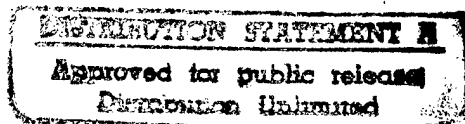


**Energy Savings Opportunity Survey
Energy Engineering Analysis Program (EEAP)
Fort Campbell, Kentucky**

Final Report - Phase II

Executive Summary



CONTRACT # DACA27-93-C-0096
SYSTEMS/CORP PROJECT # 93006.01
NOVEMBER 24, 1993

SYSTEMS*corp*

SYSTEMS ENGINEERING AND MANAGEMENT CORPORATION



US Army Corps
of Engineers




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FINAL REPORT EXECUTIVE SUMMARY

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1 EXECUTIVE SUMMARY

1.1 SYNOPSIS

Systems Corp surveyed and completed energy analyses for 112 buildings, two generators, four chillers, and roadway lighting. The energy conservation opportunities (ECOs) evaluated were lighting efficiency improvements, peak-shaving generators, chiller replacement, variable speed circulation pumps, EMCS expansion, and Commissary lighting. Cost estimates were prepared using M-CACES. Life cycle cost analyses were performed using the Life Cycle Cost in Design (LCCID) computer program. Project development brochures (PDBs) and DD1391 forms were prepared for Energy Conservation Investment Program (ECIP) projects. The projects that were developed represent \$187,203 in annual savings with favorable simple paybacks and savings to investment ratios (SIRs).

1.2 INTRODUCTION

Systems Engineering and Management Corporation (Systems Corp) was contracted by the Louisville District of the United States Army Corps of Engineers in June 1993 to perform an energy savings opportunity survey (ESOS) for 112 buildings at Fort Campbell, Kentucky. In addition, the project includes an exterior lighting survey of five locations around the facility, a comprehensive survey of two generators at the Water Treatment Plant and Boiling Springs Pump House, and four chillers serving four buildings.

1.2.1 Scope of Work

1. Evaluate selected energy conservation opportunities (ECOs) to determine their energy savings potential and economic feasibility.
2. Conduct 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.
3. Survey generators to determine required equipment for use for peak-shaving.

1 EXECUTIVE SUMMARY

4. Determine efficiency of existing chillers. Determine the replacement option with the highest SIR.
5. Provide complete programming or implementation documentation for all recommended ECOs.
6. Prepare a comprehensive report to document the work performed, the results, and the recommendations.

1.2.2 Organization of the Final Report

The submitted material for this report consists of the following:

Energy Savings Opportunity Survey
Energy Engineering Analysis Program (EEAP)
Fort Campbell, Kentucky

- Volume 1: Sections 1 - 3
- Volume 2: Sections 3 (cont.) - 4
- Volume 3: Sections 4 (cont.) - 14

1.3 PRESENT AND HISTORICAL ENERGY CONSUMPTION

The baseline energy consumption and energy conservation opportunity energy consumption were determined using spreadsheets and manual calculations to model system energy consumption. These have been included in *Section 2* of this report.

1 EXECUTIVE SUMMARY

1.3.1 Natural Gas Costs

The natural gas consumption and cost for the 12 months (July 1992-June 1993) at Fort Campbell are shown in *Table 1.3.1, Fort Campbell Natural Gas*. *Figure 1.3.1* is a bar graph of the monthly consumption and costs. The natural gas cost used for evaluating the ECOs is as follows:

$$\begin{aligned}\text{COST/MCF} &= \$3.41/\text{MCF} \\ \text{COST/MBTU} &= \$4.00/\text{MBTU}\end{aligned}$$

1.3.2 Electric Costs

The electric energy consumption, demand, and costs for the past 12 months (July 1992-June 1993) are shown in *Table 1.3.2 Fort Campbell Electric*. *Figure 1.3.2* is a bar graph of the monthly consumption and cost. The electric cost used to calculate the electric cost savings for the project is as follows:

$$\begin{aligned}\text{COST/KWH} &= \$0.02114/\text{KWH (No Demand)} \\ \text{COST/MBTU} &= \$6.19/\text{MBTU (No Demand)} \\ \text{COST/KW} &= \$11.78/\text{KW (Monthly Demand)}\end{aligned}$$

1.3.3 Fuel Oil Costs

The fuel oil consumption and costs for FY92 are shown in *Table 1.3.3.1 Fort Campbell Fuel Oil #2*. The fuel oil costs used to calculate savings for this project is as follows:

$$\text{COST/MBTU} = \$4.98/\text{MBTU}$$

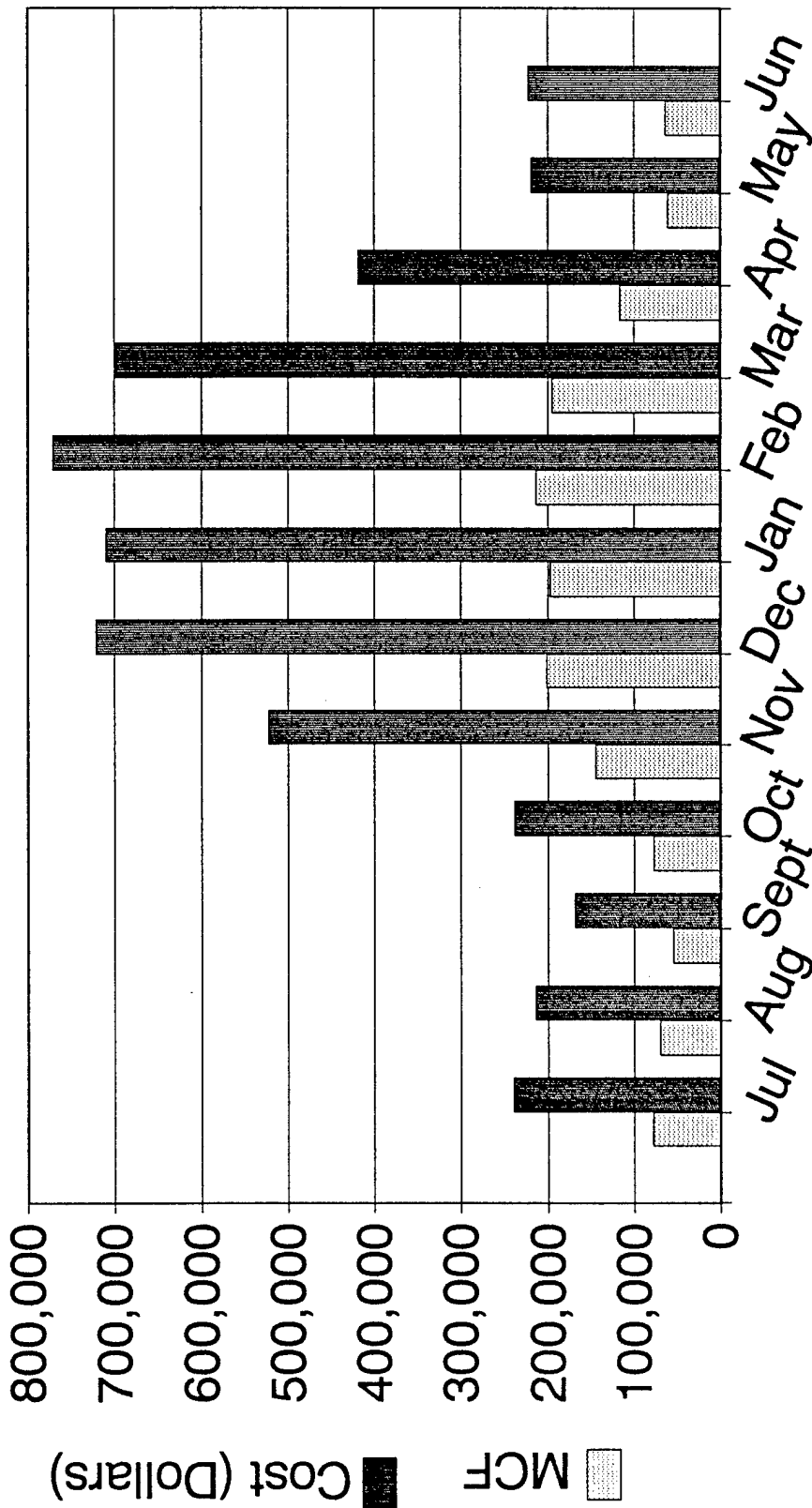
FORT CAMPBELL NATURAL GAS

July 92 - June 93

MONTH	MCF	COST	COST/MCF
Jul 92	77,701	\$239,700	3.08
Aug	69,605	214,724	3.08
Sept	54,771	168,963	3.08
Oct	77,298	238,456	3.08
Nov	145,408	522,621	3.59
Dec	201,521	722,174	3.58
Jan 93	196,833	710,486	3.61
Feb	213,900	771,339	3.61
Mar	195,479	699,147	3.58
Apr	116,968	419,168	3.58
May	60,884	219,255	3.60
Jun	64,113	222,479	3.47
TOTAL	1,474,481	\$5,148,485	3.49
<i>Min</i>	<i>54,771</i>	<i>168,963</i>	<i>3.08</i>
<i>Max</i>	<i>213,900</i>	<i>771,339</i>	<i>3.61</i>
<i>Avg</i>	<i>122,873</i>	<i>429,040</i>	<i>3.41</i>

FORT CAMPBELL ESOS

Natural Gas July 92 - June 93



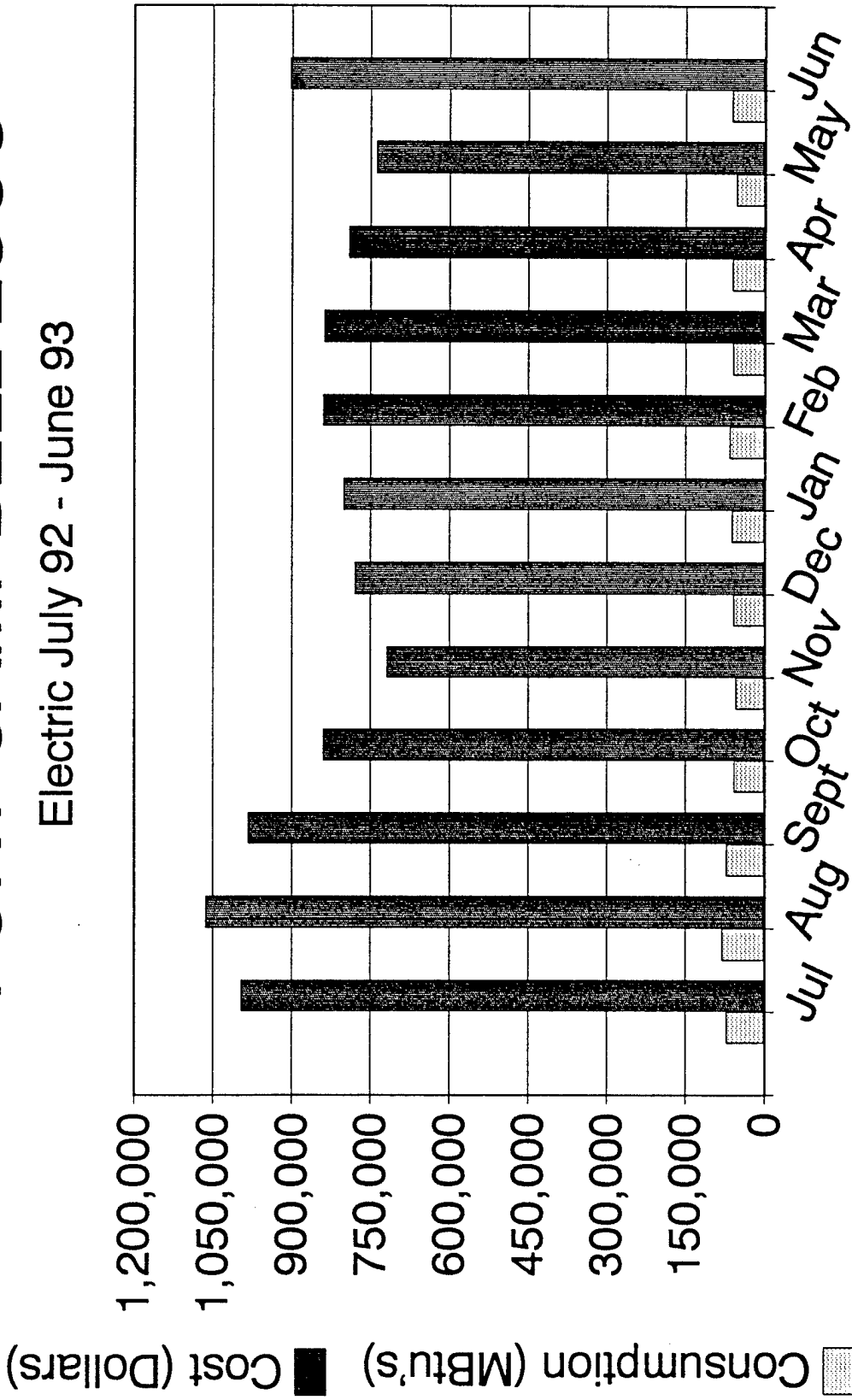
FORT CAMPBELL ELECTRIC

July 92 - June 93

MONTH	DEMAND KW	DEMAND COST	CONSUMPTION KWH	CONSUMPTION COST	COST DEM & CONS	COST/KWH
Jul 92	45,171	\$532,114	21,096,600	\$464,810	\$996,924	.047
Aug	45,927	541,020	23,818,200	523,607	1,064,627	.045
Sept	43,697	514,751	21,319,200	469,265	984,016	.046
Oct	39,425	464,427	17,047,800	376,277	840,704	.049
Nov	31,072	366,028	16,077,600	353,458	719,486	.045
Dec	34,020	400,756	17,287,200	380,190	780,946	.045
Jan 93	33,907	399,424	18,320,400	402,420	801,844	.044
Feb	35,381	416,788	19,307,400	424,019	840,807	.044
Mar	38,140	449,289	17,644,200	388,828	838,117	.048
Apr	33,944	399,860	17,808,000	391,392	791,252	.044
May	34,663	408,330	15,691,200	331,712	740,042	.047
Jun	43,697	514,751	18,429,600	389,601	904,352	.049
TOTAL	459,044	\$5,407,588	223,847,400	\$4,895,579	\$10,303,117	.046
Min	31,072	366,028	15,691,200	331,712	719,486	.044
Max	45,927	541,020	23,818,200	523,607	1,064,627	.049
AVG	38,254	450,628	18,653,950	407,965	858,593	.046

FORT CAMPBELL ESOS

Electric July 92 - June 93



FORT CAMPBELL FUEL OIL #2

FY92

MONTH	BARRELS	MBtu
Oct 91	379	2208
Nov	646	3763
Dec	1041	6064
Jan 92	1820	10,601
Feb	1152	6710
Mar	913	5318
Apr	478	2784
May	0	0
Jun	0	0
Jul	0	0
Aug	286	1666
Sep	0	0
TOTAL	6715	39,114
Total Cost \$195,000		Avg Cost/MBtu \$4.98/MBtu

1 EXECUTIVE SUMMARY

1.4 ENERGY CONSERVATION OPPORTUNITIES INVESTIGATED

Systems Corp analyzed six energy conservation opportunities (ECOs) at Fort Campbell, Kentucky. The analysis was performed utilizing energy models developed by Systems Corp and data collected during the field survey of the facilities at Fort Campbell. Each ECO was evaluated to determine the potential energy savings, dollar savings, implementation costs, simple payback, life cycle cost, and savings to investment ratio (SIR). The six ECOs that were evaluated are as follows:

- ECO - 6 Improve Lighting Efficiency
- ECO - 7 Peak-shaving Generators
- ECO - 8 Replace Chillers with High Efficiency Chillers
- ECO - 9 Variable Speed Circulation Pumps
- ECO - 10 EMCS Expansion
- ECO - 11 Improve Commissary Lighting Efficiency

Systems Corp's energy analysis models were used to determine the savings achieved for implementing each ECO in the facilities that were evaluated. The U.S Army Corp of Engineers M-CACES software was used to estimate the implementation cost of each ECO in each facility evaluated. The U.S Army Corp of Engineers Life Cycle Cost in Design, Version 1.0, Level 72, software was used to perform life cycle cost analyses and determine the SIR of each ECO for each facility evaluated.

1.4.1 ECOs Recommended

Systems Corp recommended that the following ECOs be implemented due to favorable simple pay backs and savings investment ratios (SIRs).

- ECO - 6 Improve Lighting Efficiency
- ECO - 7 Peak-shaving Generators
- ECO - 9 Variable Speed Circulation Pumps

1 EXECUTIVE SUMMARY

ECO - 10 EMCS Expansion

ECO - 11 Improve Commissary Lighting Efficiency

1.4.2 ECOs Rejected

ECO-8, Replace Chiller with High Efficiency Chillers, was rejected due to the fact that the potential energy savings was found to be small for each building that was evaluated. The implementation costs for each building evaluated represented a large investment, and when compared to the savings resulted in simple paybacks in excess of twenty years. Replacing the chillers did not yield an acceptable simple payback in any of the four buildings evaluated.

1.4.3 ECIP Projects Developed

Systems Corp developed two ECIP projects. The projects include the improvement of lighting efficiency in 36 buildings and five family housing areas, and a combination of peak-shaving generators in two facilities, variable speed circulation pumps in two Korean war era barracks, and EMCS expansion in 15 facilities. The following table summarizes the savings and investment for each project.

1 EXECUTIVE SUMMARY

**TABLE 1.4.3
ECIP PROJECT SUMMARY**

1st Yr
Energy Savings
MBTU

		1st Yr Savings	Investment	SIR	SPB (yrs)
1,800	ECIP-1 Lighting	\$44,078	\$342,581	7.77	1.44
1,162	ECIP-2 Gen/EMCS/VSD	\$143,125	\$558,366	3.33	3.90
2,962	TOTAL	\$187,203	\$900,947	5.02*	2.96*

* These numbers are weighted averages to show representative values for a total life cycle cost analysis.

1.4.4 Non-ECIP Projects Developed

Systems Corp developed 2 projects that did not qualify for ECIP funding due to not meeting the \$300,000 investment criteria. The 2 projects are improved lighting efficiency at the Commissary and improved lighting efficiency in non-appropriated funded facilities.

1st YR
ENERGY SAVINGS
MBTU

**TABLE 1.4.4
NON-ECIP PROJECT SUMMARY**

	1st Yr Savings	Investment	SIR	SPB	
3,078	COMMISSARY LIGHTING	\$39,904	\$130,696	3.48	3.28
48	NAF LIGHTING	1,218	7,422	1.84	6.09
3,126	TOTAL	\$41,122	\$138,118	3.39*	3.43*

* These numbers are weighted averages to show representative values for a total life cycle cost analysis.

6,088 GRLND TOTALS 228,325