $  1000000.
D. TOTAL COST (1A+1B+1C)   $ 18900000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                    $ 18900000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST    SAVINGS       ANNUAL $      DISCOUNT    DISCOUNTED
    FUEL     $/MBTU(1)   MBTU/YR(2)    SAVINGS(3)    FACTOR(4)   SAVINGS(5)

    A. ELECT $ 19.03       27636.      $  525913.       15.61    $   8209504.
    B. DIST  $   .00           0.      $        0.      17.56    $         0.
    C. RESID $   .00           0.      $        0.      19.97    $         0.
    D. NAT G $   .00           0.      $        0.      20.96    $         0.
    E. COAL  $   .00           0.      $        0.      17.58    $         0.
    F. LPG   $   .00           0.      $        0.      16.12    $         0.
    M. DEMAND SAVINGS                  $        0.      14.74    $         0.
    N. TOTAL               27636.      $  525913.                $   8209504.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                      $    78000.
       (1) DISCOUNT FACTOR (TABLE A)                    14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                      $  1149720.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                                  SAVINGS(+)   YR   DISCNT     DISCOUNTED
                 ITEM              COST(-)     OC   FACTR      SAVINGS(+)/
                                     (1)      (2)    (3)       COST(-)(4)

    d. TOTAL                $      0.                                0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$  1149720.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$   603913.

5. SIMPLE PAYBACK PERIOD (1G/4)                                 31.30 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $  9359224.

7. SAVINGS TO INVESTMENT RATIO          (SIR)=(6 / 1G)=             .50
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                        -.46 %
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6.8 Alternative No. 6

— Chiller Type Comparison

6.8.1 Existing

A description of the existing chilled water system is provided in Section 3.4.

6.8.2 Description

The costs, advantages, and disadvantages of five (5) chiller types which could be utilized at this facility were analyzed. Using both EZDOE and hand calculations, Entech simulated 1,700 tons of each chiller type operating base loaded over an entire year.

Type	COP
Electric centrifugal	6.4
Two-stage steam absorption	1.0
Gas-fired absorption	1.2
Gas engine driven	1.6
Steam turbine driven	1.2

6.8.3 Construction Cost

The expected construction cost for each chiller type is summarized below. Costs are for material and labor associated with 1,700 tons of chiller, pumps, towers, and piping. (Reference attached cost estimate).

Type	Cost	Additional
Electric centrifugal	$1,100,000	Base
Two-stage steam absorption	$1,800,000	$700,000
Gas-fired absorption	$1,900,000	$800,000
Gas engine driven	$1,800,000	$700,000
Steam turbine driven	$2,000,000	$900,000

6.8.4 Annual Energy Savings

The expected energy cost of each chiller type is summarized below and detailed in Table 6.8.4.1, on the following two (2) pages, in more detail.

Type	Cost	Additional
Electric centrifugal	$ 483,000	Base
Two-stage steam absorption	$1,040,000	($557,000)
Gas-fired absorption	$ 705,000	($222,000)
Gas engine driven	$ 480,000	$3,000
Steam turbine driven	$ 918,000	($435,000)

New Ele
Ch

Month	Chiller					Tower Fan				
	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh
January	1,030	642,389	138,148	138,148	366,093	34	25,002	5,377	5,377	14,249
February	1,029	597,660	142,300	142,300	313,060	34	22,584	5,377	5,377	11,830
March	1,038	697,851	150,075	150,075	397,700	34	25,007	5,378	5,378	14,251
April	1,039	698,550	155,233	155,233	388,084	34	24,200	5,378	5,378	13,444
May	1,041	750,906	161,485	161,485	427,936	34	25,007	5,378	5,378	14,251
June	1,042	744,529	165,451	165,451	413,627	34	24,200	5,378	5,378	13,444
July	1,043	771,898	166,000	166,000	439,899	34	25,007	5,378	5,378	14,251
August	1,042	772,038	166,030	166,030	439,978	34	25,007	5,378	5,378	14,251
September	1,042	737,341	163,853	163,853	409,634	34	24,200	5,378	5,378	13,444
October	1,041	734,562	157,970	157,970	418,621	34	25,007	5,378	5,378	14,251
November	1,042	672,744	149,499	149,499	373,746	34	24,200	5,378	5,378	13,444
December	1,036	654,543	140,762	140,762	373,019	34	25,007	5,378	5,378	14,251
Totals	12,465	8,475,011	1,856,807	1,856,807	4,761,397	403	294,426	64,532	64,532	165,362

New Gas-F
Cl

Month	Chiller					Tower Fan				
	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh
January	4	3,113	669	669	1,774	34	25,002	5,377	5,377	14,249
February	4	2,812	669	669	1,473	34	22,584	5,377	5,377	11,830
March	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
April	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444
y	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
une	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444
July	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
August	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
September	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444
October	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
November	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444
December	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251
	50	36,652	8,033	8,033	20,585	403	294,426	64,532	64,532	165,362

New Gas-
Ch

Month	Chiller					Tower Fan				
	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh
January	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
February	42	28,518	6,790	6,790	14,938	34	23,123	5,505	5,505	12,112
March	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
April	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764
May	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
June	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764
July	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
August	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
September	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764
October	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
November	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764
December	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589
	509	371,755	81,480	81,480	208,794	413	301,422	66,065	66,065	169,292

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Table 6.8.4.1
New Electric Centrifugal Chiller
Chiller Base Loaded

Tower Fan					Tower Pump					Total all Coo		
nd	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh
34	25,002	5,377	5,377	14,249	100	74,271	15,972	15,972	42,326	1,163	741,662	159,49
34	22,584	5,377	5,377	11,830	100	67,083	15,972	15,972	35,139	1,162	687,327	163,64
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,172	797,128	171,42
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	1,173	794,625	176,58
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,174	850,183	182,83
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	1,176	840,604	186,80
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,177	871,176	187,35
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,176	871,315	187,38
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	1,176	833,415	185,20
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,174	833,839	179,32
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	1,175	768,818	170,84
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	1,169	753,820	162,11
403	294,426	64,532	64,532	165,362	1,198	874,477	191,666	191,666	491,145	14,066	9,643,913	2,113,00

New Gas-Fired Engine Driven Chiller
Chiller Base Loaded

Tower Fan					Tower Pump					Total all Coo		
d	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh
34	25,002	5,377	5,377	14,249	100	74,271	15,972	15,972	42,326	138	102,386	22,01
34	22,584	5,377	5,377	11,830	100	67,083	15,972	15,972	35,139	138	92,479	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
403	294,426	64,532	64,532	165,362	1,198	874,477	191,666	191,666	491,145	1,651	1,205,555	264,23

New Gas-Fired Absorption Chiller
Chiller Base Loaded

Tower Fan					Tower Pump					Total all Coo		
d	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	23,123	5,505	5,505	12,112	120	80,500	19,167	19,167	42,167	197	132,141	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	197	141,579	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	197	141,579	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	197	141,579	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	197	141,579	31,462
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	197	146,299	31,462
13	301,422	66,065	66,065	169,292	1,437	1,049,372	229,999	229,999	589,374	2,360	1,722,549	377,545

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Pump			Total all Cooling Equipment						Chiller	
eak h	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Cost $	Gas Mcf	Gas Cost
5,972	15,972	42,326	1,163	741,662	159,497	159,497	422,667	$37,623		
5,972	15,972	35,139	1,162	687,327	163,649	163,649	360,029	$35,817		
5,972	15,972	42,326	1,172	797,128	171,425	171,425	454,277	$39,918		
5,972	15,972	39,930	1,173	794,625	176,583	176,583	441,458	$39,967		
5,972	15,972	42,326	1,174	850,183	182,835	182,835	484,513	$42,077		
5,972	15,972	39,930	1,176	840,604	186,801	186,801	467,002	$41,851		
5,972	15,972	42,326	1,177	871,176	187,350	187,350	496,476	$42,940		
5,972	15,972	42,326	1,176	871,315	187,380	187,380	496,556	$42,940		
5,972	15,972	39,930	1,176	833,415	185,203	185,203	463,009	$41,559		
5,972	15,972	42,326	1,174	833,839	179,320	179,320	475,199	$41,417		
5,972	15,972	39,930	1,175	768,818	170,849	170,849	427,121	$38,935		
5,972	15,972	42,326	1,169	753,820	162,112	162,112	429,596	$38,152		
,666	191,666	491,145	14,066	9,643,913	2,113,004	2,113,004	5,417,904	$483,196		

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Pump			Total all Cooling Equipment						Chiller	
eak h	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Cost $	Gas Mcf	Gas Cost
,972	15,972	42,326	138	102,386	22,018	22,018	58,349	$9,141	7,420	$26,565
,972	15,972	35,139	138	92,479	22,019	22,019	48,441	$8,289	6,927	$24,797
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$9,141	8,133	$29,118
,972	15,972	39,930	138	99,087	22,019	22,019	55,048	$8,857	8,194	$29,335
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$9,141	8,927	$31,960
,972	15,972	39,930	138	99,087	22,019	22,019	55,048	$11,105	9,060	$32,436
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$11,412	9,533	$34,127
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$11,412	9,493	$33,984
,972	15,972	39,930	138	99,087	22,019	22,019	55,048	$11,105	8,900	$31,862
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$11,412	8,686	$31,096
,972	15,972	39,930	138	99,087	22,019	22,019	55,048	$8,857	7,868	$28,168
,972	15,972	42,326	138	102,390	22,019	22,019	58,351	$9,141	7,577	$27,126
,666	191,666	491,145	1,651	1,205,555	264,231	264,231	677,092	$119,013	100,719	$360,574

ump			Total all Cooling Equipment						Chiller	
eak h	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Cost $	Gas Mcf	Gas Cost
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$13,061	11,134	$39,860
,167	19,167	42,167	197	132,141	31,462	31,462	69,217	$11,844	10,309	$36,905
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$13,061	11,939	$42,743
,167	19,167	47,917	197	141,579	31,462	31,462	78,655	$12,656	11,880	$42,530
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$13,061	12,912	$46,223
,167	19,167	47,917	197	141,579	31,462	31,462	78,655	$15,867	13,547	$48,500
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$16,306	14,642	$52,419
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$16,306	14,510	$51,946
,167	19,167	47,917	197	141,579	31,462	31,462	78,655	$15,867	13,151	$47,081
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$16,306	12,562	$44,972
,167	19,167	47,917	197	141,579	31,462	31,462	78,655	$12,656	11,640	$41,670
,167	19,167	50,792	197	146,299	31,462	31,462	83,375	$13,061	11,304	$40,469
,999	229,999	589,374	2,360	1,722,549	377,545	377,545	967,459	$170,051	149,530	$535,317

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Month	Chiller					Tower Fan					
	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Den k
January	42	31,129	6,694	6,694	17,740	34	25,600	5,505	5,505	14,589	
February	42	28.116	6,694	6,694	14,728	34	23,123	5,505	5,505	12.112	
March	42	31,129	6,694	6,694	17,740	34	25,600	5,505	5,505	14,589	
April	42	30,125	6,694	6,694	16,736	34	24,774	5,505	5,505	13,764	
May	42	31,129	6,694	6,694	17,740	34	25,600	5,505	5,505	14,589	
June	42	30,125	6,694	6,694	16,736	34	24,774	5,505	5,505	13,764	
July	42	31,129	6,694	6,694	17,740	34	25,600	5,505	5,505	14,589	
August	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589	
September	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764	
October	42	31,574	6,790	6,790	17,994	34	25,600	5,505	5,505	14,589	
November	42	30,555	6,790	6,790	16,975	34	24,774	5,505	5,505	13,764	
December	42	30,555	6,571	6,571	17,413	34	25,600	5,505	5,505	14,589	
	502	367,695	80,592	80,592	206,511	413	301,422				

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Month	Chiller					Tower Fan					
	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Der k
January	4	3,113	669	669	1,774	34	25,002	5,377	5,377	14,249	
February	4	2,812	669	669	1,473	34	22,584	5,377	5,377	11,830	
March	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
ril	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444	
May	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
June	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444	
July	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
August	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
September	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444	
October	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
November	4	3,012	669	669	1,674	34	24,200	5,378	5,378	13,444	
December	4	3,113	669	669	1,774	34	25,007	5,378	5,378	14,251	
	50	36,652	8,033	8,033	20,585	403	294,426	64,532	64,532	165,362	

Table 6.8.4.1 (Cont.)
New Two Stage Steam Absorption Chiller
Chiller Base Loaded

	Tower Fan				Tower Pump					Total all C		
nd	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Pea kWh
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	145,854	31,3
34	23,123	5,505	5,505	12,112	120	80,500	19,167	19,167	42,167	196	131,739	31,3
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	145,854	31,3
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	196	141,149	31,3
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	145,854	31,3
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	196	141,149	31,3
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	145,854	31,3
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	146,299	31,4
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	196	141,579	31,4
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	146,299	31,4
34	24,774	5,505	5,505	13,764	120	86,250	19,167	19,167	47,917	196	141,579	31,4
34	25,600	5,505	5,505	14,589	120	89,125	19,167	19,167	50,792	196	145,280	31,2
413	301,422				1,437	1,049,372	229,999	229,999	589,374	2,352	1,718,489	376,6

New Steam-Turbine Driven Chiller
Chiller Base Loaded

	Tower Fan				Tower Pump					Total all Co		
d	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Pea kWh
34	25,002	5,377	5,377	14,249	100	74,271	15,972	15,972	42,326	138	102,386	22,01
34	22,584	5,377	5,377	11,830	100	67,083	15,972	15,972	35,139	138	92,479	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
34	24,200	5,378	5,378	13,444	100	71,875	15,972	15,972	39,930	138	99,087	22,01
34	25,007	5,378	5,378	14,251	100	74,271	15,972	15,972	42,326	138	102,390	22,01
403	294,426	64,532	64,532	165,362	1,198	874,477	191,666	191,666	491,145	1,651	1,205,555	264,2

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r Pump			Total all Cooling Equipment						Chiller	
-Peak Wh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Cost $	Gas Mcf	Gas Cost
19.167	19.167	50.792	196	145,854	31,366	31,366	83,121	$13,022	20.077	$71,875
19.167	19.167	42.167	196	131,739	31,366	31,366	69,006	$11,808	18.570	$66,482
19.167	19.167	50.792	196	145,854	31,366	31,366	83,121	$13,022	21.477	$76,887
19.167	19.167	47.917	196	141,149	31,366	31,366	78,416	$12,617	21.282	$76,189
19.167	19.167	50.792	196	145,854	31,366	31,366	83,121	$13,022	21.878	$78,322
19.167	19.167	47.917	196	141,149	31,366	31,366	78,416	$15,818	19.465	$69,685
19.167	19.167	50.792	196	145,854	31,366	31,366	83,121	$16,256	18.732	$67,060
19.167	19.167	50.792	196	146,299	31,462	31,462	83,375	$16,295	19.039	$68,159
19.167	19.167	47.917	196	141,579	31,462	31,462	78,655	$15,857	20.162	$72,181
19.167	19.167	50.792	196	146,299	31,462	31,462	83,375	$16,295	21.848	$78,217
19.167	19.167	47.917	196	141,579	31,462	31,462	78,655	$12,652	20.384	$72,976
19.167	19.167	50.792	196	145,280	31,243	31,243	82,794	$12,976	20.423	$73,115
29.999	229.999	589.374	2,352	1,718,489	376,656	376,656	965,176	$169,640	243.337	$871,147

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r Pump			Total all Cooling Equipment						Chiller	
-Peak Wh	Intermediate kWh	Off-Peak kWh	Demand kW	Usage kWh	On-Peak kWh	Intermediate kWh	Off-Peak kWh	Cost $	Gas Mcf	Gas Cost
15.972	15.972	42.326	138	102,386	22,018	22,018	58,349	$9,141	16.920	$60,573
15.972	15.972	35.139	138	92,479	22,019	22,019	48,441	$8,289	15.742	$56,355
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$9,141	18.381	$65,802
15.972	15.972	39.930	138	99,087	22,019	22,019	55,048	$8,857	18.399	$65,868
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$9,141	19.778	$70,805
15.972	15.972	39.930	138	99,087	22,019	22,019	55,048	$11,105	19.610	$70,204
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$11,412	20.331	$72,785
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$11,412	20.335	$72,798
15.972	15.972	39.930	138	99,087	22,019	22,019	55,048	$11,105	19.421	$69,526
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$11,412	19.347	$69,264
15.972	15.972	39.930	138	99,087	22,019	22,019	55,048	$8,857	17.719	$63,435
15.972	15.972	42.326	138	102,390	22,019	22,019	58,351	$9,141	17.240	$61,719
91.666	191.666	491.145	1,651	1,205,555	264,231	264,231	677,092	$119,013	223.222	$799,134

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6.8.5 Annual Operation and Maintenance Cost

The estimated recurring O&M cost for each chiller type is shown below:

Type	Maintenance Cost	Additional Cost
Electric centrifugal	$1,000	Base
Two-stage steam absorption	$1,500	($500)
Gas-fired absorption	$1,500	($500)
Gas engine driven	$1,500	($500)
Steam turbine driven	$2,000	($1,000)

6.8.6 Economics

Using the LCCID program, the economics for this project are as follows:

Chiller	Payback (Yes)	SIR
Electric centrifugal	Base	Base
Two-stage steam absorption*	None	None
Gas-fired absorption*	None	None
Gas engine driven	35.2	0
Steam turbine driven*	None	None

* These three (3) chiller systems have greater energy costs than the base electric centrifugal, and therefore, have a negative payback SIR.

6.8.7 Expected Service Life

All chiller types are twenty to twenty-five years.

6.8.8 Environmental Consideration

The following table indicates which chillers emit ozone-depleting HCFCs (Refer to Section 9.0 for explanation of HCFC Refrigerant issues):

Chiller Type	Emission of HCFC
Electric centrifugal	Yes
Two-stage steam absorption	No
Gas-fired absorption	No
Gas engine driven	Yes
Steam turbine driven	Yes

6.8.9 Advantages as Compared to Electric Centrifugal

Type	Advantages
Two-stage steam absorption	- Utilize excess steam from steam plant - Good partial load efficiency - No CFC or HCFC emissions
Gas-fired absorption	- Minimal electric demand and usage - Can also provide hot water for heating - No CFC or HCFC emissions - Good partial load efficiency
Gas engine driven	- High partial load efficiency - Low energy cost - Heat recovery available
Steam turbine driven	- Utilize excess steam from steam plant

6.8.10 Disadvantages as Compared to Electric Centrifugal

Type	Disadvantages
Two-stage steam absorption	- High energy cost - High installed cost - High head room required - Larger tower and pump required
Gas-fired absorption	- High energy cost - High installed cost - Larger tower and pump required
Gas engine driven	- Larger space required - High installed cost - Noise
Steam turbine driven	- Special order only - High energy cost - High installed cost

ALTERNATE NO. 6
CHILLER TYPE OPTIONS FOR NEW CENTRAL CHILLED WATER PLANT

				MATERIAL		LABOR		LINE	
	DESCRIPTION	QUAN.	UNITS	$/UNIT	TOTAL	$/UNIT	TOTAL	TOTAL	#
1	**ELECTRIC CENTRIFUGAL CHILLER**								1
2	1700 TON ELEC CENTRIFUGAL	1700	TON	$220	$374,000	$90	$153,000	$527,000	2
3	CONDENSER PUMP 40 HP 2 @2500 GPM	2	EA	$14,000	$28,000	$900	$1,800	$29,800	3
4	COOLING TOWER 120 HP 5000 GPM	1	EA	$150,000	$150,000	$25,000	$25,000	$175,000	4
5	CONDENSER PIPE 16"	500	LF	$85	$42,500	$85	$42,500	$85,000	5
6	ELECTRICAL REQUIREMENTS	1	LOT	$20,000	$20,000	$20,000	$20,000	$40,000	6
7					$0		$0	$0	7
8	CONTINGENCY				$185,500		$57,700	$243,200	8
9	**TOTAL**				**$800,000**		**$300,000**	**$1,100,000**	9
10									10
11	**GAS ENGINE DRIVEN CHILLER**								11
12	1700 TON GAS ENGINE CENTRIF CHILLER	1700	TON	$575	$977,500	$100	$170,000	$1,147,500	12
13	CONDENSER PUMP 40 HP 2 @2500 GPM	2	EA	$14,000	$28,000	$900	$1,800	$29,800	13
14	COOLING TOWER 120 HP 5000 GPM	1	EA	$150,000	$150,000	$25,000	$25,000	$175,000	14
15	CONDENSER PIPE 16"	500	LF	$85	$42,500	$85	$42,500	$85,000	15
16	GAS PIPE 4"	400	LF	$11	$4,400	$15	$6,000	$10,400	16
17	ENGINE EXHAUST PIPE, 8"	200	LF	$30	$6,000	$30	$6,000	$12,000	17
18	EXHAUST MUFFLER, DUPLEX	2	EA	$1,000	$2,000	$500	$1,000	$3,000	18
19	ELECTRICAL REQUIREMENTS	1	LOT	$15,000	$15,000	$15,000	$15,000	$30,000	19
20					$0		$0	$0	20
21	CONTINGENCY				$254,600		$52,700	$307,300	21
22	**TOTAL**				**$1,480,000**		**$320,000**	**$1,800,000**	22
23									23
24	**GAS ABSORPTION CHILLER**								24
25	1700 TON GAS FIRED ABSORPT CHILLER	1700	TON	$550	$935,000	$100	$170,000	$1,105,000	25
26	CONDENSER PUMP 40 HP 3 @2500 GPM	3	EA	$14,000	$42,000	$1,100	$3,300	$45,300	26
27	COOLING TOWER 150 HP 7500 GPM	1	EA	$200,000	$200,000	$30,000	$30,000	$230,000	27
28	CONDENSER PIPE 20"	500	LF	$95	$47,500	$100	$50,000	$97,500	28
29	GAS PIPE 5"	400	LF	$17	$6,800	$17	$6,800	$13,600	29
30	ELECTRICAL REQUIREMENTS	1	LOT	$15,000	$15,000	$15,000	$15,000	$30,000	30
					$0		$0	$0	31
2	CONTINGENCY				$253,700		$124,900	$378,600	32
33	**TOTAL**				**$1,500,000**		**$400,000**	**$1,900,000**	33
34									34
35	**STEAM ABSORPTION CHILLER**								35
36	1700 TON STEAM ABSORPT CHILLER	1700	TON	$450	$765,000	$100	$170,000	$935,000	36
37	CONDENSER PUMP 40 HP 3 @2500 GPM	3	EA	$14,000	$42,000	$1,100	$3,300	$45,300	37
38	COOLING TOWER 150 HP 7500 GPM	1	EA	$200,000	$200,000	$30,000	$30,000	$230,000	38
39	CONDENSER PIPE 20", SCH 40	500	LF	$95	$47,500	$100	$50,000	$97,500	39
40	STEAM PIPE 14", SCH 40 W/INSULATION	500	LF	$70	$35,000	$70	$35,000	$70,000	40
41	CONDENSATE PIPE 8",SCH 80 W/INSULATIO	500	LF	$69	$34,500	$39	$19,500	$54,000	41
42	ELECTRICAL REQUIREMENTS	1	LOT	$15,000	$15,000	$15,000	$15,000	$30,000	42
43					$0		$0	$0	43
44	CONTINGENCY				$261,000		$77,200	$338,200	44
45	**TOTAL**				**$1,400,000**		**$400,000**	**$1,800,000**	45
46									46
47	**STEAM TURBINE DRIVEN CHILLER**								47
48	1700 TON STEAM TURBINE CENTRIF CHILL	1700	TON	$600	$1,020,000	$100	$170,000	$1,190,000	48
49	CONDENSER PUMP 40 HP 2 @2500 GPM	2	EA	$14,000	$28,000	$900	$1,800	$29,800	49
50	COOLING TOWER 120 HP 5000 GPM	1	EA	$150,000	$150,000	$25,000	$25,000	$175,000	50
51	CONDENSER PIPE 20", SCH 40	500	LF	$85	$42,500	$85	$42,500	$85,000	51
52	STEAM PIPE 14", SCH 40 W/INSULATION	500	LF	$70	$35,000	$70	$35,000	$70,000	52
53	CONDENSATE PIPE 8",SCH 80 W/INSULATIO	500	LF	$69	$34,500	$39	$19,500	$54,000	53
54	ELECTRICAL REQUIREMENTS	1	LOT	$15,000	$15,000	$15,000	$15,000	$30,000	54
55					$0		$0	$0	55
56	CONTINGENCY				$275,000		$91,200	$366,200	56
57	**TOTAL**				**$1,600,000**		**$400,000**	**$2,000,000**	57
58									58
59									59
60									60
61									61

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          LIFE CYCLE COST ANALYSIS SUMMARY                  STUDY: WALTER1
      ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)          LCCID  1.080
INSTALLATION & LOCATION:                     REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: ALT#6
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST       $   700000.
B. SIOH                    $        0.
C. DESIGN COST             $        0.
D. TOTAL COST (1A+1B+1C)   $   700000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $       0.
F. PUBLIC UTILITY COMPANY REBATE       $       0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                    $   700000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST   SAVINGS       ANNUAL $      DISCOUNT   DISCOUNTED
    FUEL     $/MBTU(1)   MBTU/YR(2)    SAVINGS(3)    FACTOR(4)  SAVINGS(5)

    A. ELECT $ 22.51      16180.       $  364212.       15.61   $  5685347.
    B. DIST  $   .00          0.       $       0.       17.56   $        0.
    C. RESID $   .00          0.       $       0.       19.97   $        0.
    D. NAT G $  3.47      *******      $ -359981.       20.96   $ -7545208.
    E. COAL  $   .00          0.       $       0.       17.58   $        0.
    F. LPG   $   .00          0.       $       0.       16.12   $        0.
    M. DEMAND SAVINGS                  $   16180.       14.74   $   238493.
    N. TOTAL              -87561.      $   20411.               $ -1621368.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                    $     -500.
       (1) DISCOUNT FACTOR (TABLE A)                    14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                    $    -7370.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                              SAVINGS(+)    YR   DISCNT     DISCOUNTED
            ITEM               COST(-)      OC   FACTR      SAVINGS(+)/
                                 (1)       (2)    (3)       COST(-)(4)

    d. TOTAL                  $      0.                          0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$    -7370.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    19911.

5. SIMPLE PAYBACK PERIOD (1G/4)                                 35.16 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $ -1628738.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=          -2.33
   (IF < 1 PROJECT DOES NOT QUALIFY)
**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                    N/A
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6.9 Alternative No. 7

— Chilled Water Storage

6.9.1 Existing

A description of the existing chilled water plant is provided in Section 3.4. From the revised electric model, the existing chillers (Building 48's chillers only) are estimated to use 21,535,075 kWh/yr and require 33,604 kW of demand per year. The estimated annual cost to operate the chillers is $1,333,000.

Building 48
Existing Chiller Energy Costs

Season	Demand kW	Off-Peak kWh	Intermediate kWh	On-Peak kWh	Cost
Non-summer	13,558	3,865,695	1,988,990	1,988,990	$413,700
Summer	20,046	7,290,000	3,200,700	3,200,700	$919,300
Totals	33,604	11,155,695	5,189,690	5,189,690	$1,333,000

6.9.2 Description

Utilize one (1) 1,200-ton chiller to produce and store chilled water during utility off-peak periods, when the cost for electricity is lower. Install equipment to store 9,600 ton/hours of chilled water for use during on-peak periods. This amount of storage is equivalent to a 1,100,000-gallon storage tank.

During the on-peak period (12:00 p.m. to 8:00 p.m.) the stored chilled water will be utilized to meet a portion of the load. One (1) 1,200-ton chiller will not operate during the on-peak period. During the off-peak and intermediate periods (8:00 p.m. to 12:00 p.m.), one (1) 1,200-ton chiller will operate to produce chilled water for storage. The storage system will be used from June to October during the summer electric rate period.

For this analysis, 1,200 tons/hr storage (the equivalent of one (1) chiller) was assumed. Therefore, the storage was sized so that during the on-peak period, 1,200 tons of the cooling will be provided by the stored chilled water for eight hours. On cooler days, a portion of the stored chilled water may be used to satisfy loads during the intermediate period. Use of the chilled water storage system will reduce demand charges. Generating cooling at night also takes advantage of the lower off-peak cost of energy (kWh). With the new chilled water storage system, on-peak kWh for one (1) chiller will be shifted to off-peak and intermediate hours. The annual building energy cost is $1,292,300.

Building 48
Proposed Chiller Energy Costs

Season	Demand kW	Off-Peak kWh	Intermediate kWh	On-Peak kWh	Cost
Non-Summer	13,558	3,865,695	1,988,990	1,988,990	$413,700
Summer	20,046	7,606,800	3,834,300	2,567,100	$878,600
Totals	33,604	11,472,495	5,823,290	4,556,090	$1,292,300

Summer Calculations:

On-Peak kW = 16,086 kW
[20,046 kW - (1,200 tons x .55 kW/ton x 6 mo/yr)]

On-Peak kWh = 2,567,100 kWh
[3,270,700 kWh - (1,200 tons x .55 kW/ton x 8 hrs/day x 20 day/mo x 6 mo/yr)]

Intermediate kWh = 3,834,300 kWh
[3,200,700 kWh + (1,200 tons x .55 kW/ton x 4 hrs/day x 20 days/mo x 6 mo/yr)]

Off-Peak kWh = 7,606,800 kWh
[7,200,000 kWh + (1,200 tons x .55 kW/ton x 4 hrs/day x 20 days/mo x 6 mo/yr)]

6.9.3 Construction Cost

The estimated cost to install 9,600 ton/hours of chilled water storage described above is $1,230,000. An itemized cost estimate is included at the end of this section.

Material	$ 620,000
Labor	480,000
SIOH	60,000
Design Fee	70,000
Total	**$1,230,000**

6.9.4 Annual Energy Savings

The estimated annual energy savings are $40,700 per year. The cost figure reflects the annual cost savings with the implementation of new chillers. All quantities are calculated on the cooling loads previously established in Section 5.0.

Savings Summary

	Existing	Proposed	Savings
Electric Demand (kW)	33,604	33,604	0
Electric Usage (kWh)	21,535,075	21,535,075	0
Cost ($)	$1,333,000	$1,292,300	$40,700

6.9.5 Annual Operation and Maintenance Cost

This alternative does not impact the number of operators that are currently used to operate and maintain the chiller plants. Maintenance costs will increase with the addition of storage tanks. It is estimated that annual operation and maintenance costs will increase by 2%.

	Existing	Proposed	Savings
Operation	$171,000	$171,000	0
Maintenance	$117,000	$119,000	($2,000)

6.9.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 0 mmBtu
(0 kWh x 3,413 Btu/kWh)

Demand Savings = $40,700

Construction $ = $1,100,000
($620,000 + $480,000)

SIOH $ = $60,000

Design $ = $70,000

Maintenance $ = ($2,000)

Simple Payback (Years)	31.8
Savings to Investment Ratio (SIR)	0.5

6.9.7 Expected Service Life

Twenty to twenty-five years.

6.9.8 Environmental Consideration

The replacement of the old chillers will provide new refrigerants which are acceptable environmentally and will be available for the normal service life of the chillers.

6.9.9 Advantages

- Lower demand costs.
- Shift electric usage to lower electric rates.

6.9.10 Disadvantages

- Capital cost.
- Does not allow for central system growth capacity.
- Requires a large area for 1,100,000-gallon storage tank.

ALTERNATIVE NO. 7
CHILLED WATER STORAGE

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1									1
2	STORAGE TANK 1,100,000 GAL 68'Dia,38'High	1	EA	$300,000	$300,000	$200,000	$200,000	$500,000	2
3	STORAGE TANK DIFFUSER	1	EA	$45,000	$45,000	$7,000	$7,000	$52,000	3
4	EXCAVATION & BACKFILL	1	EA		$0	$50,000	$50,000	$50,000	4
5	INSULATION	1	EA	$40,000	$40,000	$27,000	$27,000	$67,000	5
6	PIPING 14"	1000	LF	$70	$70,000	$70	$70,000	$140,000	6
7	CONTROL VALVE	2	EA	$5,000	$10,000	$1,000	$2,000	$12,000	7
8	CONTROLS	20	PTS	$750	$15,000	$750	$15,000	$30,000	8
9	PUMP, 75 HP	1	EA	$9,700	$9,700	$800	$800	$10,500	9
10					$0		$0	$0	10
11					$0		$0	$0	11
12					$0		$0	$0	12
13					$0		$0	$0	13
14					$0		$0	$0	14
15					$0		$0	$0	15
16					$0		$0	$0	16
17					$0		$0	$0	17
18					$0		$0	$0	18
19					$0		$0	$0	19
20					$0		$0	$0	20
21					$0		$0	$0	21
22					$0		$0	$0	22
23					$0		$0	$0	23
24					$0		$0	$0	24
25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
30					$0		$0	$0	30
1					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
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36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
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43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
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51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59					$0		$0	$0	59
60	CONTINGENCY				$130,300		$108,200	$238,500	60
61					$0		$0	$0	61
2	**TOTALS>>>>>>>>>**				**$620,000**		**$480,000**	**$1,100,000**	62

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          LIFE CYCLE COST ANALYSIS SUMMARY         STUDY: WALTER1
     ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID  1.080
INSTALLATION & LOCATION:               REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: OPTION#7
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST      $  1100000.
B. SIOH                   $    60000.
C. DESIGN COST            $    70000.
D. TOTAL COST (1A+1B+1C)  $  1230000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                  $  1230000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST   SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
    FUEL     $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)   FACTOR(4)  SAVINGS(5)

    A. ELECT $ 22.51          0.      $       0.      15.61   $        0.
    B. DIST  $   .00          0.      $       0.      17.56   $        0.
    C. RESID $   .00          0.      $       0.      19.97   $        0.
    D. NAT G $  3.47          0.      $       0.      20.96   $        0.
    E. COAL  $   .00          0.      $       0.      17.58   $        0.
    F. LPG   $   .00          0.      $       0.      16.12   $        0.
    M. DEMAND SAVINGS                 $   40700.      14.74   $   599918.
    N. TOTAL                  0.      $   40700.              $   599918.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                  $    -2000.
       (1) DISCOUNT FACTOR (TABLE A)                  14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                  $   -29480.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                            SAVINGS(+)   YR  DISCNT     DISCOUNTED
               ITEM           COST(-)    OC  FACTR      SAVINGS(+)/
                                 (1)    (2)    (3)      COST(-)(4)

    d. TOTAL                $      0.                            0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$   -29480.

3. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    38700.

5. SIMPLE PAYBACK PERIOD (1G/4)                                 31.78 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                     $   570438.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=            .46
    (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                      -.79 %
```

7.0 CHILLER CAPACITY REDUCTION ALTERNATIVES

7.1 General

This section of the report evaluates various alternatives for reducing current cooling plant capacity deficiencies. These alternatives were added to the project following the Interim Review Meeting at the request of the Director of Public Works. The intent of these alternatives is to try to reduce some of the excess chiller load and thereby reduce the overall chilled water shortfall. These alternatives have been developed to meet several overall objectives as follows:

1. Lower the Medical Center's peak-cooling load.
2. Improve building energy efficiency.

Each alternative will be described in the following format:

Existing:	Generally describes the existing conditions, energy usage, and energy cost.
Description:	Generally describes the alternative and its critical components. Estimates the amount of energy usage and cost to operate the proposed system. Provides results of the effect on cooling loads.
Construction Cost:	Summarizes the construction cost estimates prepared for the work necessary to implement the alternative. The costs are broken down into material, labor, and engineering.

Annual Energy Savings:	Compares the existing energy usage and costs with the proposed energy usage and costs.
Annual Operation and Maintenance Cost:	An estimate of the average annual operation and maintenance costs during the expected equipment service life of the proposed system.
Economics:	Studies the payback for installing the proposed system.
Expected Life:	The average expected service life of the equipment.
Environmental Considerations:	A discussion of the environmental impact of the alternative.
Advantages:	A list of advantages that can be expected for the type of system described.
Disadvantages:	A list of the disadvantages associated with the system.

Each alternative is evaluated in order to provide the Director of Public Works with feasibility of specific capacity reduction measures which have been previously discussed by WRAMC personnel. In some cases, these alternatives would require interface with a large building renovation project.

7.2 Alternative No. 8

— Reduce Outside Air Quantities in Buildings 1 and 40

7.2.1 Existing

Buildings 1 and 40 have heating, ventilating, and air conditioning systems that are nearly 80% outside air. The figures in the following table are quoted from Table 5.4.1:

	Sq. Ft.	Supply Air CFM	Outdoor Air CFM	Outdoor Air %	Building Cooling Tonnage
Building 40	218,090	251,660	193,880	77%	1,200
Building 1	227,530	318,600	247,730	78%	1,520

7.2.2 Description

Building 1 houses administrative offices which do not require a high amount of outdoor air. Building 1 was the original hospital and the high outdoor air hospital systems still operate to heat and cool the current administrative offices. The current total outdoor air quantity in Building 1 is estimated to be 247,730 CFM. There are an estimated 750 people in the building which translates to 330 CFM/person of outdoor air. ASHRAE currently recommends 20 CFM/person of minimum outdoor air and at 750 people, the total would be 15,000 CFM. This is quite low compared to the current amount of outdoor air. The new recommended outdoor air quantity would be 50,000 CFM (0.15 x 318,600 CFM supply air).

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Building 40 houses laboratories and administrative offices. Current planning at WRAMC has identified Building 40 services to be relocated to the Forrest Glenn site. This would allow for a complete renovation of Building 40 HVAC system.

Should Building 40 be renovated for administrative use, the HVAC systems would be replaced allowing the use of greater return air and much lower outside air. Assuring maximum outside air at 15% of total air circulation a significant cooling load reduction would be realized.

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7.2.3 Capital Cost Estimate

The existing air-handling systems in Buildings 1 and 40 have minimal return air systems. Each system in each building would have to be modified to add a return air system. The return air systems will be very costly. A full study on each building would have to be undertaken in order to quantify the cost of the return air systems. The cost of these systems will create an SIR of much less than 1.0.

7.2.4 Annual Energy Savings

The EZDOE program will be utilized to estimate the annual energy savings. The savings will be calculated by comparing the EZDOE output, as programmed for Section 5, and comparing that output to the program output after changing the outdoor air quantities in

Buildings 1 and 40 only. This will provide the energy savings by reducing the outdoor air in Buildings 1 and 40.

The EZDOE program calculated the initial peak-cooling load for Building 1 at 1,520 tons and the peak load after outdoor air reduction at 640 tons. In Building 40, the initial peak-cooling load was calculated at 1,200 tons and at 525 tons after outdoor air reduction. A comparison of the energy usage for both buildings, before and after outdoor air reduction, was performed and the results are as follows:

Table 7.2.4.1
Energy Savings Totals

Supply	Electric Demand (kW)	Electric Usage (kWh)	Gas Usage (mcf)	Cost Savings ($)
Heating System	--------	--------	34,823	$132,000
Cooling System	35	267,343	------	$11,100
Totals	**35**	**267,343**	**34,823**	**$143,100**

7.2.5 Annual Operation and Maintenance Cost

There would be no additional charge in operation and maintenance costs for this alternative.

7.2.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 912 mmBtu (267,343 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $12.17/mmBtu (11,100 ÷ 912 mmBtu)

Gas Energy Saved = 35,902 mmBtu (34,823 mcf x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Gas = $3.67/mmBtu ($132,000 ÷ 35,902 mmBtu)

Construction $ = N/A

SIOH $ = N/A

Design $ = N/A

Maintenance = N/A

Simple Payback (Years)	N/A
Savings to Investment Ratio (SIR)	N/A

7.2.7 Expected Service Life

This alternative does not effect the service life of the existing air-handling units.

7.2.8 Environmental Consideration

There are no environmental considerations for this alternative.

7.2.9 Advantages

- Reduces demand on Building 48 chillers.

7.2.10 Disadvantages

- High cost involved if existing system does not have return air capacity or insufficient return capacity.
- The existing supply air systems have no return air systems.

7.2.11 Discussion

This alternative is not recommended for implementation. It is recommended that when the time comes for a general renovation of Buildings 1 and 40, the HVAC systems be renovated and changed to a system typical for office spaces. The new systems should have outdoor quantities to accommodate the amount of people to occupy the building according to current codes.

7.3 Alternative No. 9

— Provide Unoccupied Space Temperature Setback in Buildings 1, 7, 11, 40, and 41

7.3.1 Existing

The heating, ventilating, and air conditioning systems in Buildings 1, 7, 11, 40, and 41 operates twenty-four hours a day, seven days a week. The systems currently do not have unoccupied space temperature setback. Buildings 1, 7, and 11 house administrative offices which are occupied from 7:00 a.m. to 6:00 p.m. Monday through Friday. Building 40 houses both administrative offices and laboratories and is only occupied from 7:00 a.m. to 6:00 p.m. Building 41 houses the fitness center which is used an average of twelve hours a day, five days a week.

7.3.2 Description

Buildings 1, 7, 11, 40, and 41 are occupied approximately twelve hours a day, five days a week. Provide occupied/unoccupied control to setback space temperatures when the buildings are unoccupied. The winter time space temperatures can be set back from 75°F occupied to 68°F unoccupied. In the summer, the space temperatures can be set back from 75°F occupied to 85°F unoccupied.

7.3.3 Capital Cost Estimate

The estimated cost to provide occupied/unoccupied building controls in Buildings 1, 7, 11, 40, and 41 is $83,600. An itemized cost estimate is included at the end of this alternative.

Material	$37,000
Labor	38,000
SIOH	4,100
Design Fee	4,500
Total	**$83,600**

7.3.4 Annual Energy Savings

The EZDOE program will be utilized to estimate the annual energy savings by setting back building temperatures when the building is unoccupied. The savings will be calculated by comparing the EZDOE output, as programmed for Section 5, to the program output after setting back to unoccupied temperatures in Buildings 1, 7, 11, 40, and 41. This will provide the energy savings by providing occupied/unoccupied control in the five (5) buildings.

By using 68°F winter setback and 85°F summer setback temperatures, and comparing the EZDOE outputs before and after, the results are as follows:

Table 7.3.4.1
Energy Savings Totals

Supply	Electric Demand (kW)	Electric Usage (kWh)	Gas Usage (mcf)	Cost Savings ($)
Heating System	------	------	1,700	$6,600
Cooling System	------	239,400	------	$9,900
Totals	------	**239,400**	**1,700**	**$16,500**

7.3.5 Annual Operation and Maintenance Cost

There would be no additional charge in operation and maintenance costs for this alternative. There may be a decrease, but the cost reduction cannot be defined.

7.3.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 817 mmBtu
(239,400 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $12.16/mmBtu
(89,900 ÷817 mmBtu)

Gas Energy Saved = 1,753 mmBtu
(1,200 mcf x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

LCCID INPUTS

$/mmBtu - Gas $3.67/mmBtu
($6,600 ÷ 1,753 mmBtu)

Construction $ = $75,000
($37,000 + $38,000)

SIOH $ = $4,100

Design $ = $4,500

Maintenance = $0

Simple Payback (Years)	5.1
Savings to Investment Ratio (SIR)	3.5

7.3.7 Expected Service Life

This alternative does not effect the service life of the existing air-handling units.

7.3.8 Environmental Consideration

There are no environmental considerations for this alternative.

7.3.9 Advantages

- Reduces night and weekend demand on Buildings 48 and 49's chillers.
- Reduced maintenance and operation costs.

7.3.10 Disadvantages

- Eliminates twenty-four hour use of building unless scheduled.

ALTERNATIVE NO. 9
PROVIDE UNOCCUPIED SPACE TEMPERATURE SETBACK IN BUILDINGS 1,7,11,40, & 41

				MATERIAL		LABOR		LINE	
	DESCRIPTION	QUAN.	UNITS	$/UNIT	TOTAL	$/UNIT	TOTAL	TOTAL	#
1									1
2	BLDG 1 Occupied/Unoccupied Controls	32	UNITS	$500	$16,000	$500	$16,000	$32,000	2
3	BLDG 7 Occupied/Unoccupied Controls	5	UNITS	$500	$2,500	$500	$2,500	$5,000	3
4	BLDG 11 Occupied/Unoccupied Controls	2	UNITS	$500	$1,000	$500	$1,000	$2,000	4
5	BLDG 40 Occupied/Unoccupied Controls	20	UNITS	$500	$10,000	$500	$10,000	$20,000	5
6	BLDG 41 Occupied/Unoccupied Controls	3	UNITS	$500	$1,500	$500	$1,500	$3,000	6
7					$0		$0	$0	7
8					$0		$0	$0	8
9					$0		$0	$0	9
10					$0		$0	$0	10
11					$0		$0	$0	11
12					$0		$0	$0	12
13					$0		$0	$0	13
14					$0		$0	$0	14
15					$0		$0	$0	15
16					$0		$0	$0	16
17					$0		$0	$0	17
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25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
30					$0		$0	$0	30
31					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
35					$0		$0	$0	35
36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
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45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59					$0		$0	$0	59
60	CONTINGENCY				$6,000		$7,000	$13,000	60
61					$0		$0	$0	61
62	**TOTALS>>>>>>>>**				**$37,000**		**$38,000**	**$75,000**	62

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ENTECH ENGINEERING INC. 01-Aug-95

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         LIFE CYCLE COST ANALYSIS SUMMARY             STUDY: WALTER1
      ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)     LCCID  1.080
INSTALLATION & LOCATION:                   REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR     DISCRETE PORTION NAME: ALT#9
ANALYSIS DATE:  08-08-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST        $     75000.
B. SIOH                     $      4100.
C. DESIGN COST              $      4500.
D. TOTAL COST (1A+1B+1C)    $     83600.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                    $     83600.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
              UNIT COST   SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
   FUEL       $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)   FACTOR(4)  SAVINGS(5)

   A. ELECT $ 12.16          817.      $     9935.      15.61  $    155081.
   B. DIST  $    .00           0.      $        0.      17.56  $         0.
   C. RESID $    .00           0.      $        0.      19.97  $         0.
   D. NAT G $  3.67         1753.      $     6434.      20.96  $    134846.
   E. COAL  $    .00           0.      $        0.      17.58  $         0.
   F. LPG   $    .00           0.      $        0.      16.12  $         0.
   M. DEMAND SAVINGS                   $        0.      14.74  $         0.
   N. TOTAL                 2570.      $    16368.             $    289927.

3. NON ENERGY SAVINGS(+) / COST(-)

  A. ANNUAL RECURRING (+/-)                                    $         0.
     (1) DISCOUNT FACTOR (TABLE A)                      14.74
     (2) DISCOUNTED SAVING/COST (3A X 3A1)                     $         0.

  B. NON RECURRING SAVINGS(+) / COSTS(-)
                              SAVINGS(+)   YR   DISCNT     DISCOUNTED
              ITEM             COST(-)     OC   FACTR      SAVINGS(+)/
                                 (1)      (2)    (3)       COST(-)(4)

   d. TOTAL                 $      0.                         0.

  C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$         0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$     16368.

5. SIMPLE PAYBACK PERIOD (1G/4)                               5.11 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                   $    289927.

7. SAVINGS TO INVESTMENT RATIO        (SIR)=(6 / 1G)=         3.47
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                   9.71 %
```

7.4 Alternative No. 10

— Balance Hot Water Heating System and Reset Preheat Coil Set Points in Building 2

7.4.1 Existing

Building 2, Heaton Pavilion, was built in the late 1970s. The hot water heating systems were never balanced during or after construction. There were several problems with preheat coil freeze up. In order to prevent this, the preheat coil discharge temperatures were set higher than design. By setting the preheat coil discharge temperature high, the cooling coil load was increased. This meant that at times during the year, when the outdoor air would normally not require heating, the air would be heated up then cooled down hence, wasting energy.

7.4.2 Description

The preheat coil freeze-up problem was probably caused by insufficient flow of water through the coils which is a result of the system not being balanced. This indicated some coils getting less flow than required and some coils having more flow than required. A simple solution is to balance the preheat coil hot water heating system. This will save energy by not heating and cooling air simultaneously. Once the system is properly balanced, all preheat coil discharge temperature set points can be reset to the proper setting.

7.4.3 Capital Cost Estimate

The estimated cost to rebalance the preheat coil hot water heating system and reset preheat coil set points is $30,000. An itemized cost estimate is included at the end of this alternative.

Material	0
Labor	$27,000
SIOH	1,400
Design Fee	1,600
Total	**$30,000**

7.4.4 Annual Energy Savings

The EZDOE program will be utilized to estimate the annual energy savings by setting all preheat coil discharge temperatures to the proper set point. The savings will be calculated by comparing the EZDOE output, as programmed for Section 5, to the program output after resetting the preheat coil discharge temperatures. This change will only be made for Building 2 with the comparison providing the energy saving associated with Building 2 only. The preheat coil temperature will be set back 8°F from the current 60°F setting to the design 52°F setting. Refer to schedule at the end of this alternative.

Comparing the energy usage before and after resetting discharge temperature, is as follows:

Table 7.4.4.1
Energy Savings Totals

Supply	Electric Demand (kW)	Electric Usage (kWh)	Gas Usage (mcf)	Cost Savings ($)
Heating System	------	------	54,523	$206,700
Cooling System	------	2,186,053	------	$90,300
Totals	------	**2,186,053**	**54,523**	**$297,000**

7.4.5 Annual Operation and Maintenance Cost

There would be no additional charge in operation and maintenance costs for this alternative.

7.4.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 7,461 mmBtu
(2,186,053 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $12.10/mmBtu
($90,300 ÷ 7,461 mmBtu)

Gas Energy Saved = 56,213 mmBtu
(54,523 mcf x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Gas = $3.67/mmBtu
($206,700 ÷ 56,213 mmBtu)

LCCID INPUTS

Construction $ = $27,000
($0 + $27,000)

SIOH $ = $1,400

Design $ = $1,600

Maintenance = $0

Simple Payback (Years)	0.1
Savings to Investment Ratio (SIR)	191

7.4.7 Expected Service Life

This alternative does not affect the service life of the existing air-handling units.

7.4.8 Environmental Consideration

There are no environmental considerations for this alternative.

7.4.9 Advantages

- No simultaneous heating and cooling.
- No disruption to building operation.
- Reduces demand on Building 48 chillers.
- Reduces demand in the central heating plant.

7.4.10 Disadvantages

- None.

BUILDING 2 - HEATON PAVILLION
AIR HANDLING UNIT SCHEDULE
100% OUTDOOR AIR UNITS ONLY

FAN UNIT TYPE	SYSTEM NUMBER	NOMINAL CFM	SYSTEM TYPE	DESIGN PREHEAT COIL LAT DEG. F	ACTUAL PREHEAT COIL LAT DEG. F	COOLING COIL LAT DEG. F
B	SA1SW1	19,850	100% O.A.	52	60	52
B	SA4NW1	20,200	100% O.A.	52	60	52
B	SA4NW2	19,025	100% O.A.	52	60	52
B	SA4SW1	22,425	100% O.A.	52	60	52
B	SA4SW2	18,625	100% O.A.	52	60	52
B	SA4SE1	14,700	100% O.A.	52	60	52
B	SA4SE2	18,625	100% O.A.	52	60	52
B	SA4NE1	17,175	100% O.A.	52	60	52
B	SA4NE2	18,950	100% O.A.	52	60	52
B	SA7SW3	19,100	100% O.A.	52	60	52
B	SA7SE1	19,195	100% O.A.	52	60	52
D	SA5NW1	13,600	100% O.A.	52	60	52
D	SA5NW2	13,100	100% O.A.	52	60	52
D	SA5SW1	13,450	100% O.A.	52	60	52
D	SA5SW2	14,250	100% O.A.	52	60	52
D	SA5SE1	14,150	100% O.A.	52	60	52
D	SA5SE2	13,250	100% O.A.	52	60	52
D	SA5NE1	13,250	100% O.A.	52	60	52
D	SA5NE2	13,175	100% O.A.	52	60	52
D	SA6NW1	13,800	100% O.A.	52	60	52
D	SA6NW2	13,300	100% O.A.	52	60	52
D	SA6SW1	13,425	100% O.A.	52	60	52
D	SA6SW2	14,050	100% O.A.	52	60	52
D	SA6SE1	14,100	100% O.A.	52	60	52
D	SA6SE2	13,175	100% O.A.	52	60	52
D	SA6NE1	13,275	100% O.A.	52	60	52
D	SA6NE2	13,400	100% O.A.	52	60	52
D	SA7NW1	14,050	100% O.A.	52	60	52
D	SA7NW2	14,275	100% O.A.	52	60	52
D	SA7SW1	13,925	100% O.A.	52	60	52
D	SA7SW2	14,825	100% O.A.	52	60	52
D	SA7SE1	19,195	100% O.A.	52	60	52
D	SA7SE2	15,275	100% O.A.	52	60	52
D	SA7NE1	14,475	100% O.A.	52	60	52
D	SA7NE2	13,725	100% O.A.	52	60	52
E	SA8NW1	16,910	100% O.A.	52	60	52
E	SA8SW1	19,195	100% O.A.	52	60	52
E	SA8SE1	23,390	100% O.A.	52	60	52
E	SA8NE1	17,175	100% O.A.	52	60	52
G	SA3SW2	16,475	100% O.A.	75	75	60
G	SA3SW3	21,450	100% O.A.	75	75	60
H	SA3SW1	11,625	100% O.A.	75	75	60
J	SA3SW4	10,550	100% O.A.	55	60	55

NOTES:

* Fan Type G and H have no heating coils which is why the preheat coil is set high for these units.
These units will be input into the EZDOE program the same as the other units for energy savings calculations.

ALTERNATIVE NO. 10
BALANCE HOT WATER HEATING SYSTEM AND RESET PREHEAT COIL SET POINTS IN BLDG 2

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1									1
2	BALANCE PREHEAT COILS	77	UNITS		$0	$150	$11,550	$11,550	2
3	BALANCE HOT WATER HEATING PUMP	12	UNITS		$0	$200	$2,400	$2,400	3
4	RESET PREHEAT COIL SET POINTS	77	UNITS		$0	$100	$7,700	$7,700	4
5					$0		$0	$0	5
6					$0		$0	$0	6
7					$0		$0	$0	7
8					$0		$0	$0	8
9					$0		$0	$0	9
10					$0		$0	$0	10
11					$0		$0	$0	11
12					$0		$0	$0	12
13					$0		$0	$0	13
14					$0		$0	$0	14
15					$0		$0	$0	15
16					$0		$0	$0	16
17					$0		$0	$0	17
18					$0		$0	$0	18
19					$0		$0	$0	19
20					$0		$0	$0	20
21					$0		$0	$0	21
22					$0		$0	$0	22
23					$0		$0	$0	23
24					$0		$0	$0	24
25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
30					$0		$0	$0	30
31					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
35					$0		$0	$0	35
36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59					$0		$0	$0	59
60	CONTINGENCY				$0		$5,350	$5,350	60
61					$0		$0	$0	61
62	**TOTALS>>>>>>>>**				**$0**		**$27,000**	**$27,000**	62

```
          LIFE CYCLE COST ANALYSIS SUMMARY                STUDY: WALTER1
      ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)        LCCID  1.080
INSTALLATION & LOCATION:                 REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR       DISCRETE PORTION NAME: ALT#10
ANALYSIS DATE:  08-08-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST         $    27000.
B. SIOH                      $     1400.
C. DESIGN COST               $     1600.
D. TOTAL COST (1A+1B+1C)     $    30000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $          0.
F. PUBLIC UTILITY COMPANY REBATE       $          0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                    $    30000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
                 UNIT COST   SAVINGS      ANNUAL $      DISCOUNT   DISCOUNTED
   FUEL          $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)    FACTOR(4)  SAVINGS(5)

   A. ELECT $ 12.10        7461.      $    90278.       15.61   $   1409241.
   B. DIST  $   .00           0.      $        0.       17.56   $         0.
   C. RESID $   .00           0.      $        0.       19.97   $         0.
   D. NAT G $  3.67       56213.      $   206302.       20.96   $   4324084.
   E. COAL  $   .00           0.      $        0.       17.58   $         0.
   F. LPG   $   .00           0.      $        0.       16.12   $         0.
   M. DEMAND SAVINGS                  $        0.       14.74   $         0.
   N. TOTAL               63674.      $   296580.               $   5733325.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                    $         0.
       (1) DISCOUNT FACTOR (TABLE A)                    14.74
       (2) DISCOUNTED SAVING/COST (3A X 3A1)                    $         0.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                               SAVINGS(+)   YR    DISCNT      DISCOUNTED
                 ITEM           COST(-)     OC    FACTR       SAVINGS(+)/
                                  (1)       (2)    (3)        COST(-)(4)

    d. TOTAL                   $      0.                            0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$         0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    296580.

5. SIMPLE PAYBACK PERIOD (1G/4)                                   .10 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $   5733325.

7. SAVINGS TO INVESTMENT RATIO         (SIR)=(6 / 1G)=          191.11
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                     34.07 %
```

7.5 Alternative No. 11

— Efficient Fluorescent Lighting in Buildings 1, 2, 7, 11, 40, 41, and 54

7.5.1 Existing

The following buildings have been identified as possessing the potential to benefit substantially from the installation of efficient lighting. In addition, these buildings can provide cooling peak tonnage reduction.

Building	Lighting kW	Cooling Tonnage
1	455	1,519
2	2,875	6,213
7	120	157
11	162	302
40	655	1,197
41	69	176
54	872	1,221

The above-listed buildings generally use 34 and 40-watt fluorescent lamps with standard energy efficient lamps. Lamp consumption with standard ballast can vary between 39 and 46 watts.

7.5.2 Description

Remove the existing 34 and 40-watt lamps and ballasts from existing fluorescent luminaires and install new T-8 lighting with electronic ballast. Typical T-8 lighting systems consume approximately 30 watts per lamp. This number is dependent on lamp and ballast manufacturer. T-8 lamps are thinner than current fluorescent lamps and can be installed using existing pin connectors.

The retrofit will reduce lighting usage and demand and can reduce building peak-cooling load. The following table displays the results of recalculating the EZDOE model with a reduction in lighting load of 20%. Lamp savings is generally between 25% and 35% of lighting kW. However, since not all the lighting load in these buildings is fluorescent, a more conservative savings of 20% was used.

Building	Lighting kW	Cooling Tonnage
1	364	1,489
2	2,300	6,063
7	96	149
11	130	293
40	524	1,154
41	55	174
54	693	1,172

7.5.3 Capital Cost Estimate

The estimated cost to retrofit the existing fluorescent lighting systems in the above-mentioned buildings is $4,300,000. An itemized cost estimate is included at the end of this section.

Material	$3,100,000
Labor	800,000
SIOH	200,000
Design Fee	200,000
Total	**$4,300,000**

7.5.4 Annual Energy Savings

The EZDOE program was used to estimate the effect of lowering the lighting loads. Savings were determined by comparing the original EZDOE output to the revised EZDOE output. The following tables summarize these results:

Table 7.5.4.1
Energy Savings Totals

System	Electric Demand (kW)	Electric Usage (kWh)	Gas Usage (mcf)	Cost Savings ($)
Heating System	------	------	(9,500)	($36,000)
Cooling System	------	335,200	------	------
Lighting System	12,100	8,104,000	------	$491,000
Totals	**12,100**	**8,439,200**	**(9,500)**	**$455,000**

Table 7.5.4.2
Cooling Tonnage Savings

Building	Existing	Proposed	Savings
1	1,519	1,489	30
2	6,213	6,063	150
7	157	149	8

Table 7.5.4.2
Cooling Tonnage Savings

Building	Existing	Proposed	Savings
11	302	293	9
40	1,197	1,154	43
41	176	174	2
54	1,221	1,172	49
		Total Savings	291

7.5.5 Annual Operation and Maintenance Cost

T-8 lamps generally have the same life expectations as standard fluorescent lamps. Therefore, there will be no resulting maintenance savings.

7.5.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 28,803 mmBtu
(8,439,200 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $17.04/mmBtu
($491,000 ÷ 28,803 mmBtu)

Gas Energy Saved = - 9,785 mmBtu
(- 9,500 mcf x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

LCCID INPUTS

$/mmBtu - Gas = $3.67/mmBtu
(- $36,000 ÷ (- 9,785 mmBtu))

Construction $ = $3,900,000
($3,100,000 + $800,000)

SIOH $ = $200,000

Design $ = $200,000

Maintenance = $0

Simple Payback (Years)	9.5
Savings to Investment Ratio (SIR)	1.6

7.5.7 Expected Service Life

This alternative does not affect the service life of the existing air-handling units.

7.5.8 Environmental Consideration

There are no environmental considerations for this alternative.

7.5.9 Advantages

- Energy savings are substantial.
- Reduces demand in on Building 48 chillers.

7.5.10 Disadvantages

- High capital cost.
- Potential for lower illumination levels.

ALTERNATIVE NO. 11
EFFICIENT FLUORESCENT LIGHTING IN BUILDINGS 1,7,11,40,41, & 54

	DESCRIPTION	QUAN.	UNITS	MATERIAL		LABOR		LINE TOTAL	#
				$/UNIT	TOTAL	$/UNIT	TOTAL		
1									1
2	BLDG 1 Lamps	11,600	lmps	$2	$23,200	$0	$0	$23,200	2
3	BLDG 1 Ballast	5,800	blst	$35	$203,000	$0	$0	$203,000	3
4	BLDG 1 Installation	2,900	Lum.	$0	$0	$20	$58,000	$58,000	4
5	BLDG 2 Lamps	73,500	lmps	$2	$147,000	$0	$0	$147,000	5
6	BLDG 2 Ballast	36,800	blst	$35	$1,288,000	$0	$0	$1,288,000	6
7	BLDG 2 Installation	18,400	Lum.	$0	$0	$20	$368,000	$368,000	7
8	BLDG 7 Lamps	3,100	lmps	$2	$6,200	$0	$0	$6,200	8
9	BLDG 7 Ballast	1,500	blst	$35	$52,500	$0	$0	$52,500	9
10	BLDG 7 Installation	800	Lum.	$0	$0	$20	$16,000	$16,000	10
11	BLDG 11 Lamps	4,100	lmps	$2	$8,200	$0	$0	$8,200	11
12	BLDG 11 Ballast	2,100	blst	$35	$73,500	$0	$0	$73,500	12
13	BLDG 11 Installation	1,000	Lum.	$0	$0	$20	$20,000	$20,000	13
14	BLDG 40 Lamps	16,800	lmps	$2	$33,600	$0	$0	$33,600	14
15	BLDG 40 Ballast	8,400	blst	$35	$294,000	$0	$0	$294,000	15
16	BLDG 40 Installation	4,200	Lum.	$0	$0	$20	$84,000	$84,000	16
17	BLDG 41 Lamps	1,800	lmps	$2	$3,600	$0	$0	$3,600	17
18	BLDG 41 Ballast	900	blst	$35	$31,500	$0	$0	$31,500	18
19	BLDG 41 Installation	400	Lum.	$0	$0	$20	$8,000	$8,000	19
20	BLDG 54 Lamps	22,300	lmps	$2	$44,600	$0	$0	$44,600	20
21	BLDG 54 Ballast	11,200	blst	$35	$392,000	$0	$0	$392,000	21
22	BLDG 54 Installation	5,600	Lum.	$0	$0	$20	$112,000	$112,000	22
23					$0		$0	$0	23
24					$0		$0	$0	24
25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
30					$0		$0	$0	30
1					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
35					$0		$0	$0	35
36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59					$0		$0	$0	59
60	CONTINGENCY				$520,180		$133,200	$653,380	60
1					$0		$0	$0	61
2	**TOTALS>>>>>>>>**				**$3,100,000**		**$800,000**	**$3,900,000**	62

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          LIFE CYCLE COST ANALYSIS SUMMARY                    STUDY: WALTER1
       ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)           LCCID  1.080
INSTALLATION & LOCATION:                  REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR       DISCRETE PORTION NAME: ALT#11
ANALYSIS DATE:  08-08-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST         $  3900000.
B. SIOH                      $   200000.
C. DESIGN COST               $   200000.
D. TOTAL COST (1A+1B+1C)     $  4300000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $         0.
F. PUBLIC UTILITY COMPANY REBATE       $         0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                  $  4300000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST    SAVINGS       ANNUAL $     DISCOUNT    DISCOUNTED
   FUEL      $/MBTU(1)    MBTU/YR(2)    SAVINGS(3)   FACTOR(4)   SAVINGS(5)

   A. ELECT $ 17.04        28803.       $   490803.     15.61    $   7661437.
   B. DIST  $   .00            0.       $        0.     17.56    $         0.
   C. RESID $   .00            0.       $        0.     19.97    $         0.
   D. NAT G $  3.67        -9785.       $   -35911.     20.96    $   -752693.
   E. COAL  $   .00            0.       $        0.     17.58    $         0.
   F. LPG   $   .00            0.       $        0.     16.12    $         0.
   M. DEMAND SAVINGS                    $        0.     14.74    $         0.
   N. TOTAL                19018.       $   454892.              $   6908744.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                     $         0.
      (1) DISCOUNT FACTOR (TABLE A)                     14.74
      (2) DISCOUNTED SAVING/COST (3A X 3A1)                      $         0.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                            SAVINGS(+)    YR    DISCNT      DISCOUNTED
                ITEM         COST(-)      OC    FACTR       SAVINGS(+)/
                               (1)       (2)     (3)        COST(-)(4)

    d. TOTAL                $       0.                             0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$         0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    454892.

5. SIMPLE PAYBACK PERIOD (1G/4)                                  9.45 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $  6908744.

7. SAVINGS TO INVESTMENT RATIO          (SIR)=(6 / 1G)=          1.61
    (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                      5.57 %
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7.6 Alternative No. 12

— Window Replacement in Buildings 1, 7, 11, 40, and 41

7.6.1 Existing

The following buildings have been identified as possessing the potential to benefit from the installtion of insulated glass. In addition, these buildings can provide cooling tonnage reduction.

Building	Window sq. ft.	Glass Type	Cooling Tonnage
1	44,900	Single	1,519
7	3,500	Single	157
11	11,500	Single	302
40	19,400	Single	1,197
41	2,700	Single	176

7.6.2 Description

Remove the existing single-pane windows and install new insulated, low E windows. The new windows will lower the thermal and solar gain through glass by approximately 50%. This is based upon insulated glass U-value of 0.5 compared to 1.1 U-value for single pane.

The table, on the following page, displays the results of recalculating the original EZDOE model with new insulated windows where applicable.

Building	Window sq. ft.	Glass Type	Cooling Tonnage
1	44,900	Insulated	1,495
7	3,500	Insulated	155
11	11,500	Insulated	297
40	19,500	Insulated	1,192
41	2,700	Insulated	175

7.6.3 Capital Cost Estimate

The estimated cost to retrofit the existing windows in the above-mentioned buildings is $6,600,000. An itemized cost estimate is included at the end of this section.

Material	$3,900,000
Labor	2,000,000
SIOH	300,000
Design Fee	400,000
Total	**$6,600,000**

—47.5/□

no way

7.6.4 Annual Energy Savings

The EZDOE program was used to estimate the effect of replacing single-pane windows with insulated windows. Savings were determined by comparing the original EZDOE output to the revised EZDOE output. Table 7.6.4.1, on the following page, summarizes these results:

Table 7.6.4.1
Energy Savings Totals

System	Electric Demand (kW)	Electric Usage (kWh)	Gas Usage (mcf)	Cost Savings ($)
Heating System	------	------	1,600	$6,000
Cooling System	133	329,000	------	$18,700
Totals	**133**	**329,000**	**1,600**	**$24,700**

7.6.5 Annual Operation and Maintenance Cost

There will be no annual recurring maintenance savings associated with this alternative.

7.6.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 1,123 mmBtu
(329,000 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $16.65/mmBtu
($18,700 ÷ 1,123 mmBtu)

Gas Energy Saved = 1,650 mmBtu
(1,600 mcf x 1,031,000 Btu/mcf ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Gas = $3.67/mmBtu
($6,000 ÷ 1,650 mmBtu)

LCCID INPUTS

Construction \$ = \$5,900,000
(\$3,300,000 + \$1,600,000)

SIOH \$ = \$300,000

Design \$ = \$400,000

Maintenance = \$0

Simple Payback (Years)	257
Savings to Investment Ratio (SIR)	0

7.6.7 Expected Service Life

This alternative does not affect the service life of the existing chillers.

7.6.8 Environmental Consideration

There are no environmental considerations for this alternative.

7.6.9 Advantages

- Increased comfort.
- Reduces demand on Building 48 chillers.

7.6.10 Disadvantages

- High investment cost.
- Poor payback.
- Small cooling tonnage reduction.

ALTERNATIVE NO. 12
WINDOW REPLACEMENT IN BUILDINGS 1,7,11,40, & 41

				MATERIAL		LABOR		LINE	
	DESCRIPTION	QUAN.	UNITS	$/UNIT	TOTAL	$/UNIT	TOTAL	TOTAL	#
1									1
2	BLDG 1 Window Demolition	44,900	sf	$0	$0	$10	$449,000	$449,000	2
3	BLDG 7 Window Demolition	3,500	sf	$0	$0	$10	$35,000	$35,000	3
4	BLDG 11 Window Demolition	11,500	sf	$0	$0	$10	$115,000	$115,000	4
5	BLDG 40 Window Demolition	19,400	sf	$0	$0	$10	$194,000	$194,000	5
6	BLDG 41 Window Demolition	2,700	sf	$0	$0	$10	$27,000	$27,000	6
7	BLDG 1 Window Installation	44,900	sf	$40	$1,796,000	$10	$449,000	$2,245,000	7
8	BLDG 7 Window Installation	3,500	sf	$40	$140,000	$10	$35,000	$175,000	8
9	BLDG 11 Window Installation	11,500	sf	$40	$460,000	$10	$115,000	$575,000	9
10	BLDG 40 Window Installation	19,400	sf	$40	$776,000	$10	$194,000	$970,000	10
11	BLDG 41 Window Installation	2,700	sf	$40	$108,000	$10	$27,000	$135,000	11
12					$0		$0	$0	12
13					$0		$0	$0	13
14					$0		$0	$0	14
15					$0		$0	$0	15
16					$0		$0	$0	16
17					$0		$0	$0	17
18					$0		$0	$0	18
19					$0		$0	$0	19
20					$0		$0	$0	20
21					$0		$0	$0	21
22					$0		$0	$0	22
23					$0		$0	$0	23
24					$0		$0	$0	24
25					$0		$0	$0	25
26					$0		$0	$0	26
27					$0		$0	$0	27
28					$0		$0	$0	28
29					$0		$0	$0	29
30					$0		$0	$0	30
31					$0		$0	$0	31
32					$0		$0	$0	32
33					$0		$0	$0	33
34					$0		$0	$0	34
35					$0		$0	$0	35
36					$0		$0	$0	36
37					$0		$0	$0	37
38					$0		$0	$0	38
39					$0		$0	$0	39
40					$0		$0	$0	40
41					$0		$0	$0	41
42					$0		$0	$0	42
43					$0		$0	$0	43
44					$0		$0	$0	44
45					$0		$0	$0	45
46					$0		$0	$0	46
47					$0		$0	$0	47
48					$0		$0	$0	48
49					$0		$0	$0	49
50					$0		$0	$0	50
51					$0		$0	$0	51
52					$0		$0	$0	52
53					$0		$0	$0	53
54					$0		$0	$0	54
55					$0		$0	$0	55
56					$0		$0	$0	56
57					$0		$0	$0	57
58					$0		$0	$0	58
59					$0		$0	$0	59
60	CONTINGENCY				$656,000		$328,000	$984,000	60
61					$0		$0	$0	61
62	**TOTALS>>>>>>>>**				**$3,900,000**		**$2,000,000**	**$5,900,000**	62

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ENTECH ENGINEERING INC. 07-Aug-95

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          LIFE CYCLE COST ANALYSIS SUMMARY              STUDY: WALTER1
      ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID  1.080
INSTALLATION & LOCATION:                 REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR        DISCRETE PORTION NAME: ALT#12
ANALYSIS DATE:  08-08-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST         $  5900000.
B. SIOH                      $   300000.
C. DESIGN COST               $   400000.
D. TOTAL COST (1A+1B+1C)     $  6600000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                    $  6600000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
             UNIT COST   SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
   FUEL      $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)   FACTOR(4)  SAVINGS(5)

   A. ELECT $ 16.65       -999.       $  -16633.     15.61    $  -259647.
   B. DIST  $   .00          0.       $       0.     17.56    $        0.
   C. RESID $   .00          0.       $       0.     19.97    $        0.
   D. NAT G $  3.67       -999.       $   -3666.     20.96    $   -76846.
   E. COAL  $   .00          0.       $       0.     17.58    $        0.
   F. LPG   $   .00          0.       $       0.     16.12    $        0.
   M. DEMAND SAVINGS                  $       0.     14.74    $        0.
   N. TOTAL              -1998.       $  -20300.              $  -336493.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                  $        0.
      (1) DISCOUNT FACTOR (TABLE A)                  14.74
      (2) DISCOUNTED SAVING/COST (3A X 3A1)                   $        0.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                            SAVINGS(+)   YR   DISCNT     DISCOUNTED
                ITEM         COST(-)     OC   FACTR      SAVINGS(+)/
                               (1)      (2)    (3)       COST(-)(4)

    d. TOTAL               $       0.                          0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$        0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$    -20300.

5. SIMPLE PAYBACK PERIOD (1G/4)                              ****** YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                      $  -336493.

7. SAVINGS TO INVESTMENT RATIO        (SIR)=(6 / 1G)=             -.05
    (IF < 1 PROJECT DOES NOT QUALIFY)
**** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                   N/A
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8.0 INDIRECT CHILLER CAPACITY ALTERNATIVE

8.1 General

This section of the report evaluates an energy-related alternative which was investigated beyond of the Contract scope. This particular evaluation was implemented using an Entech-generated program to determine the preliminary feasibility of a cogeneration plant to generate electricity and steam, which can be used to reduce electric demand and usage. This alternative has been developed to meet several overall objectives as follows:

1. Energy efficiency.
2. Ability to phase-in, while minimizing impact on existing building function.
3. Overall serviceability and operation by plant operators.
4. Provides source of chilled water generation as a byproduct of generating electricity.

Each alternative will be described in the following format:

Existing:	Generally describes the existing conditions, energy usage, and energy cost.
Description:	Generally describes the alternative and its critical components. Estimates the amount of energy usage and cost to operate the proposed system.

Construction Cost:	Summarizes the construction cost estimates prepared for the work necessary to implement the alternative. The costs are broken down into material, labor, and engineering.
Annual Energy Savings:	Compares the existing energy usage and costs with the proposed energy usage and costs.
Annual Operation and Maintenance Cost:	An estimate of the average annual operation and maintenance costs during the expected equipment service life of the proposed system.
Economics:	Studies the payback for installing the proposed system.
Expected Life:	The average expected service life of the equipment.
Environmental Considerations:	A discussion of the environmental impact of the alternative.
Advantages:	A list of advantages that can be expected for the type of system described.
Disadvantages:	A list of the disadvantages associated with the system.

8.2 Alternative No. 13 — Cogeneration

8.2.1 Existing

Walter Reed Medical Center produces steam continuously through the year. In Table 4.3.2 page 4-9, July is found to have the lowest steam production, with steam production averaging 23,000 lb/hr based on gas usage.

Electrical power is purchased from the utility through a main meter which includes all but one of the buildings. The electrical consumption base load for the year is approximately 9,000 kW.

In 1994, $5,845,300 was spent for electricity for the entire base, except Building 54. In addition, $2,206,000 in natural gas and fuel oil were consumed at the boiler plant. Total energy cost, excluding Building 54's electric usage, is $8,051,300.

Gas Consumed = 387,400 mcf/yr
Oil Consumed = 1,055,866 gal/yr
Electrical Demand = 153,433 kW/yr
Electrical Usage = 94,638,974 kWh/yr
Energy Cost = $8,051,300

8.2.2 Description

Install a cogeneration system to generate electricity for on-site use, and to produce steam with a heat recovery boiler. In order to maximize the economic feasibility of such a project, it is normally best to size the cogeneration system for the electrical and steam base load requirements. The cogeneration system would run continuously at capacity. Steam and electricity would be produced for on-site use. Export sales are not considered since the prices paid for steam and electricity will be less than "displacement" rates.

It is estimated that the base steam load is below 23,000 lb/hr. The average base electric demand is approximately 9,000 kW (12,000 kW x 75% usage factor). For this analysis, a combustion turbine to drive a generator will be considered. The heat from the turbine exhaust is approximately 900-1000°F, and is directed to a heat recovery boiler to produce steam. The combustion turbine can be fueled on natural gas or fuel oil.

Generally, 30% of the energy input to the cogeneration system is converted to electricity, approximately 50% of the energy input can be recovered to produce steam, and the remaining 20% is considered a loss.

In order to keep within the base load requirements described on the previous page, a cogeneration system with the following characteristics is being used in the evaluation.

Rated Electrical Output = 3,545 kW
Fuel Consumption = 23.3 mmBtu/hr
Fuel Consumption = 429 mcf/hr
Steam Production = 20,970 lb/hr

The turbine/generator is approximately 27′ x 8′ x 8′ and a new building will have to be constructed to house the unit adjacent to Building 15. Piping and electrical connections would have to be extended to the new equipment.

The estimated cost for site electricity and fuel after the cogeneration unit is installed is $6,848,200. We have assumed that oil consumption at the boiler plant will remain constant.

Boiler Plant
Gas Consumed = 260,409 mcf/yr
[490,800 mcf - 230,391 mcf]

Cogeneration
Gas Consumed = 343,200 mcf/yr

Oil Consumed = 1,055,866 gal/yr

Electric Demand = 114,933 kW/yr

Electric Usage = 66,278,974 kWh/yr
[94,608,474 kWh - 28,360,000 kWh]

Energy Cost = $6,848,200

This analysis assumes the unit is brought off-line once a year for scheduled maintenance. If unscheduled maintenance occurs in any other month, savings will be reduced because of additional electrical demand charges.

8.2.3 Capital Cost Estimate

The estimated cost to provide a cogeneration plant is $5,600,000.

Material	$3,000,000
Labor	2,000,000
SIOH	300,000
Design Fee	300,000
Total	**$5,600,000**

8.2.4 Annual Energy Savings

From the cogeneration payback analysis sheets (attached), the estimated annual energy savings are $1,203,100 per year. A summary of the savings and costs is as follows:

Savings Summary

	Existing	Proposed	Savings
Gas Consumption (mcf/yr)	490,800	603,609	(112,809)
Oil Consumption (gal/yr)	1,055,866	1,055,866	0

	Existing	Proposed	Savings
Electric Demand (kW/yr)	153,433	114,933	38,500
Electric Usage (kWh/yr)	94,638,974	66,278,974	28,360,000
Energy Usage (mmBtu/yr)	975,467	994,980	(19,513)
Energy Cost	$8,051,300	$6,848,200	$1,203,100

8.2.5 Annual Operation and Maintenance Cost

The estimated additional operations and maintenance cost created with the addition of a cogeneration plant is $227,700.

	Existing	Proposed
Operation	0	$100,000
Maintenance	0	$127,700

8.2.6 Economics

Using the LCCID program, the economics for this project are as follows: (Reference attached LCCID output.)

LCCID INPUTS

Electric Energy Saved = 96,793 mmBtu
(28,360,000 kWh x 3,413 Btu/kWh ÷ 1,000,000 Btu/mmBtu)

$/mmBtu - Electric = $16.6/mmBtu
($1,607,000 ÷ 96,793 mmBtu)

Natural Gas Saved = - 116,193 mmBtu
(112,809 x 1.03 mmBtu/mcf)

LCCID INPUTS

Construction $ = $5,000,000
SIOH $ = $300,000
Design $ = $300,000
Maintenance = - $227,700

Simple Payback (Years)	5.7
Savings to Investment Ratio (SIR)	2.4

8.2.7 Expected Service Life

Fifteen years.

8.2.8 Environmental Considerations

- There are no CFC issues.
- The gas turbine generator's exhaust will have to meet federal emissions standards.

8.2.9 Advantages

- Reduces electric usage and demand costs.
- Provides on-site electric supply.
- Steam from the cogeneration system could be included to absorption chillers which could generate approximately 2,000 tons of chilled water.
- May decrease the need for additional boilers in the future.

8.2.10 Disadvantages

- More difficult piece of machinery to operate; personnel must be thoroughly trained.
- Locating the equipment on site may be difficult.
- Extra attention to noise reduction will be required.

COGENERATION PAYBACK ANALYSIS

JOB TITLE: Walter Reed OPTION NO. 1

DATE: 02-Jun-95

EQUIPMENT DESCRIPTION: 3645 KW Gas Turbine with heat recovery

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DATA INPUT :

INCREMENTAL RATES

Electric Usage Rate = $0.042 $/KWH
Electric Demand Rate = $10.80 $/KW
Cogen Fuel Price = $3.58 $/MCF
Present Heating Price = $4.92 $/MMBTU
Electric Buyback Rate = $0.000 $/KWH
Fixed Maintenance Cost = $15,000 $/YR
Variable Maintenance Cost = $0.008 $/KWH

Equipment Rating(per unit)

Fuel Input = 42.9 MCF/HR
Peak Electrical Output = 3545 KWH/HR
Available Exhaust Heat = 23.3 MMBTU/HR
Recoverable Jacket Heat = 0 MMBTU/HR
Recoverable Lube Oil Heat = 0 MMBTU/HR
Total Recoverable Heat = 20.97 MMBTU/HR
Aux Equip Elec Consumption= 0 KWH/HR

CONSTRUCTION COSTS = $5,000 (thousand)
* NUMBER OF UNITS = 1 UNIT(S)

CALCULATIONS:

Energy

KWH Displaced per Year = 28,360,000 KWH/YR
KW Displaced per Year = 38,500 KW/YR
KW Ratchet Effect Reduction= 0 KW/YR
KWH Sold per Year = 0 KWH/YR
Heat Produced per Year = 167,760 MMBTU/YR
Fuel Consumed per Year = 343,200 MCF/YR

ANNUAL SAVINGS & COSTS

Displaced Electrical Usage = $1,191,120
Reduced Electrical Billing Demand = $415,800
Electricity Sold = $0
Recoverable Heat Produced = $824,798

Fuel Cost = ($1,228,656)
Maintenance Cost = ($227,700)

TOTAL SAVINGS PER YEAR = $975,362

SIMPLE PAYBACK PERIOD = 5.1 YEARS

Cogeneration Payback Analysis

DATA INPUT SHEET

JOB TITLE: Walter Reed OPTION NO. 1

DATE: 02-Jun-95

EQUIP DESCRIPTN: 3645 KW Gas Turbine with heat recovery

FUEL AND MAINTENANCE COSTS

PRESENT FUEL = 1

1 = NATURAL GAS
2 = NO.6 OIL
3 = NO.2 OIL
4 = COAL
5 = ELECTRIC
6 = PROPANE

PRESENT FUEL PRICE = $3.58 ($/UNIT)
PRESENT ELECTRIC USAGE RATE = $0.042 ($/KWH)
PRESENT ELECTRIC DEMAND RATE = $10.80 ($/KW)

PROPOSED COGEN GAS PRICE = $3.58 $/MCF
EXCESS ELECTRIC BUY BACK RATE = 0.000 $/KWH

PRESENT BOILER SYSTEM EFFICIENCY = 75 %
COGEN HEAT RECOVERY BOILER EFFICIENCY = 90 %

FIXED ANNUAL MAINTENANCE COST = $15,000 ($/YR)
VARIABLE MAINTENANCE COST = $0.0075 ($/KWH)

EQUIPMENT RATING

EQUIPMENT DESCRIPTION: Allison Gas Turbine 501-KB5
NUMBER OF UNITS = 1 EACH

KW RATING AT STANDARD CONDITIONS = 3545 KW
FUEL INPUT RATE = 42.9 MCF/HR
RECOVERABLE HEAT OUTPUT RATE = 23.3 MMBTU/HR

AUX EQUIPMENT KW RATING = 0 KW

ESTIMATED RUN TIME AT RATED LOAD 1ST UNIT= 8000 HRS/YR

COGEN DEMAND REDUCTION = 3500 KW/MO
ESTIMATED MONTHS DEMND SAVINGS 1ST UNIT= 11 MO/YR

PERCENTAGE OF GENERATED KWH SOLD TO UTILITY = 0 %

TOTAL ESTIMATED CONSTRUCTION COSTS = $5,000,000

MISCELLANEOUS INFORMATION

JOB TITLE: Walter Reed OPTION NO. 1

DATE: 02-Jun-95

EQUIP DESCRIPTN: 3645 KW Gas Turbine with heat recovery

AVG COST GENERATED ELECTRICITY = (Displacement & sell-back)	$0.057
EFFICIENCY OF COGENERATION SYSTEM	
ELECTRICAL PRODUCTION =	27.4 %
USABLE HEAT =	47.5 %
LOSSES =	25.2 %
CONSTRUCTION COST IN $/KW =	$1,410

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          LIFE CYCLE COST ANALYSIS SUMMARY               STUDY: WALTER2
      ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)       LCCID  1.080
INSTALLATION & LOCATION:                   REGION NOS.  3 CENSUS: 3
PROJECT NO. & TITLE:
FISCAL YEAR      DISCRETE PORTION NAME: ALT#1
ANALYSIS DATE:  06-20-95  ECONOMIC LIFE 20 YEARS PREPARED BY:

1. INVESTMENT
A. CONSTRUCTION COST       $  5000000.
B. SIOH                    $   300000.
C. DESIGN COST             $   300000.
D. TOTAL COST (1A+1B+1C)   $  5600000.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $        0.
F. PUBLIC UTILITY COMPANY REBATE       $        0.
G. TOTAL INVESTMENT (1D - 1E - 1F)                   $  5600000.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993
            UNIT COST   SAVINGS      ANNUAL $     DISCOUNT   DISCOUNTED
    FUEL    $/MBTU(1)   MBTU/YR(2)   SAVINGS(3)   FACTOR(4)  SAVINGS(5)

    A. ELECT $ 16.60      96793.     $ 1606764.      15.61   $ 25081580.
    B. DIST  $   .00          0.     $       0.      17.56   $        0.
    C. RESID $   .00          0.     $       0.      19.97   $        0.
    D. NAT G $  3.47    *******      $ -403190.      20.96   $ -8450856.
    E. COAL  $   .00          0.     $       0.      17.58   $        0.
    F. LPG   $   .00          0.     $       0.      16.12   $        0.
    M. DEMAND SAVINGS                $       0.      14.74   $        0.
    N. TOTAL            -19400.      $ 1203574.              $ 16630730.

3. NON ENERGY SAVINGS(+) / COST(-)

   A. ANNUAL RECURRING (+/-)                                 $   -227700.
      (1) DISCOUNT FACTOR (TABLE A)                  14.74
      (2) DISCOUNTED SAVING/COST (3A X 3A1)                  $ -3356298.

   B. NON RECURRING SAVINGS(+) / COSTS(-)
                               SAVINGS(+)   YR   DISCNT     DISCOUNTED
              ITEM               COST(-)    OC   FACTR      SAVINGS(+)/
                                   (1)     (2)    (3)       COST(-)(4)

    d. TOTAL                  $       0.                           0.

   C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ -3356298.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$   975874.

5. SIMPLE PAYBACK PERIOD (1G/4)                                5.74 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)                    $ 13274430.

7. SAVINGS TO INVESTMENT RATIO        (SIR)=(6 / 1G)=          2.37
   (IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):                    7.65 %
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9.0 CHILLER REFRIGERANT ISSUES

9.1 General

The investigation into potential damage to the environment by chlorofluorocarbons (CFCs) has been ongoing since the early 1970s. Studies have already indicated that CFCs pass through the ozone layer hence, being broken down and releasing chlorine. Chlorine in turn, depletes the earth's ozone layer, a factor in potential global warming.

9.2 History

CFCs were first introduced in 1930 by General Motors, Frigidare Division, by a chemist named Thomas Midgley Jr., to replace the toxic ammonia and sulfur dioxide that was being utilized in refrigerators.

This new CFC was stable and non-flammable and was considered the "Perfect Refrigerant." It is only some sixty-five (65) years later and a billion lbs. of CFCs later, that their destructive power to the ozone layer is being fully realized.

9.3 Environmental Legislation

According to Federal Law, Title VI of the Clean Air Act (CCA) Amendment, requires that the production of all fully-halogenated chlorofluorocarbon (CFC) refrigerants first be reduced and finally production ceased. Table 9.3.1, on the following page, is a time schedule depicting dates and required action for CFC refrigerant. Dates listed prior to the issuance of this report are listed for information.

Table 9.3.1
Legislation

Date	Action Required
July 1, 1992	The capture and recycling of CFC refrigerants will be required by the Clean Air Act and no known venting of refrigerant will be allowed either by service or during maintenance. The penalty for violation can be as much as $25,000 per day, per violation.
January 1, 1993	Production of CFCs limited to 1986 levels. HFC-134a scheduled for large scale production.
January 1, 1994	Production of CFCs reduced to 25% of 1986 levels and CFC tax increases to $4.35/lb.
1995	CFC tax raised to $5.35/lb.
January 1, 1996	Production of CFCs will cease. HCFC production will be capped at 1989 levels.

9.4 Major Equipment Utilizing CFC Refrigerant

Refer to Table 9.4.1 below, listing the existing chillers at WRAMC, the approximate date of manufacturing/installation, and the refrigerant currently being utilized.

Table 9.4.1
Chiller List

Chiller Design/ Manuf.	Model	Year Built	Refrig.	Type	Chiller Location (Building)	Comments
Carrier	30GB		R-22	Air cooled	T-2	Serves T-2 only, no longer operative.
Carrier				Air cooled	7	Serves 7 only.
York	HT-T2	1974	R-500	Water cooled	48	Serves chilled water central distribution grid.
York	HT-T2	1974	R-500	Water cooled	48	Serves chilled water central distribution grid.

Chiller Design/ Manuf.	Model	Year Built	Refrig.	Type	Chiller Location (Building)	Comments
Trane	CVHF	1994	R-123	Water cooled	48	Serves chilled water central distribution grid.
Carrier	19C	1958	R-11	Water cooled	48	Serves chilled water central distribution grid.
Carrier	19C	1958	R-11	Water cooled	48	Serves chilled water central distribution grid.
Carrier	19C	1958	R-11	Water cooled	48	Serves chilled water central distribution grid.
Trane	CV6H	1976	R-11	Water cooled	49	Serves chilled water central distribution grid.
Carrier	17M	1952	R-11	Water cooled	54	Serves 54 only.
Carrier	17M	1952	R-11	Water cooled	54	Serves 54 only.
Trane	CVHE	1983	R-11	Water cooled	54	Serves 54 only.
Future				Air cooled	6	Building under construction. Will serve BRAC Clinic only.

9.5 Alternative Refrigerants

The option of retrofitting existing chillers to alternative refrigerants is a possibility, however, due to the age of the existing equipment and costs associated (i.e. reduction of capacity, storage and detection systems, oxygen sensors, etc.) as well as the useful life of a centrifugal chiller of approximately twenty-three (23) years, (source ASHRAE HVAC Application Ch. 33), Entech Engineering has elected to focus on equipment replacement.

In regards to equipment that was manufactured in 1983 (Chiller C-54-1) this unit presently serves only Building 54, and with future upgrades utilizing new equipment to serve the present chilled water distribution grid, this unit could be phased out or refrigerant upgraded to be utilized as a standby chiller.

Refer to Table 9.5.1 which lists present refrigerant types, their possible alternates, regulations, and controls.

Table 9.5.1
Regulations

Existing	Alternative	Regulation	Use	Controls	Remarks
CFC-11	HCFC-123	No production permitted after 1996. Allowable Exposure Limit = 1000 ppm		Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	Used by 80% of U.S. chillers as of March 1992.
CFC-12	HFC-134a	No production permitted after 1996. Allowable Exposure Limit - 1000 ppm		Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	

Table 9.5.1
Regulations

Existing	Alternative	Regulation	Use	Controls	Remarks
CFC-114	HCFC-124	No production permitted after 1996.		Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	
CFC-500	HFC-134a	No production permitted after 1996.		Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	75% CFC - 12 and 25% HCFC-22 make CFC-500.
HCFC-22		Capture and recycling required in 1995. No production permitted after 2030. Allowable Exposure Limit - 1000 ppm	Screw Chillers and Reciprocating Chillers.	Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	Contains 41% chlorine by weight.

Table 9.5.1
Regulations

Existing	Alternative	Regulation	Use	Controls	Remarks
HCFC-123		Capture and recycling required in 1995. No production permitted after 2030. Allowable Exposure Limit - 10 ppm Emergency Exposure Limit - 1000 ppm	Provided in York Codepak centrifugal chillers and Trane chillers.	Alarm activated at 10 ppm, mechanical ventilation system, available self-contained breath apparatus, and pipe the rupture disk to purge outdoors for a system containing more than 6.6 lb of refrigerant.	Corrosive to hermetic motor winding insulations and seals but miscible with CFC-11.
HFC-134a		Allowable Exposure Limit = 1000 ppm	Recommended by McQuay	Oxygen sensor to warn of oxygen levels below 19.5 volume percent, mechanical ventilation system, pipe the rupture disk to purge outdoors for a system containing more than 110 lb of refrigerant.	Large scale production began 1993. It has 28% more head than CFC-12 and CFC-500. Chiller must be scrupulously cleaned of old refrigerant before retrofit.

Consideration must also be given when employing these alternative refrigerants in the immediate future. A time schedule, Table 9.5.2 on the following page, depicts dates and required actions for HCFC refrigerants.

Table 9.5.2 Time Schedule	
Date/Year	**Action Required/Resultant**
2004	HCFC production limited to 65% of cap.
2010	HCFC production limited to 35% of cap.
2015	Production of HCFCs will be limited to 10% of the cap.
2020	Production of HCFCs will be limited to 0.5% of the cap.
2030	A total HCFC production ban becomes effective.

9.6 Equipment and Refrigerant Manufacturer Involvement

Both equipment manufacturers and refrigerant manufacturers are currently spending millions of dollars in research to provide a CFC-free chiller that is safe for the environment and the building occupants.

9.7 Engineer/Owner Involvement

Until the manufacturers develop CFC-free equipment, both specifying Engineers as well as Owners must select equipment that can be easily convertible to future low-pressure refrigerants.

10.0 CONCLUSION

10.1 General

A summary of alternatives in the order presented in Sections 6, 7, and 8 is shown in Table 10.1.1 on the following page. Included with each alternative are construction costs, annual energy savings, annual maintenance savings, simple payback periods, SIR, and annual energy saved.

The lists of the recommended or non-recommended alternatives are shown in the following sections. In addition to the summary information for each alternative, a comment is added to each alternative in the two lists which relates to which category the project falls under. Below is the criteria that is used to categorize the report's findings (ie. ECIP, Non-ECIP, etc.). Qualifying for ECIP requires a project to have a low limit for construction, and an acceptable payback and investment ratio. In addition, it cannot be an operation and maintenance project which is defined as:

> **O & M Energy Projects:** An O & M Energy Project is one that results in needed maintenance and repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings.

The following criteria is the basis to recommended or not recommended alternatives for this report.

WALTER REED ARMY MEDICAL CENTER
ALTERNATIVE SUMMERY

TABLE 10.1.1

NO.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback (years)	LCCID SIR	Energy Savings			
							Elec. Demand (KW)	Elec. Usage (KWh)	Gas Usage (mcf)	Total (MMBTU)
1	Upgrade Existing Chilled Water Plants with New Chillers	$4,500,000	$524,800	$78,000	7.5	2.1	14,224	8,125,297	0	27,732
2	Convert Building 48 Chilled Water Distribution System to a Variable-Flow Primary/Secondary System	$1,450,000	$38,300	$0	38	0.4	347	842,418	0	2,875
3	Upgrade Existing Condenser and Chilled Water Free-Cooling Systems	$670,000	$164,000	$0	4.1	3.8	5,333	3,121,600	0	10,654
4	Upgrade Existing Building 48 Chilled Water Plant and Provide New Building 49 Chilled Water Plant	$11,100,000	$503,000	$78,000	19.1	0.8	13,223	7,871,314	0	26,865
5	Provide a New Central Chilled Water Plant Adjacent to the Central Heating Plant	$18,900,000	$526,000	$78,000	31.3	0.5	14,906	8,097,374	0	27,636
6	Chiller Type Comparison **									
	Two-Stage Steam Absorption	$700,000	($557,000)	($500)	N/A	N/A	11,714	7,925,424	(243,337)	(223,831)
	Gas-Fired Absorption	$800,000	($222,000)	($500)	N/A	N/A	11,706	7,921,364	(149,530)	(127,130)
	Gas Engine Driven Centrifugal	$700,000	$3,000	($500)	35.2	0	12,415	8,438,358	(100,719)	(75,041)
	Steam Turbine Driven Centrifugal	$900,000	($435,000)	($1,000)	N/A	N/A	12,415	8,438,358	(223,222)	(201,342)
7	Chilled Water Storage	$1,230,000	$40,700	($2,000)	31.8	0.5	0	0	0	0
8	Reduce Outside Air Quantities in Buildings 1 and 40	N/A	$143,100	$0	N/A	N/A	35	267,343	34,823	36,815
9	Provide Unoccupied Space Temperature Setback in Buildings 1, 7, 11, 40, and 41	$83,600	$23,400	$0	5.1	3.5	0	239,400	1,700	2,570
10	Balance Hot Water Heating System and Reset Preheat Coil Set Points in Building 2	$30,000	$297,000	$0	0.1	191	0	2,186,053	54,523	63,674
11	Efficient Fluorescent Lighting in Buildings 1, 2, 7, 11, 40, 41, & 54	$4,300,000	$455,000	$0	9.5	1.6	12,100	8,439,200	0	28,803
12	Window Replacement in Buildings 1, 7, 11, 40, & 41	$6,600,000	$25,700	$0	257	0	133	329,000	0	1,123
13	Cogeneration	$5,600,000	$1,203,100	$227,700	5.7	2.4	38,500	28,360,000	(112,809)	(19,513)

** SAVINGS AND COSTS FOR EACH CHILLER TYPE ARE IN ADDITION TO OR SUBTRACTION FROM THE SAME VALUES FOR AN ELECTRIC CENTRIFUGAL CHILLER.

Qualifications for project recommendation:

1. **ECIP:** Projects that have > $300,000 construction cost, SIR > 1.25, payback < 10 years.
   Non-ECIP: Projects that do not meet the criteria of No. 1 above, or they fall under the categories of Nos. 2 or 3 below.

2. **O & M Projects (by definition):** > $300,000 construction cost, SIR > 1.25, payback < 10 years.

3. **Low Cost/No Cost Projects:** Walter Reed Army Medical Center can implement with their own resources.

4. **Non-feasible:** Alternatives that are not recommended based on findings for Nos. 1, 2, and 3 above, or because of reasons stated in the conclusion section and/or the non-recommended table.

10.2 Recommended Alternatives

Of the thirteen (13) alternatives reviewed, five (5) have been found to be acceptable, and they are listed in Table 10.2.1 on the following page. The recommended alternatives are listed from highest to lowest savings to investment ratio. The list includes alternatives from Section 6.0 and 7.0. Of the five (5) recommended alternatives only two (2) apply directly to the central chilled water systems. The other three (3) address cooling capacity reduction in the individual buildings.

WALTER REED ARMY MEDICAL CENTER
RECOMMENDED ALTERNATIVE SUMMERY

TABLE 10.2.1

NO.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback (years)	LCCID SIR	Comments
10	Balance Hot Water Heating System and Reset Preheat Coil Set Points in Building 2	$30,000	$297,000	$0	0.1	191	Non-ECIP Low Cost/No Cost Project
3	Upgrade Existing Condenser and Chilled Water Free-Cooling Systems	$670,000	$164,000	$0	4.1	3.8	ECIP
9	Provide Unoccupied Space Temperature Setback in Buildings 1, 7, 11, 40, and 41	$83,600	$23,400	$0	5.1	3.5	Non-ECIP Low Cost/No Cost Project
1	Upgrade Existing Chilled Water Plants with New Chillers	$4,500,000	$524,800	$78,000	7.5	2.1	ECIP
11	Efficient Fluorescent Lighting in Buildings 1, 2, 7, 11, 40, 41, & 54	$4,300,000	$455,000	$0	9.5	1.6	ECIP

Alternative No. 10 is a non-ECIP project with a near instant payback, a high energy savings and a low construction cost. This alternative will help reduce the cold weather cooling requirements at Heaton Pavilion. Alternative No. 9 is also a non-ECIP project with a 5.1-year payback. This alternative will reduce the night and weekend summer cooling requirements for Buildings 48 and 49 central chilled water plants.

Alternatives No. 3, 1, and 11 are ECIP projects. Alternatives No. 3 and 1 address the central chilled water plants. Alternative No. 3 will provide free cooling in the cooler months which will reduce electric demand and usage at the Building 48 chilled water plant. Alternative No. 1 is to replace the centrifugal chillers in Buildings 48, 49 and 54 with new more efficient chillers. All of the chillers, except one, in these three buildings utilize out-of-production refrigerants, and all but two have an age greater than twenty (20) years. The maintenance on the chillers will continue to increase and become extremely costly due to equipment age and the future unavailability of refrigerants currently used.

Alternative No. 11 addresses electric energy reduction in several buildings by installing new more efficient fluorescent lighting. The new fluorescent lighting will slightly reduce the amount of cooling required, and increase the amount of heating due to reduced internal loads. This alternative is recommended since it has less than a ten-year payback and an SIR greater than 1.0, but is best integrated as part of normal renovations to individual buildings.

These five (5) recommended alternatives amount to approximately $9.6 million dollars in construction costs and a saving of approximately $1.5 million dollars. If all five (5) are implemented, a total simple payback of 6.4 years could be realized.

10.3 Non-Recommended Alternatives

Eight (8) of the thirteen (13) alternatives are not recommended for implementation. These non-recommended alternatives are listed on Table 10.3.1 on the following page. They are listed in the same order as they were presented in Section 6.0, 7.0, and 8.0. Included in the table are alternative descriptions, construction costs, savings, maintenance savings, simple payback, SIR, and general comments on each.

Alternative No. 13 has a simple payback and SIR in the recommended range. However, this alternative cannot be recommended without a more detailed study. The scope of this study only addresses the central chilled water plants and not the central heating plant. The outcome of this alternative indicates that a further study is warranted to determine the feasibility of a cogeneration unit at Walter Reed Army Medical Center.

WALTER REED ARMY MEDICAL CENTER
NON-RECOMMENDED ALTERNATIVE SUMMERY

TABLE 10.3.1

NO.	Description	Construction Cost	Annual Energy Savings	Annual Maint. Savings	Simple Payback (years)	LCCID SIR	Comments
2	Convert Building 48 Chilled Water Distribution System to a Variable-Flow Primary/Secondary System	$1,450,000	$38,300	$0	38	0.4	High construction cost and a low savings potential
4	Upgrade Existing Building 48 Chilled Water Plant and Provide New Building 49 Chilled Water Plant	$11,100,000	$503,000	$78,000	19.1	0.8	High construction cost and a low savings potential
5	Provide a New Central Chilled Water Plant Adjacent to the Central Heating Plant	$18,900,000	$526,000	$78,000	31.3	0.5	High construction cost and a low savings potential
6	Chiller Type Comparison **	$0	$0	$0	0	0	Alternate chiller types use more energy
	Two-Stage Steam Absorption	$700,000	($557,000)	($500)	N/A	N/A	
	Gas-Fired Absorption	$800,000	($222,000)	($500)	N/A	N/A	
	Gas Engine Driven Centrifugal	$700,000	$3,000	($500)	35.2	0	
	Steam Turbine Driven Centrifugal	$900,000	($435,000)	($1,000)	N/A	N/A	
7	Chilled Water Storage	$1,230,000	$40,700	($2,000)	31.8	0.5	High construction cost and a low savings potential
8	Reduce Outside Air Quantities in Buildings 1 and 40	N/A	$143,100	$0	N/A	N/A	Existing systems have no return air systems. New system cannot be defined within this project's scope
12	Window Replacement in Buildings 1, 7, 11, 40, & 41	$6,600,000	$25,700	$0	257	0	High construction cost and a low savings potential
13	Cogeneration	$5,600,000	$1,203,100	$227,700	5.7	2.4	Requires a more detailed study in order to determine actual feasibility

** SAVINGS AND COSTS FOR EACH CHILLER TYPE ARE IN ADDITION TO OR SUBTRACTION FROM THE SAME VALUES FOR AN ELECTRIC CENTRIFUGAL CHILLER.