

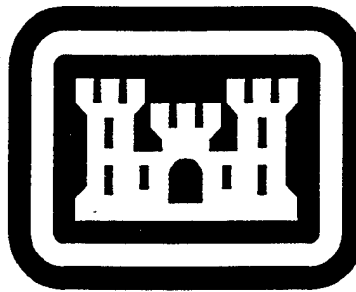
# **(EEAP) BOILER AND CHILLER STUDY**

AT

## **FORT SAM HOUSTON**

**SAN ANTONIO, TEXAS**

### **FINAL REPORT**



**US Army Corps  
of Engineers**

Fort Worth Division



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CONDUCTED BY

**HUITT-ZOLLARS, INC.**

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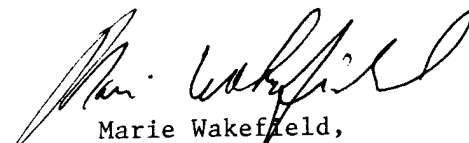


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## I. EXECUTIVE SUMMARY

### A. Introduction

This energy conservation study was performed by Huitt-Zollars Inc, for the U.S. Army Engineer District (USAED), Fort Worth, under contract number DACAC63-94-D-0015. The study was conducted at Fort Sam Houston (FSH) in San Antonio, Texas, between November 28, 1994 and June 15, 1995. The site survey, data collection and analysis was performed by John Carter, E.I.T, Tom Holthaus, P.E., Walter H. Williams III, P.E., and C.A. Pieper, P.E..

The purpose of the study was to perform a limited site survey of specific buildings at the facility, identify specific Energy Conservation Opportunities (ECOs) that exist, and then evaluate these ECOs for technical and economic feasibility. These ECOs were limited to central boiler and chiller plant systems serving specific building groups at FSH.

This survey was conducted with the assistance of many individuals at the FSH facility. Special thanks are extended to all of them, including the following individuals:

Gerardo De La Pena, Energy Coordinator  
Frank Carbonell, Engineering Service  
Gene Rodriguez, Engineering Service  
Ray Mendoza, Engineering Service  
Mike Brynes, Operations and Maintenance  
Henry Guerra, Operations and Maintenance  
Al Mote, Energy Program Specialist

Other individuals who assisted in this study by providing equipment and cost data are listed as follows:

Tom McGreal, York International, Dallas, TX  
John Neal, Sr., Neal and Associates, Dallas, TX  
Joe Scolaro and Brian Mitchell, Mitchell Technical Sales, Dallas, TX  
Preston Dickson, Timberlake and Woffard, Inc., Dallas, TX  
Larry Carpenter, The Trane Company, Fort Worth, TX  
David Recca, DynaService, Fort Worth, TX

Any questions concerning this report should be directed to the Project Manager at Huitt-Zollars Inc., 512 Main Street, Suite 1500, Fort Worth, Texas 76102. Phone 817-335-3000.

### B. Buildings Studied

This study was performed on five separate groups of buildings at the Fort Sam Houston installation in San Antonio, Tx. These groups were identified as areas 100, 900, 1300, 2200 and Quadrangle. Buildings in each of these areas are briefly described as follows:

- Area 100: These twenty buildings are currently used as office buildings, barracks, and other miscellaneous things such as a band rehearsal hall.
- Area 900: These buildings consisted of sixteen barracks, four smaller support buildings and one large administrative building, all occupied by army personnel.

Area 1300: The buildings in this group consisted of six barracks, one dining hall and one administrative office building.

Area 2200: The four buildings in this group consisted of three barracks and one administrative office building, which were all approximately 25 years old.

Quadrangle: The four buildings in this group are all administrative offices, one of which serves as the headquarters of the 5th Army.

C. Present Energy Consumption

*Base Year Energy Consumption:* The total metered electrical and gas consumptions for 12 consecutive months, prior to this study, were obtained from the facility and are referred to as the 'base year'. These data are shown on page 12 and are summarized as follows:

**Figure 1. Base Year Energy Usage By Source**

| ENERGY SOURCE | ANNUAL USAGE  |               | COST \$   |
|---------------|---------------|---------------|-----------|
|               |               |               |           |
| Electricity   | 153,580 MWH   | 524,169 MMBTU | 6,567,101 |
| Natural Gas   | 51,415 MCF    | 51,415 MMBTU  | 192,985   |
| Total         | 575,584 MMBTU |               | 6,760,086 |

*Boiler & Chiller Systems Energy Consumption:* The annual energy consumption for the boiler & chiller systems studied was calculated in Appendix B, using the Trace 600 computer program to model the buildings and HVAC systems. This consumption amounted to a total of 11.1% of the base year energy usage and 7.4% of the energy costs. These system energy consumptions are given as follows:

**Figure 2. Annual Boiler & Chiller Systems Energy Consumption**

| AREA                                       | COOLING SYSTEM DEMAND \$/YR | COOLING SYSTEM ELECT. KWH/YR | COOLING SYSTEM ELECT. \$/YR | HEATING SYSTEM DEMAND \$/YR | HEATING SYSTEM ELECT. KWH/YR | HEATING SYSTEM ELECT. \$/YR | HEATING SYSTEM GAS MCF/YR | HEATING SYSTEM GAS \$/YR |
|--|-----------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-----------------------------|---------------------------|--------------------------|
| 100  | 46,621                      | 1,687,278                    | 35,433                      | 1,269                       | 89,804                       | 1,886                       | 1,927                     | 5,126                    |
| 900  | 13,242                      | 621,339                      | 13,048                      | 1,000                       | 88,213                       | 1,852                       | 7,809                     | 20,771                   |
| 1300                                       | 67,861                      | 3,019,253                    | 63,404                      | 2,687                       | 259,249                      | 5,444                       | 18,751                    | 49,878                   |
| 2200                                       | 36,390                      | 1,609,767                    | 33,805                      | 797                         | 51,536                       | 1,082                       | 4,949                     | 13,163                   |
| QUAD                                       | 51,292                      | 1,633,303                    | 34,299                      | 221                         | 6,096                        | 128                         | 1,210                     | 3,220                    |
| SUBTOTALS                                  | 215,405                     | 8,570,940                    | 179,990                     | 5,973                       | 494,898                      | 10,393                      | 34,646                    | 92,158                   |
| ANNUAL BOILER & CHILLER SYSTEM ENERGY      |                             |                              |                             | 63,898 MMBTU/YR             |                              |                             |                           |                          |
| ANNUAL BOILER & CHILLER SYSTEM COST, \$/YR |                             |                              |                             | 503,919 \$/YR               |                              |                             |                           |                          |

**D. Energy Conservation Opportunity (ECO) Analysis**

*ECOs Rejected:* After reviewing the data collected at the facility and considering all of the practical limitations involved, there were no potential ECOs which were rejected prior to performing calculations. Therefore, energy savings calculations were performed for all ECOs identified in the scope of work.

*ECOs Recommended:* Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility and are recommended for implementation. Complete documentation of all calculations as well as information required for implementation is included in Appendix D. These recommended ECOs are summarized in order of descending Savings to Investment Ratio (SIR) in Table 1 on page 6.

*ECOs Not Recommended:* Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility but are not recommended for implementation. Complete documentation of all calculations are included in Appendix E. These non-recommended ECOs are summarized in order of order of descending SIR in Table 2 on page 6.

*ECIP Projects Developed:* The facility will submit three projects for ECIP funding, from the recommended ECOs shown in Table 1. The DD-1391 forms needed to request ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

| ECIP Project | Description   | Cost \$ | Payback yrs | SIR  |
|--------------|---|---------|-------------|------|
| 1            | Chiller Retrofits, Areas 2200 & 900, Boiler Retrofit, Area 1300 | 558,058 | 7.7         | 2.27 |
| 2            | Chiller Retrofit, Area 1300                                     | 479,191 | 8.4         | 1.98 |
| 3            | New Central Chiller Plant, Area 100                             | 556,559 | 8.6         | 1.73 |

*Non-ECIP Projects Developed:* The facility will also submit all ECOs individually as projects for non-ECIP funding. The DD-1391 forms needed to request non-ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

| Non-ECIP Project | Description                         | Cost \$ | Payback yrs | SIR  |
|------------------|-------------------------------------|---------|-------------|------|
| 1                | Chiller Retrofit, Area 2200         | 237,078 | 6.3         | 2.73 |
| 2                | Chiller Retrofit, Area 900          | 157,256 | 8.9         | 2.08 |
| 3                | Chiller Retrofit, Area 1300         | 479,191 | 8.4         | 1.98 |
| 4                | Boiler Retrofit, Area 1300          | 163,724 | 9.6         | 1.79 |
| 5                | New Central Chiller Plant, Area 100 | 556,559 | 8.6         | 1.73 |

*Recommended Maintenance & Operations Practices:* The following maintenance and operations (M&O) practices are recommended to help conserve boiler and chiller plant energy at FSH.

1. The Energy Coordinator and the FSH Director of Public Works should develop a master plan specification for all future central boiler and chiller plant maintenance and renovation projects. All facility project managers, as well as any central plant maintenance contractors should be required to follow this specification. The energy coordinator should review all new central boiler and chiller plant designs to check for compliance with the specifications.
2. The energy coordinator should attend training seminars for building energy.
3. The installation should increase the size of their current maintenance staff by adding trained HVAC technicians.
4. The installation should provide technical training for it's current HVAC staff, especially in the area of HVAC controls.
5. Revise the current HVAC preventative maintenance program as needed to improve the overall condition of the existing systems and equipment. The Energy Manager should be involved in this process to ensure that energy conservation concerns are addressed.
6. Add status, alarm, start and stop capabilities for all central boiler and chiller systems and auxiliaries to the post's existing building automation system. This will allow the maintenance staff to have better monitoring and control capabilities than they currently have.
7. Repair or replace all building HVAC control systems to improve space temperature control and conserve heating and cooling system energy.

E. Energy And Cost Savings

Total Potential Energy and Cost Savings. The energy and cost savings from the implementation of all ECIP projects was calculated as follows:

|                           |           |          |
|---------------------------|-----------|----------|
| Electrical Energy Savings | 8,690     | MMBTU/yr |
| Electrical Demand Savings | 49,884    | \$/yr    |
| Gas Energy Savings        | 4,020     | MMBTU/yr |
| Total Energy Savings      | 12,710    | MMBTU/yr |
| Total Cost Savings        | 193,496   | \$/yr    |
| Total Investment          | 1,593,808 | \$       |
| Simple Payback            | 8.2       | yrs      |

*Energy Use and Costs Before and After.* Based on the base year electrical and gas energy consumptions and costs shown on page 12, and the calculated total potential savings above, the FSH energy and usage and costs before and after implementation of the 3 Non-ECIP projects is as follows:

|            | <u>Before</u> | <u>After</u> |
|------------|---------------|--------------|
| Electrical | 153,580 MWH   | 151,033 MWH  |
| Gas        | 51,415 MCF    | 47,395 MCF   |
| Total Cost | 6,760,086 \$  | 6,566,590 \$ |

*Percentage Saved.* Based on the base year electrical and gas energy consumptions and costs, the percentage of savings from the 3 projects is as follows:

$$\text{Electrical Energy Saved} = \left[ \frac{2,546 \text{ MWH}}{153,580 \text{ MWH}} \right] = 1.6\%$$

$$\text{Gas Energy Savings} = \left[ \frac{4,020 \text{ MCF}}{51,415 \text{ MCF}} \right] = 7.8\%$$

$$\text{Energy Cost Savings} = \left[ \frac{193,496 \text{ \$}}{6,760,086 \text{ \$}} \right] = 2.8\%$$

**TABLE 1. ENERGY CONSERVATION OPPORTUNITIES (ECOS) RECOMMENDED**

| ECO | Description  | Electrical Energy Savings MMBTU/yr | Electrical Demand Savings \$/yr | Gas Energy Savings MMBTU/yr | Total Energy Savings MMBTU/yr | Total Cost Savings \$/yr | Total Investment \$ | Simple Payback Yrs | SIR  |
|-----|--|------------------------------------|---------------------------------|-----------------------------|-------------------------------|--------------------------|---------------------|--------------------|------|
|     | AREA 2200  |                                    |                                 |                             |                               |                          |                     |                    |      |
| E   | Replace Existing Chiller With New Centrifugal Chiller  | 1,304                              | 11,822                          | 0                           | 1,304                         | 37,433                   | 237,078             | 6.3                | 2.73 |
|     | AREA 900   |                                    |                                 |                             |                               |                          |                     |                    |      |
| A   | Replace Existing Central Chiller with Screw Chiller    | 434                                | 2,520                           | 0                           | 434                           | 17,650                   | 157,256             | 8.9                | 2.08 |
|     | AREA 1300  |                                    |                                 |                             |                               |                          |                     |                    |      |
| C   | Replace Existing Chillers With Centrifugal Chillers    | 3,424                              | 13,914                          | 0                           | 3,424                         | 56,936                   | 479,191             | 8.4                | 1.98 |
|     | AREA 1300  |                                    |                                 |                             |                               |                          |                     |                    |      |
| D   | Replace Existing Boilers With High % Modular Boilers   | 712                                | 1,847                           | 4,020                       | 4,732                         | 17,012                   | 163,724             | 9.6                | 1.79 |
|     | AREA 100   |                                    |                                 |                             |                               |                          |                     |                    |      |
| I   | Replace Individual Chillers With Central Chiller Plant | 2,816                              | 19,781                          | 0                           | 2,816                         | 64,465                   | 556,559             | 8.6                | 1.73 |
|     | Totals   | 8,690                              | 49,884                          | 4,020                       | 12,710                        | 193,496                  | 1,593,808           | 8.2                |      |

**TABLE 2. ENERGY CONSERVATION OPPORTUNITIES (ECOS) NOT RECOMMENDED**

| ECO | Description  | Electrical Energy Savings MMBTU/yr | Electrical Demand Savings \$/yr | Gas Energy Savings MMBTU/yr | Total Energy Savings MMBTU/yr | Total Cost Savings \$/yr | Total Investment \$ | Simple Payback Yrs | SIR  |
|-----|--|------------------------------------|---------------------------------|-----------------------------|-------------------------------|--------------------------|---------------------|--------------------|------|
|     | AREA 900   |                                    |                                 |                             |                               |                          |                     |                    |      |
| B   | Replace Existing Boilers With High % Modular Boilers | 0                                  | 0                               | 1,235                       | 1,235                         | 3,285                    | 50,591              | 15.4               | 1.21 |
|     | QUADRANGLE AREA                                      |                                    |                                 |                             | 0                             |                          |                     |                    |      |
| G   | Replace Existing Chillers With Central Chiller Plant | 2,212                              | 14,116                          | 0                           | 2,212                         | 39,257                   | 824,178             | 20.9               | 0.71 |
|     | AREA 2200  |                                    |                                 |                             | 0                             |                          |                     |                    |      |
| F   | Replace Existing Boilers With High % Modular Boilers | 38                                 | 378                             | 910                         | 948                           | 3,037                    | 78,553              | 25.8               | 0.69 |
|     | AREA 100   |                                    |                                 |                             | 0                             |                          |                     |                    |      |
| J   | Replace Existing Boilers With Central Boiler Plant   | 186                                | 680                             | 680                         | 866                           | 11,483                   | 273,951             | 23.8               | 0.66 |
|     | QUADRANGLE AREA                                      |                                    |                                 |                             |                               |                          |                     |                    |      |
| H   | Replace Existing Boilers With Central Boiler Plant   | -12                                | 122                             | -434                        | -446                          | 5,542                    | 394,910             | 71.2               | 0.20 |
|     | Totals   | 18,066                             | 100,722                         | 10,431                      | 28,497                        | 394,513                  | 4,415,465           | 11.2               |      |