ENERGY SURVEYS OF ARMY HOSPITALS
ENERGY ENGINEERING ANALYSIS PROGRAM

DARNALL ARMY COMMUNITY HOSPITAL
FORT HOOD, TEXAS

FINAL REPORT
Executive Summary

PREPARED FOR:

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NOTE: Volume 4 has only been made in a limited number. Distribution has been made only to Ft. Hood DEH and Ft. Worth District.

1.0 INTRODUCTION

This document is the Executive Summary of the Final Report of the Energy Surveys of Army Hospitals/ Energy Engineering Analysis Program for Darnall Army Community Hospital, and related medical facility, Building 36001, Fort Hood, Texas. This report is prepared under Contract No. DACA63-84-C-0135 Modification P00001, between the Department of the Army (Fort Worth District), Corps of Engineers, and Chilton Engineering, Chartered. This project has been executed as a part of the Department of the Army's Energy Engineering Analysis Program (EEAP). The overall objective of this project is to develop a systematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan (AFEP), without decreasing the readiness posture of the Army.

The project evaluations contained herein are performed in accordance with the "Energy Conservation Investment Program (ECIP) Guidance", described in the letter from DAEN-ZCF-U, 4 March 1985 [5]. The Scope of Work, HNDED-PM/ME, dated 1 September, 1984 [1], is used extensively in performing this study and is presented in Appendix C of the Main Report.

The study methodology is segmented into three phases of work. Phase I consists of data collection and field inspection of Darnall Army Community Hospital and Building No. 36001 facilities, plans, and records. Phase I also involves the identification of potential energy conservation projects. Phase II consists of accomplishing sufficient analysis to develop a list of potential Energy Conservation Opportunities (ECO's) based upon preliminary evaluations. Phase III involves preparing the appropriate programming documentation. This document is the Executive Summary of the Final Report.

Section 2.0 of this Executive Summay discusses the energy conservation opportunities analyzed, the results of the analyses, and the funding categorization for the feasible projects. Section 3.0 summarizes the results of this study, including conclusions and recommendations.

2.0 ENERGY CONSERVATION ANALYSES

The ECO's developed within this EEAP study are categorized and described. Utilizing the implementation cost and economic feasibility results, ECO's or combinations of ECO's are categorized into the project funding categories described in Section 2.1. Project packaging was accomplished in conjunction with Director of Facilities Engineering (DFE) and hospital personnel. Sections 2.2 through 2.10 describe the projects and technical results identified for each category.

2.1 Project Categorization

Energy Conservation Opportunities (ECO's) are categorized into eight (8) project types for the purpose of complying with objectives set forth in the scope of the Energy Engineering Analysis Program (EEAP). The classification of ECO's enables identification of the projects which should be implemented through facility funds, through the Energy Conservation Investment Program (ECIP), through other non-ECIP funding programs (QRIP, OSD PIF, PECIP) or do not apply to any funding means. These categories are defined below.

o General Recommendations. General recommendations apply to the entire facility representing ECO's essential to a continuing maintenance program for attaining and maintaining efficient energy use. These measures involve operation and maintenance procedures in which the quantification of energy savings is impossible to define. These recommendations are to be implemented by facility personnel on a continuing basis.

o Non-ECIP Projects

- No Cost/Low Cost ECO's. These ECO's are characterized by requiring minimal or no capital investment, a quick return on any investment required, and immediate implementation by the facility engineer and hospital personnel. No Cost/Low Cost ECO's are synonymous with operation, maintenance, and repair type projects.

- Quick Return on Investment Program (QRIP). This program is for ECO's which have a total cost not over $100,000 and will amortize in two (2) years or less.

- OSD Productivity Investment Funding (OSD PIF). This program is for ECO's having a total cost greater than $100,000 and an amortization period of less than four (4) years.

- Productivity Enhancing Capital Investment Program (PECIP). This program is for ECO's having a total cost of more than $3,000 and an amortization period of less than four(4) years.

o ECIP Projects. ECO's or combinations of ECO's which qualify for ECIP funding must comply with the investment, energy savings, and economic feasibility criteria outlined in the Energy Conservation Investment Program, governed by the ECIP Guidance, as described in the letter from DAEN-ZCF-U, 4 March 1985 [5]. ECIP projects require a capital investment of greater than $200,000 and must exhibit a Savings-to-Investment Ratio (SIR) greater than one.

- **Projects Requiring Further Investigation.** These projects are potentially viable ECO's which cannot be satisfactorily treated within the scope of this contract. They require further study and analysis in order to determine capital investment, energy savings, and economic feasibility. Upon future analysis of these potential projects they can be classified into one of the other categories outlined herein.

- **Non-Feasible ECO's.** These ECO's are non-feasible based upon economic analysis results and show an SIR less than one.

- **Non-Applicable ECO's.** ECO's which are non-applicable are for systems which do not exist or in which the system already incorporates the ECO.

The hospital and DFE staff will be consulted to determine how projects should be categorized. This will occur prior to the submittal of the Draft Final Report and upon completion of ECO analyses. The final results of the project categorization will be presented in the Draft Final Report.

2.2 General Recommendations

General recommendations apply to the entire hospital facility representing projects that are essential to a continuing maintenance program for assuring the efficient use of energy. These measures involve operation and maintenance procedures in which quantification of energy savings is impossible to define. It is recommended, however, that these actions receive high priority and be implemented as soon as possible. The implementation of these measures is crucial to attaining and maintaining the projected energy savings identified throughout this document.

In most cases these recommendations are to be implemented by facility personnel on a continuing basis. However, due to the current state of disrepair and misadjustment of the hospital HVAC systems, some costly one time remedies are required. The ECO recommended to "Repair, Calibrate, and Adjust HVAC Controls" is one such remedy. This ECO does have identifiable energy savings and is therefore analyzed as an ECO. An equally important remedy involves air balancing all HVAC air distribution systems. This recommendations stems from the results of the Air Measurement Study conducted at the hospital. The results of this study are presented in the following section. Other general recommendations that are addressed in the following section include regular service and calibration of HVAC equipment, personnel training, and the EMCS. The final section addresses the Medical Facility Building No. 360001.

2.2.1 Air Balance HVAC Distribution Systems

An Air Measurement Study was conducted at Darnall Army Community Hospital to determine if the hospital HVAC systems require balancing. The focus and results of this study are presented in Section 2.2.1.1. A related study conducted by the United States Army Environmental Hygiene Agency (AEHA) supports the findings of the Air Measurement Study conducted under this contract. The conclusions of AEHA study are briefly summarized in Section 7.2.1.2. Lastly, Section 7.2.1.3 presents recommendations for air balancing the hospital HVAC systems.

2.2.1.1. Air Measurement Study

An Air Measurement Study of the hospital HVAC systems was conducted in April, 1986. The reader is referred to Volume IV, Air Measurement Study, of the main document for the complete data and results of this study. The study involved measuring and recording air handler equipment running data for twenty-three (23) supply air fans and twenty-three (23) return air fans, plus the supply and exhaust fans for the heat recovery system. The running data included volts, amps for each phase, motor rpm, and pressure profile (total pressure, static pressure across coils) at a given air flow. Duct traverse air measurements to determine total supply air flow and return air flow of the twenty-three (23) air handlers, plus supply and exhaust air flows of the heat recovery system were also conducted. Total air flows were measured during thermostat calls for full cooling. In dual duct systems, measurements were made in both the cold and hot ducts during the call for full cooling. Air flow measurements were also conducted at supply air diffusers and/or mixing boxes. The measurements were based upon a sample of a minimum of twenty percent (20%) of each of the twenty-three (23) supply air handlers. These data are used to substantiate air balance problems.

The traverses of the duct systems and static pressure readings for each of the air handling units were performed using an electronic digital micro-manometer manufactured by Neotronics and a pitot tube manufactured by Dwyer Instruments. The supply air diffuser flows were measured with a Shortridge Flowhood. The low velocity grid was inserted in the hood and the calibration factor for the hood was established by pitot tube traverse at the jobsite. All amperage readings were taken with a digital ammeter manufactured by Amprobe. Rpm readings were taken with a Jaquet No. 2301 rpm counter.

Table 2.2.1 summarizes the results of the air flow measurements of the air handler systems. This table lists the supply and return air flow result in relation to design conditions. The percent low or high when compared to design air flows is indicated for each system. Comments regarding noted system deficiencies are also listed.

As can be seen in Table 2.2.1, over seventy-five percent (75%) of the supply and return air delivery rates are lower than design air flows. The remaining twenty-five percent (25%) are either at design or are higher than design air flowrates. The low air flows average thirty percent (30%) below design levels and are as much as sixty to seventy percent (60-70%) low for some fans. The majority of the air outlet measurements, that provided samples of each air handler's supply diffusers, also showed low air flows. These results are presented in detail in Volume IV of this document.

The measured air flows at supply and return fans, and at room supply air diffusers vary considerably from design air flows. Most air flows are well below design levels causing human comfort problems, as well as inadequate ventilation. These results clearly show the need for complete HVAC distribution system air balancing.

TABLE 2.2.1
AIR MEASUREMENT STUDY RESULTS

SYSTEM	FAN (a)	AIR MEASUREMENT RESULT PERCENT LOW	AIR MEASUREMENT RESULT PERCENT HIGH	COMMENTS
GC-1	S	20	-	
	R	NM(b)	NM	1. Motor starter relay will not stay engaged
GC-2	S	50	-	1. Actuator controlling the inlet vanes is not working properly. Linkage is binding.
	R	44	-	1. Fan discharge static pressure is -1.40.
GD-1	S	32	-	1. Outside air not set properly.
	R	-	15	1. Fan discharge static pressure negative because outside air requirements are not set properly in air handling unit. 2. Actuator on minimum outside air damper is in a bind.
GD 2	S	18	-	
	R	22	-	1 Linkage on outside air damper is disconnected.
GD-3	S	-	32	
	R	-	13	
GE-1	S	55	-	
	R	21	-	
GE-2	S	10	-	
	R	25	-	1. Discharge static pressure is -0.05.
GE-3	S	20	-	1. All four belts need to be replaced.
	R	45	-	1. Fan discharge static pressure is -3.0. 2. Inlet vanes do not operate properly.
1A-1	S	5	-	
	R	18	-	1. Fan discharge pressure is -0.15.
1D-1	S	-	7	
	R	-	30	1. Fan discharge pressure is -2.10. 2 Outside air is not properly set.
2C-1	S	-	22	
	R	23	-	1. Terminals TU-2C-G and TU-2C-4 which are connected to the return system do not operate properly (serves operating rooms 1 and 2, respectively).
2C-2	S	-	17	
	R	29	-	1. Terminal TU-2C-10 serving return air system does not operate properly (serves cystoscopy room).
2C-3	S	11	-	
	R	10	-	1 Fan discharge pressure is -0.06.
2E 1	S	45	-	
	R	60	-	1. Inlet vanes do not operate properly
2E-2	S	44	-	
	R	35	-	1. Fan discharge pressure is -0.12.

a S = Supply Fan; R = Return Fan; E = Exhaust Fan
b. NM = No Measurement.

TABLE 2.2.1 (Continued)
AIR MEASUREMENT STUDY RESULTS

SYSTEM	FAN (a)	AIR MEASUREMENT RESULT PERCENT LOW	AIR MEASUREMENT RESULT PERCENT HIGH	COMMENTS
2E-3	S	33	-	
	R	58	-	1. Fan discharge pressure is -0.20.
2F-1	S	-	24	1. Bypass dust is not operating properly (By passing 81% of system air flow in full cooling mode).
	R	35	-	
3B-1	S	-	4	1. One belt is missing and the other two are loose.
	R	-	38	1. Fan discharge pressure is -0.235.
3B-2	S	13	-	1. Zones 3B-2-1 and 3B-2-9 actuator rods are not connected to swing arm in constant volume boxes. 2. Zone 3B-2-8 actuator not operating properly.
	R	5	-	1. Fan discharge pressure is -0.95.
3B-3	S	27	-	1. Maximum outside air dampers are leaking. 2. Constant volume box serving outside air damper motors, from heat recovery system are not operative; box is in a fully closed position.
	R	70	-	1. Static pressure readings across the air monitoring station indicate that the straightening grid is clogged.
[illegible]-1	S	8	-	
	R	18	-	1. Excess air on return fan is being forced out of the exhaust/relief.
P-2A	S	32	-	1. Outside air not set properly, at zero ventilation flow.
	R	38	-	1. Fan discharge pressure is -3.5. 2. Canvas connection on discharge of fan is torn.
P-3A	S	24	-	
	R	0	0	1. Flow at design levels.
SF38-1	S	63	-	
EF33-1	E	23	-	1. Actuator leakage; has been hooked and vanes locked into place with a bolt.
SF38-2	S	NM	NM	1. Inlet vanes not operative.
EF38-2	E	NM	NM	1. Needs new belts; would not run.

a. S = Supply Fan; R = Return Fan; E = Exhaust Fan
b. NM = No Measurement

In addition to air flow measurement results, the Air Measurement Study identifies numerous HVAC control system problems. The most significant of these problems which apply to many of the systems are:

- Thermostats are out of calibration and several are inoperable. Also, some of the springs that hold the thermostat to the mounting base are distorted such that they no longer hold the thermostat.

- The air handler receiver controllers located in Mechanical Room 3B blew a stream of oil out of the bleed port during the tests. Other panels also appear to have oil in the controls.

- Many of the outside ventilation air control systems were either inoperative or were not set properly. For example, outside air damper linkages were found disconnected or in a bind. These situations cause a serious lack of ventilation air.

- The controls serving the fan inlet vanes on the air handling units do not control static pressure properly, or the air handling unit and return fan vortex damper did not track properly. In some cases the controllers were "hunting".

The individual problems noted for each air handler are identified in Table 2.2.1.

The above system deficiencies and those listed in Table 2.2.1 are not only detrimental to the building comfort conditions, but also create significant health hazards. The absence of properly balanced air flows and the low air flow conditions cause improper air changes in the various hospital use areas and disrupt the proper pressure balance between adjacent areas. The outside air system control problems cause inadequate ventilation air. These deficiencies verifiably support the conclusion that Darnall Army Community Hospital is not in compliance with ETL 1110-3-344, Interior Mechanical Design Conditions for Medical Facilities, 4 October, 1983. These system inadequacies should be repaired immediately.

2.2 1.2 <u>Environmental Hygiene Agency</u>

In early November, 1985 the U.S. Army Environmental Hygiene Agency evaluated selected ventilation systems at Darnall Army Community Hospital. This study conducted air flow measurements of specific critical hospital areas including: nuclear medicine, operating surgery/delivery rooms, pathology, and radiology/autopsy.

The results of this study directly support the findings of the Air Measurement Study. The majority of the above areas did not meet minimum ventilation requirements and were lower than design specifications. Also, improper pressure balance situations between adjacent spaces were also found, as well as control system deficiencies. The final recommendations of the study are to rebalance the ventilation systems and to maintain or replace malfunctioning controls. These conclusions coincide with the Air Measurement Study recommendations.

2.2.1.3 Recommendations

Based upon the Air Measurement Study and the Environmental Hygiene Agency study results, the HVAC distribution recommendations are summarized. The hospital HVAC systems are currently providing inadequate air flows and ventilation air. Additionally, the air flows vary considerably from area to area and rarely match design conditions. This situation not only causes human comfort problems but also poses significant health problems due to the lack of ventilation air and due to improper air pressure balances between spaces. Consequently, all the hospital HVAC distribution systems must be air balanced to provide proper air flows, ventilation, and pressure balances.

Additionally, HVAC control systems are in poor condition and must be repaired and calibrated to provide proper HVAC control. This recommendation is presented separately below and must be implemented to achieve effective air balance results.

2.2.2 Regularly Service/Calibrate HVAC Equipment

The HVAC control systems at Darnall Army Community Hospital are in a state of disrepair. The existing control system deficiencies are addressed in detail in Section 2.2.3.2 (Tables 2.2.7, 2.2.8, 2.2.8A, and 2.2.9) of the Main Report and above as a result of the Air Measurement Study. This equipment must be serviced to bring all control components back into proper operating condition. The HVAC controls servicing includes calibration, adjustment, and repair/replacement, as needed, of all room thermostats and humidistats; all air handler terminal unit controls; and, all air handler controls including temperature, humidity, pressure, and flow sensors, control valves, receiver controllers, and damper controls and linkages.

A one time repair of the HVAC controls is addressed in the ECO titled "Repair, Calibrate, and Adjust HVAC Controls". The total cost to implement this project is $35,036. This one time cost will bring all control systems back into proper and efficient operating condition.

The implementation of this ECO alone will, however, not insure that these systems remain in proper operating conditions. It is essential that these systems be maintained on a continuing basis to insure energy efficient operation, and to insure that the energy savings projected in the above ECO and other ECO's recommended in this study are realized for years to come. For these reasons, an annual cost to maintain these systems is included in the economic analysis of the above ECO. This annual cost is estimated at $36,021.

Consequently, the hospital HVAC systems must be regularly serviced and calibrated by building maintenance personnel or by an outside controls contractor. The best way to accomplish this is to institute a preventative maintenance system, manual or computerized, to insure that equipment is serviced in a timely manner. The importance of this recommendation cannot be stressed enough. Continued maintenance of these control systems is essential to efficient building operation.

2.2.3 HVAC Maintenance Personnel Training

In order to implement the above recommendations associated with a preventative maintenance system, it is apparent that additional training of maintenance personnel is necessary. One of the primary reasons the HVAC systems are in poor operating condition is the lack of maintenance personnel knowledge of the operation and maintenance of the hospital systems.

The hospital HVAC systems are not simple systems. They are, however, excellent state-of-the-art HVAC systems. These systems provide excellent control capabilities and have excellent energy efficient characteristics. If properly maintained, these systems will provide good human comfort conditions in an energy efficient manner.

The training of both maintenance management personnel and HVAC maintenance personnel is highly recommended. HVAC controls courses which address state-of-the-art control operation and maintenance, and new technologies are suggested. This training will insure the proper maintenance of these systems and energy efficient operation. Recommended courses which are part of the Army PROSPECT program include:

- Energy Conservation in Existing Buildings
  Course No. P3MECB   Duration: 38 Hours   Cost: $605
- Energy Conservation in New Buildings
  Course No. P3MECP   Duration: 38 Hours   Cost: $605
- Mechanical Inspection
  Course No. T1MMIN   Duration: 40 Hours   Cost: $330
- Refrigeration and Air Conditioning Inspection
  Course No. T1MRACIN   Duration: 40 Hours   Cost: $335
- HVAC and Refrigeration System Inspection
  Course No. P3MHRSI   Duration: 40 Hours   Cost: $595

Lastly, specialized courses are offered by the major controls companies (Barber-Colman, Honeywell, Johnson, and York). These can generally be arranged on the Fort Hood area. Contacts for these courses are shown below. Personnel should seek out the particular area of HVAC controls in which they are deficient and take course offered by these companies.

- Barber-Colman
  Barber-Colman Training Center
  Energy Management Group
  555 Colman Center Drive
  Rockford, IL 61125-7040
  (815) 397-7400
- Honeywell
  Building Services Division
  Customer Training Services
  1111 West Mockingbird Lane
  Dallas, TX 75247
  (214) 482-7600
  Contact: Jonny Hills

- o Johnson

  Johnson Controls, Inc.
  Training Institute/M45
  507 East Michigan Street
  Milwaukee, WI 53202
  1-(800)-558-9950 Ext. 4112

- o York

  York Institute of Air Conditioning and Refrigeration
  Borg Warner Air Conditioning, Inc.
  P. O. Box 1592
  York, PA 17405-1592
  (717) 771-6299

A second area of primary interest is the calibration, operation, and maintenance of the primary HVAC equipment. Training of the boiler and chiller operation personnel in state-of-the-art equipment, maintenance, operation, control systems, and new technology is essential to energy efficient performance of Darnall Army Community Hospital's equipment. Two courses are recommended to obtain boiler training. The first is offered by:

Dr. Dupree Maples
Boiler Efficiency Institute
P. O. Box 184308
Baton Rouge, LA 70893
(504) 388-5792

The second recommended course is titled "Boiler Control and Maintenance Seminar" and is offered by:

Hawman Consulting Energiste
1200 South Rock Boulevard
Sparks, NV 89431
(702) 356-8331

Contact Art Hawman for information on the three day, $400 course.

Chiller operation and maintenance classes are offered by Honeywell (see Lubbock, Texas address mentioned previously), Trane Air Conditioning, and Carrier Air Conditioning. Contacts are listed below:

Trane Air Conditioning
251 Commerce Circle
Sacramento, CA 95815
(916) 929-6600

Carrier Houston Company
P. O. Box 19308
7007 Katy Road
Houston, TX 77024
Contact: Larry Giroux

The Army PROSPECT courses also cover air conditioning and refrigeration information.

National organizations can also play an important role in education. They offer up-to-date information on new products, maintenance techniques and procedures, and notification of training seminars. They typically publish monthly magazine or journals. Affiliation with these societies is valuable.

Membership in association such as the following is highly advocated:

ASHRAE, Inc.
1791 Tullie Circle N.E.
Atlanta, GA 30329
(404) 636-8400

The Association of Energy Engineers
4025 Pleasantdale Road, Suite 340
Atlanta, GA 30340
(404) 447-5083

The Association of Professional Energy Managers
1 Market Plaza, Suite 3001
San Francisco, CA 94105
(415) 332-8055

Membership in national organizations typically includes a subscription to the group's magazine. Other informative journals should be acquired via publication subscription. Suggested periodicals with their 1987 contacts and prices include:

Energy User News
P. O. Box 402
Martinsville, NJ 08836
Attn: Circulation Department
1 (800) 447-4700
50 issues/Yr - $56

Piping/Heating/Air Conditioning
P. O. Box 95759
Cleveland, OH 44101
(312) 861-0880
12 issues/Yr - Free

Consulting Engineer
Circulation Department
Barrington, IL 60010
(312) 381-1840
12 issues/Yr - Free

Specifying Engineer
270 St. Paul Street
Denver, CO 80206
(303) 388-4511
13 issues/Yr - Free

Plumbing Engineer
135 Addison Avenue
Elmhurst, IL 60126
(312) 530-6161
12 issues/Yr - Free to Government Officials

Power
P. O. Box 2031
Mahopec, NY 10541
(914) 628-0108
12 issues/Yr - $16

Subscriptions to periodicals are a good cornerstone for building a reference library. Literature should be collected and organized by maintenance trade. Along with journals, the reference library should contain company publications, books, equipment data and other relevant information. The value of such a library cannot be stressed enough, and immediate action is suggested.

2.2.4 Energy Monitoring and Control System (EMCS)

The maintenance problems and personnel training issues presented for the HVAC control systems also apply to the EMCS. A one time repair, adjustment, and recalibration cost for the EMCS is included in the ECO titled "Expansion of the Existing EMCS". The analysis of this ECO also includes annual maintenance costs. Again, maintenance of these systems is essential to the proper and efficient operation of the EMCS.

The EMCS Master Control Room (MCR) equipment is currently located in an easily accessible and dirty environment. All MCR equipment should be located in a clean, isolated environment with a devoted air conditioning system. This will improve EMCS performance by reducing downtime caused by improper temperature and cleanliness conditions.

As with the HVAC control system the importance of a preventative maintenance system and trained EMCS operators cannot be stressed enough. Identical recommendations for training are applicable to the EMCS and are outlined in Section 2.2.3.

2.2.5 Medical Facility Building No. 36001

HVAC and general maintenance of mechanical systems is also crucial to attaining and maintaining projected energy savings for Building No. 36001. A dedicated program to train personnel to regularly service and calibrate equipment is highly recommended. As with the hospital, the importance of this recommendation cannot be stressed highly enough.

There is one recommendation specific to Building No. 36001. The supply room was cluttered at the time of the field investigation, and the radiators in the room were obscured. They should be cleared as soon as possible, before the next heating season begins.

2.3 No Cost/Low Cost Projects

Section 2.3 presents the No Cost/Low Cost ECO's recommended as projects for implementation by Darnall Army Community Hospital and by Building No. 36001, both at Fort Hood. The projects are characterized by requiring minimal or no capital investment, a quick return on any investment required, and immediate implementation by the facility engineer and personnel.

Ten (10) No Cost/Low Cost projects are recommended for immediate implementation at Darnall Army Community Hospital, and four (4) are recommended for Building No. 36001. The projects are structured so that local funding can be appropriated by the facilities. These projects are discussed in Sections 2.3.1 through 2.3.14, and summarized in Section 2.3.15. Modifications are recommended for lighting systems, for the envelope, the domestic hot water systems, the HVAC systems and controls, and for special facilities such as laundry dryers and elevators.

2.3.1 Lower Domestic Hot Water (DHW) Temperature - Darnall

This project recommends lowering the DHW temperature setpoint from 120°F to 112°F. Savings occur due to reduced standby heat losses from the tank and pipes, which are directly proportional to the setpoint.

The project r[illegible]ires an investment of $40, and saves 530.4 MBtu/Yr of natural gas. The cor[illegible]ponding dollar savings are $1,973/Yr. The SIR is 825.36 and the simple payback is 0.02 years, or approximately one week.

2.3.2 Utilize Existing Exhaust Air Heat Recovery System - Darnall

This project recommends turning on the exhaust air heat recovery system. Savings result by transferring heating or cooling energy from the exhaust air to the incoming air, rather than exhausting it.

The project costs $34, and saves 250.1 MBtu/Yr of electricity or $735. The SIR is 243.26 and the simple payback is 0.04 years.

2.3.3 Reinstate Automatic Control Functions of Energy Management Control System - Darnall

This project recommends using the EMCS to shutdown appropriate air handler units during unoccupied periods, and implementing morning warm up, conditioning an area without introducing (and conditioning) outside air.

The implementation cost is $2,741. The energy savings are 5,684.2 MBtu/Yr of electricity, and 2,631.4 MBtu/Yr of natural gas. The total savings are 8,315.6 MBtu/Yr and the equivalent $26,499/Yr. Increased costs of $840/Yr result in annual savings of $25,659. The SIR is 126.15 and the simple payback is 0.10 years.

2.3.4 Repair Existing Solar Domestic Water Heating System - Darnall

This project recommends repairing and recalibrating the solar domestic water heating system controls. Correct operation will result, so that the solar system will produce hot water that would otherwise be provided by the hot water generators.

Project implementation requires $1,322 and saves $10,378/Yr. Energy savings include 665.0 MBtu/Yr of electricity and 2,264.4 MBtu/Yr of natural gas, totalling 2,929.4 MBtu/Yr. The SIR is 82.37, and the simple payback is 0.11 years.

2.3.5 Reduce Steam Distribution Pressure - Darnall

This project recommends lowering the steam temperature setpoint from 328°F (100 PSI) to 303°F (70 PSI). Savings result from reduced standby heat losses.

The project's cost is $40. Savings are 29.3 MBtu/Yr of natural gas, and the corresponding $108/Yr. The SIR is 45.17 and the simple payback is 0.33 years.

2.3.6 Shutdown Elevators at Night - Darnall

This project recommends night shutdown of three (3) elevators, for eight (8) hours each night. Electricity savings will result.

The project requires a $551 investment, which will save $904/Yr by saving 307.8 MBtu/Yr of electricity. The SIR is 18.70 and the simple payback is 0.55 years.

2.3.7 Install Shower Flow Restrictors - Darnall

This project recommends installing shower flow restrictors to reduce hot water consumption. Natural gas savings result.

$2,692 is needed for implementation, and will save $1,818/Yr. The energy savings are 488.9 MBtu/Yr of natural gas. The SIR is 11.30 and the simple payback is 1.33 years.

2.3.8 Provide Motion Detector Control of Selected Interior Lights - Darnall

This project recommends installing motion detectors in the second floor medical library to control lighting. Electricity savings will result form reduced hours of lighting.

The project requires $882 to implement, and save $271/Yr. There are $228/Yr savings from the 77.8 MBtu/Yr electricity savings, and $43 savings from reduced lamp replacement. The SIR is 2.55 and the simple payback is 2.93 years.

2.3.9 Install Motion Detectors on Rest Room Lights - Darnell

This project recommends installing motion detectors on the rest room lights. Electricity savings will result from reduced lighting hours, and reduced air cooling demands. An increase in heating energy consumption will occur.

The project costs $2,688 to implement. Electricity savings are 171.7 MBtu/Yr. The annual energy dollar savings are $504. Non energy savings from less frequent lamp replacement is $181/Yr, resulting in total annual savings of $685. The SIR is 2.82 and the simple payback if 3.53 years.

2.3.10 Weatherstrip Exterior Doors - Darnall

This project recommends sealing air spaces around the entrance doors. This will reduce the infiltration rate and thereby reduce the energy consumed conditioning the air.

The project requires an investment of $387, and will save $68/Yr. Energy savings are 0.3 MBtu/Yr of electricity and 18.4 MBtu/Yr of natural gas, totalling 18.7 MBtu/Yr. The SIR is 1.92 and the simple payback is 5.13 years.

2.3.11 Lower Domestic Hot Water (DHW) Temperature - Building No. 36001

This project recommends lowering the DHW temperature setpoint from 130°F to 115°F. Savings result from reduced standby heat losses from the tank and pipes.

The implementation cost is $14. The project saves 48.0 MBtu/Yr, corresponding to $178/Yr. The SIR is 206.15, and the simple payback is 0.07 years.

2.3.12 Install Shower Flow Restrictors - Building No. 36001

This project recommends installing shower flow restrictors to reduce hot water consumption. Natural gas savings result.

The project requires $694 to implement, and saves 90.2 MBtu/Yr of natural gas. The cost savings are $335/Yr. The SIR is 8.07 and the simple payback is 1.87 years.

2.3.13 Revise Efficient HVAC Controls Operation - Building No. 36001

This project recommends reconnecting the night setback and ambient lockout control functions to prevent unnecessary or excessive conditioning.

The $4,500 cost will result in 856.2 MBtu/Yr electricity savings and 1,613.5 MBtu/Yr natural gas savings. The total cost savings are $8,519/Yr. The SIR is 28.69 and the simple payback is 0.48 years.

2.3.14 Insulate Domestic Hot Water (DHW) Pipes - Building No. 36001

This project recommends insulating applicable hot water pipes, reducing natural gas consumption by lowering heat loss from the pipes.

The cost is $52.00, and the project saves 2.5 MBtu/Yr of natural gas. The dollar savings are $9/Yr. The SIR is 2.87 and the simple payback is 5.22 years.

2.3.15 No Cost/Low Cost Project Summary

The analyses results for the No Cost/Low Cost projects are shown in Table 2.3.1. The table includes energy and dollar savings, implementation costs, SIR's and simple paybacks. Subtotals are presented for Darnall Army Community Hospital's total No Cost/Low Cost projects and for Building No. 36001's total.

It will cost $11,377 to implement all of the No Cost/Low Cost projects for Darnall Army Community Hospital. The electricity savings are 7,156.9 MBtu/Yr, and the natural gas savings are 5,937.8 MBtu/Yr. The annual dollar savings from all the projects are $42,506. The cumulative SIR is 48.09 and the simple payback is 0.24 years.

The total implementation cost for the No Cost/Low Cost projects for Building No. 36001 is $5,260. There are 856.2 MBtu/Yr electricity savings and 1,754.2 MBtu/Yr natural gas savings, and the corresponding $9,041. The cumulative SIR is 26.21, and the simple payback is 0.52 years.

2.4 Quick Return on Investment Projects (QRIP)

This section presents the two (2) QRIP projects recommended for implementation at Darnall Army Community Hospital. There are no QRIP projects for Building No. 36001. The projects require implementation investments of less than $100,000 and must amortize in two (2) years or less.

2.4.1 Reduce Lighting Levels - Darnall

This project recommends reducing lighting levels in overlit areas of the hospital by either delamping or installing power reducers. The total cost of this project is $64,348. 12,041.5 MBtu/Yr of electricity are saved, while 911.6 MBtu/Yr more natural gas is consumed. The net 11,129.9 MBtu/Yr reduced consumption saves $32,010. Additional savings from reduced lamp replacement are $4,972/Yr. The annual savings are $36,982. The SIR is 8.35, and the simple payback is 1.57 years.

2.4.2 Install Variable Frequency Drive on Chilled Water Pumps - Darnall

This project recommends installing variable frequency drive on the chilled water pumps so that the flow rate varies according to the cooling load. This control method reduces electricity consumption of the pump 4,852.6 MBtu/Yr, saving $14,266 annually. The implementation cost is $26,365, resulting in an SIR of 4.55 and a simple payback of 1.66 years.

2.5 OSD Productivity Investment Funding (OSD PIF)

No ECO's recommended for implementation at Darnall Army Community Hospital or Building No. 36001 are categorized as OSD PIF projects.

TABLE 2.3.1
NO COST/ LOW COST PROJECT SUMMARY
DARNALL ARMY COMMUNITY HOSPITAL
MEDICAL FACILITY, BUILDING NO. 36001

NO COST/LOW COST PROJECT	TOTAL COST ($)	ENERGY SAVINGS: ELECTRICITY SAVINGS (MBTU/YR)	ENERGY SAVINGS: NATURAL GAS SAVINGS (MBTU/YR)	ENERGY SAVINGS: FUEL OIL COSTS (MBTU/YR)	ENERGY SAVINGS: TOTAL SAVINGS (MBTU/YR)	ANNUAL ENERGY COST SAVINGS ($/YR)	NON-ENERGY SAVINGS: ANNUAL RECURRING ($)	NON-ENERGY SAVINGS: NON-RECURRING ($)	FIRST YEAR DOLLAR SAVINGS ($/YR)	SAVINGS TO INVESTMENT RATIO (SIR)	SIMPLE PAYBACK (YR)	ANALYSIS PERIOD (YR)
DARNALL ARMY COMMUNITY HOSPITAL												
LOWER DOMESTIC HOT WATER TEMPERATURE	40	0.0	530.4	0.0	530.4	1,973	0	0	1,973	825.36	0.02	15
UTILIZE EXISTING EXHAUST AIR HEAT RECOVERY SYSTEM	38	250.1	0.0	0.0	250.1	735	0	0	735	293.26	0.04	15
REINSTATE AUTOMATIC CONTROL FUNCTION OF EMCS	2,701	5,604.2	2,630.4	0.0	8,315.6	26,399	(840)	0	25,659	126.15	0.10	15
REPAIR EXISTING SOLAR DOMESTIC WATER HEATING SYSTEM	1,322	665.0	2,264.4	0.0	2,929.4	10,370	0	0	10,370	82.37	0.11	20
REDUCE STEAM DISTRIBUTION PRESSURE	40	0.0	29.3	0.0	29.3	100	0	0	100	45.13	0.33	15
SHUTDOWN ELEVATORS AT NIGHT	551	307.8	0.0	0.0	307.8	904	0	0	904	18.70	0.55	15
INSTALL SHOWER FLOW RESTRICTORS	2,617	0.0	486.5	0.0	486.5	1,810	0	0	1,810	11.30	1.31	15
PROVIDE MOTION DETECTOR CONTROL OF SEL. INTERIOR LGTS	802	77.3	0.0	0.0	77.3	228	43	0	271	2.55	2.93	10
INSTALL MOTION DETECTORS ON REST ROOM LIGHTS	2,500	171.7	0.0	0.0	171.7	504	101	0	605	2.82	1.53	15
WEATHERSTRIP EXTERIOR DOORS	307	0.3	18.4	0.0	18.7	68	0	0	68	1.92	5.13	20
DARNALL PROJECT TOTALS	11,377	7,156.9	5,962.8	0.0	13,119.7	43,215	(616)	0	42,599	68.27	0.26	NA
MEDICAL FACILITY, BUILDING NO. 36001												
LOWER DOMESTIC HOT WATER (DHW) SETPOINT	10	0.0	40.0	0.0	40.0	170	0	0	170	207.15	0.07	15
REVISE EFFICIENT HVAC CONTROLS OPERATION	4,500	856.2	1,613.5	0.0	2,469.7	8,519	0	0	8,519	[illegible]	0.48	15
INSTALL SHOWER FLOW RESTRICTORS	[illegible]	0.0	90.2	0.0	90.2	335	0	0	335	8.07	[illegible]	15
INSULATE DOMESTIC HOT WATER PIPES	52	0.0	2.5	0.0	2.5	9	0	0	9	2.87	5.22	15
BUILDING NO. 36001 PROJECT TOTALS	[illegible]	856	1,754	0	2,610.4	9,041	0	0	9,041	25.21	0.52	NA

2.6 Productivity Enhancing Capital Investment Program (PECIP)

This section presents the two PECIP projects recommended for implementation at Darnall Army Community Hospital. There are no PECIP projects for Building No. 36001. The PECIP program funds projects that cost more than $3,000 and amortize in four (4) years of less.

2.6.1 Repair, Calibrate, and Adjust HVAC Controls - Darnall

This project recommends reducing outside air quantities to standard levels, resetting interior space thermostats to 73°F, resetting preheat temperature setpoints to 55°F, returning dual duct system hot deck controls to design conditions, and returning supply air temperature setpoints to design levels. The implementation cost is $55,036, and annual maintenance costs are $36,021. Electricity consumption is reduced 8,626.7 MBtu/Yr and natural gas consumption is reduced 9,116.1 MBtu/Yr saving $59,273. The annual savings are $23,252, the SIR is 8.94, and the simple payback is 2.13 years.

2.6.2 Provide Variable Frequency Drive Control at Variable Air Volume Fan Motors - Darnall

This project recommends installing variable frequency drive control on the variable air volume fan motors. The motors typically run in the 40%-70% CFM range, where there is greatly reduced consumption using variable frequency drive rather than the existing inlet vane control. The cost is $27,828. Savings are 3,692.8 MBtu/Yr of electricity, while increasing natural gas consumption 15.4 MBtu/Yr. The annual cost savings are $10,798, the SIR is 4.41 and the simple payback is 2.32 years.

2.7 Other Projects

This section presence other feasible non-ECIP projects which have not yet been categorized. There are three (3) projects for Darnall Army Community Hospital, and four (4) for Medical Facility Building No. 36001.

2.7.1 Provide Boiler Stack Heat Recovery to Preheat Feed Water - Darnall

This project recommends transferring heat from the boiler exhaust gases to the feed water using a stack heat recovery system on the three (3) boilers. The implementation cost is $19,628, and the project saves 1,005.4 MBtu/Yr. The annual cost savings of $3,740 result in an SIR Of 3.19 and a simple payback of 4.72 years.

2.7.2 Reclaim Heat From Kitchen Exhaust Air - Darnall

This project recommends reclaiming heat from the kitchen exhaust air, using a "run around cycle system" to preheat incoming supply air. Nine (9) air to liquid heat exchangers and an ethylene glycol circulation loop are required.

The cost is $34,673 and will reduce natural gas consumption by 787.2 MBtu/Yr. The cost savings of $2,938 result in an SIR of 1.41 and a simple payback of 10.66 years.

2.7.3 Replace Incandescent Lamps With Screw-In Fluorescent Lamps - Darnall

This project recommends the replacement of incandescent lamps with high efficiency flourescent lamps. Electricity savings result.

$21,258 is the total construction cost, and the project saves 688.2 MBtu/Yr of electricity, but increases natural gas (heating) consumption by 100.4 MBtu/Yr. The net energy savings are 578.8 MBtu/Yr, corresponding to $1,649/Yr. Non energy savings/costs arise from changes in lamp replacement costs and schedules. The non-energy savings are $1,806/Yr, for total annual dollar savings of $3,455. The SIR is 1.05. The simple payback is 5.54 years. For MCA funding the SIR is 1.65.

2.7.4 Install Automatic Valves on Fan Coil Units - Building No. 36001

This project recommends installing automatic valves on the fan coil units to prevent hot water flow through the units when there is no heating demand. The necessary investment is $11,127 and will save 37.7 MBtu/Yr of electricity and 301.2 MBtu/Yr of natural gas. The annual savings are $1,230/Yr with a resultant SIR of 1.80 and a simple payback of 8.14 years.

2.7.5 Provide Laundry Dryer With Electronic Ignition - Building No. 36001

This project proposes replacing the laundry dryer's flame pilot light with an electronic ignition unit. The unit costs $287 and saves 7.0 MBtu/Yr of natural gas. The $26/Yr savings results in an SIR of 1.51 and a simple payback of 9.96 years.

2.7.6 Install High Efficiency Boiler - Building No. 36001

This project proposes installing a high efficiency modular boiler system to replace the existing old, inefficient boiler. The $38,140 cost saves 974.6 MBtu/Yr of natural gas. The energy cost savings are $3,439/Yr. Water conditioners cost $35/Yr, so the annual savings are $3,404. The SIR is 1.50 and the simple payback is 10.08 years.

2.7.7. Provide Thermostat Control of Entry-Way Radiators - Building No. 36001

This project proposes providing thermostat control of the entry-way radiators. They currently operate twenty four (24) hours per day during the heating season. The $1,299 implementation cost will provide 6.8 MBtu/Yr of electricity, and 19.0 MBtu/Yr of natural gas. The 25.8 MBtu/Yr energy savings correspond to $89/Yr. The SIR is 1.07 and the simple payback is 13.15 years.

2.8 Energy Conservation Investment Program (ECIP)

This section presents the Darnall Army Community Hospital's group of ECO's that are classified as an ECIP project. To qualify for the ECIP, the project's total capital investment must exceed $200,000 and the project must exhibit an SIR greater than one (1.00).

2.8.1 HVAC Modification - Darnall

This ECIP project combines three (3) ECO's into one package. Each ECO has an SIR greater than one (1.00) and is highly recommended for implementation. The following sections present a discussion of each ECO in this ECIP project.

2.8.1.1 Install a Small Boiler

This ECO recommends installing a five (5) MBtu/Hr boiler at the hospital. The existing boilers are each 10 MBtu/Hr boilers. The average load on the boilers is considerably less than the capacity of any one existing boiler, so the smaller boiler will operate more efficiently. The new boiler costs $74,620. Energy savings include 932.1 MBtu/Hr of electricity and 3,776.9 MBtu/Hr of natural gas. The dollar savings are $16,790/Yr. The SIR is 3.57 and the simple payback is 4.00 years. With a SIR of 4.00 the project can be considered for PECIP funding.

2.8.1.2 Existing Energy Monitoring and Control System (EMCS) Expansion

This ECO recommends expansion of the existing EMCS to control the HVAC systems. The measures include:

1. Implementing hot deck/cold deck reset based on controlling the temperatures in proportion to the zone demand rather than being set constant or based on outside air temperature.

2. Resetting the hot water supply temperature so the temperature can be reduced when the demand is low, reducing losses.

3. Duty cycling the noncritical HVAC equipment for five (5) minutes out of each operating hour.

4. Repairing, recalibrating and maintaining the existing EMCS.

This ECO can be implemented for $124,262 and saves 12,300.3 MBtu/Yr. The cost savings are $15,511 annually. The resulting SIR is 2.33 and the simple payback is 7.21 years.

2.8.1.3 Install High Efficiency Motors

This project recommends replacing standard efficiency supply, return and exhaust fan motors in the hospital with high efficiency models. The ECO costs $39,852 to implement, and will save $1,838.4 MBtu/Yr. The annual cost savings are $5,404, the SIR is 1.54, and the simple payback is 6.64 years.

2.8.1.4 HVAC Modification Summary

The ECIP project, HVAC Modification, combines the three (3) ECO's discussed above. Upon implementation of the entire ECIP project, significant reductions in energy consumption and costs will be realized. Table 7.8.1 summarizes the results. With a combined implementation cost of $238,774, the entire project reduces annual energy consumption by $18,847.7 MBtu/Yr. This corresponds to $61,597/Yr. Non-energy costs of $23,892/Yr are required, resulting in annual savings of $37,705. The SIR is 2.59 and the cumulative simple payback is 5.70 years.

Table 2.8.1

HVAC Modification Summary

ECO	COST ($)	ENERGY SAVINGS (MBTU/YR)	DOLLAR SAVINGS ($/YR)	SIR	SIMPLE PAYBACK (YEAR)
Install a Small Boiler	74,620	4,709.0	16,790	3.57	4.00
Existing EMCS Expansion	124,262	12,300.3	15,511	2.33	7.21
Install High Efficiency Motors	39,892	1,838.4	5,404	1.54	6.64
TOTAL	238,774	18,847.7	37,705	2.59	5.70

2.9 ECO's Suggested for Further Study

No ECO's were suggested for further study of Darnall Army Community Hospital or Medical Facility Building No. 36001.

2.10 Non-Feasible ECO's

During the ECO analysis process of this study, some ECO's are classified as non-feasible due to poor economics (SIR less than 1.0). The non-feasible projects are discussed in this section . There are fourteen (14) non-feasible ECO's for Darnall Army Community Hospital, and two (2) non-feasible ECO's for Building No. 36001.

2.10.1 Provide Cooling with Condenser Water - Darnall (Appendix G2.9)

The cost to provide free cooling by using the cooling towers is $88,331. The $6,475/Yr cost savings do not warrant its implementation, even though 2,232.5 MBtu/Yr would be saved. The SIR of 0.84 demonstrates the non-feasible classification of this project. The simple payback is 12.28 years.

2.10.2 Install Waste Heat Recovery Boiler - Darnall (Appendix G2.12)

The economic analysis for this ECO to install a waste heat recovery trash incinerator-boiler system reveals an SIR of 0.78 based on ECIP requirements. The measure therefore cannot be recommended. The implementation cost of $362,025 can be reduced, however, by using in-house personnel for installation. The energy savings of 3,398.2 MBtu/Yr ($12,641) could be increased by using trash generated at the the entire Fort Hood installation to provide steam to the hospital twenty-four (24) hours per day. The savings would be five fold, increasing the SIR to greater than four (4.00). With the SIR of 1.42, calculated in step 6 in the LCCA summary sheet, the project will be able to get funding from MCA.

2.10.3 Provide Photocell Control of Selected Interior Light - Darnall (Appendix G1.2)

The 84.3 MBtu/Yr energy savings and corresponding $240/Yr are insufficient to justify the $4,714 cost necessary to install photocell control of selected corridor lights. The SIR of 0.71 and the 13.34 year payback substantiate this ECO's infeasibility.

2.10.4 Install Reflective Film on Windows - Darnall (Appendix G2.2)

Installing reflective sun control films on the south, east and west exposed windows would cost $20,762. The 522.8 MBtu/Yr potential energy savings correspond to $1,576. This creates an SIR of 0.66 and an 11.86 year simple payback, so the savings are insufficient to justify the expenditure.

2.10.5 New Energy Monitoring and Control System (EMCS) - Darnall (Appendix G5)

Installation of a new EMCS would cost $675,039, and would save $28,826 annually. Although the savings are substantial, the cost is too high to recommend implementation. The SIR is just 0.65, and the simple payback is 21.08 years.

2.10.6 Provide Evaporative Precooling of Heat Recovery Exhaust Air - Darnall (Appendix G2.7)

Evaporative precooling of the exhaust air would decrease the temperature of the supply air that passes through the heat exchanger, reducing the cooling load on the A/C systems. 175.5 MBtu/Yr electricity savings would result, and the corresponding $515. The cost is $11,584 and is too high to result in economically feasible implementation. The SIR is 0.51 and the simple payback is 20.24 years.

2.10.7 Extend Main Entrance Vestibule - Darnall (Appendix G2.4.2)

Vestibules are expensive to install. An extension of the main entrance vestibule costs $30,413, and saves only $289 (80.0 MBtu) annually. Implementation is not recommended. The SIR of 0.24 and the simple payback of 94.71 substantiate the ECO's non-feasibility.

2.10.8 Install Vestibule on Women's Health Clinic Entrance - Darnall (Appendix G2.4.2)

This vestibule costs $15,883, half that of the main entrance extension, but saves much less (17.0 MBtu/Yr and $61/Yr). Implementation is not economical. The SIR of 0.10 and the simple payback of 234.34 years substantiates the ECO's non-feasibility.

2.10.9 Install Vestibule on OB/GYN Clinic Entrance - Darnall (Appendix G2.4.2)

This ECO costs $23,401 to implement. Electricity consumption increases 1.4 MBtu/Yr, and natural gas consumption decreases 6.7 MBtu/Yr. The $19/Yr savings are far too small to result in an implementation recommendation. The SIR 0.02 and the simple payback of greater than 1,000 years substantiates this.

2.10.10 Provide Reflective Roof Coating - Darnall (Appendix G2.3)

Reflective roof coating reduces the cooling load by 219.2 MBtu/Yr, but increases the heating load 127.7 MBtu/Yr. The net $169/Yr savings are insufficient to provide a recommendation to implement this ECO that costs $48,641. The SIR is 0.00 and the simple payback is 259.04 years.

2.10.11 Peak Shaving Using Emergency Generators - Darnall (Appendix G1.12)

This project costs $8,144 to implement, and saves $44,469/Yr. The simple payback is 0.16 years. The SIR is -242.1, because of a higher energy rate for fuel oil than electricity, and therefore is not feasible according to ECIP criteria. The project is very economical, however, and implementation using facility funds is highly recommended.

The project was re-evaluated and all calculations and back-up data are shown in Appendix G1.12.A. Using the "new information" for evaluation of the project, the ECO becomes very feasible, with a SIR of 110.72 and a simple payback of 0.06 years.

2.10.12 Repair Cooling Tower Controls - Darnall (Appendix G1.5)

Repairing the cooling tower controls to maintain condenser water temperature at 80°F results in a lower chiller C.O.P., and an increase in energy consumption. This project is therefore not recommended.

2.10.13 Reinstate Economizer Controls - Darnall (Appendix G1.9)

Reinstating economizer controls results in a net increase in energy consumption. This is attributed to a greater increase in heating energy consumption than a decrease in cooling energy consumption. This indicates that when the economizer is used (ambient temperature below 55°F) the building experiences a greater heating demand than designed for. The heating coils are undersized and cannot raise the hot deck temperature high enough from the 55°F economizer base to provide adequate heating. This ECO is not recommended.

2.10.14 Install Roof Insulation - Darnall (Appendix G2.5)

The cost to implement this ECO is $262,043. The payback for a similar project on a barracks at Fort Hood is about fifty (50) years. The savings at the hospital will be smaller or nil, and the ECO is therefore not recommended.

2.10.15 Weatherstrip Entrance Doors - Building No. 36001 (Appendix G3.3)

Weatherstripping the entrance doors would only cost $886, but the savings are minimal, only $24/Yr. The SIR of 0.29 and the simple payback of 33.25 years substantiate this ECO's infeasibility.

2.10.16 Install High Efficiency Pump Motors - Building No. 36001 (Appendix G3.1)

The six (6) motors considered for replacement all result in SIR's less than 1.00, and are therefore not recommended. The cumulative implementation cost is $3,190, but the savings are only $59. The savings are low because either the motors are small, or they run very infrequently. The cumulative SIR is 0.21, and the simple payback is 48.66 years.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Section 3 summarizes the results of the ESOS study conducted on Darnall Army Community Hospital and Medical Facility Building No. 36001. The impacts on annual energy consumption associated with each recommended ECO are presented. Recommendations are ranked in order of the Savings-to-Investment Ratio (SIR). Section 3.1 discusses Darnall Army Community Hospital, and Section 3.2 addresses Medical Facility Building No. 36001.

3.1 Darnall Army Community Hospital

This section presents a summary of recommended ECO's for Darnall Army Community Hospital. Table 3.1.1 lists each recommended ECO in order of decreasing Savings-to-Investment Ratio (SIR). The table delineates project cost, energy and cost savings, SIR, simple payback, project classification, program year and program year cost. The table shows that implementation of the twenty (20) ECO's requires an investment of $500,329. The hospital will reduce electricity consumption by 47,973.6 MBtu/Yr and natural gas consumption by 23,751.9 MBtu/Yr. These savings totaling 71,725.5 MBtu/Yr correspond to annual cost savings of $229,383. Non-energy costs resulting from the projects are $53,751, so the total annual savings are $175,632. The cumulative SIR is 5.16, and the simple payback is 2.56 years.

Figure 3.1.1 shows the impact of these savings in relation to the existing annual consumption. Electricity consumption is reduced from 169,130.8 MBtu/Yr to 121,157.2 MBtu/Yr, a 28.4% reduction. Natural gas consumption drops from 32,993.1 MBtu/Yr to 9,181.2 MBtu/Yr, a 72.0% reduction. There is a total energy use reduction of 71,725.5 MBtu/Yr, savings of 35.5%.

3.2 Medical Facility Building No. 36001

This section presents a summary of recommerded the ECO's for Medical Facility Building No. 36001. Table 3.2.1 lists each recommended ECO in order of decreasing Savings-to-Investment Ratio (SIR). The table delineates project cost, energy and cost savings, SIR, simple payback, project classification, program year and program year cost. The table shows that implementation of the eight (8) ECO's will require an investment of $[illegible]5,113. The facility will save 900.7 MBtu of electricity and 3,006.0 MBtu of natural gas annually. The 3,906.7 MBtu/Yr total energy savings correspond to $13,825 annually. The annual non-energy cost is $35, resulting in total annual savings of $13,790. The cumulative SIR is 3.86, and the simple payback is 3.66 years.

Figure 3.2.1 shows the impact of these savings in relation to the existing annual consumption. Electricity consumption is reduced from 3,714.7 MBtu/Yr to 2,814.0 MBtu/Yr, a 24.2% reduction. Natural gas consumption drops from 4,149.7 MBtu/Yr to 1,143.7 MBtu/Yr, a 72.4% reduction. The total energy use reduction is 3,906.7 MBtu/Yr, savings of 49.7%.

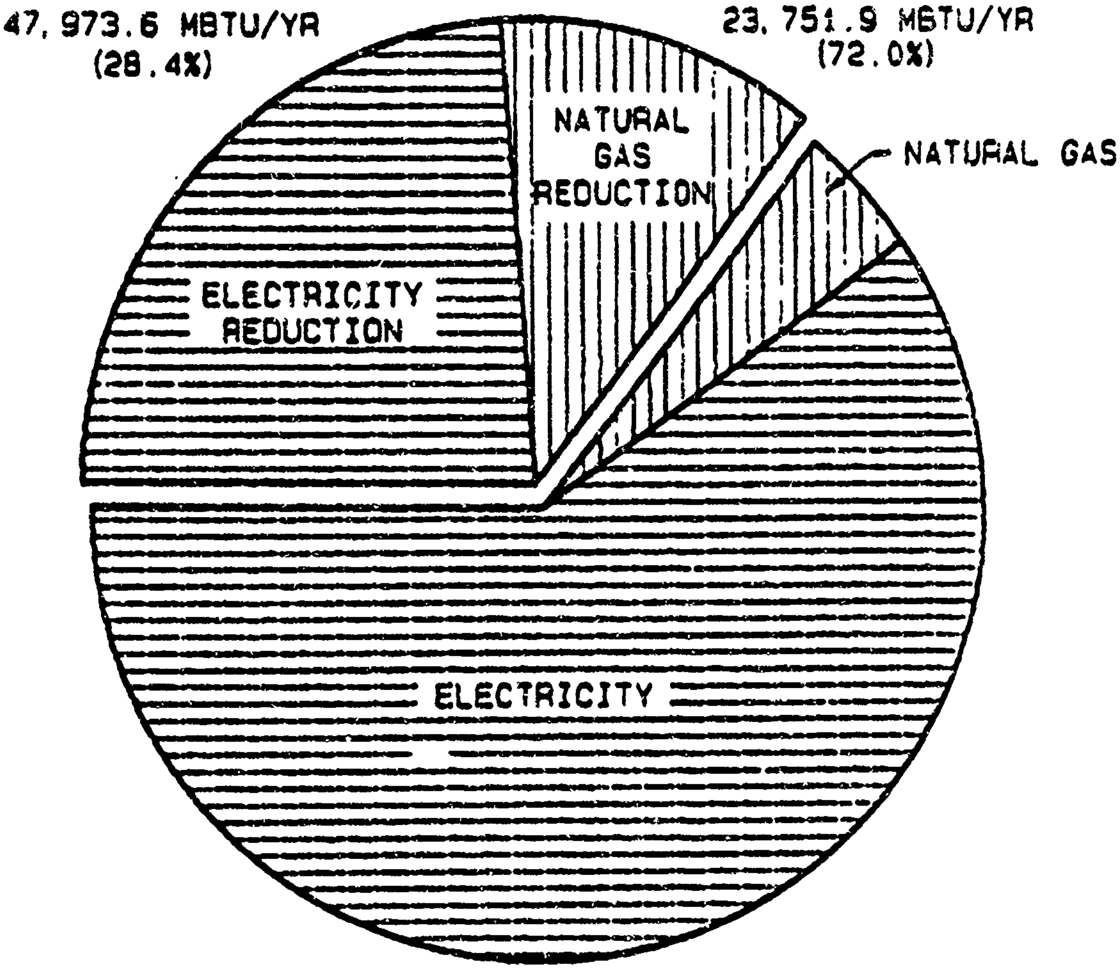
TABLE 3.1.1
ECO ANALYSIS SUMMARY
DARNALL ARMY COMMUNITY HOSPITAL
RECOMMENDED ECO'S

ECO	TOTAL COST ($)	ENERGY SAVINGS: ELECTRICITY SAVINGS (MBTU/YR)	ENERGY SAVINGS: NATURAL GAS SAVINGS (MBTU/YR)	ENERGY SAVINGS: TOTAL SAVINGS (MBTU/YR)	FIRST YEAR DOLLAR SAVINGS ($/YR)	SAVINGS TO INVESTMENT RATIO (SIR)	SIMPLE PAYBACK (YR)	PROJECT CLASSIFICATION	PROGRAM YEAR	PROGRAM YEAR COST ($)
LOWER DOMESTIC HOT WATER TEMPERATURE	40	0.0	530.4	530.4	1,973	825.36	0.02	NC/LC	(b)	(b)
UTILIZE EXISTING EXHAUST AIR HEAT RECOVERY SYSTEM	30	250.1	0.0	250.1	735	243.26	0.04	NC/LC	(b)	(b)
REINSTATE AUTOMATIC CONTROL FUNCTION OF EMCS	2,741	5,884.2	2,431.4	8,315.6	25,830	128.15	0.10	NC/LC	(b)	(b)
REPAIR EXISTING SOLAR DOMESTIC WATER HEATING SYSTEM	1,322	665.0	2,264.4	2,929.4	10,370	82.37	0.11	NC/LC	(b)	(b)
REDUCE STEAM DISTRIBUTION PRESSURE	40	0.0	29.3	29.3	108	45.17	0.33	NC/LC	(b)	(b)
SHUTDOWN ELEVATORS AT NIGHT	561	307.8	0.0	307.0	904	18.70	0.55	NC/LC	(b)	(b)
INSTALL SHOWER FLOW RESTRICTORS	2,092	0.0	600.9	600.9	1,018	11.30	1.99	NC/LC	(b)	(b)
REPAIR, CALIBRATE, AND ADJUST HVAC CONTROLS	56,036	8,626.7	9,116.1	17,742.8	23,252	8.94	2.13	PECIP	1988	58,740
REDUCE LIGHTING LEVELS	64,348	12,041.5	(911.6)	11,129.0	36,882	8.35	1.57	QRIP	1988	68,687
INSTALL VARIABLE FREQUENCY DRIVE ON CHILLED WATER PMPS	26,365	4,852.6	0.0	4,852.6	14,266	4.55	1.86	QRIP	1988	28,143
PROVIDE VARIABLE FREQ. DRIVE CONTROL OF VAV FAN MOTORS	27,828	3,882.8	(15.4)	3,677.4	10,790	4.41	2.32	PECIP	1988	29,705
INSTALL A SMALL BOILER	75,862	932.1	3,776.9	4,709.0	16,790	3.52	4.06	ECIP (a)	1991	90,000
PROVIDE BOILER STACK HEAT RECVRY TO PRENT MAKEUP WATER	19,620	6.0	1,005.4	1,005.4	3,740	3.19	4.72	OTHER	(c)	(c)
PROVIDE MOTION DETECTOR CONTROL OF SEL. INTERIOR LGTS	802	77.8	0.0	77.8	271	2.55	2.93	NC/LC	(b)	(b)
EXISTING EMCS EXPANSION	124,262	8,144.4	4,155.9	12,300.3	15,511	2.33	7.21	ECIP (a)	1994	147,000
INSTALL MOTION DETECTORS ON REST ROOM LIGHTS	2,058	171.7	(25.0)	146.7	592	2.07	4.03	NC/LC	(b)	(b)
WEATHERSTRIP EXTERIOR DOORS	307	0.3	18.4	18.7	58	1.92	5.13	NC/LC	(b)	(b)
INSTALL HIGH EFFICIENCY MOTORS	30,002	1,830.4	0.0	1,830.4	5,404	1.54	6.64	ECIP (a)	1991	46,000
RECLAIM HEAT FROM KITCHEN EXHAUST AIR	30,073	0.0	707.2	707.2	2,920	1.41	10.66	OTHER	(c)	(c)
REPLACE INCANDESCNT LMPS WITH SCREW-IN FLUORESCNT LMPS	21,250	688.2	(100.4)	587.8	3,455	1.05	5.54	OTHER	(c)	(c)
FEASIBLE ECO TOTALS	500,329	47,973.6	23,751.9	71,725.5	175,832	5.16	2.56	NA	NA	NA

(a) These three projects are combined to result in one ECIP project.
(b) Program Year and Program Year Cost are not applicable because these projects are recommended for immediate implementation.
(c) These projects are more capital intensive than the No Cost/Low Cost projects but do not qualify economically as program projects.

FIGURE 3.1.1
EFFECTS ON ANNUAL ENERGY CONSUMPTION
DARNALL ARMY COMMUNITY HOSPITAL

TOTAL REDUCTION: 71,725.5 MBTU/YR (35.5%)



EXISTING ANNUAL CONSUMPTION
ELECTRICITY: 169,130.8 MBTU/YR
NATURAL GAS: 32,993.1 MBTU/YR

TOTAL: 202,123.9 MBTU/YR

TABLE 3.2.1
ECO ANALYSIS SUMMARY
MEDICAL FACILITY BUILDING NO. 38001
RECOMMENDED ECO'S

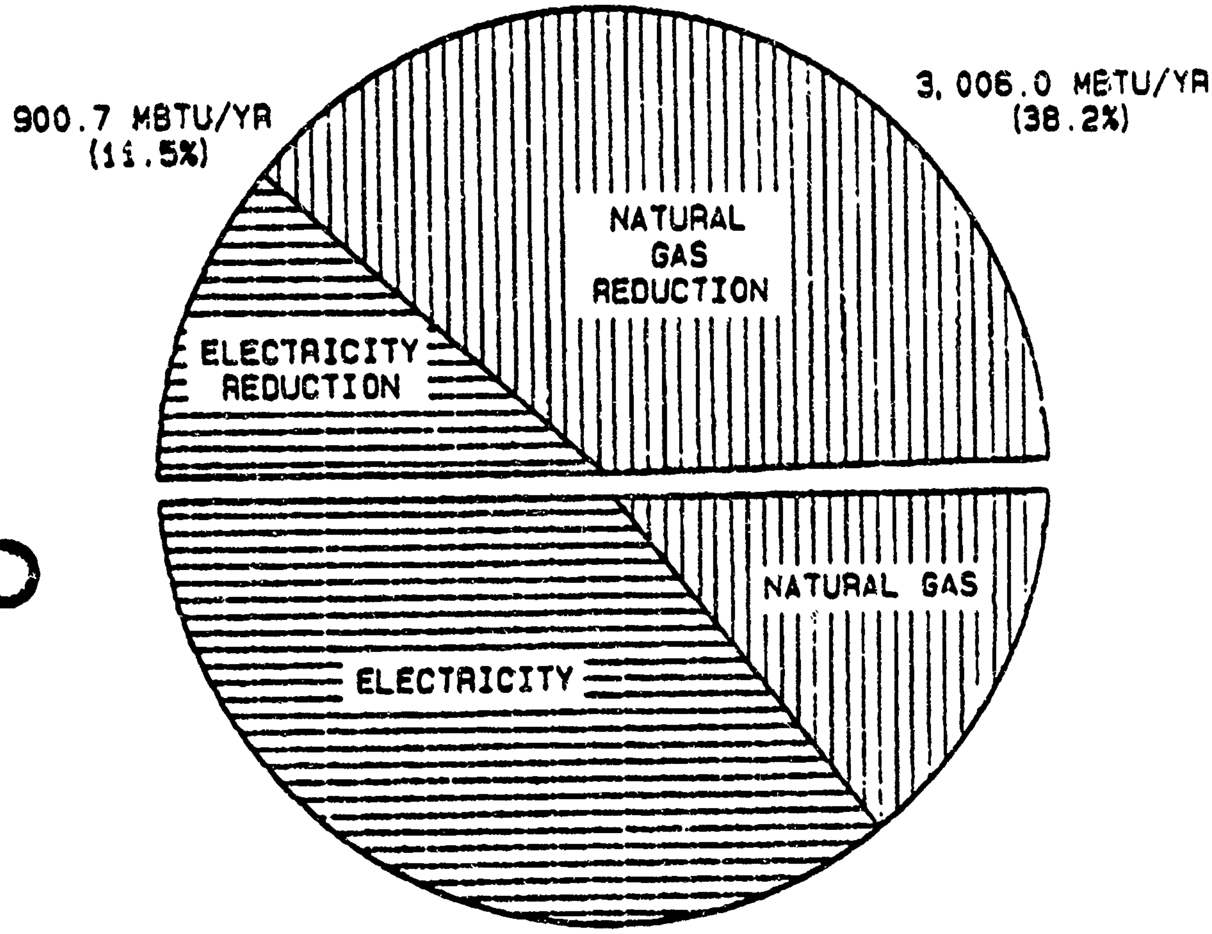
ECO	TOTAL COST ($)	ENERGY SAVINGS: ELECTRICITY SAVINGS (MBTU/YR)	ENERGY SAVINGS: NATURAL GAS SAVINGS (MBTU/YR)	TOTAL SAVINGS (MBTU/YR)	FIRST YEAR DOLLAR SAVINGS ($/YR)	SAVINGS TO INVESTMENT RATIO (SIR)	SIMPLE PAYBACK (YR)	PROJECT CLASSIFICATION	PROGRAM YEAR	PROGRAM YEAR COST ($)
LOWER DOMESTIC HOT WATER TEMPERATURE	15	0.0	40.0	40.0	178	206.15	0.07	NC/LC	(a)	(a)
REVISE EFFICIENT HVAC CONTROLS OPERATION	4,500	856.2	1,613.5	2,469.7	8,519	20.00	0.48	NC/LC	(a)	(a)
INSTALL SHOWER FLOW RESTRICTORS	604	0.0	90.2	90.2	335	8.07	1.37	NC/LC	(a)	(a)
INSULATE DOMESTIC HOT WATER PIPES	52	0.0	2.5	2.5	9	2.87	5.22	NC/LC	(a)	(a)
INSTALL AUTOMATIC VALVES ON FAN COIL UNITS	11,127	37.7	301.2	338.9	1,230	1.80	8.14	OTHER	(b)	(b)
PROVIDE LAUNDRY DRYER WITH ELECTRONIC IGNITION	207	0.0	7.0	7.0	28	1.51	9.96	OTHER	(b)	(b)
INSTALL HIGH EFFICIENCY BOILER	38,140	0.0	924.6	924.6	3,404	1.50	10.08	OTHER	(b)	(b)
PROVIDE THERMOSTAT CONTROL OF ENTRY-WAY RADIATORS	1,290	6.0	19.0	25.0	80	1.07	13.15	OTHER	(b)	(b)
FEASIBLE ECO TOTALS	56,113	890.7	3,006.0	3,906.7	13,790	3.06	3.66	NA	NA	NA

(a) Program Year and Program Year Cost are not applicable because these projects are recommended for immediate implementation.

(b) These projects are more capital intensive than the No Cost/Low Cost projects but do not qualify economically as programs projects.

FIGURE 3.2.1
EFFECTS ON ANNUAL ENERGY CONSUMPTION
MEDICAL FACILITY, BUILDING NO. 36001

TOTAL REDUCTION: 3,906.7 MBTU/YR (49.7%)



EXISTING ANNUAL CONSUMPTION
ELECTRICITY: 3,714.7 MBTU/YR
NATURAL GAS: 4,149.7 MBTU/YR

TOTAL: 7,864.4 MBTU/YR

APPENDIX A:

GLOSSARY AND ABBREVIATIONS

APPENDIX A:

GLOSSARY

1. A: Area (Ft^2)

2. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers

3. BHP: Boiler Horsepower - Equivalent to 33440 Btu/Hr or 34.5 Lbs of steam.

4. BTU: British Thermal Unit - Amount of heat energy required to raise the temperature of one pound of water one degree F.

5. CCC: Central Communication Controller - A minicomputer or microcomputer

6. CCU: Central Control Unit - A minicomputer or microcomputer

7. CFM: Cubic Feet per Minute

8. CLT: Communications Link Termination

9. C.O.P.: Coefficient Of Performance - Ratio of the rate of heat removal to the rate of energy input, in consistent units, for a refrigerating plant, air conditioner, or heat pump under designated operating conditions.

$$C.O.P. = \frac{\text{Heat Removed (Btu/Hr)}}{\text{Work In (Btu/Hr)}}$$

10. DEGREE DAY: A unit based on temperature difference and time, used in estimating fuel consumption and specifying nominal heating or cooling load of building. To determine Heating Degree Days (HDD) for any given day, when the mean temperature is less than 65°F, there are as many HDD's as degree fahrenheit difference in temperature between that day's mean temperature and 65°F.

11. DIESEL FUEL NO. 2: A distillate oil used for general purpose heating. Same as DF-2, Diesel Fuel, Fuel Oil No. 2.

12. DF-2: Diesel Fuel Oil No. 2

13. DHW: Domestic Hot Water

14. DTM: Data Transmission Media

15. DX: Direct Expansion

16. ECIP: Energy Conservation Investment Program

17. ECO's: Energy Conservation Opportunities - steps or modifications applied to building envelopes or mechanical systems to rectify inefficient design and/or operational procedures.

GLOSSARY (Continued)

18. EEAP: Energy Engineering Analysis Program

19. E.E.R.: Energy Efficient Ratio - the ratio of net cooling capacity in Btu/Hr to total rate of electrical energy input in watts under designated operating conditions. Similar to coefficient of performance (see C.O.P.).

20. EMCS: Energy Monitoring and Control Systems

21. ESOS: Energy Savings Opportunity Survey

22. E.U.I.: Energy Utilization Index - a measure of the annual energy consumption in $KBtu/Ft^2$-Yr of any structure, building component, equipment, etc.; and used to define the energy performance of these elements and changes in this due to any given modification.

23. °F: Degree Fahrenheit (also Degree F and DEG F)

24. °F Day: Degree Day

25. FID: Field Interface Device.

26. FPS: Feet Per Second

27. Ft: Foot or Feet

28. Ft^2: Square foot or feet (also Sq. Ft.)

29. FT.HD.: Feet of Hydraulic Column - a measure of the pressure termed in the height of a column of fluid, usually water which it would support.

30. FUEL OIL NO. 2: Diesel Fuel, Diesel Fuel No. 2, DF-2

31. FY: Fiscal Year

32. Gal: Gallon

33. GPD: Gallons Per Day (also Gal/Day)

34. GPH: Gallons Per Hour

35. GPM: Gallons Per Minute

36. GPY: Gallons Per Year (also Gal/Yr)

37. HD: Head - a measure of pressure termed in the height of a column of fluid. (See FT. HD.)

38. HDD: Heating Degree Days

39. HP. Horsepower - a unit of power equipment to 550 Ft.-lb./Sec. or 2545 Btu/Hr.

GLOSSARY (Continued)

40. Hr: Hour

41. HVAC: Heating, Ventilating, and Air Conditioning - usually refers to equipment or system type.

42. I.D.: Inside Diameter

43. IMUX: Intelligent Multiplexer

44. IN H_2O: Inches of Water Column - A measure of pressure termed in the height of a column of fluid (see FT. HO.).

45. IN Hg: Inches of Mercury Column (see IN H_2O).

46. kGal: Thousands of gallons

47. kBtu: One thousand (10^3) Btu

48. KV: Kilovolt or one thousand volts

49. KVA: Kilovolt Ampere

50. kW: Kilowatt or one thousand watts

51. kWh: Kilowatt Hour - Unit of energy equal to that expended by one kilowatt in one hour (equals 3413 Btu Site Energy; 11,600 Btu Source Energy).

52. Lb: Pound

53. LF: Linear Feet/Foot

54. MBtu: One million (10^6) Btu

55. MUX: Multiplexer

56. MWh: Megawatt ' Hour - one million (10^6) watt hours.

57. O.D.: Outside Diameter

58. OSA: Outside Air

59. P: Pressure

60. PSF: Pounds Per Square Foot

61. PSI: Pounds Per Square Inch

62. PSIA: PSI Absolute

63. PSIG PSI Gauge

64. RPM: Revolutions Per Minute

GLOSSARY (Continued)

65. RTC: Real Time Clock

66. S-W: Steam-to-Water

67. T: Temperature °F (also Temp.)

68. Therm: A unit of energy equal to one hundred thousand (10^5) Btu.

69. TLF: Total Linear Feet

70. Ton: One Ton of refrigeration or cooling equal to 12,000 Btu/Hr.

71. T-STAT: Thermostat

72. U-Value: A coefficient expressing the thermal transmittance of a building element expressed in Btu per square foot-hour-°F temperature difference. The reciprocal of R-Value.

73. VFD: Variable Frequency Drive

74. Watt: A unit of energy equal to 3.413 Btu/Hr Site Power (11.6 Btu/Hr Source Power)

75. Whr: Watt · Hour

76. W-S: Water-to-Steam

77. W-W: Water-to-Water

78. Yr: Year

79. c_p: Specific heat at constant pressure (Btu/Lb-°F)

80. db: Dry Bulb (also DB)

81. h: Enthalpy - total heat content of a given mass of a substance (Btu/Lb).

82. k: Thermal conductivity (Btu/Hr-Ft-°F)

83. m: Mass Flow Rate

84. wb: Wet Bulb (also WB)

85. Δ: (Delta) difference between values

APPENDIX B.

REFERENCES

APPENDIX B:

REFERENCES

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APPENDIX C:

SCOPE OF WORK

HNDED-PM/ME

September 1984

GENERAL

SCOPE OF WORK

ENERGY SURVEYS OF ARMY HOSPITALS

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK
ENERGY SURVEYS OF ARMY HOSPITALS
ENERGY ENGINEERING ANALYSIS PROGRAM

TABLE OF CONTENTS

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1.1 Perform a complete energy Audit and Analysis of the entire hospital facility.

1.2 Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.

1.3 Prepare programming documentation for all Energy Conservation Investment Program (ECIP) projects (DD Form 1391, Life Cycle Cost Analysis Summary Sheet with backup calculations and Project Development Brochure (PDB)).

1.4 Prepare implementation documentation for all justifiable energy conservation opportunities.

1.5 List and prioritize all recommended energy conservation opportunities.

1.6 Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

2. GENERAL

2.1 A coordinated energy study, including a detailed energy survey, shall be accomplished for the entire hospital facility. The study shall integrate the results of all prior or ongoing energy conservation studies, projects, designs, or plans, which have previously been accomplished, with work done under this contract. This Scope of Work is not intended to prescribe the details in which the studies are to be conducted or limit the AE in the exercise of his professional engineering expertise, good judgment or investigative ingenuity. However, the information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study. The study shall include a comprehensive energy report documenting study methods and results.

2.2 All ECOs recommended shall comply with all current criteria for medical facilities. This criteria includes the Joint Commission for Accreditation of Hospitals (JCAH), Occupational Safety and Health Act (OSHA) and the National Fire Protection Association (NFPA) Life Safety Code. This criteria has changed significantly since the hospitals were constructed. In many cases the current criteria will allow reductions in outside air quantities, ventilation rates, and similar items, resulting in significant energy savings.

2.3 All recommended ECOs, including maintenance, operational and low cost/no cost opportunities as well as ECIP projects shall be ranked inorder of highest to lowest Savings Investment Ratio (SIR).

N/A

~~2.4 An Energy Engineering Analysis Program (EEAP) study has been accomplished for the installation at which the hospital is located. The portions of the study applicable to the hospital, if any, shall be incorporated into this study. The report shall list the recommended hospital related ECOs from the previous study. This list shall identify the previous study, summarize the hospital related ECOs and the anticipated energy savings, and identify the fiscal year for which the project was or is programmed. The back-up calculations and project documentation from the previous study shall be reproduced and included as an appendix to the report. Any hospital related ECOs identified in previous studies but not recommended shall be reevaluated under this contract. Any hospital related ECOs recommended from the previous studies but not implemented nor programmed for implementation shall be updated in accordance with the latest ECIP guidance.~~

3. WORK TO BE ACCOMPLISHED

3.1 Audit. The audit consists of gathering data and inspecting facilities in the field. These activities shall be closely coordinated with the Contracting Officer, the Director of Engineering and Housing (DEH) and the Hospital Commander. The AE shall become thoroughly familiar with each hospital facility and undertake all necessary field trips to obtain required data. The AE shall document his field surveys on forms developed for the survey, or standard forms, and submit the completed forms as part of the report. Data sources shall be identified and assumptions clearly stated and justified.

3.1.1 Boiler plants, chilled water plants, kitchens, incinerators and similar facilities listed in Annex D that are associated with the hospital shall be included in the study. They shall be studied to determine the condition of existing equipment, efficiency of boiler plant equipment, operational procedures, adequacy of plant capacity, and heat recovery possibilities in addition to the general items listed.

N/A

~~3.1.2 During the audit process, promising applications of solar energy shall be identified. A short discussion of these applications shall be included in the report with recommendations for a detailed study. Quantitative analysis is not required.~~

3.1.3 Data collected during the audit shall be in sufficient detail to identify each air handling system and zone, areas served, supply, return and exhaust air quantities, temperatures and relative humidities, lighting levels and similar data. Area and system air quantities, temperatures etc., shall be based on measurements made during the audit and not on "as-built" drawings. It is anticipated that a large portion of the energy savings will result from correctly balancing the air systems and incorporating current air quantity and temperature/humidity criteria. Data collected during the audit shall, as a minimum, include:

3.1.3.1 Building data.

a. Building number, building age, number of floors, and gross square feet.

b. Floor area, HVAC zones, non-conditioned spaces, usage of space.

c. Glass areas.

d. Wall and roof surface areas and condition, type of construction, "U" factors.

e. Drawings, equipment schedules, distribution layouts, control diagrams, electrical drawings, lighting layout, fixture types, and lighting levels of major systems and areas.

f. Opportunities for maintenance improvements.

g. Nameplate data of major energy related equipment and the condition of the equipment.

h. An assessment of air flow rates, outside air, exhaust rates, water, and other energy media quantities, by zone or area as appropriate.

3.1.3.2 Weather information.

3.1.3.3 Operating methods.

a. Facilities operating hours.

b. System and equipment operating and control schedules.

c. Control set points, chilled water temperatures, and freeze protection temperatures.

d. Rooms, areas, or zones with special or critical requirements.

e. Building occupancy and distribution of personnel.

f. Frequency of use of building access points.

g. Unauthorized modifications to existing equipment/systems by building occupants.

3.1.3.4 Past performance records.

a. Energy peak demands.

b. Energy consumption (Gross BTU/yr and BTU/conditioned SF/yr).

c. Utility rate schedules.

3.1.3.5 Energy sources

3.1.3.6 Boiler efficiency and water chemistry tests.

3.2 Analysis. The energy analysis is a comprehensive study of the facilities energy usage. It includes a detailed investigation of the facilities operation, its environment and its equipment. The analysis shall use computer modeling. Computer modeling shall be used to incorporate field survey data, weather data, occupancy schedules, building construction data, energy distribution systems and equipment data into a model of the total facility. The computer program shall be used to develop load profiles, calculate energy savings, and evaluate energy conservation opportunities. The computer program shall be capable of analyzing the energy requirements of buildings, performance of heating, cooling, and ventilating equipment, energy distribution systems, and energy conversion equipment. The computer results should be verified by comparing them to any available past utility bills or records. The computer program shall analyze the facility on an hour by hour basis rather than the bin data method or bin data to simulate an hour by hour analysis. Unless the Building Loads Analysis and Systems Thermodynamic (BLAST) program is used, the AE shall submit a sample computer run with an explanation of all input and output data and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis. The computer program used must be comparable to the BLAST program.

3.2.1 The energy analysis shall provide the following types of information:

a. A theoretical baseline of energy usage of the existing facility.

b. Peak energy demand.

c. Average energy consumption.

d. Comparison of equipment capacities with expected requirements.

e. Energy usage by systems.

f. Basis for evaluating ECOs.

g. A theoretical baseline of energy usage of the facility after incorporation of all recommended ECOs.

3.2.2 The AE shall develop graphic presentations, i.e., graphs and charts which depict a complete energy consumption picture for the hospital facilities both presently and after implementation of energy saving recommendations.

3.2.3 The AE shall develop a listing of each zone or area of the hospital as appropriate. The list shall include the air handling system serving the area, the supply, return and exhaust air quantities, temperature and humidity setpoints, lighting levels and similar data. The current criteria requirements for supply, return and exhaust air quantities, temperature and humidity setpoints, lighting levels, etc., shall also be shown. The listing shall be in sufficient detail so that areas with potential energy savings from air balancing, incorporation of current criteria, control revisions and similar measures can be identified.

3.2.4 If data is available, the AE shall develop an historical load profile by month for the past three fiscal years for each energy source used.

3.2.5 The AE shall project energy costs for three fiscal years from date of contract award. Department of Energy (DOE) projections are acceptable.

3.3 Project Development. All methods of energy conservation which are reasonable and practical shall be considered, including operational methods, procedures and maintenance practices as well as physical facilities. A list of energy conservation opportunities is included as Annex A to this scope. This list is not intended to be restrictive but only to assure that those opportunities are considered. Each of the items shall be discussed in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility.

3.3.1 The AE shall be familiar with latest Army hospital criteria and evaluate installed systems for possible energy saving revisions which may be permitted by current criteria.

3.3.2 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAEN-MPO-U, 10 August 1982 and revised by letter from DAEN-ECP-U, 18 January 1983, establishes criteria for ECIP Projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 submission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

3.3.3 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation and hospital personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or MCA funding, and determining, in coordination with installation and hospital personnel, the appropriate packaging and implementation approach for all feasible ECOs.

3.3.4 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by Savings Investment Ratio (SIR).

3.3.5 All energy saving opportunities shall be listed and prioritized by SIR.

3.4 Energy Monitoring and Control Systems (EMCS).

3.4.1 The AE shall determine the feasibility of an EMCS for the hospital electrical, mechanical and utility distribution systems. Boiler and/or chilled water plants, laundries, kitchens, incinerators, and other similar facilities associated with the hospital shall be included. The intent of this study is to determine the basic conceptual architecture of the EMCS to the extent that primary economic calculations can be made to determine feasibility per ECIP criteria. The documentation shall be of sufficient accuracy to insure that future project design calculations that will be done after completion of this study will not deviate more than 20 percent from the results of this study.

3.4.2 The AE shall survey all buildings and perform feasibility evaluations in accordance with guidance in HNDSP-84-076-ED-ME. Any existing basewide EMCS project or any currently under design or study shall be considered and evaluated for integration. The use of existing survey data is acceptable only if it is in sufficient detail and can be easily revalidated by building walk through inspections. The standard evaluation forms contained in HNDSP-84-076-ED-ME shall be a part of the submittal. EMCS analyses and evaluations shall be developed using TM 5-815-2. Energy savings calculations shall be in accordance with NCEL CR 82.030. The AE shall consider connection of the hospital to this basewide system. The hospital would have control of the hospital functions with only monitoring capability at the basewide terminal. The evaluation shall recognize that hospital users may be reluctant to surrender control of their systems to installation operating engineers. An independent system for the hospital with the hospital having control and some type of communication with the basewide system for monitoring and data gathering shall also be considered. Fire reporting and/or supervised smoke control shall be considered recognizing that special life-safety criteria, such as Underwriters Laboratories and National Fire Protection Association compliance, not found in most basewide EMCS will be required. EMCS evaluations shall consider but not be limited to the following features:

a. Start/Stop Programs
   - Scheduling
   - Duty cycling
   - Load shedding for electrical demand limiting
   - Lighting control
   - Start/Stop Optimization

b. Ventilation and Recirculation Program
Dry bulb economizer
Outside air reduction

c. Temperature Reset Programs
Space Temperature night setback
Hot and cold deck
Reheat coil
Chilled water
Chiller plant optimization
Boiler plant optimization

d. Labor Savings/Monitoring
Example: Boiler plant monitoring (EMCS logging of points which at present are manually logged).

3.4.3 The AE's recommendations for an EMCS shall be in sufficient detail to define the system configuration, the approximate quantity and types of control instruments and sensors, and the data transmission system. The selection of points to be monitored and controlled shall be given priority based upon ECIP criteria. The development of the data transmission system shall follow the procedures stated in ETL 1110-3-318. The control system functions, expected energy reduction, and monetary savings (including the manner in which these savings are to be achieved) shall be explained.

3.4.4 The AE shall prepare and provide recommendations in narrative form. Input/output (I/O) summary tables shall be prepared and provided for each system selected in accordance with HNDSP-84-076-ED-ME. Cost estimates shall be prepared and provided in accordance with HNDSP-84-076-ED-ME for the mechanical and electrical modifications required to implement the EMCS.

3.4.5 Inoperative controls shall be surveyed in accordance with TM 5-815-2. Cost estimates to repair and replace inoperative controls shall be as described in HNDSP-84-076-ED-ME.

3.4.6 Labor savings/monitoring shall be included, provided the SIR is not affected to the extent of jeopardizing the ECIP requirements.

3.5 Documentation. All energy conservation opportunities (ECOs) the AE has considered shall be included in one of the following categories:

3.5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000 and Savings Investment Ratio greater than one (1). The overall project, and each discrete part of the project, shall have a SIR greater than one (1). For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, Life Cycle Cost Analysis Summary Sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). A Life Cycle Cost Analysis Summary Sheet shall be developed for each ECO and for the overall project when more than one (1) ECO is combined. ~~For projects and ECOs updated or developed from the previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages updating and revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to prevent duplication of projects in any future reports. For projects or ECOs the installation wants submitted as ECIP projects complete programming documentation shall be prepared.~~

3.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex B. These forms shall be separate from the report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required prior to submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation and hospital officials. All documents shall be complete except for the required signatures.

3.5.1.2 Project Development Brochures (PDBs). Preparation of PDBs requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

3.5.1.3 Supporting Data. The AE shall provide all data needed to support the recommended project. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the project were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included as needed.

3.5.2 Non-ECIP Projects. Projects which normally do not meet ECIP criteria, but which have an overall SIR greater than one (1) shall be individually packaged and fully documented. The Life Cycle Cost Analysis Summary Sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they are feasible even if they do not meet ECIP criteria. For projects or ECOs which meet this criteria, the Life Cycle Cost Analysis Summary Sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple amortization period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Contracting Officer's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost not over $100,000 and an amortization period of two (2) years or less.

b. OSD Productivity Investment Funding (OSD PIF). This pr[illegible] s for projects which have a total cost greater than $100,000 and an am[illegible] ization period of four (4) years or less.

c. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of more than $3,000 and an amortization period of four (4) years or less.

The above programs are described and documentation shall be prepared in accordance with AR 5-4, Change No. 1.

d. Low cost/no cost projects. These are projects that the Director of Engineering and Housing can perform with his personnel. For these projects the following information shall be provided:

(1) brief description of the project

(2) brief description of the reasons for the modification

(3) specific instructions for performing the modification

(4) estimated dollar and energy savings per year

(5) estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours are to be listed by trade. For projects that would repair an existing system so that it will function properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications. Separate sheets for each project showing the above information shall be prepared and included in the report.

e. Other. These are energy conservation opportunities (ECOs) which are not appropriate for any of the funding programs previously described. The documentation required for these projects will be as indicated by the Contracting Officer's representative.

3.5.3 Non-feasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with the reasons why they were rejected.

3.6 Report. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. The final report shall be presented in standard three ring binders allowing easy disassembly and reassembly. The report shall be arranged in the following manner:

o Executive Summary. The executive summary shall be separately bound. See Annex C for minimum requirements for the executive summary. The executive summary shall be submitted with the prefinal and final reports.

o Narrative Report. Contains a copy of the executive summary and is the main body of the report.

o Appendix. Contains detailed calculations and reference material.

o Separately bound items. Programming documents, sample computer outputs, completed survey forms, etc.

4. DETAILED SCOPE OF WORK: The general Scope of Work is intended to apply to contract efforts for all Army hospitals except as modified by the detailed Scope of Work for each specific installation. The detailed Scope of Work is contained in Annex D.

5. PROJECT MANAGEMENT.

5.1 Project manager. The AE shall designate a project manager to serve as a point of contact and liaison for all work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager must be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for complete coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Contracting Officer's representative.

5.2 Installation assistance. The Commanding Officer at each installation and the hospital Commander will each designate an individual who will serve as the point of contact for obtaining available information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

5.3 Public disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed under this contract, except as authorized by the Contracting Officer.

5.4 Conferences. Conferences will be scheduled after each submittal except the final report. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all conferences pertinent to the work required under this contract as directed by the Contracting Officer.

5.5 Site visits, inspections, and investigations. The AE, consultants, if applicable, and/or designated representative(s) thereof shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

5.6 Records.

5.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representatives(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten (10) calendar days a reproducible copy of the records.

5.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, supplies, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten (10) calendar days a reproducible copy of the record or receipt.

6. SUBMITTALS, PRESENTATIONS, AND REVIEWS.

6.1 General. The AE shall give a brief presentation of all but the final submittal to installation, hospital, command, and other government personnel. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted on the same day following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide written notification of the action taken on each comment to all reviewing agencies within three (3) weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the hospital personnel, the Director of Engineering and Housing, the AE and the Contracting Officer. The Contracting Officer may require a resubmittal of any document(s) if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

6.2 Interim submittal. An interim report shall be submitted for review after completion of the field survey and a preliminary analysis has been performed on the ECOs. It is expected that the study will be essentially 60% complete. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. The survey forms completed during the audit shall be submitted with this report. Preliminary calculations showing the approaches taken to calculate energy and dollar savings of the various ECOs shall be included. The simple amortization period of all ECOs shall be calculated and shown in the report. Any potential ECIP projects shall be identified at this time. The AE shall submit the Scope of Work and the minutes of the prenegotiation meeting as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Contracting Officer's representative shall coordinate with the hospital commander and the Director of Engineering and Housing and provide the AE with direction for packaging or combining projects for programming purposes. A sample programming document (DD Form 1391, PDB and supporting data) for one ECIP project shall be submitted with this submittal for review and approval prior to the preparation of the other programming documents. To the degree possible, the project selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. This sample shall consist of complete project documentation with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy saving data. The AE shall clearly indicate at the time of submittal any items submitted which should be retained. An example would be the completed survey forms. Items that are to be retained shall be bound in a standard three ring binder which will allow repeated disassembly and reassembly of the material contained within.

6.3 Prefinal submittal. The AE shall prepare and submit the prefinal report when all of the work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and the minutes of the prenegotiation meeting as an appendix to the submittal. The submittal shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. Completed programming and implementation documents for all recommended new and reevaluated projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal submittal shall be bound in standard three ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include a separately bound Executive Summary, to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible, the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study and appendices to include the detailed calculations and all backup material. These may be in more than one volume as necessary. Programming and implementation documentation shall be separately bound in a standard three ring binder which will allow repeated disassembly and reassembly. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the Life Cycle Cost Analysis Summary Sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. The simple amortization period shall also be shown for these projects and ECOs.

6.4 Final submittal. Any revisions or corrections resulting from comments made during the review of the prefinal submittal or during the presentation will be incorporated into the final submittal. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal submittal, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the Prefinal submittal should be retained. Failure to do so will require resubmission of the complete volumes. If new volumes are submitted, they shall be in standard three ring binders to allow for repeated disassembly and reassembly and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

7. OPERATION AND MAINTENANCE INSTRUCTION. The AE shall prepare a one-day instructional course for the mechanical and electrical operation and maintenance personnel to explain possible energy saving potentials due to modified equipment and systems operation. The course will identify operational items noted during the audit, which will affect energy conservation, and will explain the savings possible. This course will be held near the end of the study period at a time agreeable to the AE and the Contracting Officer's representative. This course is in addition to the formal review and presentations required for the submittals. An outline of the topics that will be covered shall be submitted with the prefinal submittal.

8. ENTRY AND EXIT INTERVIEWS. The AE and the Contracting Officer's representative shall conduct entry and exit interviews with the Director of Engineering and Housing and Hospital Commander before starting work at the facility and after completion of the field work. The Contracting Officer's representative shall schedule the interviews at least one (1) week in advance.

8.1 The entry interviews shall thoroughly describe the intended procedures for the survey. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Engineering and Housing and hospital personnel.

e. Limitations imposed by hospital operations.

8.2 The exit interview shall include a thorough briefing describing the work accomplished, problems encountered, probable areas of energy conservation, and any follow-on efforts which may be required. The interview shall also solicit input and advice from the Director of Engineering and Housing and Hospital Commander.

9. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract shall be included in the lump sum price of the contract.

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES

Heating, ventilating, and air conditioning

1. Shut off air handling units whenever possible.
2. Reduce outside air intake when air must be heated or cooled before use.
3. Reduce volume of air circulated through air handling units.
4. Shut off or reduce speed of room fan coils.
5. Shut off or reduce stairwell heating.
6. Shut off unneeded circulating pumps.
7. Reduce humidification to minimum requirements.
8. Reduce condenser water temperature.
9. Cycle fans and pumps.
10. Reduce pumping flow.
11. Reset thermostats higher during cooling and lower during heating.
12. Repair and maintain steam lines and steam traps.
13. Use damper controls to shut off air to unoccupied areas.
14. Reset hot and cold deck temperatures based on areas with greatest need.
15. Raise chilled water temperature.
16. Shed loads during peak electrical use periods.
17. Use outside air for free cooling whenever possible.
18. Reduce reheating of cooled air.
19. Recover heating or cooling with energy recovery units.
20. Reduce chilled water circulated during light cooling loads.
21. Install minimum sized motor to meet loads.
22. Replace hand valves with automatic controls.
23. Install variable air volume controls.
24. Insulate ducts and piping.
25. Eliminate simultaneous heating and cooling.
26. Install night setback controls.
27. Clean coils.
28. Maintain filters.
29. Repair and/or maintain air handling controls.
30. Multi speed/variable speed cooling tower fans.
31. Use centrifugal chillers instead of absorption chillers.

Boiler plant

1. Reduce steam distribution pressure.
2. Shut off steam to laundry when not in use.
3. Increase boiler efficiency.
4. Repair, replace, or install condensate return system.
5. Insulate boiler and boiler piping.
6. Install economizer. - or [illegible] make up water
7. Install air preheater.
8. Check boiler water chemistry program.
9. Clean boiler tubes.
10. Blowdown controls.
11. Boiler and chiller control modifications.
12. Common manifolding of chillers.
13. Water treatment to prevent tube fouling.

Lighting

1. Shut off lights when not needed.
2. Reduce lighting levels.
3. Revise cleaning schedules.
4. Convert to energy efficient systems.

Building envelope

1. Reduce infiltration by caulking and weatherstripping.
2. Install storm windows or double pane windows.
3. Install roof insulation.
4. Install loading dock seals.
5. Install vestibules on entrances.
6. Reduce window heat gain by solar shading, screening, curtains or blinds.
7. Install wall insulation.

Electrical equipment

1. Shut off elevators wherever possible.
2. Shut off pneumatic tube system whenever possible.
3. Install capacitors or synchronous motors to increase power factor.
4. Use emergency generator to reduce peak demand
5. Shed or cycle electrical loads to reduce peak demand.
6. Balance loads.
7. Reduce transformer losses by proper loading and balancing.
8. Convert to energy efficient motors.

Plumbing

1. Reduce domestic hot water temperature
2. Repair and maintain hot water and steam piping insulation.
3. Install flow restrictors.
4. Install faucets which automatically shut off water flow.
5. Decentralize hot water heating.
6. Add pipe insulation.

Laundry

1. Install heat reclamation system for laundry wash water.
2. Install heat reclamation system on dryers.
3. Install heat reclamation system on irons.
4. Install thermal fluid heated equipment.

Kitchen

1. Shut off range hood exhaust whenever possible.
2. Install high-efficiency steam control valves.
3. Shut off equipment and appliances whenever possible.
4. Install makeup air supply for exhaust.
5. Install heat reclamation system for exhaust heat.
6. Turn off lights in coolers.

Miscellaneous

1. Install incinerator and heat recovery system.
2. Install computerized energy monitoring and control system.

ANNEX B

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects as "ECIP."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.).

d. List references, assumptions and provide calculations to support dollar and energy savings, and indicate any added costs.

(1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage floor area, window and wall area for each exposure.

(2) Identify weather data source.

(3) Identify infiltration assumptions before and after improvements.

(4) Provide and justify inside temperature profiles before and after retrofit. Include source of expertise and demonstrate savings claimed by work sample techniques. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, malfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures fixtures is not considered an ECIP type project.

g. An ECIP Life Cycle Cost Analysis Summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each descrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

i. The calendar year in which the cost were calculated shall be clearly shown on the DD Form 1391.

j. The five (5) digit category code number for all ECIP projects developed under this scope of work is 80000.

ANNEX C

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Present Energy Consumption.

   - Total Annual Energy Used.

   - Source Energy Consumption.

     Electricity - KWH, Dollars, BTU
     Fuel Oil - GALS, Dollars, BTU
     Natural Gas - THERMS, Dollars, BTU
     Propane - GALS, Dollars, BTU
     Other - QTY, Dollars, BTU

   - Breakout of Energy Consumption.

3. Historical Energy Consumption.

4. Energy Conservation Analysis.

   - ECOs Investigated.

   - ECOs Recommended.

   - ECIP Projects Developed. (Provide list)*

   - Other Energy Conservation Projects. (Provide list)*

   - Operational or Policy Change Recommendations.

* Include the following data from the Life Cycle Cost Analysis Summary Sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost. Show the simple amortization period for all ECOs.

5. Energy and Cost Savings.

   - Total Potential Energy Savings.

   - Percentage of Energy Conserved.

   - Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

6. Energy Plan.

- Project Breakouts with Total Cost and SIR.
- Schedule of Energy Conservation Projects.

ANNEX "D"

Darnall US Army Hospital
Fort Hood, TX

1. General Description:

a. The work to be accomplished under this contract modification shall consist of performing a detailed energy study for Darnall US Army Community Hospital, Fort Hood, TX.

b. The buildings to be included in this work are Buildings 36000 and 36001.

c. The exterior parking lighting and Helipad lighting for the hospital are also included in this work.

d. The boiler plant and chilled water plant that serves the hospital, Building 36000, is physically located in and dedicated to serve Building 36000 and shall be included in this work.

e. The hospital building 36000 is basically a six story facility, originally constructed in 1966, of approximately 215,000 square feet. Subsequent MCA construction has enlarged the hospital to approximately 500,000 square feet at the present.

f. Building 36001 is a converted medical barracks building which now contains various hospital related functions such as: dermatology, allergy and various administrative functions. The building was constructed in 1968, three stories and a basement, of approximately 45,000 square feet.

2. Detailed Requirements:

a. Feasible projects or ECO's with a SIR greater than or equal to 1.0, which do not qualify for ECIP, PCIP, or MCA funding and which could be implemented by the facility, shall be documented on DA Form 4283 with the necessary sketches and implementation instructions as required in the General Scope of Work, Paragraph 3.5.2.d. A feasible project is one with simple payback within life expectancy, or 25 years, whichever is less.

b. This study must identify potential energy conservation opportunities which are feasible projects as that term is defined in Paragraph 2a above, regardless of the implementation cost.

c. The A-E shall include in this study ECOs resulting from operational procedure changes of both hospital personnel and maintenance and operating personnel which includes major medical equipment, as related to energy use.

d. Reference General Scope of Work, Paragraph 2.4 Delete in its entirety.

e. Reference General Scope of Work, Paragraph 3.1.2. Delete in its entirety.

f. Reference General Scope of Work, Paragraph 3.1.3. The A-E shall investigate each zone and/or area system. The actual survey must be in sufficient detail to ensure that a final report and the projects generated are complete and are a clear representation of the hospital. Flow measurements may be taken either in the ductwork on a zone-by-zone basis or at each diffuser, at the discretion of the A-E.

g. Reference General Scope of Work, Paragraph 3 2 Computer modeling of Building 36001 is not required but the A-E shall use his own discretion and may use an appropriate computer program, although hand calculations will suffice.

h. Reference General Scope of Work, Paragraph 3.4. An EMCS is in operation at the hospital, presently controlled by a Honeywell Delta 5100 Computer. The system operation is mainly a monitoring system, with very little control capability. The A-E is to study the existing system configuration and determine additional functions that can be added to the existing system that will save rooms, etc , or determine if a new EMCS system should be installed to accomplish these additional functions plus the original functions.

i. Reference General Scope of Work, Paragraph 3.5.1. There has been no previous energy study performed for the hospital, therefore, there are no existing projects or ECOs to be updated.

j. The following ECOs are to be added to ANNEX "A":

(1) Investigate feasibility of small, individual boilers at end points sterilizers and bed pan washers in lieu of using plant steam. Evaluate the losses in steam lines form source to point v/s point steam production.

(2) Investigate the feasibility of heat reclamation of chiller condenser water from preheating of domestic water (reduce operating of cooling tower fans).

k. ECO number 7 under Boiler Plant shall read "Install air and/or make-up water preheater".

l. Investigate thoroughly ECO number 5 under Building Envelope. This is a deficiency and known area of concern.

m. Reference General Scope of Work, Paragraph 3.5. All ECIP and MCA projects shall be initially evaluated as FY 89 projects. Redesignation of the program year for each project will be made during the Interim Submittal Review, if necessary.

n. Reference General Scope of Work, Paragraph 7. The A-E shall prepare and submit for approval and Instructional Course outline and handout with the Prefinal Submittal. After approval of this outline and handout, the A-E shall conduct two one day, identical instructional courses for the Mechanical and Electrical Operation and Maintenance personnel. The courses shall be scheduled to accommodate all shift employees. One of the instructional courses will be video recorded by Fort Hood personnel utilizing Government equipment This video recording will become the property of the Government.

o. The formal Prefinal Submittal presentation will be video recorded by Fort Hood personnel utilizing Government equipment This video recording will become the property of the Government.

p. The A-E will not be required to input the 1391's into the Government 1391 Processor System.

q. The A-E will not be required to prepare Environmental Impacts or Assessments of any ECIP or MCA or any other project developed during this work.

7 The Government furnished information to be provided to the A-E shall include as a minimum, but not limited to:

a. Army Facilities Energy Plan.

b. ETLs 1110-3-282, Energy Conservation, 1110-3-294, Interior Design Temperatures, 1110-3-303, Stairway Design Requirements for Hospitals, 1110-3-316, Hold Open Devices for Critical Care Areas or US Army Medical Facilities, 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) funded through the MCA Program, 1110-3-330, Coordination of Utility Systems for Health Care Facilities, 1110-3-332, Economic Studies, 1110-3-335, General Planning/Design Criteria Standards for Medical Facilities, 1110-3-34-, Interior Medical Design Conditions for Army and Air Force Medical Facilities.

c. DOD Construction Criteria Manual 4270.1-4.

d. Energy Conservation Investment Program (ECIP) Guidance, date 15 February 1985. (Change to General Scope of Work, Paragraph 3.3.2).

e. Information on existing EMCS Studies, Designs, Construction Contracts, or Operation Systems.

f. TM 5-785, Engineering Weather Data, TM 5-800-3, Project Development Brochure, TM 5-815-2, Energy Monitoring and Control Systems (EMCS), and TM 5-838-2, Army Health Facility Design.

g. AR 415-15, Military Construction Army (MCA) Program Development, AR 415-17, Cost Estimating for Military Programming, AR 415-20, Construction Project Development and Design Approval, AR 415-28, Department of the Army Facility Classes and Construction Categories, AR 415-35, Construction, Minor Construction, AR 420-10, General Provisions, Organization, Functions, and Personnel, and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

h. DA Pamphlet 420-6, Resources Management System.

i. HNDSP-84-076-ED-ME, Preliminary Survey and Feasibility Study for Energy Monitoring and Control System.

j. NCEL CR 82.030, Standardized EMCS Energy Savings Calculations.

k. The latest applicable Engineer Improvement Recommendations System (EIRS) bulletin.

l. An example of a correctly completed programming document of an ECIP project for a FORSCOM installation.

m. Any other studies, as appropriate and available.

	INTERIM SUBMITTAL	PRE-FINAL SUBMITTAL	FINAL SUBMITTAL	FINAL PROGRAMMING DOCUMENTS
CDR, Darnall Hospital	2	2	2	1
CDR, III Corps & Ft Hood	6	6	6	Original + 1
CDR, SWF	2	2	2	2
CDR, SWD	2	2	2	1
HQ, USACE	1	1	1	1
CDR, Huntsville Division	3	3	3	1
CDR, HSC	1	1	1	2
CDR, FORSCOM	2	2	2	2
CDR, LEA	1	1	1	1
	19	19	19	Original + 12

4. Deliverables:

a. The following specific deliverables will be developed and submitted as follows:

(1) Interim Submittal: One hundred-sixty (160) calendar days after receipt of the Supplemental Agreement, the A-E shall submit the Interim Report.

(2) Prefinal Submittal: Sixty (60) calendar days after resolution of Interim Submittal comments, the A-E shall submit the Prefinal Report.

(3) Final Submittal with Programming Documents: Thirty (30) calendar days after resolution of Prefinal Submittal comments, the A-E shall submit the Final Report with Final Programming Documents.

(4) Government review time for each submittal shall not exceed forty-five (45) calendar days.

b. The number of copies for each submittal is: (See attached sheet).

c. The number of copies as required by paragraph 4b above shall be mailed directly to the following addresses:

Commander, US Army Engineer Division, Southwestern, ATTN: SWDED-M/ Mr. Carr, 1114 Commerce Street, Dallas, TX 75242-0216

Commander, US Army Engineer Division, Huntsville, ATTN: HNDED-PM/ Mr. Ganus, P.O. Box 1600, Huntsville, AL 35807-4301

HQ, USACE (DAEN-ECE-E)/Mr. McCarty), Washington, D.C. 20314-1000

Commander, HSC, ATTN: DSC-HSLO-F, Fort Sam Houston, TX 78234

Commander, Logistics Evaluation Agency, ATTN: DALO-LEP/MAJ Heibel, New Cumberland Army Depot, PA, 17070-5007

Commander, FORSCOM, ATTN: AFEN-TSE, Fort McPherson, GA 30330

Commander, III Corps & Fort Hood, ATTN: AFZF-FE-EPO, Fort Hood, TX 76544

Commander, Darnall US Army Community Hospital, ATTN: DACH-LMG/ LTC Bulla, Fort Hood, TX 76544-5057

Commander, US Army Engineer District, Fort Worth, ATTN: SWFED-PM/ Mr. Paul Cox, Fort Worth, TX 76102-0300

April 11, 1985

ENERGY SURVEYS OF ARMY HOSPITALS
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)
DARNALL U.S. ARMY COMMUNITY HOSPITAL, FORT HOOD, TEXAS

PRE-NEGOTIATION CONFERENCE MINUTES

1. A Pre-Negotiation Conference was held at Darnall U.S. Army Community Hospital located at Fort Hood, Texas on Thursday, March 28, 1985. A list of conference attendees is attached. The following paragraphs describe the substantive issues discussed.

2. Mr. Paul Cox, FWD COE Project Manager, read the Detailed Scope of Work, Annex "D", so that the contents could be discussed.

3. It was noted that in Paragraph 1e of Annex "D" Building 36001 is actually three (3) stories, and not one (1) story as currently indicated.

4. It was noted during the discussion of Paragraph 2a that the new ECIP criteria would be included in this study.

5. Although new applications of solar energy are not to be addressed, the AE will consider operation maintenance of the existing solar array (Paragraph 2e).

6. The AE requested that the period of service for the Pre-Final Submittal be changed from forty-five (45) calendar days to sixty (60) calendar days. Everyone agreed and this change was made.

7. The AE was familiar with the General Scope of Work so discussion was not required.

8. The AE requested the assistance and involvement of the facility personnel so that a useful product results from the study.

9. The AE answered some questions regarding the length of the field survey and the number of people involved, etc.

CONFERENCE ATTENDEES

DARNALL ENERGY AUDIT
PRE-NEGOTIATION MEETING
MARCH 28, 1985

Paul Cox	FWD COE - Project Manager	817-334-2887
Joe F. Fritz	DEH/Energy Branch	287-8774
Bobby Lynn	DEH/Energy Brarch	287-7283
Nancy Nooney, Col	CN	288-8013
Louis J. Hansen	JCA	288-8002
Thomas E. Small	Huntsville Division Corps of Engineers	205-895-5120
Col. Ken Jayne	DEH	287-5707
Sheldon S. Gordon	Chilton Engineering	702-827-6560
Allan J. Giesbrecht	Chilton Engineering	702-827-6560
Shannon R. Anderson, II	DEH-QA	287-3506
John Easterwood	DEH-EPS	287-4117
Bill F. Bulla, LtC	LOG DACH	288-8792
T.J. Turley	DEH-ERM	287-6701
Paul Hatkoff, Maj.	MEDDAC	288-8004
Albert McNamee	DEH-ERM	287-6702
Col. Al Braga	C, SVC Brach DACH	288-8770