CHILLED WATER STUDY
EEAP PROGRAM

FOR

Walter Reed
Army Medical Center

US Army Corps
of Engineers

U.S. ARMY ENGINEER DISTRICT, NORFOLK
CORPS OF ENGINEERS
NORFOLK, VIRGINIA

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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 SUMMERY

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	$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.

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.