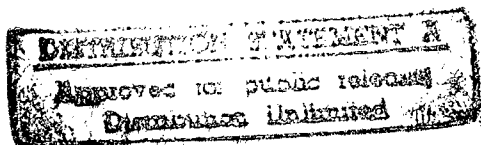


Basewide Energy Systems Plan

19971022 108

Executive Summary

Final Report



Fort Rucker, Alabama

February 1983

Prepared For
MOBILE DISTRICT CORPS OF ENGINEERS
MOBILE, ALABAMA
CONTRACT DACA01-77-C-0094

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Prepared By
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KANSAS CITY, MISSOURI

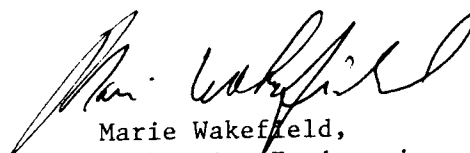


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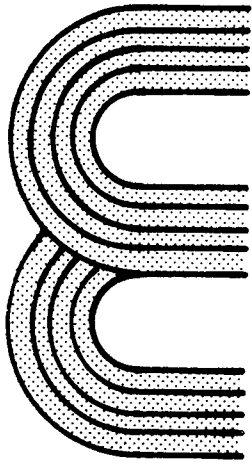
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EXECUTIVE SUMMARY - INCREMENTS A, B, C, D and E

Included in this summary are the results of the first five increments of the Basewide Energy Systems Plan for Fort Rucker, Alabama. This plan includes analyses and recommendations of energy conservation projects for the reduction of the installation's present energy consumption. The savings figures presented in this summary can only be realized after all projects have been implemented. Black & Veatch has developed projects that would meet funding requirements for the energy conservation program. Furthermore, the recommended projects provide partial compliance with the energy conservation requirement for the installation as outlined in the Army Facilities Energy Plan. This summary presents data on the following:

- Existing energy consumption and the basewide energy use model
- Source energy reductions due to energy conservation techniques for buildings and their systems
- Application of solar energy to reduce fossil fuel consumption
- Use of solid waste as an alternate energy source
- Savings utilizing central energy monitoring and control systems (EMCS)

Tables 1 and 2 (all tables are included in Appendix A) present information pertaining to the physical descriptions and energy consumption of 35 typical buildings used to verify historical energy consumption in the development of the basewide energy use model. This model

was then utilized as the foundation for energy conservation project analyses and recommendations. Table 3 summarizes the daily personnel occupancy for each typical building. Tables 1, 2 and 3 also provide information which was used to estimate source energy consumption for similar buildings within the designated groupings.

The foundation for the basewide energy model was the estimated average annual source energy consumed by each of the significant building groups, as indicated in Table 4, totalling 1,822,240 mega-Btu per year. The model was within 2 percent of the FY 75 historical source energy consumption shown below.

FY 75 Source Energy
Consumption in Btu x 10⁶

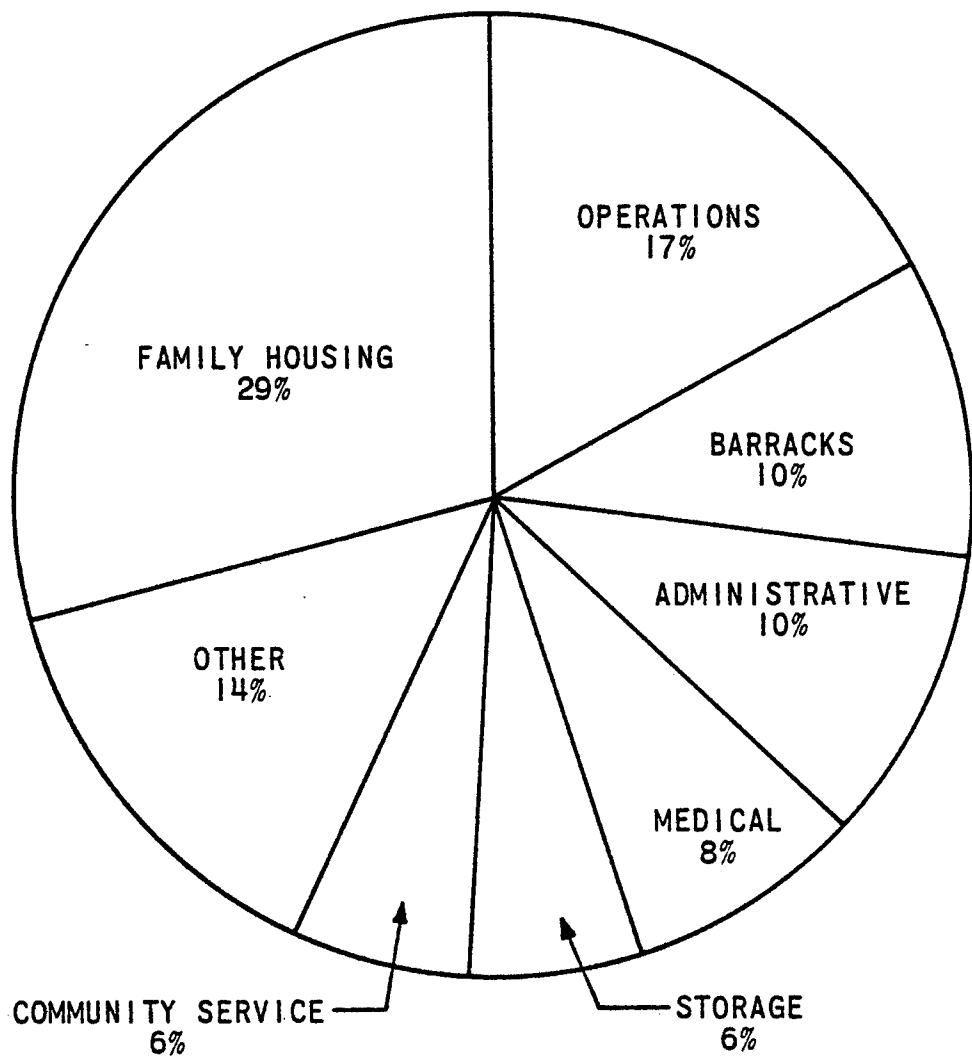
Electricity	918,279
Natural Gas	759,502
Propane Gas	6,947
Fuel Oil No. 2	90,484
Fuel Oil No. 5	<u>22,982</u>

TOTAL 1,798,194

The estimated annual percentage of source energy consumption for all building types contributing to the historical basewide annual total consumed during base year 1975, is shown on Figure 1.

Further explanation of the historical energy consumption and development of the basewide energy model can be found in the Energy Use Survey.

The total estimated source energy savings due to implementation of all feasible energy conservation projects developed within Increments A, B, C, D, and E of this study is 630,344 mega-Btu per year. These



FY'75 CONSUMPTION
(1,798,194 x 10⁶ BTU'S)

FIGURE 1

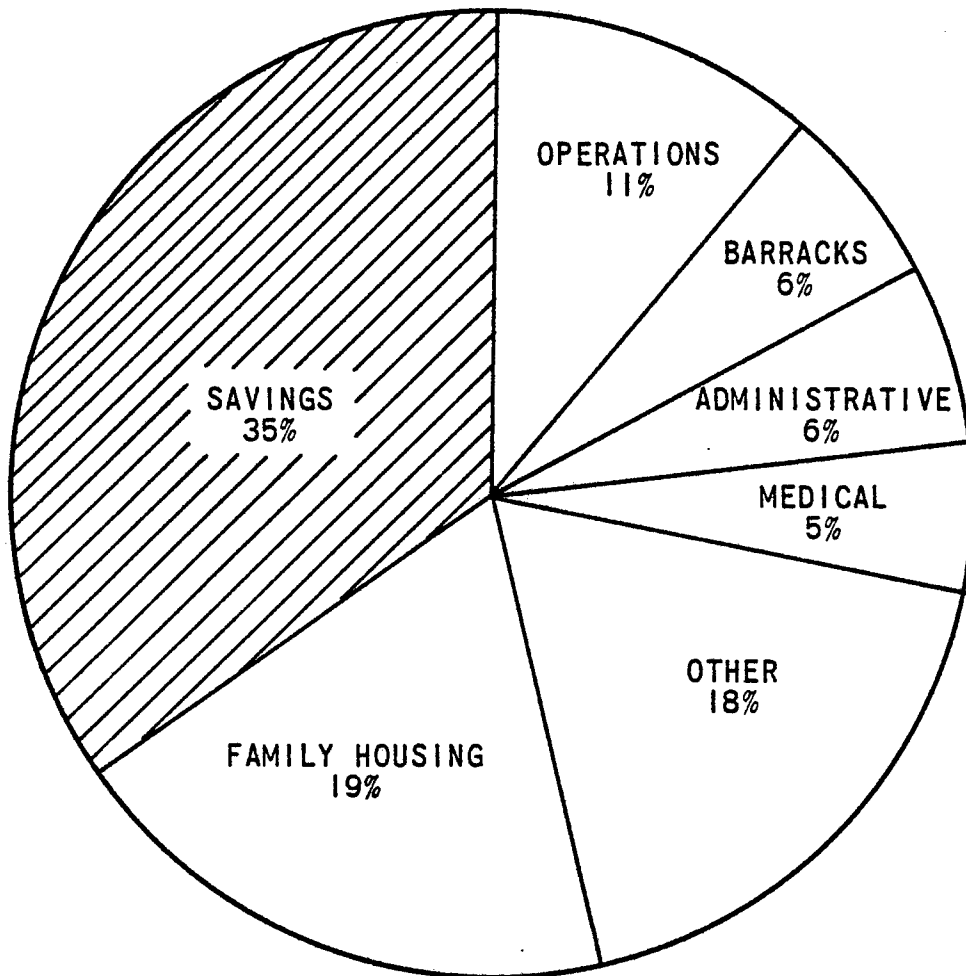
projects consisted of various architectural improvements, and mechanical and electrical system modifications, and are summarized in Tables 5 and 6.

Table 5 presents, by building type, the source energy savings and the percent basewide reduction to be realized by implementation of each of the projects. Figure 2 illustrates the combined effect of the recommended energy saving improvements, as compared to the FY 1975 source energy expenditure. Our calculations indicate a savings of 630,344 mega-Btu per year, approximately 35 percent, over the base year (1975). Figure 3 illustrates the allocation of the energy conservation projects savings for significant building groups.

Table 6 was developed to give a prioritized schedule, in order of fiscal year, for implementing the recommended energy conservation projects. A detailed analysis of the projects listed in Tables 5 and 6, and further explanation of the energy conservation analysis can be found in the Energy Use Survey.

Nine concepts for the reduction of Fort Rucker's dependence on nonrenewable energy sources by utilizing solar energy, a renewable energy source, were evaluated. This evaluation resulted in the recommendation of Project No. 43500 which indicated a total savings of 2,040 mega-Btu per year. The nine concepts and analyses are presented in the Solar Energy Applications and Evaluation.

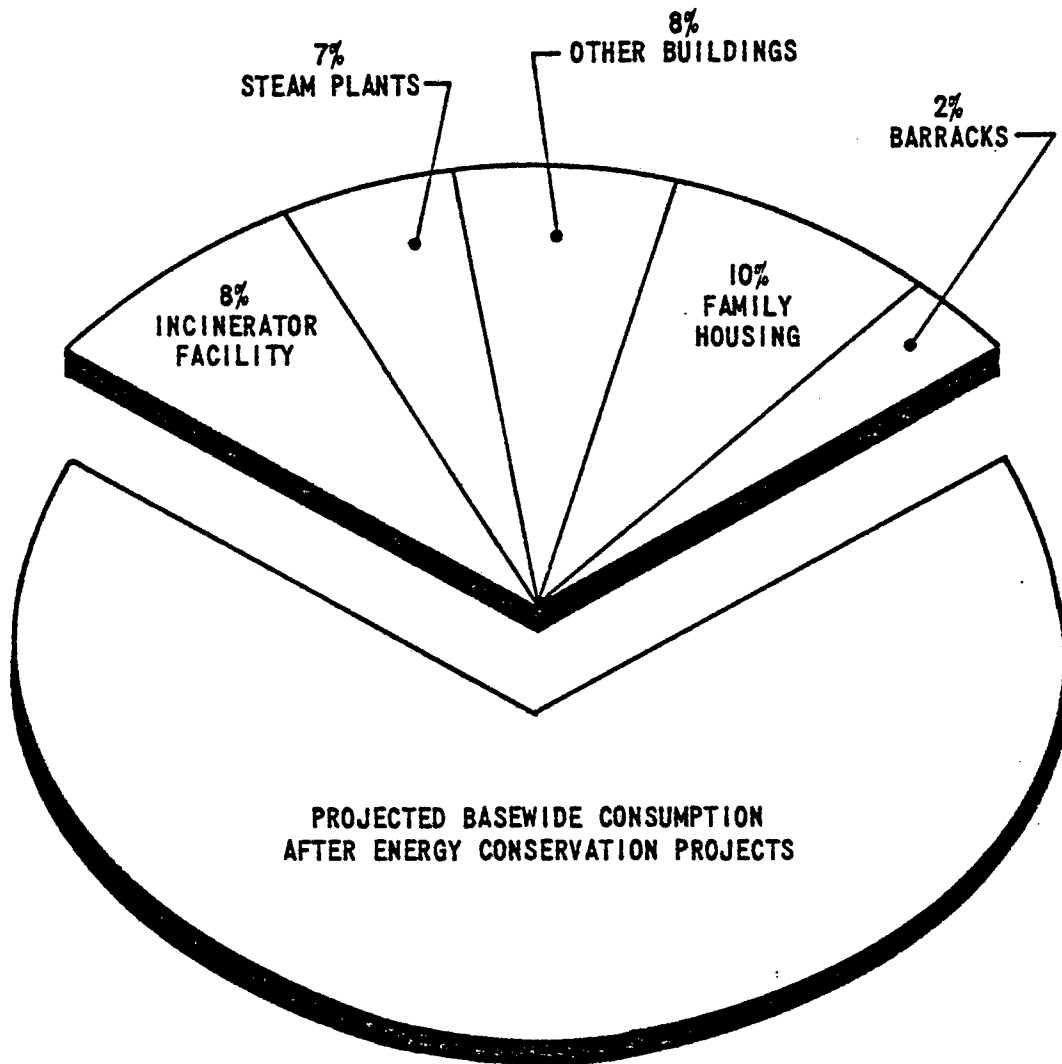
The report on Energy Monitoring and Control Systems (EMCS) includes recommendations for an extension of the existing system (design completed by Newcomb and Boyd, Consulting Engineers) and the utilization of an FM



BASEWIDE CONSUMPTION AFTER ENERGY
CONSERVATION PROJECTS

(1,169,489 x 10⁶ BTU'S)

FIGURE 2



ALLOCATION OF ENERGY
 CONSERVATION PROJECTS SAVINGS
 FOR SIGNIFICANT BUILDING GROUPS

FIGURE 3

control system. An extension of the existing system (EMCS Phase III) would result in a savings of 28,744 mega-Btu per year, while the FM control system would save 75,308 mega-Btu per year.

The investigation of solid waste for reducing source energy consumption at Fort Rucker resulted in the development of Project No. 224. This project recommends the installation of a solid waste burning incinerator facility to provide steam to the existing steam distribution system. The proposed plant would enable the installation to retire one of the two existing heating plants (Nos. 6021 or 4701), thereby reducing fuel oil and electric consumption totalling 142,535 mega-Btu per year. The details and descriptions of the systems analyzed can be found in the report, Total Energy, Selective Energy, and Central Boiler Plants.

The incorporation of a total energy or selective energy (TE/SE) system at this installation is not recommended. The application of TE/SE systems was rejected due to the relative low steam demand and the high cost of expanding the existing steam distribution system.

EXECUTIVE SUMMARY-INCREMENTS F AND G

Increment F - Facilities Engineer Conservation Measures.
Increment G - Maintenance, Repair, and Minor Construction Projects.

This is a summary of the two phases of work that were started after the completion of Increments A, B, C, D, and E in May of 1980. Increments F and G were completed in December, 1982.

The purpose of Increment F of the Basewide Energy Systems Plan is to identify and develop recommendations that can be used by Fort Rucker in preparing its energy management plan. Included are a number of comparatively low cost projects, recommendations for training, and prioritized lists of possible energy conservation measures. Increment G identified maintenance, repair, and minor construction projects for the purpose of conserving energy. These are energy conservation projects that did not meet ECIP criteria or did not fit the ECIP program at the time that the remainder of the study was completed.

The average costs of energy for FY 1981 are given in Table 7. These costs have been used as the basis for determining the dollar savings due to energy conservation.

Projects developed within the scope of Increments F and G of the study are summarized in Tables 8 and 9 respectively, and are prioritized by their E/C ratio. The E/C ratio is defined as the ratio of yearly energy savings in million Btu to the cost estimate in thousands of dollars. Any project showing a payback of 15 years or less is recommended. Material and labor cost estimates are representative of April, 1981 prices.

Five 1391's were prepared which combined twelve of the projects developed under Increments F and G. The ECIP documentation for these projects appears in Appendix B of Volume V.

The first project, Ceiling Fans and Destratifiers, involves installation of ceiling fans in 26 high ceiling buildings and portable de-stratifying fans in aircraft maintenance hangars.

The Window Treatment project is a combination of three projects: window insulation for 76 buildings where 100 percent visibility is not needed and diffuse sunlight is beneficial, application of solar film to nine administrative type buildings, and installation of insulated panels over unnecessary windows in ten buildings.

The Automatic Chiller Condenser Tube Cleaning project involves installation of a free-floating brush in all chiller tubes and one four-way flow reversing valve in each chiller in ten buildings.

Weatherization is a combination of four projects: weatherstripping exterior doors in 175 buildings, application of blown-on insulation on the walls and/or ceilings of 47 buildings, installation of aluminum storm windows on 155 buildings, and addition of insulation to the underside of the floor in 24 buildings.

The fifth project involves expansion of the EMCS and FM Control Systems.

The total estimated source energy savings due to implementation of all the recommended projects in Increment F is 294,543 mega-Btu per year. The total estimated savings due to implementation of all recommended projects in Increment G is 144,205 mega-Btu per year.

CONCLUSION

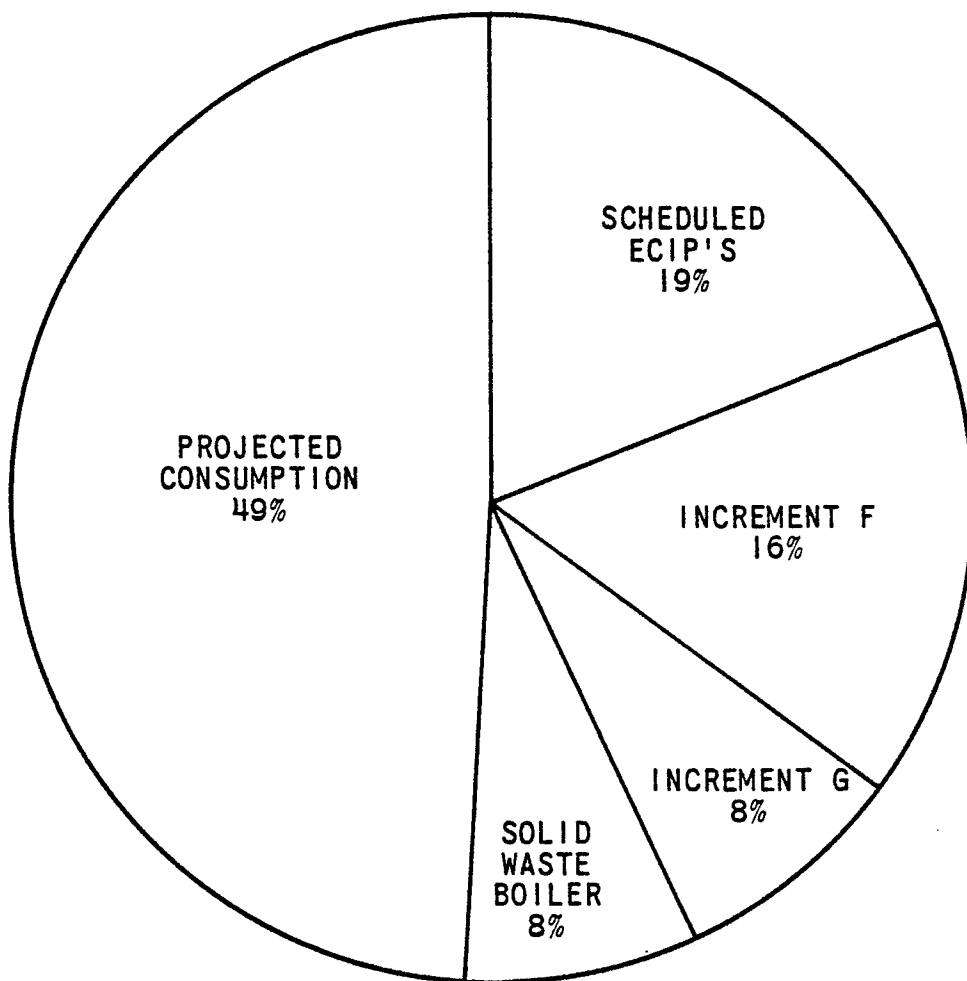
The projected future energy savings at Fort Rucker due to implementation of the scheduled ECIP projects developed under Increments A, B, C, D and E, construction of the Solid Waste Incinerator Facility, and implementation of the recommended projects from Increments F and G, is shown in Figure 4. The following projects comprise the "Scheduled ECIP's" section of Figure 4:

T-41100	Insulated Panels, Storm Windows, and Weatherstrip Doors in Permanent Buildings.
T-41200	Insulation, Weatherstripping, and Storm Windows in Temporary Buildings.
T-41300	Storm Windows, Weatherstrip Doors and Kitchen Lighting Fixture in Family Housing.
T-41500	FM Radio Control System.
T-42200	Family Housing Equipment Modifications.
T-42400	Steam Plant Modifications.
T-44500	EMCS Phase III.

Figure 5 is a forecast of future energy costs at Fort Rucker. The graph compares how costs could escalate if no energy conservation projects were implemented versus energy costs if all cost effective projects are implemented. The energy conservation projects are assumed to be implemented in the following three phases:

- Phase I - Scheduled ECIP projects
- Phase II - Solid Waste Incinerator Facility
- Phase III - Increments F and G projects

Figure 5 does not account for new building construction.



FORT RUCKER
BASEWIDE CONSUMPTION FY'81

FIGURE 4

EFFECT OF ESCALATION AND ENERGY CONSERVATION ON FUEL COST

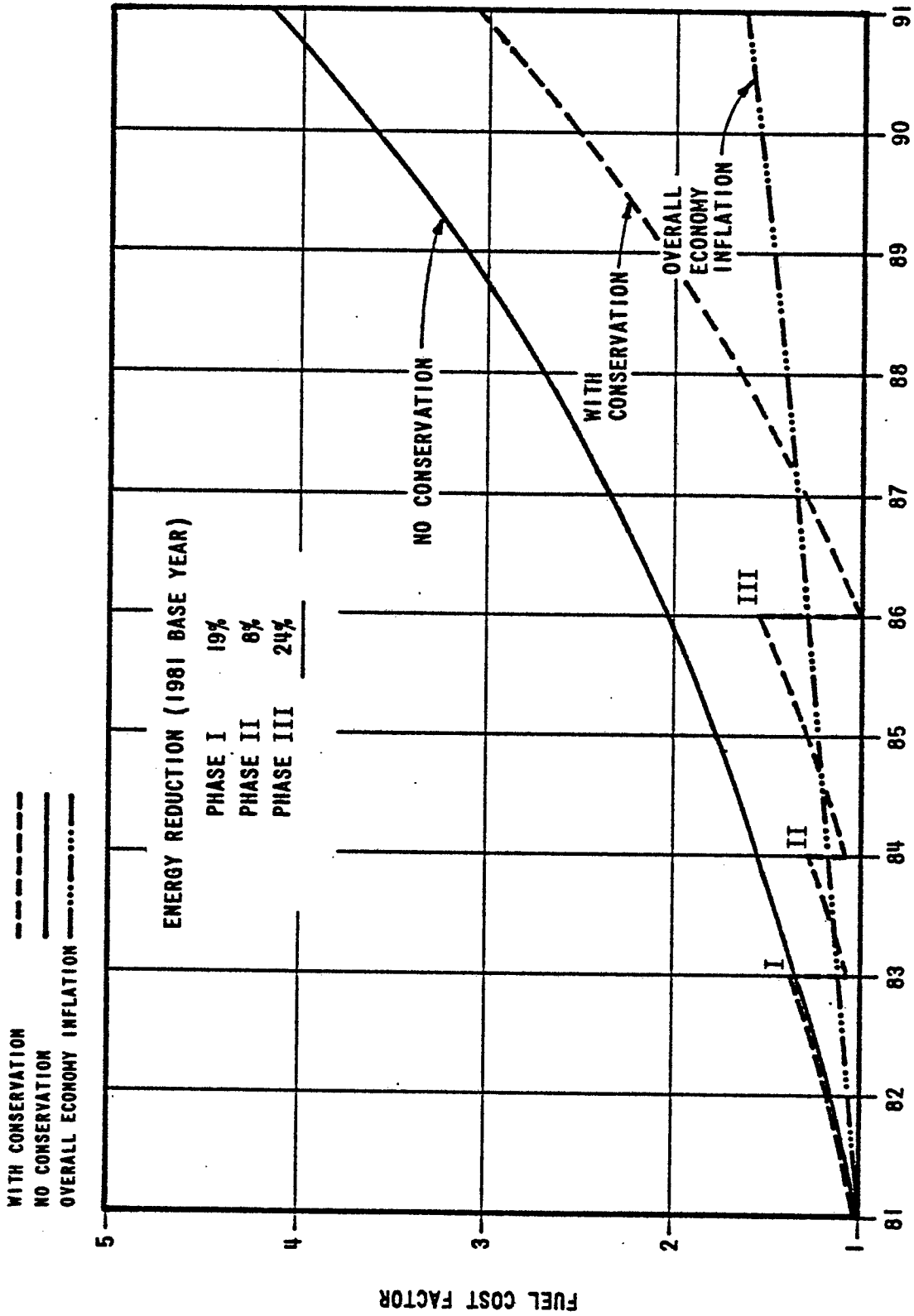


FIGURE 5

APPENDIX

TABLES

TABLE I
TYPICAL BUILDING CONSTRUCTION DATA
FORT RUCKER

GROUP NO.	Bldg. No.	BUILDING DESCRIPTION	NO. FLS.	CONSTRUCTION										"U" VALUES										WINDOW SQ. FT.	AREA (FT. 2)	COOLING		HEATING		PEAR TRNS LOAD MM		DOMESTIC HOT WATER
				ROOF	WALL	FLOOR	WINDOW	DOOR	ROOF	MALL	FLOOR	WINDOW	DOOR	SYSTEM	CAP (TONS)	SYSTEM	SYSTEM	FUEL	LOSS	GAIN	LOSS	FUEL	CAP. (G)									
A-1	8700	USAIN ROOMS	1	COMPOSITE SHINGLES	T & G ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.23	.85	1.13	.49	236	2350	SPLIT SYSTEM	9	B.P. 8795	STEAM	46.9	109.9	90	STEAM ELEC.								
A-2	812	AIRCRAFT MAINT. OFFICE	2	BUILT-UP SHINGLES	BRICK ON CONC. FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.10	.25	1.13	1.06	.55	1088	16602	WATER SYSTEM	82	B.P. 1102	STEAM	78.6	202.6	80	GAS								
A-3	704	VEHICLE MAINT. OFFICE	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.08	.26	.84	1.13	.49	189	720	WINDOW UNITS	2	CENTRAL MTR.	GAS	9.9	41.2	40	GAS								
B-1	8509	BARRACKS	3	BUILT-UP SHINGLES	BRICK ON CONC. FRAME	TILE, VENTED CRANK SPACE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.04	.29	.82	1.13	.85	4668	9063	CENTRAL CHILLER PLANT	47	B.P. 8701	STEAM TO RM	229.0	644.0	200	STEAM								
B-2	313	BOO	2	BUILT-UP SHINGLES	BRICK ON CONC. FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.16	.29	1.13	1.06	.45	1836	18133	ABSORPT CHILLER	40	B.P. 311	STEAM TO RM	107.0	250.8	150	STEAM								
B-3	8789	BARRACKS	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.06	.23	.84	1.13	.49	384	4350	WINDOW UNITS	—	B.P. 8795	STEAM	—	140.3	78	GAS								
B-4	129	BOO	2	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.05	.26	.84	1.13	.49	744	8044	PACKAGE	15	BOILER	GAS	90.1	173.1	150	GAS								
B-5	6904	BARRACKS	2	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.05	.26	.84	1.13	.49	744	8044	WINDOW UNITS	—	BOILER	OIL	—	173.1	100	GAS								
C-1	3712	SUNDAY SCHOOL CLASSROOMS	2	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.26	.84	1.13	.49	436	9310	WINDOW UNITS	1	BOILER	OIL	8.16	172.2	15	OIL								
C-2	3710	STORAGE A	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.05	.26	.84	1.13	.49	270	3000	WINDOW UNITS	—	FURNACE UNIT MTRS.	GAS	—	96.1	—	WIRE								
C-3	8780	MEDICAL SUPPLY	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.23	.85	1.13	.49	288	4082	WINDOW UNITS	16	B.P. 8795	STEAM	80.0	181.1	180	STEAM								
C-4	207	YOUTH CLUB	2	ASPHALT SHINGLES	WOOD SIDING & FRAME	LINOLEUM OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.27	.22	.81	1.13	.49	1588	21290	CENTRAL CHILLER	58	BOILER	GAS	159.4	389.0	50	GAS (HUB)								
E-1	4508	MESS HALL	1	BUILT-UP SHINGLES	BRICK ON CONC. FRAME	TILE, CLOSED CRANK SPACE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.33	.22	.84	1.13	.49	1317	11234	CENTRAL CHILLER	40	B.P. 8701	STEAM	61.9	212.0	200	STEAM								
F-1	21517	SINGLE FAMILY HOUSING	1	ASPHALT SHINGLES	WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.07	.26	1.13	1.06	.47	245	1870	SPLIT SYSTEM	4	FURNACE	GAS	14.1	41.1	30	GAS								
F-2	22460	DUPLIC FAMILY HOUSING	1	ASPHALT SHINGLES	WOOD SIDING & BRICK	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.11	.16	1.13	1.06	.47	485	2732	CENTRAL CHILLER	3	FURNACE	GAS	28.8	61.1	80	GAS								
H-1	301	HOSPITAL	2	BUILT-UP SHINGLES	BRICK ON CONC. BLOCK	TILE, VENTED CRANK SPACE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.10	.27	.81	1.13	.49	850	93936	ABSORPT CHILLER	352	B.P. 311	STEAM	107.0	250.8	150	STEAM								
H-2	8733	VISION RESEARCH	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.26	.84	1.13	.49	188	4470	WINDOW UNITS	13	B.P. 8795	STEAM	103.0	222.3	130	STEAM ELEC.								
L-1	1012	LAUNDRY	1	METAL SHINGLES	CLAPBOARD ON WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.24	.21	1.13	1.06	.47	918	52531	WINDOW UNITS	1.25	WIRE	—	10.1	—	W/A	—								
H-1	4004	TRUCK MAINTENANCE	1	COMPOSITE SHINGLES	ASBESTOS ON WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.44	.27	1.13	1.06	.47	231	3108	WINDOW UNITS	—	BOILER	OIL	—	74.4	42	ELEC.								
H-2	8712	VEHICLE MAINTENANCE	1	BUILT-UP SHINGLES	CONCRETE & CHU	SLAB ON GRADE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.11	.31	1.13	1.06	.47	947	4817	WINDOW UNITS	—	B.P. 8701	STEAM	—	131.7	—	WIRE								
H-3	1413	WORK SHOP	1	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.44	.26	1.13	1.06	.47	504	5980	WINDOW UNITS	2	BOILER	GAS	7.8	135.0	90	GAS								
O-1	6410	GRAD FLIGHT SUPPLY	1	ASPHALT SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.20	.84	1.13	.49	535	2500	WINDOW UNITS	—	FURNACE	GAS	—	119.4	40	ELEC.								
O-2	4511	BATTALION HEADQUARTERS	1	BUILT-UP SHINGLES	BRICK ON CONC. FRAME	SLAB ON GRADE	SINGLE CLEAR GLASS	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.06	.30	1.13	1.06	.47	1036	6180	CENTRAL CHILLER	40	B.P. 8701	STEAM	50.1	137.5	42	ELEC.								
O-3	801	OFFICE A STORAGE	2	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.24	.26	.87	1.13	.49	446	5310	CENTRAL CHILLER	6	BOILER	GAS	51.4	181.9	40	GAS								
O-4	5205	CLASSROOM A AUDITORIUM	1	BUILT-UP SHINGLES	BRICK & CONC. FRAME	TILE BASEMENT	WIRE	STEEL HOLLOW CORE	STEEL HOLLOW CORE	.16	.27	.84	1.13	.49	0	19933	ABSORPT CHILLER	101	B.P. 6021	STEAM	73.5	202.4	80	GAS								
S-1	3208	STORAGE	2	COMPOSITE SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.26	.84	1.13	.49	908	5310	WINDOW UNITS	—	BOILER	OIL	—	34.3	80	(HUB)								
S-2	8009	WAREHOUSE	1	ASPHALT SHINGLES	WOOD SIDING & SHINGLES	SLAB ON GRADE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.27	1.13	1.06	.47	280	3108	WINDOW UNITS	—	SPACE MTR.	ELEC.	—	7.00	—	WIRE								
S-3	1309	WAREHOUSE	1	ASPHALT SHINGLES	METAL ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.45	.40	.84	1.13	.49	209	9000	WINDOW UNITS	—	UNIT MTRS.	GAS	—	318.4	40	GAS								
S-4	105	BOOKSTORE/STORAGE	1	ASPHALT SHINGLES	CLAPBOARD ON WOOD FRAME	TILE, OPEN CRANK SPACE	SINGLE CLEAR GLASS	WOOD SOLID CORE	WOOD SOLID CORE	.26	.20	.84	1.13	.49	336	2330	CENTRAL CHILLER	10	BOILER	GAS	48.1	108.3	—	WIRE								

TABLE 2
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT RUCKER

GROUP NO.	BLDG.	BUILDING DESCRIPTION	ANNUAL ENER. SOURCE CONSUMPTION BTU x 10 ⁶			ELEC'L ENER. CONSUMPTION		BTU x 10 ³ FT ²
			FUEL	ELEC.	TOTAL	KW PEAK	KWH/YR	
A-1	8708	USAARL HDQTRS.	384	398	782	23	34270	347.6
A-2	412	AIRCRAFT MAINT. OFFICE	1382	4152	5534	129	357910	379.0
A-3	704	VEHICLE MAINT. OFFICE	141	94	237	6	8290	329.2
B-1	4509	BARRACKS	2670	3711	6381	126	319910	126.0
B-2	313	BOQ	3228	935	4163	13	80570	229.6
B-3	8749	BARRACKS	756	134	892	3	11700	205.1
B-4	129	BOQ	847	771	1618	38	66430	201.1
B-5	6904	BARRACKS	1091	330	1421	7	28440	176.7
C-1	3712	SUNDAY SCHOOL CLASSROOMS	727	85	812	7	7340	152.9
C-2	3710	STORAGE & DRIVERS TRAINING	307	97	404	3	8350	134.7
C-3	8740	MEDICAL SUPPLY	731	459	1190	28	39350	291.5
C-4	207	YOUTH CLUB	1731	1093	2824	62	94190	132.6
E-1	4508	MESS HALL	2415	3982	6397	108	343300	564.4
F-1	21517	SINGLE FAMILY HOUSING	171	257	428	9	22140	272.6
F-2	22460	DUPLEX FAMILY HOUSING	276	478	754	16	41210	274.0
H-1	301	HOSPITAL	53499	25577	79076	411	2377370	841.8
H-2	8733	VISION RESEARCH	810	1243	2053	55	107160	459.3
L-1	1012	LAUNDRY	23946	1379	25325	82	118890	481.9
M-1	4004	TRUCK MAINTENANCE	180	143	323	10	12290	103.9
M-2	4712	VEHICLE MAINTENANCE	234	68	302	2	5820	62.7
M-3	1413	WORK SHOP	276	72	348	5	6220	64.7
O-1	6410	GRAD FLIGHT. SUPPLY	505	70	575	2	6034	230.0
O-2	4511	BATTALION HEADQUARTERS	531	2325	2856	76	200520	445.1
O-3	801	OFFICE & STORAGE	940	321	1261	15	27640	237.5
O-4	5205	CLASSROOM & AUDITORIUM	8191	1516	9707	32	130700	487.0
S-1	3208	STORAGE	574	39	613	1	3320	115.4
S-2	8009	WAREHOUSE	0	58	58	3	5000	18.7
S-3	1309	WAREHOUSE	711	779	1490	17	67160	165.6
S-4	105	BOOKSTORE/STORAGE	493	285	718	15	24400	305.5

TABLE 4

Building Group Source Energy Consumption

<u>Group</u>	<u>Description</u>	<u>Group Sq. Ft.</u>	<u>Total Source Consumption⁶ Btu's x 10⁶</u>
A	Administrative	492,387	171,349
B	Barracks	1,091,182	202,585
C	Community Service	667,169	101,318
E	Dining	55,888	31,537
F	Family Housing	2,122,560	581,455
H	Hospital	235,584	148,883
L	Laundry	52,551	25,325
M	Maintenance	447,738	30,248
O	Operations	823,068	310,094
S	Supply and Storage, Warehouse	725,538	113,166
U-1	Sewage Treatment	3,987	8,078
U-3	Pump Houses	12,958	11,149
U-4	Boiler Plants	23,887	2,101
Z	Electric Only (includes outdoor lights)	83,040	<u>84,952</u>
		Total	1,822,240

ENERGY CONSERVATION PROJECTS
SOURCE ENERGY SAVINGS - FORT RUCKER, ALABAMA

BUILDING TYPE	ENERGY SAVINGS BTUx1,000,000	% BASEWIDE REDUCTION FY '75	PROJECT NUMBER
FAMILY HOUSING	84,974	4.73	T-41300
	46,026	2.56	T-41500
	45,746	2.54	T-42200
	<u>176,746</u>	<u>9.83</u>	
BARRACKS	14,384	0.80	T-42300
	14,279	0.79	T-41100
	6,312	0.35	T-41200
	1,652	0.09	T-41400
	6,192	0.34	T-44500
	<u>42,819</u>	<u>2.37</u>	
INCINERATOR FACILITY	142,535	7.93	224
STEAM PLANTS	20,734	1.15	T-42400
	98,183*	5.46	T-42500
	<u>118,917</u>	<u>6.61</u>	
OTHER BUILDINGS AFFECTED BY ECIP'S	29,282	1.63	T-41500
	62,293	3.46	T-41200
	21,578	1.20	T-41400
	3,694	0.21	T-42100
	2,040	0.11	T-43500
	6,628	0.37	T-42300
	1,260	0.07	T-41100
	22,552	1.25	T-44500
	<u>149,327</u>	<u>8.30</u>	
	TOTAL	630,344	35.05

*ENERGY SAVINGS WOULD BE $90,314 \times 10^6$ BTU'S IF BLDG. NO. 4701 IS RETIRED DUE TO INSTALLATION OF INCINERATOR FACILITY.

TABLE 5

ENERGY CONSERVATION PROJECTS DEVELOPED SCHEDULE - FORT RUCKER, ALABAMA

PROJECT TITLE	PROJECT NUMBER	RECOMMENDED FISCAL YEAR	COST \$ x 1000	E/C RATIO	ENERGY SAVINGS BTUx1,000,000	YEARS PAYBACK	B/C RATIO
STORM WINDOWS, WEATHERSTRIP DOORS AND KITCHEN LIGHTING FIXTURE IN FAMILY HOUSING.	T-41300	1980	2,073	43.18	84,974	6.22	2.82
FM RADIO CONTROL SYSTEM	T-41500	1980	592	127.2	75,308	2.02	5.7
INSULATION, WEATHERSTRIPPING, AND STORM WINDOWS IN TEMPORARY BUILDINGS.	T-41200	1980	1,348	50.88	68,605	4.51	1.89
RELAMPING FLUORESCENT FIXTURES	T-41400	1980	289	80.45	23,230	1.7	4.70
TOTAL			4,302		252,117		
SOLID WASTE BURNING INCINERATOR FACILITY	224	1981	4,079	34.9	142,535	8.36	2.75
FAMILY HOUSING EQUIPMENT MODIFICATIONS	T-42200	1981	1,443	33.4	45,746	10.02	1.79
ADJUST FRESH AIR QUANTITIES	T-42300	1981	30	696.0	21,012	.41	43.68
STEAM PLANT MODIFICATIONS	T-42400	1981	354	58.6	20,734	3.97	4.99
INSULATE PANELS, STORM WINDOWS, AND WEATHER-STRIP DOORS IN PERMANENT BUILDINGS.	T-41100	1981	471	33.0	15,539	5.11	3.6
CEILING FANS IN AIRCRAFT HANGARS AND MAINTENANCE FACILITIES	T-42100	1981	60	61.75	3,694	3.81	5.02
SOLAR HEATING OF FIELDHOUSE SWIMMING POOL AND SHOWER WATER	T-43500	1981	112	18.3	2,040	10.7	1.77
TOTAL			6,549		251,300		
UPGRADE COOLING SYSTEMS	T-42500	1982	1,085	90.5	98,183	4.57	4.23
EMCS PHASE III	T-44500	1982	621	46.27	28,744	6.36	1.95
TOTAL			1,399		126,927		

TABLE 6

TABLE 7

FY81 Average
Energy Costs

Electricity	
Demand	\$5.59/kW
kWh (without demand)	\$0.0198/kWh
kWh (including demand)	\$0.0370/kWh
Natural Gas	
Commodity (including demand)	\$3.33/mcf
Propane	
Commodity	\$0.5540/gal
Fuel Oil	
No. 2	\$1.22/gal
No. 5	\$0.87/gal

TABLE 8
Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference In-house Cost		Pages Narr. Calcs.		
								Material	Manhours			
Reduction of Domestic Water Temperature in Barracks	10 Buildings	875	\$ 4,104	.05	4,550	641	\$ 192	-	Laborer	10	34	A17
Reduction of Ventilation Air Quantities	25 Buildings	38,090	243,854	.06	2,727	424	13,970	\$6,704	A/C Mech.	228	27	A13
Cycle Pool Pumps	4 Buildings	1,334	5,629	.09	2,531	142	527	395	Electrician	6.5	33	A16
Filter Maintenance	Postwide	23,223	87,837	.10	2,285	206	10,164	2,338	Laborer	425	31	A15
Swimming Pool Cover	4,605	1,948	8,722	.20	1,104	153	1,765	-	-	-	12	A3
Receptacle Insulation	Family Housing	16,784	74,653	.32	696	80	24,115	4,005	Laborer	1,040	22	A9
Turn Off Hot Water	21 Buildings	1,013	4,749	.32	671	95	1,510	-	Plumber	42	19	A7
Insulate Water Heaters	120 Gal. - Nat. Gas	11	52	.43	494	70	22.40	13	Laborer	.5	37	A19
Insulate Water Heaters	80 Gal. - Nat. Gas	8.6	40	.48	440	62	19.57	10	Laborer	.5	37	A19
Thermostat - Type	Postwide	88,580	490,246	.47	383	60	231,441	194,800	A/C Mech.	1,148	41	A22
Insulate Water Heaters	40 Gal. - Nat. Gas	6.2	29	.58	367	502	16.75	7	Laborer	.5	37	A19
Insulate Water Heaters	120 Gal. - Electric	6.2	26	.92	258	24	23.82	14	Laborer	.5	37	A19

TABLE 8 (Cont'd)

Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference		Pages	
								In-House Cost	Manhours		
								Material	Manhours	Narr. Calcs.	
✓ Thermostatic Steam Valves	8301	448	\$ 2,101	.92	233	33	\$ 1,924	\$ 917	Plumber	28 39	A20
✓ Insulate Water Heaters	80 Gal. - Elec.	4.7	20	1.04	229	21	20.43	11	Laborer	.5 37	A19
✓ Weatherstrip Doors	175 Buildings	56,443	31,540	.92	194	28	29,111	7,860	Laborer	1,099 10	A2
✓ Insulate Water Heaters	40 Gal. Elec.	3.3	14	1.24	192	17	17.31	8	Laborer	.5 37	A19
✓ Duct Insulation in Unconditioned Spaces	4 Buildings	305	1,491	1.27	160	22	1,900	811	Laborer	56 16	A5
✗ Reduce Infiltration in Family Housing	Family Housing	26,804	116,444	1.81	127	13	210,528	72,858	Laborer	7,120 23	A10
✓ Variable Air Volume	4905	2,666	11,251	5.6	42	4	63,327	53,231	Electrician	500 29	A14
✓ Replace Incandescent Lights	63 Buildings	13,884	82,742	4.9	35	4	402,588	239,314	Electrician	4,558 35	A18
✓ Solar Film	9 Buildings	963	4,215	7.6	30	3	31,961	-	-	- 20	A8
✓ Window Insulation	5 Buildings	149	878	7.0	24	4	6,148	2,729	Laborer	177 14	A4
✓ Install Dropped Ceiling and Insulate Floor	8301	162	760	12.1	18	3	9,175	6,778	Laborer	124 40	A21
✓ Window Insulation	71 Buildings	2,814	21,687	7.4	18	3	160,587	71,267	Laborer	4,620 14	A4
✓ Roof Spray Cooling	5205	118	556	12.6	17	3	6,985	-	-	- 42	A23
✓ Replace Incandescent Light Fixtures in Family Housing	Family Housing	4,757	23,811	30.7	7	6	731,237	463,525	Electrician	7,367 9	A1

TABLE 8 (Cont'd)

Summary of Increment F Projects

Project	Location(s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	Reference		Pages		
								In-house Cost Material	Manhours			
Flush Valve Restrictors	52 Buildings	0	\$ 4,944	2.55	0	4	\$12,539	\$ 7,776	Laborer	246	17	A6
Toilet Tank Dams	Family Housing and 149 Buildings	0	11,564	2.60	0	4	29,705	17,793	Laborer	616	25	A11
		0	2,377	3.60	0	3	8,545	5,118	Laborer	177	25	A11

TABLE 9

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-house Cost		Reference Pages
								Material	Manhours	
✓ Barracks HVAC Modifications	6 Buildings	6,525	\$41,019	.63	253	37	\$25,812	10,771	A/C Mechanic 162 Electrician 8	31 B13
PH Control System Expansion	38 Buildings	5,220	29,002	1.11	162	14	37,233	24,367	Electrician 388	20 B7
Automatic Chiller-Condenser Tube Cleaning	301	6,885	52,877	.94	139	25	49,692	-----	-----	13 B4
✓ Swimming Pool Heater	4605	1,228	5,759	1.78	120	17	10,260	9,685	Plumber 16	8 B1
Automatic Chiller-Condenser Tube Cleaning	4901	3,306	13,951	2.49	95	9	34,777	-----	-----	13 B4
Automatic Chiller-Condenser Tube Cleaning	5102	3,306	13,951	2.49	95	9	34,777	-----	-----	13 B4
De-stairifiers	5 Buildings	1,829	22,347	.91	90	26	20,283	16,922	Electrician 151	28 B12
Automatic Chiller-Condenser Tube Cleaning	4701	1,552	6,549	3.08	77	7	20,198	-----	-----	13 B1
Automatic Chiller-Condenser Tube Cleaning	4502	1,980	15,206	1.72	76	14	26,089	-----	-----	13 B1
Ceiling Fans	26 Buildings	7,152	41,649	2.40	73	12	98,051	42,204	Electrician 1,684	17 B6
✓ RHCS-Extension	5 Buildings	13,787	59,598	3.38	68	4	201,454	-----	-----	22 B8
Automatic Chiller-Condenser Tube Cleaning	4905	1,584	12,165	2.03	64	12	24,644	-----	-----	13 B1

TABLE 9 (Cont'd)

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	B/C	Contract Cost	In-House Cost		Reference Pages		
								Material	Manhours		Marr.	Calcs.
Automatic Chiller Condenser Tube Cleaning	6005	1,584	12,165	2.03	64	12	24,644			13	B1	
Fluorescent Lighting Load Reduction	Postwide	15,072	92,394	2.90	56	7	268,596	195,235	Electrician	2,210	24	B9
Automatic Chiller Condenser Tube Cleaning	113	1,218	14,178	1.63	53	15	23,106			13	B1	
Automatic Chiller Condenser Tube Cleaning	308	921	7,073	3.06	43	8	21,642			13	B1	
Automatic Chiller Condenser Tube Cleaning	2908	891	4,179	5.15	41	6	21,536			13	B1	
Floor Insulation	24 Buildings	21,200	99,428	6.33	34	5	629,827	395,891	Carpenter	8,182	37	B16
Boiler Upgrade	50 Buildings	13,140	79,132	5.50	30	5	434,690	295,074	Plumber	3,888	11	B3
Insulated Panels	10 Buildings	858	4,914	6.40	27	4	31,627	21,643	Carpenter	360	16	B5
Storm Windows	155 Buildings	14,384	83,702	7.26	24	4	608,383	452,388	Laborer	12,057	33	B14
Blow-on Insulation	47 Buildings	20,469	121,563	7.00	23	4	851,340	434,357	Insulator	21,420	35	B15
Heat Recovery From Dust Collector	8902	114	533	11.90	18	3	6,351	5,873	Sheet Metal Carpenter	8 8	38	B17
Low Pressure Sodium Street Lighting	Postwide	3,156	7,131	51.90	9	.4	370,504	319,053	Electrician	1550	27	B11

TABLE 9 (Cont'd)

Summary of Increment G Projects

Project	Location (s)	Energy Savings/Year MMBtu	Dollar Savings/Year	Payback Years	E/C	D/C	Contract Cost	In-House Cost		Reference Pages	
								Material	Manhours	Narr.	Calcs.
Infrared Heating	7 Buildings	528	3,695	23.0	6	1	84,865	51,711	1040	10	R2
High Pressure Sodium Street Lighting	Postwide	2,041	4,612	77.6	6	.3	357,958	306,506	Electrician-1550	27	R11
Replace Flight Simulators	4910 and 5102	76,501	322,834	204.0	1	.1	65,856,000	-----	-----	26	R10