Energy Savings Opportunity Survey
Carlisle Barracks, PA
Contract No. DACA65-93-C-0118

EXECUTIVE SUMMARY
and
FINAL REPORT

Prepared By

Benatec Associates

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27 July 1994

benatec associates
ENGINEERING ■ ARCHITECTURE ■ ENVIRONMENTAL

933702/AE94-835

July 27, 1994

Commander
U.S. Army Engineer District, Mobile
Attention CESAM-EN-CM (Mr. Battaglia)
P.O. Box 2288
Mobile, AL 36628-0001

Gentlemen:

Re: Contract No. DACA65-93-C-0118
Energy Savings Opportunity Survey (ESOS)
Carlisle Barracks, Pennsylvania
FINAL SUBMISSION

Please find attached the Final Submission on the above referenced project. The submission consists of the following:

One (1) copy of Executive Summary text for insertion into binder.
One (1) copy of Pages for insertion into Appendix D.
Instruction for replacement and insertion of pages are included with each packet.

Very truly yours,

BENATEC ASSOCIATES

David M. Burkett

David M. Burkett, P.E.
Project Manager

DMB/ms
Enclosures

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EXECUTIVE SUMMARY AND FINAL REPORT

Remove existing cover sheet and replace with the attached cover sheet.

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Remove existing Executive Summary, Pages 1, 2, and 3 and replace with the attached pages.

APPENDIX D

Replace existing kilo-watt hour consumption. Calculation worksheets for Buildings ~~22~~, ~~306~~, ~~308~~, ~~309~~, ~~325~~, ~~327~~, ~~450~~, ~~452~~, and ~~844~~ and replace with attached worksheets.

benatec associates
ENGINEERING | ARCHITECTURE | ENVIRONMENTAL

933702/AE94-568

May 30, 1994

Commander
U.S. Army Engineer District, Mobile
Attention CESAM-EN-CM (Mr. Battaglia)
P.O. Box 2288
Mobile, AL 36628-0001

Gentlemen:

Re: Contract No. DACA65-93-C-0118
Energy Savings Opportunity Survey (ESOS)
Carlisle Barracks, Pennsylvania
90% PREFINAL SUBMISSION

Please find attached the 90% Prefinal Submission on the above referenced project. The submission consists of the following:

One (1) copy of Executive Summary text for insertion into binder.
One (1) copy of Pages for insertion into Appendices A, C, and D.
Instruction for replacement and insertion of pages are included with each packet.

Please retain all copies of this report, as future submissions will be in the form of inserts and replacement pages for the books.

Also, please note that an Prefinal Review Conference has tentatively been scheduled for July 1, 1994. Please confirm this meeting and advise as to the time and place.

Very truly yours,

BENATEC ASSOCIATES

David M. Burkett

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EXECUTIVE SUMMARY AND INTERIM REPORT

Remove entire contents of this binder including cover sheet. Replace with attached cover sheet and pages.

APPENDIX A

Remove Summary Report and replace with the attached pages.

APPENDIX A

Insert attached sheets in Appendix before Building 001 - Wall and Roof Insulation.

APPENDIX A

Remove the existing LCCID Summary Sheets for the following buildings:

- Building 002 - Wall and Roof Insulation
- Building 040 - Wall and Roof Insulation
- Building 118 - Wall and Roof Insulation
- Building 122 - Replace Fixtures
- Building 311 - Wall and Roof Insulation
- Building 318 - Wall and Roof Insulation
- Building 321 - Wall and Roof Insulation

Replace with the attached sheets.

APPENDIX A

Replace existing kilo-watt hour consumption. Calculation worksheets for Buildings 22, 306, 308, 309, 325, 327, 450, 452, and 844 and replace with attached worksheets.

APPENDIX D

Remove the cost estimate for Building 122 - Replace Fixtures and replace with the following.

APPENDIX C

Remove the cost estimate sheets for the following buildings and ECO's:

- Building 002 - Wall and Roof Insulation
- Building 040 - Wall and Roof Insulation
- Building 118 - Wall and Roof Insulation
- Building 311 - Wall and Roof Insulation
- Building 318 - Wall and Roof Insulation
- Building 321 - Wall and Roof Insulation

Replace with the attached sheets.

ENERGY SAVINGS OPPORTUNITY SURVEY
CARLISLE BARRACKS, PENNSYLVANIA

Contract No. DACA65-93-C-0118

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I. EXECUTIVE SUMMARY

An Energy Savings Opportunity Survey has been conducted at Carlisle Barracks, Pennsylvania. Actual field survey of the studied facilities was performed from August 1993 through October 1993. Architectural, electrical, and mechanical energy conservation opportunities were investigated in accordance with the detailed scope of work.

A copy of the summary report and Recommended ECO's Summary has been included with the Executive Summary. All pertinent information relative to any given energy conservation opportunity is listed in the summary reports. The summary reports presented herewith are supported by detailed reports in the Appendices.

The following areas are the most lucrative with regard to sufficiently reducing energy costs to offset the capital cost:

- Lighting - Replacing Lamps
- Weatherstripping and Caulking
- Insulated or Double Glazed Windows

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use throughout the year.

During the survey and analysis phase of the project, two hundred seventy-six (276) normal ECO's in eighty-eight (88) buildings and nine (9) special ECO's in nine (9) buildings were investigated.

During the survey phase, it was discovered that nineteen (19) normal ECO's in fifteen (15) buildings and one (1) special ECO's in 1 building were already done. With these ECO's already in place, the Barracks is realizing energy savings from them now.

Of the remaining ECO's, thirty (30) ECO's in forty-five (45) building had an SIR of greater than 1.00, indicating that they are feasible.

As indicated in the Recommended ECO's Summary, these ECO's are separated into Housing and OMA Buildings and listed in order based on their SIR.

The following Table 1 provides information relative to the total ECO's for each type of the building.

TABLE 1

Building Type	Number of Buildings Included	Number of ECO's	Total Construction Cost	Total Annual Savings	SIR	Simple Payback (Years)
OMA	19	22	$182,719	$17,978	1.49	10.16
Housing	26	8	$ 72,288	$ 6,486	1.50	11.15

The project to replace the head-end EMCS system cannot be classified as an ECIP project, but it can be classified as an O & M Energy Project. This project costs $21,185 to construct but will save $4,000 per year in maintenance costs. This gives the project an SIR of 2.78 and a simple payback of 5.30 years.

If all projects are completed, a total construction cost of $276,192 will be required in order to save $28,464 per year. This is a simple payback of 9.70 years.

Some studied energy conservation opportunities were not economically feasible because of the following reasons:

- Relatively Low Fuel Costs
- High Construction Costs Relative to Energy Costs

After discussing the Prefinal Submission with the Carlisle Barracks, they have decided that they will not be submitting the project to the Corps of Engineers for funding under the ECIP Projects.

The Barracks will make some of the suggested improvements to various buildings at some time in the future as the funds become available.

II. INTRODUCTION

Benatec Associates was contracted by the Corps of Engineers, Norfolk District on September 16, 1993 to perform an Energy Savings Opportunity Survey at Carlisle Barracks, Pennsylvania. Actual field survey of the studied facilities was performed from August 1993 through December 1993. Field survey reports are included in Appendix B. Architectural, electrical, and mechanical energy conservation opportunities were investigated in accordance with the detailed scope of work, which is included at the back of this binder.

The various references used in the study are as follows:

- TM-5785 Engineering Weather Data, July 1, 1978
- Memorandum CEHSC-FU-M Energy Conservation Investment Program (ECIP)
- 1994 Means Construction Cost Data
- 1994 Means Mechanical Cost Data
- 1994 Means Electrical Cost Data

Several computer programs were also utilized during the study. The program names and versions are as follows:

- Trane Trace 600, Version 11.09
- MCACES Gold Version 5.2
- Life Cycle Cost in Design (LCCID), Version 1.080

Based on concept designs, energy analyses were performed. Electrical system analyses were performed using in-house spreadsheet computer programs. Electrical analysis calculations are included in Appendix D. Mechanical system analyses were performed using the Trane Trace building energy

analysis computer programs. Mechanical system load calculations are included in Appendix F. Preliminary estimates were prepared based on the concept designs.

Upon completion of fuel costs analyses and preliminary estimates, the savings/investment ratio was calculated with the Life Cycle Cost in Design (LCCID) computer program.

SIR summary data is included in the front of Appendix A and detailed SIR support data, LCCID computer output, is included in the back of Appendix A. Building data is in numerical order per building number in all appendices.

III. BUILDING DATA

The building studied are of two (2) major types. These types are housing and OMA buildings. Each of these two (2) types can then be broken down further.

The housing units consist of single family units, two family units, and apartment style units.

The OMA buildings consist of many types of buildings such as gyms, offices, fire hall, chapel, post exchange, etc.

At the end of this section is a Building Data matrix for each type of building detailing all data on the buildings.

Many of the buildings analyzed are located within the Historical District. Due to their historical status, none of the ECOs could affect the exterior appearances of these buildings.

CARLISLE BARRACKS ENERGY STUDY

BUILDING DATA MATRIX

HOUSING UNITS

Bldg. No.	Building Name	Similar Buildings	Area (Ft^2) Each	Year Constructed	Number of Floors	Type of Construction	Building Use	Type Mechanical Systems**	Lighting System
1	Quarters 1	None	11,651	1932	2	Stone	Housing	1	Incandescent
2	Quarters 2*	None	6,708	1892	2	Brick	Housing	1	Incandescent
3	Quarters 3*	None	5,483	1892	2	Brick	Housing	1	Incandescent
4	Garrison Avenue*	None	3,785	1940	2	Brick	Housing	1	Incandescent
5	Garrison Avenue*	6, 17, 18, 19, 20, 21, 26, 29	7,620	1940	2	Brick	Housing	1	Incandescent
24	Coren Apartments*	None	20,018	1863	2	Brick	Housing	1	Incandescent
25	Building 25*	None	1,291	1915	1	Wood Frame	Housing	1	Incandescent
28	Garrison Avenue	None	3,785	1940	2	Brick	Housing	1	Incandescent
32	Building 32*	33	1,797	1915	1	Wood Frame	Housing	1	Incandescent
34	Building 34*	None	1,785	1915	1	Wood Frame	Housing	1	Incandescent
40	Truscott Hall	None	8,707	1966	2	Brick	Housing	11	Incandescent
101	Forbes Avenue	102 through 114	4,090	1939	2	Brick	Housing	1	Incandescent
116	Young Hall	None	90,120	1936	3	Brick	Housing	4	Incandescent
201	Marshal Ridge	202, 203, 204	1,898	1964	2	Wood Frame	Housing	10	Incandescent
205	Marshal Ridge	206 through 220	3,944	1964	2	Wood Frame	Housing	10	Incandescent
259	Wilson House	None	4,265	1959	2	Brick	Housing	1	Incandescent
311	Building 311*	312	6,696	1904	2	Wood Frame	Housing	13	Incandescent
318	Building 318*	None	4,112	1905	2	Wood Frame	Housing	16	Incandescent
321	Building 321*	None	3,340	1909	2	Wood Frame	Housing	13	Incandescent
441	Faith Apartments	442, 443, 444, 445	4,442	1947	2	Brick	Housing	1	Incandescent
	TOTALS	64	396,689						

* Historical District
** See the following Mechanical System Types Section for further information

CARLISLE BARRACKS ENERGY STUDY

BUILDING DATA MATRIX

OMA BUILDINGS

Bldg. No.	Building Name	Similar Buildings	Area (Ft^2) Each	Year Constructed	Number of Floors	Type of Construction	Building Use	Type Mechanical Systems**	Lighting System
22	Upton Hall	None	59,272	1941	4	Stone	Museum	N/A	Fluorescent
23	Thorpe Gym*	None	23,142	1895	3	Brick	Gym	14	Fluorescent
45	Bouquet Hall	None	6,950	1940	1	Brick	Post Headquarters	4	Fluorescent
46	Anne Ely Hall	None	21,208	1931	2	Brick	Game Room, Library, etc.	12	Fluorescent
118	Theatre	None	6,002	1933	1	Brick	Theatre	16	Fluorescent
120	Fitness Center	None	18,858	1986	2	Block	Fitness Center	5	Fluorescent
122	Root Hall	None	176,167	1966	4	Brick	War College	6	Fluorescent
253	Medical Supply	None	14,008	1959	1	Brick	Med. Warehouse	8	Fluorescent
301	Central Heat	None	6,437	1933	1	Brick	Heat Plant	2	HID
304	Shop	305, 309	2,863	1936	1	Brick	Warehouse	N/A	Fluorescent
306	Post Supply	None	6,382	1936	1	Brick	Warehouse	N/A	Fluorescent
308	Shop	None	4,480	1940	1	Brick	Warehouse	N/A	Fluorescent
313	Officer's Club*	None	21,860	1909	2	Brick	Officers Club	7	Fluorescent
325	Shop	None	3,381	1937	1	Brick	Warehouse	N/A	Fluorescent
327	Shop	None	2,923	1936	1	Brick	Warehouse	N/A	HID
330	DPW Office	None	5,155	1941	2	Wood Frame	DPW Office	N/A	Fluorescent
400	Fire Hall	None	9,792	1939	2	Brick	Fire Hall	4	Fluorescent
420	Headquarters Co.	None	21,481	1939	3	Brick	Co. Headquarters	9	Fluorescent
450	Dunham Clinic	None	28,631	1961	1	Brick	Clinic	N/A	Fluorescent
452	Chapel	None	18,595	1964	1	Brick	Chapel	3	Fluorescent
844	Post Exchange	None	36,667	1975	1	Brick	Post Exchange	N/A	Fluorescent
901	Golf House	None	6,872	1965	2	Block	Golf Shop/Rest.	15	Fluorescent
	TOTALS	24	506,852						

* Historic District
** See the following Mechanical System Types Section for further information

MECHANICAL SYSTEM TYPES

1.	Heating:	Steam radiation supplied from central base heating plant via underground pipes.
	Cooling:	Individual window air conditioning units.
2.	Heating:	Steam unit heaters supplied from central base heating plant.
	Cooling:	None.
3.	Heating:	Two-pipe fan coil system with hot water heating coils supplied from local oil fired boiler.
	Cooling:	Two-pipe fan coil system with chilled water cooling coils supplied from local air cooled, split system chiller.
4.	Heating:	Hot water radiation supplied from steam to hot water heat exchanger. Steam supplied from central base heating plant via underground piping.
	Cooling:	Split system air handling units.
5.	Heating:	Air handling units with hot water coils supplied from steam to hot water heat exchanger. Steam supplied from central base heating plant via underground piping.
	Cooling:	Split system air handling units.
6.	Heating:	High pressure induction units with hot water coils supplied from steam to hot water heat exchangers. Steam supplied from central base heating plant via underground piping.
	Cooling:	High pressure induction units with chilled water coils supplied from local, water cooled chiller.
7.	Heating:	Air handling units with hot water coils supplied from steam to hot water converter. Steam supplied from central base heating plant via underground piping.
	Cooling:	Air handling units with chilled water coils supplied from local split system, air cooled chillers.
8.	Heating:	Air handling units (office) and unit heaters (warehouse) supplied with hot water from local oil fired boiler.
	Cooling:	Split system air handling units (offices only).
9.	Heating:	Two-pipe fan coil system with hot water coils supplied from steam to hot water heat exchanger. Steam supplied from central base heating plant via underground piping.
	Cooling:	Two-pipe fan coil system with chilled water coils supplied from air cooled chiller.
10.	Heating:	Gas fired warm air furnace.
	Cooling:	Individual window air conditioning units.

11.	Heating:	Packaged Terminal Air Conditioning (PTAC) units with hot water coils supplied from steam to hot water heat exchanger. Steam supplied from central base heating plant via underground piping.
	Cooling:	PTAC units with integral refrigerant cooling systems.
12.	Heating:	Air handling units with steam coils and steam radiation supplied from central base heating plant via underground piping.
	Cooling:	Air handling units with split system cooling.
13.	Heating:	Hot water radiation supplied from steam to hot water heat exchanger. Steam supplied from central base heating plant via underground piping.
	Cooling:	Individual window air conditioning units.
14.	Heating:	Air handling units with steam coils supplied from central base heating plant via underground piping.
	Cooling:	None.
15.	Heating:	Hot water radiation supplied from local, oil fired boiler.
	Cooling:	Split system air conditioning units.
16.	Heating:	Steam radiation supplied from central base heating plant via underground piping.
	Cooling:	Air handling units with split system cooling.

IV. ANALYSIS

Fuel Costs

Fuel costs used in this report were current as of February 9, 1994. The fuel costs used on this project are included in Table 1. Copies of letters from the Directorate of Public Works at Carlisle Barracks and of Pennsylvania Power and Light (PP&L) Electrical Rates are included at the end of this section.

TABLE 1

FUEL COSTS AT CARLISLE BARRACKS, PENNSYLVANIA

Electric KWH	PP&L Rate LP-5 per KWH
Electric PKW	$4.39 per KW
No. 2 Individual MMBTU	$5.20 per MMBTU
District STM MMBTU	$5.00 per MMBTU
District HW MMBTU	$5.00 per MMBTU
Gas Individual MMBTU	$5.00 per MMBTU

Rates were calculated for each fuel as follows:

Electric rates, as per PP&L Rate LP-5, were based on a set cost of $4.39 per KW for demand and a varying cost for KWH based on the amount of kilowatt-hours used. See Rate Schedule at the end of the section. These demand and KWH rates were entered into the Trane Trace Program, which then calculated total demand and usage costs based on these rates and the amount of energy used. The LCCID Program does not allow varying rates, so the total costs from the Trane Program were divided by the total KWH from the Trane Program for each building to obtain a cost per KWH to use in the LCCID Program. Since different buildings used different amounts, the dollars per

KWH in the LCCID Program are different for each building to ensure that the total usage cost used in the LCCID Program agreed with the cost calculated by the Trane Program.

Number 2 individual energy costs were calculated as follows using a cost of 73 cents per gallon for oil:

$$\$/MMBTU = \frac{\$0.73}{Gallon} \times \frac{1\ Gallon}{138{,}700\ BTU} \times \frac{1{,}000{,}000\ BTU}{1\ MMBTU}$$

$$= \$5.20 \text{ per MMBTU}$$

Cost for oil was obtained from Carlisle Barracks.

Gas individual MMBTU energy costs were calculated as follows using a cost of $5.15 per MCF for gas:

$$\$/MMBTU = \frac{\$5.15}{MCF} \times \frac{1\ MCF}{1{,}031{,}000\ BTU} \times \frac{1{,}000{,}000\ BTU}{1\ MMBTU}$$

$$= \$5.00 \text{ per MMBTU}$$

Cost for gas was obtained from Carlisle Barracks.

District steam MMBTU energy cost were calculated based on the fact that gas fired boilers in the central steam plant supplied the steam, so the dollars per MMBTU costs were set the same as gas.

District hot water MMBTU energy costs were calculated the same as the District steam costs since the steam was used to make the steam with a heat exchanger in each building. Associated pumping costs for hot water systems were calculated separately.

Lighting System Energy Conservation Opportunities

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use of lighting throughout the year.

This study limits the installation of the occupancy sensors to offices, bathrooms, storage rooms and other similar areas. The sensors are not considered for areas with book stacks or other high shelving devices. Occupancy sensors are not considered in the corridors either, simply because of the heavy usage of these areas which does not result in any savings. Also, periodic clicking the lights on and off can result in lesser lamp life which is directly proportional with higher maintenance cost for lamp replacement.

In certain areas, wall mounted occupancy sensors can easily replace the existing light switches. This is decided based on the square footage coverage of the area and visibility of the switch. Keep in mind that this study does not consider any furniture layout and for the actual design of the occupancy sensors, it is recommended that the furniture layout is verified to make sure the sensors can indeed see the occupant(s) and are not blocked by any pieces of furniture.

The kilowatt hour cost of electricity is assumed to be $0.06. This number has been verified with the current utility bills at the Barracks.

Existing corridor 2' x 2' fluorescent light fixtures in Building 122, the Root Hall, have three (3) or four (4) 2' long fluorescent tubes, F-20 type. For the replacement of these fixtures, it is assumed that 2' x 4' light fixtures can be replace the 2' x 2's. At the present time, electronic ballasts are not made for F-20 type tubes.

Detailed electrical analyses are included in Appendix D.

Consumption

Base building energy consumption was calculated using the Trane Trace programs. Output is located in Appendix F.

The output in Appendix F also includes estimated energy consumption for the buildings with the ECOs in place.

Energy Conservation Analysis

The ECOs investigated were as described in the attached detailed scope of work.

A summary of the ECOs investigated along with ECOs recommended and rejected is included in this section and in Appendix A.

Appendix A also includes the detailed LCCID output forms for all ECOs on all buildings. This output sheet lists cost, annual energy savings, annual dollar savings, SIR, simple payback period and analysis data for each ECO.

The specific ECOs that were investigated included: the addition of wall and roof insulation, insulated or double-glazed windows, weatherstripping and caulking, low "E" glass, duct and pipe insulation, lighting occupancy sensors, energy conserving lamps, electronic ballasts, new lighting fixtures, prevention of air stratification, heat recovery units, infrared heaters, vestibules, replacement of building controls, and replacement of head-end EMCS systems.

Conditions affecting each ECO were verified in the field surveys. Some of the ECO's were not investigated for various reasons. These include:

1. Insulated or double-glazed windows were not investigated for Buildings 3, 4, 5, 26, 28, 45, 101, 102, 116, 201, 205, 259, 313, and 452 since these buildings either already had storm windows or new double-glazed windows installed.

2. Duct and pipe insulation was not investigated for Buildings 2, 3, 4, 45, and 313 since the insulation on these buildings was relatively new and still in good shape.

3. Low "E" glass was not investigated for Building 301. Building 301 is the Central Heat Plant housing the boilers and all related accessories. The main purpose of low "E" glass is to reduce the solar gain through the windows, thereby, reducing the air conditioning costs. Since Building 301 is not air conditioned, there can be no savings generated by installing low "E" glass.

4. Heat recovery was not investigated for Building 313 since heat recovery is already in place on the kitchen hood exhaust system. The only other exhaust systems in the building are the various small systems from toilets, storage areas,

etc. These small systems do not have enough volume or temperature to make heat recovery possible.

The ECOs regarding the replacement of temperature controls in Building 313 and the replacement of the head-end of the EMCS system are discussed later in this section in the Special Report Conditions section.

The details of implementing the ECOs are detailed in Appendices C, D, and E and below.

The addition of wall and roof insulation was accomplished in various ways as indicated in Appendix C. In most cases, furring strips, rigid insulation and drywall were added to the inside of exterior walls. Where possible blown-in insulation was used. Also in Buildings 311 and 312, the existing plaster will be removed and then insulation and drywall will be added. The roofs were insulated with lay-in batts, blown-in insulation, etc. as applicable.

The windows in Buildings 25 and 901 will be replaced with double-glazed windows as detailed in Appendix C. The existing windows in Building 122 will remain and storm panels will be added to the interior of the windows.

The low "E" glass ECO on Building 122 will be accomplished by installing a low "E" film on the existing windows.

Heat recovery for Building 122 will be accomplished by adding air to air heat exchangers to units AC-4, AC-5, and AC-6 located in the basement. This system will use the exhaust air stream to preheat the incoming outdoor air in the winter and pre-cool it in the summer. It should be noted that with the

heat recovery units in place, these three (3) units will no longer have an economizer cycle due to the fact that the cool, incoming outdoor air will be preheated by the warm exhaust air, thereby, rendering the economizer cycle useless.

The pipe and duct insulation ECO's were investigated for thirty (30) buildings. All of the buildings were housing units and had no ductwork, so pipe insulation only was studied. None of the buildings had piping with no insulation. All of the piping was insulated with small areas in each building missing. For this reason, heat loss of base pipe was not used in the base building calculations. Since, the piping was partially insulated, the SIR and payback for reinsulating these lines did not payback.

The remainder of the ECOs are self-explanatory as detailed in the Appendices.

Energy and Cost Savings

The energy and cost savings for each ECO has been calculated and is located in the various appendices.

Energy use before and after each ECO is detailed in Appendices D and F and summarized in the LCCID input forms located in Appendix A.

Thermal Environmental System Simulation

Thermal environmental system analyses were performed with the Trane Trace building energy analysis computer program.

Building simulations were performed to account for energy conditions that would effect the studied ECO. Evaluation of perimeter skin system, such as wall insulation, was performed accounting for solar load gains/losses and infiltration effect; however, non-effect loads such as isolated process loads were not summarized.

The buildings were zoned, for purposes of calculations, based on the existing equipment zones.

The following Building Zoning Matrix indicates the number of zones that were simulated for each of the OMA Building runs.

CARLISLE BARRACKS ENERGY STUDY			
BUILDING ZONING MATRIX for TRANE TRACE RUNS			
OMA BUILDINGS			
Building No.	**Building Name**	**Total Area (Ft^2 Each)**	**No. of Existing Zones (No. of Zones Used in Calculations)**
23	Thorpe Gym	23,142	4
45	Bouquet Hall	6,950	3
46	Anne Ely Hall	21,208	8
118	Theatre	6,002	3
122	Root Hall	176,167	16
253	Medical Supply	14,008	6
313	Officer's Club	21,860	13
330	DPW Office	5,155	3
400	Fire Hall	9,792	3
420	Headquarters Company	21,481	6
452	Chapel	18,595	4
901	Golf House	6,870	5

Samples of simulation program input forms are included in Appendix H. In addition to the computer input forms, the following items are included in Appendix H:

- Thermostat Schedules
- Occupancy Schedules
- Materials Listings
- Wall/Roof Listings

Thermostat schedules were generated based on occupancy hours as reported by building users and set points as specified in AR 11-27. Occupancy schedules were generated based on occupancy hours and approximate numbers of people as reported by building users. The materials listing and the wall/roof listing includes all standard materials included with the computer software package, special materials observed during field surveys, and special materials generated during concept design.

Occupancy schedules are generally self-explanatory.

Determination of Building Infiltration

Considerable amounts of energy is consumed in buildings overcoming the thermal loads caused by infiltration. In addition to direct heat loss associated with infiltration, infiltration extracts stored heat in the winter when the building is in the night setback mode. The mass of a building with a high infiltration rate will cool to 55°F faster than a building with a low infiltration rate. When the mass of the building is cooled faster, night heating is required for more hours. The ideal heating building would store all heat in the building mass for use on subsequent days.

To account for the energy drain effect of building mass and general energy consumption due to infiltration, three (3) basic infiltration conditions were utilized as follows:

- Base infiltration normal building
- Base infiltration infrared heated building
- ECO specific infiltration

Calculated infiltration quantities were determined in accordance with guidelines and equations as presented in ASHRAE 1993 Fundamentals Handbook, Chapter 23, Infiltration and Ventilation.

Base infiltration for normal buildings was broken down into the following three (3) categories:

• Loose	One Air Change
• Medium	3/4 Air Change
• Tight	1/2 Air Change

During field surveys, building construction and existing conditions were observed to make a judgement as to the infiltration category for specific buildings. A concrete block building with cracked block, large expanses of glass, and loose fitting window frames was classified as loose. Well constructed and maintained concrete block or steel sided buildings with moderate glass exposure and medium fit windows were classified as medium. If a building wall was well constructed and maintained with less than 50% glass per exposure, the building was classified as tight.

Base infiltration for infrared heated buildings was determined by adjusting the infiltration calculated to occur on the building in the present condition. Space temperatures in infrared heated buildings are lower than in conventionally heated buildings. With reduced temperature differentials between inside and outside the driving forces of the infiltration is reduced. To account for the reduction

of infiltration in infrared heated buildings, infiltration was set at 75% of the infiltration of the conventionally heated building.

ECO specific infiltration is that infiltration that will change with the application of a specific ECO. An example of ECO specific infiltration is the comparison of infiltration of existing windows with infiltration with storm glazing over existing windows.

Infrared Heater Simulation

Infrared heating saves energy by reducing the space temperature while maintaining occupant comfort with infrared energy. Infiltration is also reduced in buildings heated with infrared heaters as the temperature difference between inside and outside is reduced.

Air Stratification Simulation

The use of ceiling fans in areas with high ceilings will reduce the effects of temperature stratification within the room.

In the heating season, the fans will distribute the heated air near the ceiling back down to the occupied levels. This will cause the temperatures in the occupied zone and at the ceiling to become equal in an ideal situation. Since the heating system no longer has to overheat the air at the ceiling to maintain temperature at the occupied zone, less energy will be used.

In the cooling season, the fans will cause greater air movement throughout the room. The air velocity within the room will cause the occupants to feel cooler. Therefore, energy can be saved in the cooling season by increasing the cooling set point temperature without sacrificing comfort.

In order to simulate the cooling energy savings, the Trace runs will be done with a cooling set point of 78°F for the base building and a cooling set point of 80°F for the ceiling fan ECO.

Simulating the heating energy savings is a bit more complicated. Temperatures were measured at each building at the floor and at the ceiling to obtain a temperature gradient within the room. The temperatures were measured with an outdoor temperature of 38°F to ensure that typical heating season values were used. Based on the measured temperature gradient, an average interior temperature was calculated. This average temperature was then input as the heating set point for the base building and 68°F was set as the heating set point for the ECO run.

Since the temperature at the ceiling will be higher for the base building then the ECO building, the greater temperature difference between indoor and outdoor temperatures will cause a greater heat loss through the roof. Stratified air temperatures cannot be simulated on the Trace programs, so in order to simulate the greater roof heat loss for the base building, the following calculations were done. The actual U-value, area, and the measured temperature at the ceiling were used to calculate the heat loss through the roof. The base building will be run at an average temperature as stated earlier to simulate the greater heat loss through the roof accurately, the calculated heat loss at the measured temperature is used to solve for a corrected U-value at the average room temperature. This corrected U-value will be used in the base building runs to simulate the heat loss through the roof. The ECO building will be run at the set point temperature of 68°F.

V. ESTIMATING

Upon completion of field surveys and concept designs, construction cost estimates were prepared in accordance with Appendix C of TM5-800-2, Cost Estimates - Military Construction dated June 12, 1985.

Estimated data was primarily taken from MCACES Gold Program and Means Building Construction Cost Data.

Cost estimates for specific energy conservation opportunities are included in Appendices C, D, and E.

VI. SPECIAL REPORT CONDITIONS

Replace Controls in Building 313

During the investigation of this ECO, it was discovered that although the Officer's Club is connected to the present EMCS system, the building HVAC systems are running 24 hours per day. Based on this fact, energy conservation can be accomplished at no or little cost by using the present EMCS to schedule occupied and unoccupied times and setting back the temperature during the unoccupied times.

Presently, the building is closed Mondays, open from 07:30 to 23:00 on Tuesdays through Fridays, 12:00 to 23:00 on Saturdays and closed Sundays. Based on these operating hours, 95 hours per week of operating time can be eliminated. Scheduling of the occupied and unoccupied times can be done by the Barracks with the present equipment at no cost.

Scheduling of night setback temperatures can be done with the present equipment.

With only operational changes, at no cost, $20,264.35 per year can be saved.

This cannot be classified as an ECIP project since it is a no cost item.

These savings can be realized by using the existing controls in the building; therefore, a complete replacement of the building controls is not required.

Occupied/Unoccupied and Night Setback Saving Calculations

Kw = Voltage x Current x 1.73 (3-phase)
Kw on chiller = 200 Volts x 213 Amps x 1.73 ÷ 1000
= 73.693 Kw

Note: The above calculation was done on each piece of equipment used in the savings calculations.

Summer Calculations:

$	=	7 months x 4.33 weeks/month x A hours/week x 0.06 $/kwh x B kw x .8
$	=	7 months x 4.33 weeks/month x 95 hours/week x 0.06 $/kwh x 138.1 kw x .8
$	=	19,087.30/cooling season

318,122 Kwhr x 3,413 BTU / Kwhr / .6 MBTU / BTU

1,086 MBTU/YR

Winter Calculations:

$	=	5 months x 4.33 weeks/month x A hours/week x 0.06 $/kwh x B kw x .667
$	=	5 months x 4.33 weeks/month x 95 hours/week x 0.06 $/kwh x 14.3 kw x .667
$	=	1,177.05/heating season

19,617 Kwhr x 3,413 BTU / Kwhr / 10^6 MBTU / BTU

67 MBTU/YR

Where:

A	=	The amount of hours available for equipment to be turned off per week
B	=	The sum of kilowatts from the equipment being turned off
.8	=	The reduced load factor for summer operation
.667	=	The off hour run time factor for winter operation
.06	=	The average cost of a kilowatt hour

Total Savings = $20,264.35

1,086 + 67 = 1,153 MBTU/YR

Replace Head-End of EMCS

The existing EMCS system head-end at Carlisle Barracks is a Johnson Controls JC 85/40 computer. This system is outdated and no longer manufactured. The system is still functional but future reliability of the system is in question since replacement parts for the system are no longer manufactured.

Converting this existing head-end system to a PC based Johnson Controls Metasys System was investigated. The cost to convert the system, as per a quote from Johnson Controls, is $19,000. The existing controls in the buildings would be reused and connected to the new Metasys System.

The new Metasys System would operate identical to the present JC 85/40 so no operation savings could be realized. However, the Maintenance Agreement for the Metasys System would be $4,000 per year less expensive then the Maintenance Agreement on the JC 85/40. This is mainly due to the unavailability of replacement parts for the JC 85/40.

This ECO does not qualify as an ECIP project since no energy savings are realized. However, since it has an SIR of 2.78 and a simple payback of 5.30 years, it does qualify as an O & M Energy project.

VII. CONCLUSION

The following areas are the most lucrative with regard to sufficiently reducing energy costs to offset the capital cost:

- Lighting - Replacing Lamps
- Weatherstripping and Caulking
- Insulated or Double-glazed Windows

Lighting system alternatives were generally more favorable than architectural or mechanical system alternatives. The primary reason lighting energy conservation opportunities were more advantageous is the reduction in demand charges and continuous use throughout the year.

During the survey phase, it was discovered that nineteen (19) normal ECO's in fifteen (15) buildings and one (1) special ECO's in 1 building were already done. With these ECO's already in place, the Barracks is realizing energy savings from them now.

Of the remaining ECO's, thirty (30) ECO's in forty-five (45) building had an SIR of greater than 1.00, indicating that they are feasible.

As indicated in the Recommended ECO's Summary, these ECO's are separated into Housing and OMA Buildings and listed in order based on their SIR.

The following Table 1 provides information relative to the total ECO's for each type of the building.

TABLE 1						
Building Type	Number of Buildings Included	Number of ECO's	Total Construction Cost	Total Annual Savings	SIR	Simple Payback (Years)
OMA	19	22	$182,719	$17,978	1.49	10.16
Housing	26	8	$ 72,288	$ 6,486	1.50	11.15

The project to replace the head-end EMCS system cannot be classified as an ECIP project, but it can be classified as an O & M Energy Project. This project costs $21,185 to construct but will save $4,000 per year in maintenance costs. This gives the project an SIR of 2.78 and a simple payback of 5.30 years.

If all projects are completed, a total construction cost of $276,192 will be required in order to save ~~$28,464~~ $ 24,464 & 2,678 MBTU per year. This is a simple payback of 9.70 years.

The connection of existing controls in Building 313 to the EMCS will save approximately $20,264 per year. Since this is a no cost item, the Barracks should complete this work immediately and start saving.

	MBTU	$
Projects	2,678	24,464
B/313	1,153	20,264
	3,831	44,728

VIII. SUMMARY REPORT

CARLISLE BARRACKS ENERGY STUDY
Summary Report

Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
001	Wall and Roof Insulation	x	$22,880	x	N/A	N/A	N/A	No (0.17)
001	Caulk & W. S.	x	$ 3,513	x	N/A	N/A	N/A	Yes (1.79)
001	Combined ECO	x	$26,393	x	N/A	N/A	N/A	No (0.38)
002	Wall and Roof Insulation	x	$20,889	x	N/A	N/A	N/A	No (0.86)
002	Caulk & W. S.	x	$ 3,295	x	N/A	N/A	N/A	Yes (1.40)
002	Pipe and Duct Insulation	N/A	N/A	x	Note 1	N/A	N/A	N/A
002	Combined ECO	x	$24,095	x	N/A	N/A	N/A	No (0.86)
003	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
003	Caulk & W. S.	x	$ 660	x	N/A	N/A	N/A	Yes (4.07)
003	Pipe and Duct Insulation	N/A	N/A	x	Note 1	N/A	N/A	N/A
004	Wall and Roof Insulation	x	$17,924	x	N/A	N/A	N/A	No (0.01)
004	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
004	Caulk & W. S.	x	$ 1,580	x	N/A	N/A	N/A	No (0.80)
004	Pipe and Duct Insulation	N/A	N/A	x	Note 1	N/A	N/A	N/A
004	Combined ECO	x	$19,504	x	N/A	N/A	N/A	No (0.35)
005	Wall and Roof Insulation	x	$21,109	x	N/A	N/A	N/A	No (0.62)
005	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
005	Caulk & W. S.	x	$ 3,002	x	N/A	N/A	N/A	No (0.54)
005	Pipe and Duct Insulation	N/A	N/A	x	$9,959	N/A	N/A	No (0.24)
005	Combined ECO	x	$24,111	x	$9,959	N/A	N/A	No (0.50)
022	Occupancy Sensors	N/A	N/A	N/A	N/A	x	$19,615	No (0.02)
022	Replace Lamps	N/A	N/A	N/A	N/A	x	$19,197	Yes (1.08)
022	Replace Ballasts	N/A	N/A	N/A	N/A	x	$89,816	No (0.54)
022	Replace Fixtures	N/A	N/A	N/A	N/A	x	$189,246	No (0.37)
022	Combined ECO	N/A	N/A	N/A	N/A	x	$208,861	No (0.33)

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Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
023	Wall and Roof Insulation	x	$59,302	x	N/A	N/A	N/A	No (0.50)
023	Caulk & W. S.	x	$ 4,385	x	N/A	N/A	N/A	Yes (1.24)
023	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 3,160	No (0.73)
023	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 13,515	No (0.41)
023	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 25,262	No (0.34)
023	Prevent Air Stratification	N/A	N/A	x	$5,431	x	N/A	Yes (1.20)
023	Combined ECO	x	$63,687	x	N/A	x	$ 25,262	No (0.46)
024	Caulk & W. S.	x	$ 5,907	x	N/A	N/A	N/A	No (0.47)
025	Insulated Glass	x	$12,754	x	N/A	N/A	N/A	No (0.12)
025	Caulk & W. S.	x	$ 833	x	N/A	N/A	N/A	Yes (1.00)
025	Combined ECO	x	$13,587	x	N/A	N/A	N/A	No (0.13)
028	Wall and Roof Insulation	x	$13,857	x	N/A	N/A	N/A	No (0.47)
028	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
028	Caulk & W. S.	x	$ 1,565	x	N/A	N/A	N/A	No (0.59)
028	Pipe and Duct Insulation	N/A	N/A	x	$7,095	N/A	N/A	No (0.18)
028	Combined ECO	x	$15,422	x	$7,095	N/A	N/A	No (0.40)
032	Caulk & W. S.	x	$ 1,095	x	N/A	N/A	N/A	No (0.62)
033	Caulk & W. S.	x	$ 1,095	x	N/A	N/A	N/A	No (0.47)
034	Caulk & W. S.	x	$ 966	x	N/A	N/A	N/A	No (0.64)
040	Wall and Roof Insulation	x	$19,458	x	N/A	N/A	N/A	No (0.37)
045	Wall and Roof Insulation	x	$23,806	x	N/A	N/A	N/A	No (0.35)
045	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
045	Caulk & W. S.	x	$ 1,124	x	N/A	N/A	N/A	Yes (1.67)
045	Pipe and Duct Insulation	N/A	N/A	x	Note 1	N/A	N/A	N/A
045	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 2,068	Yes (1.84)

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Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
045	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 8,554	No (0.92)
045	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 22,979	No (0.54)
045	Combined ECO	x	$24,930	x	N/A	x	$ 22,979	No (0.47)
046	Wall and Roof Insulation	x	$55,561	x	N/A	N/A	N/A	No (0.42)
046	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 9,935	Yes (1.61)
046	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 41,315	No (0.77)
046	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 78,674	No (0.61)
046	Combined ECO	x	$55,561	x	N/A	x	$ 78,674	No (0.53)
101	Wall and Roof Insulation	x	$12,752	x	N/A	N/A	N/A	No (0.46)
101	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
101	Caulk & W. S.	x	$ 2,658	x	N/A	N/A	N/A	No (0.16)
101	Pipe and Duct Insulation	N/A	N/A	x	$9,286	N/A	N/A	No (0.29)
101	Combined ECO	x	$15,410	x	$9,286	N/A	N/A	No (0.38)
102	Wall and Roof Insulation	x	$12,752	x	N/A	N/A	N/A	No (0.46)
102	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
102	Caulk & W. S.	x	$ 2,658	x	N/A	N/A	N/A	No (0.16)
102	Pipe and Duct Insulation	N/A	N/A	x	$9,286	N/A	N/A	No (0.29)
102	Combined ECO	x	$15,410	x	$9,286	N/A	N/A	No (0.38)
116	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
116	Caulk & W. S.	x	$17,290	x	N/A	N/A	N/A	No (0.67)
118	Wall and Roof Insulation	x	$34,596	x	N/A	N/A	N/A	No (0.95)
120	Prevent Air Stratification	N/A	N/A	x	$5,272	N/A	N/A	No (0.02)
122	Insulated Glass	x	$24,242	x	N/A	N/A	N/A	Yes (1.85)
122	Caulk & W. S.	x	$15,668	x	N/A	N/A	N/A	Yes (1.82)
122	Low "E" Glass	x	$76,259	x	N/A	N/A	N/A	No (0.23)

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Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
122	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 71,610	No (0.92)
122	Replace Ballasts	N/A	N/A	N/A	N/A	x	$359,777	No (0.39)
122	Replace Fixtures	N/A	N/A	N/A	N/A	x	$711,632	No (0.31)
122	Heat Recovery	N/A	N/A	x	$127,111	N/A	N/A	No (0.00)
122	Combined ECO	x	$116,169	x	$127,111	x	$711,302	No (0.28)
201	Wall and Roof Insulation	x	$ 3,054	x	N/A	N/A	N/A	No (0.93)
201	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
201	Caulk & W. S.	x	$ 1,436	x	N/A	N/A	N/A	Yes (1.86)
201	Combined ECO	x	$ 4,490	x	N/A	N/A	N/A	Yes (1.11)
205	Wall and Roof Insulation	x	$ 6,108	x	N/A	N/A	N/A	No (0.46)
205	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
205	Caulk & W. S.	x	$ 2,872	x	N/A	N/A	N/A	Yes (1.28)
205	Combined ECO	x	$ 8,980	x	N/A	N/A	N/A	No (0.77)
253	Wall and Roof Insulation	x	$14,516	x	N/A	N/A	N/A	No (0.63)
253	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 2,913	Yes (2.56)
253	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 13,002	No (0.96)
253	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 29,962	No (0.63)
253	Prevent Air Stratification	N/A	N/A	x	$5,431	x	N/A	No (0.18)
253	Infrared Heaters	N/A	N/A	x	$73,217	x	N/A	No (0.01)
253	Combined ECO	x	$14,516	x	$78,648	x	N/A	No (0.26)
259	Wall and Roof Insulation	x	$12,659	x	N/A	N/A	N/A	No (0.97)
259	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
259	Caulk & W. S.	x	$ 1,883	x	N/A	N/A	N/A	No (0.82)
259	Combined ECO	x	$14,542	x	N/A	N/A	N/A	No (0.96)
301	Low "E" Glass	x	Note 3	x	N/A	N/A	N/A	N/A

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Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
304	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 1,830	Yes (1.14)
304	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 7,870	No (0.57)
304	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 19,076	No (0.34)
306	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 1,489	Yes (1.14)
306	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 6,672	No (0.56)
306	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 17,069	No (0.32)
308	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 372	Yes (1.14)
308	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 1,198	No (0.74)
308	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 3,304	No (0.40)
311	Wall and Roof Insulation	x	$19,242	x	N/A	N/A	N/A	No (0.24)
311	Caulk & W. S.	x	$ 2,444	x	N/A	N/A	N/A	No (0.76)
311	Combined ECO	x	$17,548	x	N/A	N/A	N/A	No (0.37)
313	Wall and Roof Insulation	x	$15,822	x	N/A	N/A	N/A	Yes (1.43)
313	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
313	Caulk & W. S.	x	$ 3,205	x	N/A	N/A	N/A	No (0.87)
313	Pipe and Duct Insulation	N/A	N/A	x	Note 1	N/A	N/A	N/A
313	Heat Recovery	N/A	N/A	x	Note 4	N/A	N/A	N/A
313	Building Controls	N/A	N/A	x	0	N/A	N/A	Note 5
313	Combined ECO	x	$19,027	x	N/A	N/A	N/A	Yes (1.38)
318	Wall and Roof Insulation	x	$ 9,701	x	N/A	N/A	N/A	No (0.46)
318	Caulk & W. S.	x	$ 2,705	x	N/A	N/A	N/A	No (0.29)
318	Combined ECO	x	$12,152	x	N/A	N/A	N/A	No (0.44)
321	Wall and Roof Insulation	x	$ 3,333	x	N/A	N/A	N/A	Yes (1.47)
321	Caulk & W. S.	x	$ 1,267	x	N/A	N/A	N/A	Yes (6.05)
321	Combined ECO	x	$ 3,780	x	N/A	N/A	N/A	Yes (1.26)

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Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
325	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 745	Yes (1.14)
325	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 3,079	No (0.58)
325	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 8,194	No (0.32)
327	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 269	Yes (1.14)
327	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 1,112	No (0.58)
327	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 3,324	No (0.29)
330	Caulk & W. S.	x	$ 1,725	x	N/A	N/A	N/A	No (0.46)
330	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 2,275	Yes (1.79)
330	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 9,409	Yes (1.06)
330	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 21,633	No (0.60)
330	Combined ECO	x	$ 1,725	x	N/A	x	$ 21,633	No (0.59)
400	Wall and Roof Insulation	x	$57,946	x	N/A	N/A	N/A	No (0.22)
400	Caulk & W. S.	x	$10,639	x	N/A	N/A	N/A	No (0.13)
400	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 2,579	Yes (1.71)
400	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 10,949	No (0.80)
400	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 22,055	No (0.60)
400	Combined ECO	x	$68,585	x	N/A	x	$ 22,055	No (0.31)
420	Wall and Roof Insulation	x	$57,946	x	N/A	N/A	N/A	No (0.57)
420	Vestibules	x	$10,639	x	N/A	N/A	N/A	No (0.09)
420	Combined ECO	x	$68,585	x	N/A	N/A	N/A	No (0.50)
441	Pipe and Duct Insulation	N/A	N/A	x	$10,197	N/A	N/A	No (0.27)
450	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 12,460	Yes (1.14)
450	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 55,258	No (0.56)
450	Replace Fixtures	N/A	N/A	N/A	N/A	x	$119,831	No (0.38)
452	Wall and Roof Insulation	x	$87,564	x	N/A	N/A	N/A	No (0.06)

CARLISLE BARRACKS ENERGY STUDY
Summary Report

Building #	Energy Item (ECO)	Architectural Survey	Architectural Est.	Mechanical Survey	Mechanical Est.	Electrical Survey	Electrical Est.	ECO Viable (SIR)
452	Insulated Glass	x	Note 2	x	N/A	N/A	N/A	N/A
452	Caulk & W. S.	x	$ 7,727	x	N/A	N/A	N/A	No (0.33)
452	Occupancy Sensors	N/A	N/A	N/A	N/A	x	$10,531	No (0.02)
452	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 4,322	No (0.33)
452	Replace Ballasts	N/A	N/A	N/A	N/A	x	$ 18,305	No (0.19)
452	Replace Fixtures	N/A	N/A	N/A	N/A	x	$ 49,087	No (0.10)
452	Combined ECO	x	$95,291	x	N/A	x	$ 59,618	No (0.09)
844	Replace Lamps	N/A	N/A	N/A	N/A	x	$ 22,976	Yes (1.14)
844	Replace Ballasts	N/A	N/A	N/A	N/A	x	$106,154	No (0.55)
844	Replace Fixtures	N/A	N/A	N/A	N/A	x	$190,687	No (0.44)
901	Wall and Roof Insulation	x	$24,871	x	N/A	N/A	N/A	No (0.28)
901	Insulated Glass	x	$ 1,815	x	N/A	N/A	N/A	Yes (3.81)
901	Caulk & W. S.	x	$ 3,193	x	N/A	N/A	N/A	Yes (2.42)
901	Combined ECO	x	$29,879	x	N/A	N/A	N/A	No (0.53)
Site	Replace EMCS	N/A	N/A	x	$ 19,000	N/A	N/A	Note 6

NOTES:

1 Pipe Insulation in good condition and no Duct Insulation present.
2 Building already has storm windows or insulated glass.
3 Building 301 is a central boiler plant. There would be no advantage to Low "E" Glass on this building.
4 Building already has heat recovery on kitchen exhaust system.
5 Does not qualify as an ECIP Project. There are no costs associated with operational changes.
6 Does not qualify as an ECIP Project. There are no energy savings with this ECO.

IX. RECOMMENDED ECO'S SUMMARY

CARLISLE BARRACKS ENERGY STUDY

RECOMMENDED ECO'S SUMMARY

OMA BUILDINGS

Ranking (Based on SIR)	Building No.	Energy Item (ECO)	No. of Typical Buildings	Cost Estimate (Each)	Cost Estimate (Total)	SIR	Simple Payback (Yeas)
1	901	Insulated Glass	1 82	$ 2,024	$ 2,024	3.81	4.52
2	253	Replace Lamps	1 31	$ 3,249	$ 3,249	2.56	5.87
3	901	Caulk & W.S.	1 94	$ 3,561	$ 3,561	2.42	7.14
4	122	Insulated Glass	1 [illegible]	$27,031	$27,031	1.85	7.97
5	122	Caulk & W.S.	1 423	$17,470	$17,470	1.82	8.12
6	045	Replace Lamps	1 [illegible]	$ 2,306	$ 2,306	1.84	8.24
7	330 ~~300~~	Replace Lamps	1 18	$ 2,538	$ 2,538	1.79	8.47
8	400	Replace Lamps	1 16	$ 2,876	$ 2,876	1.71	8.87
9	045	Caulk & W.S.	1 25	$ 1,254	$ 1,254	1.67	8.80
10	046	Replace Lamps	1 [illegible]	$11,078	$11,078	1.61	9.41
11	313	Wall & Roof Insulation	1 [illegible]	$17,643	$17,643	1.43	10.45
12	023	Caulk & W.S.	1 [illegible]	$ 4,890	$ 4,890	1.24	11.92
13	023	Air Stratification	1 112	$ 6,056	$ 6,056	1.20	12.28
14	306	Replace Lamps	1 7	$ 1,661	$ 1,661	1.14	13.46
15	450	Replace Lamps	1 59	$13,894	$13,894	1.14	13.46
16	844	Replace Lamps	1 108	$25,619	$25,619	1.14	13.46
17	325	Replace Lamps	1 4	$ 831	$ 831	1.14	13.47
18	304	Replace Lamps	3 27	$ 2,041	$ 6,123	1.14	13.47
19	327	Replace Lamps	1 1	$ 301	$ 301	1.14	13.48
20	308	Replace Lamps	1 2	$ 416	$ 416	1.14	13.52
21	022	Replace Lamps	1 [illegible]	$21,405	$21,405	1.08	14.32
22	330	Replace Ballasts	1 52	$10,492	$10,492	1.06	14.33
				PROJECT TOTALS	$182,718		

P/J Total 2,229

CARLISLE BARRACKS ENERGY STUDY

RECOMMENDED ECO'S SUMMARY

HOUSING UNITS

Ranking (Based on SIR)	Building No.	Energy Item (ECO)	No. of Typical Buildings	Cost Estimate (Each)	Cost Estimate (Total)	SIR	Simple Payback (Yeas)
1	321	Caulk & W.S.	1 114	$ 1,413	$ 1,413	6.05	2.44
2	003	Caulk & W.S.	1 38	$ 737	$ 737	4.07	3.62
3	201	Caulk & W.S.	4 2.8	$ 1,602	$ 6,408	1.86	9.46
4	001	Caulk & W.S.	1 89	$ 3,918	$ 3,918	1.79	8.23
5	321	Wall & Roof Insulation	1 59	$ 3,717	$ 3,717	1.47	10.08
6	002	Caulk & W.S.	1 70	$ 3,918	$ 3,918	1.40	10.54
7	205	Caulk & W.S.	16 39	$ 3,203	$51,248	1.28	13.78
8	025	Caulk & W.S.	1 12	$ 929	$ 929	1.00	14.75
		Pg TOTAL	449	PROJECT TOTALS	$ 72,288		

TOTAL 2,678 MBTU

X. SCOPE OF WORK

CENAO-EN-MP

June 2, 1993

SCOPE OF WORK
FOR AN
ENERGY SAVINGS OPPORTUNITY SURVEY (ESOS)
AT
CARLISLE BARRACKS

Performed as part of the
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK

FOR AN
ENERGY SAVINGS OPPORTUNITY SURVEY (ESOS)
AT CARLISLE BARRACKS

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ANNEXES

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

1.1 Review for general information the previously completed Energy Engineering Analysis Program (EEAP) study and any other energy studies which were performed at this installation.

1.2 Perform a limited site survey of selected buildings or areas to insure that any methods of energy conservation which are practical and have not been evaluated in any previous energy study have been considered and the results documented.

1.3 Reevaluate selected projects and energy conservation opportunities (ECOs) from the previous studies to determine their economic feasibility based on revised criteria, current site conditions and technical applicability.

1.4 Evaluate selected ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide complete programming or implementation documentation for all recommended ECOs.

1.6 Prepare a comprehensive report to document the work performed, the results and the recommendations.

2. GENERAL

2.1 Other studies performed under the EEAP have been performed at this installation. Criteria for both the study and the resulting documentation has changed since the previous study was completed. This study is intended to reevaluate selected projects from the previous study which have not been implemented nor programmed for implementation and to consider specific ECOs in buildings and areas that may have been overlooked previously or recently identified.

2.2 The information and analysis outlined herein are considered to be minimum essentials for adequate performance of this study.

2.3 The A-E shall ensure that all methods of energy conservation which will reduce the energy consumption of the installation in compliance with the Energy Resources Management Plan including those listed in Annex A have been considered and documented. All methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination. Annex A contains a list of ECOs by building specifically for this installation. The A-E may be aware of other ECOs not included in Annex A that will produce energy, manpower or

dollar savings. These should be evaluated the same as the listed ECOs.

2.4 The study shall include the energy consuming buildings or areas listed in Annex A. The work in the areas may be reduced somewhat by repetition.

2.5 The study shall consider the use of all energy sources. The energy sources may include electricity, natural gas, liquefied petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, solar, etc.

2.6 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from CEHSC-FU, dated 4 November 1992, established 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.

2.7 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the A-E desires to use a different program it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.

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

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

2.8.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

3. PROJECT MANAGEMENT

3.1 Project Managers. The A-E shall designate a project manager to serve as a point of contact and liaison for the work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The A-E's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for 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 Government's representative.

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

3.3 Public Disclosures. The A-E shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the A-E or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The A-E and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

3.5 Site Visits, Inspections and Investigations. The A-E shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records.

3.6.1 The A-E 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 A-E and/or designated representative(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 A-E shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

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

3.7 Interviews. The A-E and the Government's representative shall conduct entry and exit interviews with the Director of Public Works before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. 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 Public Works.

3.7.2 Exit. The exit interview shall briefly describe the items surveyed and probable areas of energy conservation. The interviews shall also solicit input and advise from the Director of Public Works.

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

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the A-E has considered shall be included in one of the following categories and presented in the report as such:

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 $300,000, a Savings to Investment Ratio greater than one and a simple payback period of less than ten years. The overall project and each discrete part of the project shall have an SIR greater than one. For all projects meeting the above criteria, complete programming documentation shall be required. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) 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 ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. For projects and ECOs reevaluated from previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages 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 under which the project or ECO was developed 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. The purpose of this information is to provide a means to prevent duplication of projects in any future reports.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate or payback period, but which have an SIR greater than one shall be documented. Projects or ECOs in this category shall be provided with the following documentation: the life cycle cost analysis (LCAA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCAA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government'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 greater than $3,000 but less than $100,000 and a simple payback period of two years or less.

b. Productivity Enhancing Capital Investment Program (PE-CIP). This program is for projects which have a total cost of greater than $3,000 but less than $100,000 and a simple payback period of four years or less.

c. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than $100,000 and a simple payback period of four years or less.

The above programs and the required documentation forms are all described in detail in AR 5-4, Change No. 1.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $300,000 and a simple payback period of four to twenty-five years. Documentation shall consist of DD Form 1391 and a Project Development Brochure.

e. Low Cost/No Cost Projects. These are projects which the

Director of Public Works (DPW) can perform using his resources. Documentation shall be as required by the DPW.

5.3 Nonfeasible ECOs. All ECOs which the A-E has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The general Scope of Work is intended to apply to contract efforts for all Army installations included under this contract except as modified by the detailed Scope of Work for each individual installation. The detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. The A-E shall review for general information the previous EEAP study along with any other energy studies performed at the installation. This review should acquaint the A-E with the work that has been performed previously. Much of the information the A-E may need to develop the ECOs in this project will be contained in the previous studies. The survey data contained in the previous study should be very helpful to the results of this study.

7.2 Perform a Limited Site Survey. The A-E shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the A-E is encouraged to use any data that may have been documented in a previous study. The A-E shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The A-E shall reevaluate the projects and ECOs listed in Annex A. These projects and ECOs are projects and ECOs that the previous study has identified but that have not been accomplished or only parts have been accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information, the project shall than be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings. The energy costs and construction cost shall be updated and the revised project or ECO shall than be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the A-E shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

7.4 Evaluate New ECOs. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined when using current ECIP guidance. The A-E shall provide all data and calculations needed to support the conclusions. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO 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. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data. The following classes of ECOs are included:

a. General ECOs: The list of ECOs for each building or area are shown in Annex A. Those items on the list which are not practical, have previously been 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.

b. Selected ECOs: These are the specific ECOs which are listed in Annex A.

c. Contractor-identified ECOs: These are those ECOs which the A-E is aware of or notes during the field survey that are not included in Annex A but will produce energy, manpower or dollar savings. These should be evaluated the same as the listed ECOs.

7.5 Provide Programming or Implementation Documentation. During the Interim Review Conference, as outlined in paragraph 7.6.1, the A-E will be advised of the DPW's preferred packaging of recommended ECOs into projects for implementation. These projects will be documented as outlined in paragraphs 5.1, 5.2, and 5.3. Programming documentation will be included in the Prefinal Submittal per par 7.6.2 Programming documents shall be separate from the narrative report, and they shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly.

7.6 Submittals, Presentations and Reviews. 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. All pages shall be numbered. The A-E shall give a formal presentation of all but the final submittal to installation, command and other Government personnel. The A-E shall prepare slides or view graphs showing the results of the study to date for his presentation. 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 the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The A-E shall provide the comments from all reviewers and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date(s) agreeable to the Director of Public Works, the A-E and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved if they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justification of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The A-E shall submit the Scope of Work and any modifications to the Scope of Work 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 Government's representative shall coordinate with the Director of Public Works and provide the A-E with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. A sample implementation document (DA Form 5108-R, sketches and manufacturers data, life cycle cost analysis summary sheet and supporting data) for one project shall be submitted with this submittal for review and approval. The survey forms completed during this audit shall be submitted in final form with this submittal. They should be clearly marked at the time of the submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Prefinal Submittal. The A-E shall prepare and submit the prefinal report when all work under this contract is complete. The A-E shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report 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. The synergistic effects of all of the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming

and implementation documents for all recommended projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal report, separately bound Executive Summary and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) 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 (See Annex C for minimum requirements), (b) 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, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. 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, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

7.6.3 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation and review conference shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, 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 volume issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of complete volumes. If new volumes are submitted they shall be in standard three-ring binders 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.

ANNEX A

DETAILED SCOPE OF WORK
CARLISLE BARRACKS

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GENERAL ECOs**

BUILDING #	P	SQ FT	ECOs TO BE EVALUATED 1	2	3	4	5	6	7	8	9
1	*	11651	X		X						
2	*	6708	X		X		X				
3	*	5483		X	X		X				
4	*	3785	X	X	X		X				
5	*	7620	X	X	X		X				
6		7620	X	X	X		X				
17		7620	X	X	X		X				
18		7620	X	X	X		X				
19		7620	X	X	X		X				
20		7620	X	X	X		X				
21		7620	X	X	X		X				
22	*	59272						X	X	X	X
23	*	23142	X		X				X	X	X
24	*	20018			X						
25	*	1291		X	X						
26	*	7620	X	X	X		X				
28	*	3785	X	X	X		X				
29		7620	X	X	X		X				
32	*	1797			X						
33	*	1954			X						
34	*	1785			X						
40	*	8707	X								
45	*	6950	X	X	X		X		X	X	X
46	*	21208	X						X	X	X
101	*	4534	X	X	X		X				
102	*	4090	X	X	X		X				
103		4534	X	X	X		X				
104		4090	X	X	X		X				
105		4534	X	X	X		X				
106		4090	X	X	X		X				
107	*	4678	X	X	X		X				
108		4090	X	X	X		X				
109		4534	X	X	X		X				
110		4090	X	X	X		X				
111		4534	X	X	X		X				
112		4090	X	X	X		X				
113		4534	X	X	X		X				
114		4534	X	X	X		X				
116	*	90120		X	X						
118	*	6002	X								
122	*	176167		X	X	X			X	X	X
201	*	3796	X	X	X						
202		3796	X	X	X						
203		3796	X	X	X						

** KEY to numerical designation of ECOs/Symbols provided at end of table

GENERAL ECOs (CONT'D)**

BUILDING #	P	SQ FT	ECOs TO BE EVALUATED 1	2	3	4	5	6	7	8	9
204		3796	X	X	X						
205	*	3944	X	X	X						
206		3944	X	X	X						
207		3944	X	X	X						
208		3944	X	X	X						
209		3944	X	X	X						
210		3944	X	X	X						
211		3944	X	X	X						
212		3944	X	X	X						
213		3944	X	X	X						
214		3944	X	X	X						
215		3944	X	X	X						
216		3944	X	X	X						
217		3944	X	X	X						
218		3944	X	X	X						
219		3944	X	X	X						
220		3944	X	X	X						
253	*	14008	X						X	X	X
259	*	4265	X	X	X						
301	*	6437				X					
304	*	2863							X	X	X
305		2863							X	X	X
306	*	4750							X	X	X
308	*	4480							X	X	X
309	*	1121							X	X	X
311	*	6696	X		X						
312	*	5468	X		X						
313	*	21860	X	X	X		X				
318	*	4112	X		X						
321	*	3340	X		X						
325	*	3381							X	X	X
327	*	2923							X	X	X
330	*	5155			X				X	X	X
400	*	4943	X		X				X	X	X
420	*	21481	X								
441	*	4442					X				
442		4442					X				
443		4442					X				
444		4442					X				
445		4442					X				
450	*	28631							X	X	X
452	*	18595	X	X	X			X	X	X	X
844	*	36667							X	X	X
901	*	6872	X	X	X						

** KEY to numerical designation of ECOs/Symbols provided on next page.

KEY TO GENERAL ECOs TABLE

NUMBER	GENERAL ENERGY CONSERVATION OPPORTUNITY (ECO)
1	Insulation (wall, roof, etc)
2	Insulated glass or double glazed windows
3	Weather stripping and caulking
4	Low emissivity windows
5	Insulate pipe, duct
6	Install occupancy sensors to control lighting
7	Replace standard fluorescent lamps with energy-conserving lamps
8	Replace standard fluorescent ballasts with electronic ballasts
9	Replace existing fluorescent fixtures with new fixtures having efficient reflectors, electronic ballasts, and energy conserving lamps

SYMBOL	MEANING
P	Building Prototype for surveys/calculations
*	Indicates buildings which require field surveys and calculations, buildings not * (left blank) should be assumed to be identical to the last starred building and energy savings should be shown as identical to the prototype

SPECIFIC ECOs

- Prevent Air Stratification - Bldg 253, Bldg 23, Bldg 120
- Infrared Heaters - Bldg 253
- Vestibule - Bldg 420
- Replace Head-End of EMCS
- Revise building HVAC controls - Bldg 313
- Heat Recovery - Bldg 313, Bldg 122

GOVERNMENT FURNISHED CRITERIA

1. Final reports of previously completed studies performed under the Energy Engineering Analysis Program (EEAP).

2. Latest copies of other energy studies performed since the previous EEAP study.

3. Energy Resources Management Plan

4. ETLs 1110-3-254, Use of Electric Power for Comfort Space Heating, 1110-3-282, Energy Conservation, 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded through the MCA Program and 1110-3-332, Economic Studies.

5. Architectural and Engineering Instructions.

6. Energy Conservation Investment Program (ECIP) Guidance, dated 4 November 1992.

7. Information on Existing EMCS Studies, Designs, Construction Contracts, or Operating Systems.

8. TM 5-785, Engineering Weather Data, TM 5-800-2, General Criteria Preparation of Cost Estimates, TM 5-800-3, Project Development Brochure, TM 5-815-2, Energy Monitoring and Control Systems (EMCS).

9. 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; AR 11-27, Army Energy Program; and AR 5-4, Change No. 1, Department of the Army Productivity Improvement Program.

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

11. CEHND-SP-90-244-ED-ME, EMCS Cost Estimating Guide.

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

13. The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin.

14. An example of a correctly completed implementation document for a project.

SPECIAL REQUIREMENTS AND INFORMATION

1. The coordinator at Carlisle Barracks to serve as the point of contact and liaison for all work required under this contract is Mr. Ray Verbish, DPW, Engineering Plans and Service, phone number (717) 245-3746, fax number (717) 245-4296.

2. The fiscal year to which all ECIP projects should be estimated to and programming or implementation documents prepared for is FY 95. Depending on project packaging, the Installation Commander may determine different program years for the final report. Remaining projects can be escalated to a FY TBD.

3. The A-E will provide a cover letter with all submittals noting a review is required and that a review conference is scheduled approximately 45 days hence. The letter will also inform recipients of letter to follow from the Norfolk District COE setting the exact conference date.

4. Acceptable programs for computer modeling include the following simulation programs:

a. Building Loads and System Thermodynamics (BLAST)

b. DOE 2.1B

c. Carrier E20 or Hourly Analysis Program (HAP)

d. Trane Air-Conditioning Economics (TRACE)

5. A computer program titled Life Cycle Costing in Design (LCCID) is available from he BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program can be used for performing the economic calculations for ECIP and non-ECIP ECOs. The A-E is encouraged to obtain and use this program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (800) 842-5278.

SUBMITTAL DISTRIBUTION LIST

Address	Interim 60%	Prefinal 90%	Final 100%
Commander U.S. Army Engineer Division, North Atlantic ATTN: CENAD-EN-MM (Mr. Wong) 90 Church Street New York, NY 10007	2 cys	2 cys	2 cy
Commander US Army Corps of Engineers ATTN: CEMP-ET (Mr. Gentil) 20 Massachusetts Ave NW Washington, DC 20314-1000		Executive Summary Only 1 cy	1 cy
Commander U.S. Army Engineer District, Norfolk ATTN: CENAO-EN-MP (~~Ms. Gibson~~ Mr. Hafner) 803 Front Street Norfolk, VA 23510	3 cys	3 cys	3 cys
Commander U.S. Army Engineer District, Mobile ATTN: CESAM-EN-CM (Mr. Battaglia) P.O.Box 2288, 109 St. Joseph Street Mobile, AL 36628-0001	1 cy	1 cy	1 cy
Commander U.S. Army Logistics Evaluation Agency ATTN: LOEA-PL (Mr. Keath) New Cumberland Army Depot New Cumberland, PA 17070-5007		Executive Summary Only 1 cy	1 cy
Commander HQ U.S. Army Training and Doctrine Command ATTN: ATBO-GFE (Mr. Dancy) Fort Monroe, VA 23651-5000	1 cy	1 cy	1 cy
Commander Carlisle Barracks ATTN: DPS-EP&S (Mr. Verbish) Carlisle Barracks, PA 17013	2 cys	3 cys	3 cys
	9 cys	12 cys	12 cys

SCHEDULE OF ACTIVITIES

Activity	Calendar Days (NTP Plus)
NTP	0
Interim Submittal	175
Interim Review Conference	220
Prefinal Submittal	290
Prefinal Review Conference	335
Prefinal (Corrected)/Final Submittal	365

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 areas, designated temporary or permanent, and usage (administration, patient treatment, etc.).

d. List references and 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) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

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

f. An ECIP life cycle cost analysis summary sheet as shown in the ECIP guidance shall be provided for the complete project and for each discrete 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.

g. 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.

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

i. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.

j. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

k. Any requirements required by ECIP guidance dated 4 November 1992 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

l. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

ANNEX C

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption.

   o Total Annual Energy Used.

   o 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

4. Historical Energy Consumption.

5. Reevaluated Projects Results.

6. Energy Conservation Analysis.

   o ECOs Investigated

   o ECOs Recommended

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP Projects Developed. (Provide list)*

   o Non-ECIP Projects Developed. (Provide list)*

   o 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, the simple payback period and the analysis data. For all programmed projects also include the year in which it is programmed and the programmed year cost.

7. Energy and Cost Savings.

   - o Total Potential Energy and Cost Savings.
   - o Percentage of Energy Conserved.
   - o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

8. Energy Plan.

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

XI. LETTERS FROM CARLISLE BARRACKS

DEPARTMENT OF THE ARMY
HEADQUARTERS CARLISLE BARRACKS
CARLISLE, PENNSYLVANIA 17013-5002

November 22, 1993

REPLY TO
ATTENTION OF

Directorate of Public Works

Benatec Associates
101 Erford Road
Attention: Mr. Dave Burkette
Camp Hill, Pennsylvania 17011

BENATEC ASSOCIATES
ENGINEERING DIVISION
PROJECT No. 933702
NOV 24 1993
RECD

Dear Dave:

As per your letter of 17 November 1993 and your telephone conversation with Ray Verbish on 19 November 1993, we are submitting the following information that you have requested:

a. The normal heating season for buildings connected to the Central Heating Plant is from mid October to the end of April with some variation due to unusual weather conditions.

b. The normal air conditioning season is from mid May to the end of September. However, Bldg 122, Root Hall, operates air conditioning most of the year unless temperatures are low enough to operate on outside air.

c. The average cost of natural gas is $5.15 per 1000 cu. ft. (MCF). There are no service or demand charges which would significantly alter the $5.15 per MCF cost for gas.

d. The number of people normally assigned to the OMA buildings included in the survey is given on the enclosed listing.

If you have any questions concerning this information please contact Mr. Raymond Verbish, Phone 717-245-3746.

Sincerely,

Alan K. Thompson, P.E.
Director, Public Works

Enclosure

APPROXIMATE NUMBER OF PERSONS USING BUILDINGS INVOLVED IN ESOS

BUILDING NO.	ASSIGNED PERSONNEL	COMMENTS
22	28	
23	5	
45	42	
46	61	
118	(328 seats)	Used for 2-3 hour periods during weekend evenings for motion pictures. Very limited use during a normal week.
122	420	
253	10	
301	5	
304	9	
305	12	
306	3	
308	0	
309	11	
313	12	See Note Below
325	2	
327	0	
330	17	
400	20	
420	52	
450	100	Approx. 500 Persons/Day As Customers.
452	8	80 to 100 Persons thru a Typical Day utilize the facility.
844	118	

NOTE: Bldg 313 (Officers Club) has on average 12 staff persons on duty during their operating hours. However, during a typical day they may average 50 persons for lunch and 30 persons for dinner and after to closing time. Also there may be an average of three parties/week with 100 or more persons present.

XII. PENNSYLVANIA POWER AND LIGHT (PP&L) RATES

PP&L Pennsylvania Power & Light Company
Two North Ninth Street • Allentown, PA 18101

Rate Schedule Base Rates - 4/1/93

RS
$4.80
8.30 ¢/KWH (200)
6.36 ¢/KWH (XS)

Separate Meter Off-peak Water Heating (Reference RW0) (Restricted)
$4.50
3.23 ¢/KWH
12 Hours On-Peak
7A-7P,8A-8P,9A-9P

Single Meter Off-peak Water Heating (Reference RW1)
$9.30
8.30 ¢/KWH (200)
4.21 ¢/KWH (400)
6.36 ¢/KWH (XS)
10 Hours On-Peak
7A-5P,8A-6P,9A-7P

RTS
$10.95
5.80 $/On-Peak KW (XS of 2 KW)
2.84 ¢/KWH
10 Hours On-Peak
7A-5P,8A-6P,9A-7P

RTD
$10.95
12.70 ¢/KWH (On-Peak)
4.21 ¢/KWH (Off-Peak)
10 Hours On-Peak
7A-5P,8A-6P,9A-7P

GH-1 (Restricted)
$15.00
1.10 $/KW
8.02 ¢/KWH (150 KWH/KW) (Max 2,500 KWH)
6.43 ¢/KWH (250 KWH/KW)
6.33 ¢/KWH (XS)
8 Hours On-Peak
7A-3P,8A-4P,9A-5P
+ $12.00/mo. Meter Charge

GH-2 (Restricted)
$15.17 (Includes 200 KWH)
6.84 ¢/KWH (XS)

GS-1
$6.56 (Includes 4 KW)
1.76 $/KW (XS of 4 KW)
9.61 ¢/KWH (150 KWH/KW)
7.00 ¢/KWH (XS)
8 Hours On-Peak
7A-3P,8A-4P,9A-5P
+ $12.00/mo. Meter Charge

Off-Peak Space Heating 7P-7A
$12.00/mo. + 2.84 ¢/KWH

GS-3 (25 KW Min)
7.00 $/KW (125 KW)
4.65 $/KW (XS)
5.70 ¢/KWH (150 KWH/KW)
4.79 ¢/KWH (100 KWH/KW)
4.41 ¢/KWH (150 KWH/KW)
3.90 ¢/KWH (XS)
8 Hours On-Peak
7A-3P,8A-4P,9A-5P
+ $12.00/mo. Meter Charge

Off-Peak Space Heating 7P-7A
$12.00/mo. + 2.84 ¢/KWH

LP-4 (25 KW Min)
6.55 $/KW (200 KW)
4.45 $/KW (XS)
5.41 ¢/KWH (150 KWH/KW)
4.49 ¢/KWH (100 KWH/KW)
4.10 ¢/KWH (150 KWH/KW)
3.80 ¢/KWH (XS)
8 Hours On-Peak
7A-3P,8A-4P,9A-5P
+ $12.00/mo. Meter Charge

Off-Peak Space Heating 7P-7A
$12.00/mo. + 2.80 ¢/KWH

LP-4 Interruptible (25 KW Min & ≥ 1,000 Interruptible KW)
9.80 $/KW
BKW = Firm KW + [Interr. KW x (1-Avg L.F.)]
3.68 ¢/KWH (1st 400 hrs. use)
2.24 ¢/KWH (XS)

LP-5 (300 KW Min)
4.39 $/KW
4.86 ¢/KWH (150 KWH/KW) (Max 1,200,000 KWH
4.43 ¢/KWH (100 KWH/KW)
3.68 ¢/KWH (150 KWH/KW)
3.21 ¢/KWH (XS)
8 Hours On-Peak
7A-3P,8A-4P,9A-5P
+ $12.00/mo. Meter Charge

LP-5 Interruptible (300 KW Min & ≥ 1,000 Interruptible KW)
9.60 $/KW
BKW = Firm KW + [Interr. KW x (1-Avg L.F.)]
3.21 ¢/KWH (1st 400 hrs. use)
2.14 ¢/KWH (XS)

IS-1 (300 KW Min)
$293.00
8.90 $/KW
3.91 ¢/KWH (730 KWH/KW)
2.91 ¢/KWH (XS)

IS-2 (7,500 KW Min)
$20,447.00
27.11 $/KW Firm
21.27 $/KW Interruptible
Above charges include 600 KWH/KW
2.10 ¢/KWH (XS of 600 KWH/KW)

BL
7.81 ¢/KWH
+1% Investment Cost to Deliver/Meter

FERC Rate Schedules

12 KV Service (150 KW Min)
5.00 $/KW
6.80 ¢/KWH (150 KWH/KW) (Max 1,200,000 KWH)
5.25 ¢/KWH (100 KWH/KW)
3.50 ¢/KWH (XS)
On-Peak Hours 7A-3P

66 KV Service (150 KW Min)
4.50 $/KW
6.58 ¢/KWH (150 KWH/KW) (Max 1,200,000 KWH)
5.03 ¢/KWH (100 KWH/KW)
3.28 ¢/KWH (XS)
On-Peak Hours 7A-3P

Rate Schedule	Description
RS	Residential
RWO(R)	Separate Meter Off-Peak Water Heating
RW1	Single Meter Off-Peak Water Heating
RTS	Residential Thermal Storage
RTD	Residential Time-Of-Day
GS-1	Small General Service (Secondary)
GS-3	Large General Service (Secondary)
LP-4	Large Power (12 KV)
LP-5	Large Power (66 KV)
GH-1(R)	Commercial Heating (All Electric)
GH-2(R)	Commercial Heating (Space Heating)
IS-1	Interruptible: Greenhouses
IS-2	Interruptible: High Load Factor
BL	Borderline
SI-1(R)	Street Light - Incandescent
SM	Street Light - Mercury Vapor
SHS	Street Light - High Pressure Sodium
SE	Street Light - Energy Only
SA	Area Lighting
TS(R)	Traffic Signals

XIII. FORM 1391

1. COMPONENT ARMY	FY 1994 MILITARY CONSTRUCTION PROJECT DATA			2. DATE May 30, 1994
3. INSTALLATION AND LOCATION Carlisle Barracks, Carlisle, PA		4. PROJECT TITLE Energy Savings Opportunity Survey		
5. PROGRAM ELEMENT	6. CATEGORY CODE 71100	7. PROJECT NUMBER		8. PROJECT COST ($000) $178,637

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Building 901 Insulated Glass	EA	1	$ 2,024	$ 2,024
Building 253 Replace Lamps	EA	1	3,249	3,249
Building 901 Caulk & W.S.	EA	1	3,561	3,561
Building 122 Caulk & W.S.	EA	1	17,470	17,470
Building 122 Insulated Glass	EA	1	27,031	27,031
Building 045 Replace Lamps	EA	1	2,306	2,306
Building 330 Replace Lamps	EA	1	2,538	2,538
Building 400 Replace Lamps	EA	1	2,876	2,876
Building 045 Caulk & W.S.	EA	1	1,254	1,254
Building 046 Replace Lamps	EA	1	11,078	11,078
Building 313 Wall & Roof Insulation	EA	1	17,643	17,643
Building 023 Caulk & W.S.	EA	1	4,890	4,890
Building 023 Prevent Air Stratification	EA	1	6,056	6,056
Building 306 Replace Lamps	EA	1	1,661	1,661
Building 450 Replace Lamps	EA	1	13,894	13,894
Building 844 Replace Lamps	EA	1	25,619	25,619
Building 325 Replace Lamps	EA	1	831	831
Building 304 Replace Lamps	EA	3	2,041	6,123
Building 327 Replace Lamps	EA	1	301	301
Building 308 Replace Lamps	EA	1	416	416
Building 022 Replace Lamps	EA	1	21,405	21,405
Building 330 Replace Ballasts	EA	1	10,492	10,492
TOTAL				$182,718

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Addition of caulking and weather stripping to four (4) buildings, replacement of windows in two (2) buildings, replacement of lamps in fifteen (15) buildings, addition of wall and roof insulation in one (1) building, addition of ceiling fans to prevent air stratification in one (1) building, and replacement of lighting ballasts in one (1) building to provide energy savings.

FORM DD 1391
1 DEC 76

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933702

1. COMPONENT ARMY	FY 1994 MILITARY CONSTRUCTION PROJECT DATA		2. DATE May 30, 1994
3. INSTALLATION AND LOCATION Carlisle Barracks, Carlisle, PA		4. PROJECT TITLE Energy Savings Opportunity Survey	
5. PROGRAM ELEMENT	6. CATEGORY CODE 80000	7. PROJECT NUMBER	8. PROJECT COST ($000) $19,437

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Building 321 Caulk & W.S.	EA	1	$ 1,413	$ 1,413
Building 003 Caulk & W.S.	EA	1	737	737
Building 201 Caulk & W.S.	EA	4	1,602	6,408
Building 001 Caulk & W.S.	EA	1	3,918	3,918
Building 321 Wall & Roof Insulation	EA	1	3,717	3,717
Building 002 Caulk & W.S.	EA	1	3,918	3,918
Building 205 Caulk & W.S.	EA	16	3,203	51,248
Building 025 Caulk & W.S.	EA	1	929	929
TOTAL				$ 72,288

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Addition of caulking and weather stripping to twenty-five (25) buildings and the addition of wall and roof insulation in one (1) building to provide energy savings.

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DD 1391
1 DEC 76

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