DEPARTMENT OF THE ARMY
EUROPEAN DIVISION CORPS OF ENGINEERS

ENERGY ENGINEERING ANALYSIS PROGRAM EUROPE

HOHENFELS MILITARY SUBCOMMUNITY

SEVENTH ARMY TRAINING COMMAND

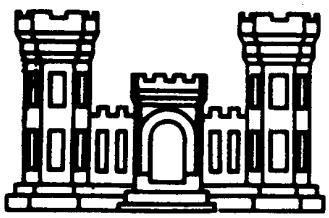
WEST GERMANY

Final Submittal

VOLUME I

EXECUTIVE SUMMARY

UNITED STATES ARMY
CORPS OF ENGINEERS
EUROPEAN DIVISION



FEBRUARY 1983

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FY 80 ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE

FINAL SUBMITTAL

FEBRUARY 1983

THE FINAL SUBMITTAL CONSISTS OF TWO SEPARATE VOLUMES:

- VOLUME I EXECUTIVE SUMMARY
- VOLUME II ENERGY REPORT

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FY80 ENGINEERING ANALYSIS PROGRAM, EUROPE

HOHENFELS

FINAL SUBMITTAL

VOLUME I

EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

HOHENFELS

1. INTRODUCTION

The Energy Engineering Analysis Program for the three U. S. Military Subcommunities of Vilseck, Wildflecken and Hohenfels in West Germany, has been authorized by the Department of the Army European Division, Corps of Engineers under Contract No. DACA90-80-C-0093 dated September 29, 1980, and subsequent Modifications:

P00001 dated April 27, 1981,
P00002 dated September 29, 1981, and
P00003 dated September 30, 1981.

1.1 OBJECTIVES OF THE ENERGY STUDY

The objectives of this contract, as explained in detail in Schedule of Title I Services for Energy Engineering Analysis Program, Europe dated September 18, 1981, are as follows:

a. Develop a systematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan.

b. Use and incorporate applicable data and results of related studies, past and current, as feasible.

c. Develop a coordinated basewide energy study.

d. Prepare Program Development Brochures (PDB), DD Forms 1391, and supporting documentation for feasible energy conservation projects.

e. Include all methods of energy conservation which are practical (in so far as the state-of-the-art is reasonably firm) and economically feasible in accordance with guidance given.

f. List and prioritize all recommended energy conservation projects.

1.2 INCREMENTS OF WORK

The work to be performed under the contract has been divided into four Increments: A, B, F and G.

Increment A - Energy conservation investigations for buildings and processes.

Increment B - Energy conservation investigations of utilities and energy distribution systems, Energy Monitoring and Control Systems (EMCS), and existing energy plant investigations.

Increment F - Facilities Engineer conservation measures.

Increment G - Projects identified in Increments A and B that do not meet the ECIP criteria of E/C> 13, but may qualify as OMA or MMCA Projects.

1.3 PHASES OF WORK

Increments A, B, F and G have been divided into three phases of work:

Phase I Data gathering and field trips.

Phase II Analysis of data, identification of potential projects, performance of feasibility and economic studies, and preparation of first page of DD Form 1391.

During this phase, all potential projects which produce energy and/or dollar savings should be identified and evaluated as to technical and economic feasibility.

Projects determined to be technically and economically feasible shall be combined into projects and ranked according to highest E/C ratio.

For FY 84, the minimum E/C = 13 MBtu/k$

Phase III Preparation of DD Form 1391 and Project Development Brochures (PDBs); and preparation of documents presenting the results and recommendations of the study.

DD Forms 1391 and PDB's are nor required for Increment F.

As a result of Modifications P00002 dated 29 September 1981, and P00003 dated November 2, 1981, it was negotiated that the Interim Submittal would not contain the Phase II effort of the EMCS study, nor the Phase I and Phase II efforts of Increment F. These would be included in the Prefinal Submittal, after additional required data is obtained by surveying all three subcommunities in early 1982.

1.4 PRESENT STATUS OF THE PROJECT

1.4.1 SURVEY

Prior to the commencement of Phase I of the project, a meeting was held between the A-E and the Corps of Engineers, and out of the approximately 160 energy consuming buildings at Hohenfels 61 buildings were selected to be surveyed in detail.

It was agreed that the sample selected was representative of the entire community; and that the results of the survey and subsequent analysis of energy consumption and energy savings based on a representative building per type at each community could be extrapolated to obtain the energy consumption, energy savings and implementation cost for the entire community, based on the total square foot area of all buildings of each given type.

By this extrapolation method, values of basewide energy consumption, energy savings, and implementation costs could be estimated; and basewide ECIP projects determined.

1.4.2 PRELIMINARY SUBMITTAL

The work listed below was accomplished and presented in the Preliminary Submittal:

a. Compilation and analysis of the data and information received from each subcommunity.

b. Review of the actual energy consumption of each subcommunity based on the energy consumption data collected; as well as a presentation of the projected energy consumption goals for each subcommunity based on the Army Facilities Energy Plan.

c. Summarized tabulations of the survey data.

d. Data of the surveyed buildings was input on Computer Program AXCESS.

e. As a "sample-pilot" ECIP analysis, one building type was selected and analyzed for energy conservation in detail.

f. The feasibility of Central Boiler Plant Projects was investigated.

The presentation of the Preliminary Submittal for Hohenfels was made on 30 July, 1981 at Grafenwoehr.

Review comments on the Preliminary Submittal were forwarded to the AE by the Project Manager in his letter dated 15 October, 1981.

1.4.3 INTERIM SUBMITTAL

The work listed below was accomplished and presented in the Interim Submittal:

a. The data received from the Subcommunity was updated.

b. Review of the actual energy consumption of the Subcommunity based on the energy consumption data collected; and a presentation of the energy consumption goals for the Subcommunity based on the Army Facilities Energy Plan.

c. We presented an updated list of the representative buildings of each type selected for detailed energy conservation analysis.

d. The Computer Program AXCESS was used to model and analyze all the buildings surveyed at the Subcommunity. Quantitative results of monthly energy consumption for space heating, domestic hot water, lighting and miscellaneous electricity usage has been obtained for each type of building.

e. Increment A: Each of the buildings types was analyzed for energy conservation opportunities (ECOs) that involved modifying, improving or retrofitting the architectural features, HVAC systems, plumbing systems and lighting.

ECOs determined to be technically and economically feasible (E/C>13, B/C>1) were combined into Energy Conservation Projects (ECP's), and extrapolated to Energy Conservation Investment Projects (ECIP's).

f. Increment G: Projects considered in Increment A that did not meet the E/C>13 criteria and yet had a B/C>1 were recommended for implementation under OMA or MMCA funding.

A complete DD Form 1391 and complete PDB-I were presented for approval.

DD Form 1391s and PDBs are not required for Increment F.

g. Increment B: Information obtained on utilities and energy distribution systems, and existing energy plants (boilers) was presented and possible energy conservation measures analyzed.

1.4.4 MODIFICATIONS P00002 AND P00003

These two modifications were negotiated and signed in September 1981.

It was agreed that the AE would perform a walk-through survey of every building in the community for Increment F's requirement to "provide recommendations for modifications and changes in system operation which are within the Facilities Engineer funding authority and management control", as well as for Increment B's EMCS analysis.

Only buildings larger than 5,000 GSF in area and consuming greater than 7500 gal/yr. of oil or 45 m-ton of coal or having a minimum 10 kw connected electrical load would be analyzed for EMCS feasibility.

The survey effort would be performed in early 1982.

1.4.5 GENERAL

296 sets of field survey forms were reviewed and from these a computer input sheet for each building surveyed was prepared. A computer data library was created storing all information gathered in the field which could be relevant to recommendations under investigation.

Tables 6-1 and 6-2 of Volume 2, the Energy Report, list the relevent data.

Computer aided manual calculations were used to obtain unescalated energy and cost savings and implementation costs. A computerized economic analysis program was used to produce E/C and B/C ratios.

Recent American and German Manufacturer's catalog data was obtained and included in the Appendices, Volume 7 of the Prefinal Submittal.

1.4.5.1 RECOMMENDATIONS

All recommended energy conserving modifications were presented in Sections 7 and 8 of the Increment F Narrative, Prefinal Submittal. These sections are new Sections 8.7 and 8.8 of Volume 2, Energy Report.

A summary sheet for each Section 7 recommendations (Modification to Building Systems) includes the following:

a. A brief description of reasons for the modification.

b. Instructions for accomplishing the modification.

c. An estimate of labor and material costs.

d. An estimate of man-hours listed by trade, where relevant.

e. The estimated dollar and energy savings.

f. The results of an economic analysis: E/C AND B/C ratios.

The analyses of Section 8 recommendations (Modifications to M/O Systems) are contained within the Increment F Narrative, Prefinal Submittal.

A Summary of all modifications for Increment F listing costs, man-hours, dollar and energy savings was prepared and is presented in Table 2-1 of the Increment F Narrative, Prefinal Submittal. A copy can be found in Section 4 of this Volume. The Table lists the modfications in order from highest to lowest E/C ratio.

All energy conserving projects from Increments A, B and G and recommendations from Increment F have been consolidated, priority ranked and presented in Table 10-1 of the Increment F Narrative. Order of priority is from highest to lowest E/C ratio. A copy can be found at the end of this section.

Energy related areas of operation for which additional training of Facilities Engineering personnel is recommended has been listed in Section 12 of the Increment F Narrative, Prefinal Submittal.

Expendable equipment which should be changed to higher efficiency types when the next replacement occurs has been investigated. Recommendations are included in Section 13 of the Increment F Narrative, Prefinal Submittal.

1.4.6 PREFINAL SUBMITTAL, INCREMENT B

a. We have obtained information on and studied in significant detail the subcommunities electrical system, street lighting system, potable water system, sewage collection and treatment system, hot water and steam distribution system; as well as existing energy plants consisting of Central Boiler Plants and Local-Building Boiler Plants.

b. We have recommended several projects that require the modification of boiler plant controls such as installation of OA HW reset control, night set-back control and installation of time-clock. These projects however, have been presented under Increments A or G.

c. We have developed electricity and fuel consumption load profiles for the past three years and presented them in Section 3 of the Interim Submittal.

d. Graphical profiles of hourly KW demand occuring on a weekday, weekend and peak demand day have been developed, presented and discussed in Paragrpah 7.2.4 for each month of FY 80. We have discussed existing peak demand limiting systems, and will investigate if the EMCS is feasible for further demand limiting.

e. Based on the AXCESS analysis of each building type, we have estimated the annual energy consumption and cost per square foot of each building type for Electricity, Fuel, Space Heating, Domestic Hot Water, Lighting and Miscellaneous Equipment. We have also projected these FY 80 to FY 84. Tabulated cost data has been presented in Section 5.

Work listed below was accomplished and submitted for Increment B, EMCS:

a. Supplement the site investigation with "as built" drawings, as well as sound engineering judgment.

b. Interview administrative personnel to determine operating hours and procedures relative to the surveyed buildings.

c. Identify EMCS energy conserving programs and strategies which might be appropriate for each of the buildings, listing the points required.

d. Evaluate by computer analysis, energy conserved by these programs as well as their implementation costs in accordance with Energy Conservation Investment Program (ECIP) requirements.

e. Make recommendations which may include in the EMCS some systems, points and/or programs which, while not directly related to energy savings, would provide management information and centralized control, making for more efficient facility operation.

1.4.7 FINAL SUMBITTAL

During the period January 13, 1983 through February 12, 1983, the Preliminary, Interim and Prefinal Submittals have been compiled into a Final Submittal. A description of the compilation is as follows:

a. For Sections 1 through 7 of the Final Submittal, the Interim Narrative was used as the basic text. Relevant material from the Preliminary was included.

b. Section 8 incorporates the Increment F Narrative.

c. Sections 9 through 11 incorporates Sections 9 through 11 of the Increment F Narrative.

d. Section 12 incorporates the Increment B, EMCS Feasibility Study.

The Final Submittal Executive Summary is made up of the Interim and the Prefinal Executive Summaries. These summaries have been adapted and brought up to date where necessary. The Final Submittal Executive Summary has been compiled as follows:

a. For Sections 1 through 4, the Prefinal Executive Summary Sections 1 through 4 have been used.

b. For Sections 5 through 8, the Interim Executive Summary Sections 2 through 5 have been used.

1.5 CONCLUSIONS

1.5.1 SAVINGS RESULTING FROM IMPLEMENTED ECO'S

The effects, in energy and cost savings, of implementing all Increment A, B, C & G projects are summarized in Table 10-1, a copy of which is included hereafter. The percent savings for these projects are obtained using the known consumption for FY 75 from Table 3.3-2. This table is presented in Section 7. The total consumption for that year is 231,889 MBtu.

Increment A projects save 16,451 MBtu/yr, or 7% of the FY 75 total consumption. Increment B projects save 11,028 MBtu/yr, or 5% of the FY 75 total consumption. Increment F projects save 40,001 MBtu/yr, or 17% of the FY 75 total consumption. Increment G projects save 20,057 MBtu/yr, or 9% of the FY 75 total consumption. The total savings for all projects is 87,537 MBtu/yr, or 38% of the total FY 75 consumption.

The effect of Increments A, B, G & F in terms of FY 84 dollars is as follows. Increment A projects will save $188,303 per year and will cost $726,026. Increment B projects will save $168,040 per year and will cost $823,845. Increment F projects will save $454,312 per year and will cost $736,070. Increment G projects will save $240,114 per year and will cost $1,788,499. The projected cost of energy in 1984 is itemized in Table 3.3-1. Escalation rates and conversion factors are given in the Attachment to Table 3.3-1. The table and attachment can be found in Section 7.

TABLE 10-1

INCREMENTS A, B, F, AND G PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	INCREMENT	E/C RATIO	PAYBACK PERIOD	FY84 CWE $	ANNUAL SAVINGS ENERGY (MBTU)	ANNUAL SAVINGS FY84 (DOLLARS)
F H15	Preventive Maintenance Program	All Buildings	F	-	Immediate	-	-	-
F H16	Temperature Control Technician	Various Buildings	F	-	Immediate	-	1,139	-
F H17	Reduction of Space Heating Temperature	All Buildings Except Dispensary	F	-	Immediate	-	9,057	114,636
F H18	Interior Lighting Control	Various Buildings	F	-	Immediate	-	-	-
F H19	Window Operation	All Buildings	F	-	Immediate	-	-	-
F H20	Door Operation	All Buildings	F	-	Immediate	-	-	-
F H21	Cooking Equipment Warm-up	Mess Halls	F	-	Immediate	-	-	-
F H23	Domestic Hot Water Circulating System	Various Buildings	F	-	Immediate	-	-	-
F H24	Resize Primary Heating Equipment	Various Buildings	F	-	Immediate	-	2,928	38,156
F H25	Energy Saving Ovens	Mess Halls	F	-	Immediate	-	-	-
F H26	Energy Saving Motors	Various Buildings	F	-	Immediate	-	-	-
OMA H17-1	Install Space Thermostat	General Instruction	G	798	Immediate	450	359	4,700
F H13	Lower Domestic Hot Water Temperature	Barracks, Mess Halls Family Housing	F	617	Immediate	2,006	1,951	24,101
OMA H10	Install Night Setback	Exchange Warehouse (Laundry)	G	546	0.1	170	93	1,210
F H7	Use Cold Water Detergent to Wash Dishes	Mess Halls	F	494	0.2	2,835	1,400	11,668
F H6	Use Cold Water Detergent to Wash Clothes	Barracks, Launderette, Family Housing	F	492	0.2	620	305	3,900
F H2	Replace 24-Hour Time Clock Heating Controls with 7-Day Type	Various Buildings	F	201	0.5	1,400	282	3,665

TABLE 10-1

INCREMENTS A, B, F, AND G PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	INCREMENT	E/C RATIO	PAYBACK PERIOD	FY84 CWE $	ANNUAL SAVINGS ENERGY (MBTU)	ANNUAL SAVINGS FY84 (DOLLARS)
OMA H11-1	Install Thermostatic Radiation Valves, Space T-Stat, Shut-off Valves, Weather Seal Garage Doors	Motor/Tank Reapir Shop	G	192	0.4	38,400	7,382	85,900
F H14	Change Burner Nozzles for Off-Peak Operation	Various Buildings	F	178	0.4	2,100	375	4,885
F H1	Install Time Clock Controls On Shower Room Heating Units	Various Buildings	F	113	1	11,025	1,245	15,660
F H4	Implement Boiler Water Treatment Program	Various Buildings	F	87.6	1	35,234	3,088	35,540
F H9	Seal Unused Flue Openings	Hutments	F	77	1	1,980	145	1,690
OMA H12	Install Night Setback & Ceiling Heat Recovery	Gymnasium	G	76	1	6,400	487	6,414
OMA H19-2	Install Centratherm Unit	Open Mess NCO	G	66	2.8	1,714	114	616
F H22	Upgrade Centratherm Control System	Various Buildings	F	57	1.5	64,400	3,473	41,795
OMA H7-1	Install Thermostatic Radiation Valves	Dependent Grade School	G	40.5	1.9	2,400	97	1,267
OMA H16	Install Centratherm Unit	Office Buildings	G	40.0	3.3	10,300	412	3,200
F H5	Install Automatic Vent in Oil-Fired Boilers	Various Buildings	F	38	2	95,640	3,640	47,450
ECIP H16	Install Thermostatic Radiation Valves & Attic Floor Insulation	Office Buildings	A	30.3	4.2	100,000	3,035	23,640
OMA H21-1	Install Thermostatic Radiation Valves, Weather Seal Doors & Windows	Dispensary	G	30.0	2.6	7,470	224	2,915
F H11	Retrofit Existing Fluo. Ltg. with Low Energy Type	Various Buildings	F	30.0	3.3	246,360	7,450	74,128

TABLE 10-1

INCREMENTS A, B, F, AND G PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	INCREMENT	E/C RATIO	PAYBACK PERIOD	FY84 CWE $	ANNUAL SAVINGS ENERGY (MBTU)	ANNUAL SAVINGS FY84 (DOLLARS)
ECIP H18	Install Thermostatic Valves, Insulate Attic Floor & Weather Seal Doors	General Storage Warehouse	A	23.7	3.2	128,800	3,047	39,700
ECIP HC1	Install ATC Radiation Valves, OA HW Reset w/Setback, Ceiling Fans, Nite Setback, Storm Windows & Weather Seal Doors	Various Buildings	A	23.1	3.6	376,126	8,296	99,463
OMA H7-3	Insulate Attic Floor & Centratherm Control	Dependent Grade School	G	22.8	8.1	7,400	169	915
OMA SL1	Street Lighting Control	Street Lighting	B	21.3	4.7	23,897	508	62,060
OMA H20-1	Install Thermostatic Radiator Valves, Centratherm Control & Storm Windows	Fire Station	G	20.5	5.3	6,370	171	1,600
OMA H8-1	Weather Seal Doors	Warehouse Refrigerated	G	19.0	4.0	1,900	36	470
F H3	Install Waste Heat Recovery From Refrigeration Equipment	H-3, H-10 & H-24	F	18.2	4.6	36,550	702	6,572
ECIP H1	Install Thermostatic Radiator Valves & Insulate Attic Floor	Barracks	A	17.0	4.7	121,100	2,073	25,500
OMA H5-1	Weather Seal Doors	Family Housing	G	15.0	7.3	1,090	17	149
ECIP EMCS	EMCS System	Various Buildings	B	13.2	7.5	799,966	10,520	105,960
F H12	Modify Kitchen Range Hood Exhaust	H-24	F	13.1	5.9	25,875	339	4,410
OMA H3-1	Install Storm Windows	Enlisted Persons Mess	G	11.0	7.0	120,600	1,323	17,240
OMA H19-1	Install Storm Windows	Open Mess NCO	G	10.8	10.5	19,500	212	1,600
OMA H1	Install Storm Windows & Weather Seal Doors	Barracks WO/Mess	G	10.5	7.8	73,900	773	9,042

TABLE 10-1

INCREMENTS A, B, F, AND G PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	INCREMENT	E/C RATIO	PAYBACK PERIOD	FY84 CWE $	ANNUAL SAVINGS ENERGY (MBTU)	ANNUAL SAVINGS FY84 (DOLLARS)
OMA H11-2	Insulate Attic Floor, Install Ceiling Heat Recovery, & Storm Windows	Motor/Tank Repair Shop	G	9.3	8.8	149,100	1,381	16,854
F H10	Install Vehicle Exhaust	H-392	F	9.0	8.8	9,725	85	1,106
OMA H23	Install Storm Windows	Library	G	8.9	8.6	1,625	15	190
F H8	Install Underground Fuel	Hutments	F	8.9	8.6	198,320	1,800	23,020
OMA H20-2	Weather Seal Doors & Insulate Attic Floor	Fire Station	G	8.4	9.1	4,900	41	540
OMA H7-2	Insulate Attic Floor, Install Storm Windows & Weather Seal Doors	Dependent Grade School	G	8.1	9.5	17,800	144	1,874
OMA H3-2	Insulate Attic Floor & Install Storm Windows	Enlisted Persons Mess	G	7.3	10.5	58,570	430	5,600
OMA H17-3	Insulate Attic Floor	General Instruction	G	6.9	11.2	20,800	143	1,870
OMA H21-2	Insulate Attic Floor & Walls	Dispensary	G	6.5	11.8	75,200	490	6,400
OMA H8-2	Install Storm Windows	Warehouse Refrigerated	G	5.6	13.6	8,140	46	600
OMA H11-3	Install Storm Windows	Motor/Tank Repair Shop	G	5.0	15.3	4,500	23	300
OMA H18	Install Storm Windows & Insulate Walls	General Purpose Warehouse	G	4.9	15.6	517,000	2,550	33,200
OMA H5-2	Insulate Walls	Family Housing	G	4.5	17.0	277,000	1,248	16,300
OMA H2	Install Storm Windows	Hutments	G	4.4	17.6	246,800	1,076	14,028

TABLE 10-1

INCREMENTS A, B, F, AND G PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	INCREMENT	E/C RATIO	PAYBACK PERIOD	FY84 CWE $	ANNUAL SAVINGS ENERGY (MBTU)	ANNUAL SAVINGS FY84 (DOLLARS)
OMA H17-2	Insulate Attic Floor	General Instruction	G	4.4	17.5	13,100	58	750
OMA H9	Insulate Walls	Theatre	G	4.0	19.4	93,900	371	4,830
		Subtotals	A = 4 Projects			726,026	16,451	188,305
			B = 2 Projects			823,845	11,028	166,040
			F = 26 Projects			736,070	40,001	454,312
			G = 29 Projects			1,788,499	20,057	240,114
		Totals	61 Projects			4,074,440	87,537	1,050,769

1.5.2 PROJECTED CONSUMPTION

Table 1.5 shows the known FY 75 total energy consumption. The projected energy consumption after energy conservation projects is identified in the table under the column heading, 1985 MBTU (PROJECTED). It assumes that all the projects in Table 10-1 are completed by 1985. This projected energy consumption is the known FY 75 consumption times (1 - % reduction). It is the amount of energy that the buildings we studied will consume in 1985 after the energy conservation projects have been implemented.

The known consumption and the projected consumption are also given on a square foot basis. The quantity under the column heading, 1975 KBTU/SF (KNOWN), uses the 1975 gross floor area, from Table 3.2-1 and the quantity under the column heading, 1985 KBTU/SF (PROJECTED) uses the 1985 gross floor area.

New construction is accounted for in Table 1.5 under the column heading, 1987 MBTU FUTURE CONSTRUCTION; an estimate for the energy that will be consumed by Hohenfels in 1987 is obtained by adding the expected energy consumption of new construction (based on Design Energy Budgets which are based on AR 415-28) to the 1985 MBTU (PROJECTED). A detailed treatment of futute energy use resulting from facilities changes can be found in Section 4.7.

1.5.3 GOALS

The goal of the U. S. Army is a 20% reduction of energy consumption for building area constructed before FY 78. The goals have been calculated for the Hohenfels ATC and presented in Table 3.2-1. A copy of which is included hereafter.

Table 1.5 presents the projected consumption for Hohenfels. It will be compared to Table 3.2-1 and it will be shown that the goals are met. From line 3 of Table 3.2-1 a FY 85 consumption of 180,158 MBtu has been set for Building Area In Use Constructed Before FY 78. This is the building area that was studied for the Energy Report. From Table 1.5, the FY 85 consumption will be 143,771 MBtu if all of the recommendations in Table 10-1 have been implemented by that time. The goal is met by a margin of 36,387 MBtu. The consumption goals on a square foot basis are met by a correspondingly large margin. The goal is 105 kBtu/sf in FY 85. From Table 1.5, the projected 1985 consumption is 84 kBtu/sf, a margin of 21 kBtu/sf.

HOHENFELS SUBCOMMUNITY

TABLE 1.5

PROJECTED TOTAL ENERGY CONSUMPTION MBTU/YEAR						
1975 KBTU/SF (KNOWN)	1975 MBTU (KNOWN)	% REDUCTION	1985 KBTU /SF (PROJECTED)	1985 MBTU (PROJECTED)	% INCREASE FUTURE CONST.	1987 MBTU FUTURE CONST.
131	231,889	38	84	143,771	2.5	147,365

TABLE 3.2-1 ENERGY CONSUMPTION: PROGRESS AND GOALS FOR FY 85: HOHENFELS

		UNITS	FY75	FY80	FY85
1a.	Electricity	MBTU	64,787	72,764	
b.	Coal	MBTU	42,432	31,013	18,392 Goal (10%)
c.	Fuel Oil # 2	MBTU	124,670	118,659	
d.	Fuel Oil # 6	MBTU		-	
e.	Solar Energy	MBTU		-	1,839 Goal (1%)
f.	Total Energy	MBTU	231,889	222,436	-
2a.	Goal: Total Energy Reduced 25%: (0.75 x $1f_{FY75}$)	MBTU	-	-	173,917
b.	Goal: Energy Per Sq. Ft. Reduced 20% by ECIPS and Mgmt, and 5% by New Efficient Bldgs (3a x 3c) + (4a x 4b)	MBTU	-	-	183,925
3a.	Building Area in use, constructed before FY78	SQ.FT.	1,763,698	1,748,491	1,715,796
b.	Energy Per Sq. Ft. (1f ÷ 3a)	KBTU/SQ. FT.	131	-	-
c.	Goal: Energy Per Sq. Ft. Reduced 20% by ECIPS (12%), and Mgmt (8%): (0.8 x $3b_{FY75}$)	KBTU/SQ. FT.	-	-	105
d.	Total Energy	MBTU	231,889	-	180,158
4a.	Building Area in use, constructed after FY78	SQ.FT.	-	11,786	52,323
b.	Goal: Energy Per Sq. Ft. Reduced 45% by Efficient Design (0.55 x $3b_{FY75}$)	KBTU/SQ. FT.	-		72
c.	Total Energy	MBTU	-		3,767
5a.	Gross Floor Area (3a + 4a)	SQ.FT.	1,763,698	1,760,277	1,768,119
b.	Energy Per Sq. Ft (1f ÷ 5a)	KBTU/SQ. FT.	131	126	-
c.	Goal: 25% Reduction (0.75 x $5b_{FY75}$)	KBTU/SQ. FT.	-	-	98
d.	Goal: Army Facilities Energy Plan, Annex B-5	KBTU/SQ. FT.	-	-	134.9
6a.	Heating Degree Days	DEG F - DAYS	6,906	7,149	—
7a.	Population		5,071	4,190	4106

When accounting for future construction and demolition, the goal for FY 85 is 183,725 MBtu. The estimate of future consumption, taking into account new construction, is 147,365 MBtu in FY 87. (Refer to Table 1.5). The goal is met by 36,560 MBtu/yr. This figure is conservative because the additional construction between 1985 and 1987 increases the estimated consumption.

2. INCREMENTS A AND G

2.1 REQUIREMENTS

Increment A deals with energy conservation investigations for buildings and processes. It deals with the investigation of ECIP projects which involve modifying, improving or retrofitting existing buildings, (including family housing), to include architectural and structural features, HVAC systems, plumbing systems, interior or exterior building and parking facilities lighting.

Increment G deals with projects developed in Increment A which result in energy savings but do not qualify under ECIP criteria.

A list of Energy Conservation Opportunities (ECO's) that we investigated is presented in Table 2.1.

2.2 SUMMARY OF RESULTS

For a project to qualify as an FY 84 ECIP project, it must have an E/C > 13, B/C > 1, and a Project Cost > $100,000. In Table 6.1, Interim Submittal we have summarized all feasible ECIP projects. A copy is included hereafter.

Energy conservation projects with E/C < 13 or Project Cost < $100,000 which cannot qualify as FY 84 ECIP projects, but which we feel are suitable for implementation from non-ECIP funding sources such as OMA or MMCA Programs, have also been included in Table 6.1 as OMA projects.

As indicated in Table 6.1, we have recommended 4 ECIP Projects and 29 OMA Projects for implementation.

The original Interim Submittal version of Table 6.1 listed the projects by building type. As a result of a suggestion by the Subcommunity, to consider the combining of smaller OMA projects, the present version of Table 6.1 groups projects by type (ECIP or OMA) and within each group lists projects by E/C ratio, highest to lowest.

The combining of projects eliminates the consideration of projects by building type. What is gained is an additional ECIP project. A copy of revised Table 6.1 is used in this volume.

Table 2.1

LEGEND: PROPOSED ECOS

1.....ATTIC FLOOR INSULATION
2.....ROOF INSULATION
3.....WALL INSULATION
4.....INSTALL STORM WINDOWS
5.....WEATHER SEAL GARAGE DOORS
6.....WEATHER SEAL ENTRANCE DOORS
7.....INSTALL RADIATOR ATC VALVE
8.....INSTALL O.A. RESET SYSTEM
9.....INSTALL NIGHT SETBACK
10....CONVERT STEAM TO H.W. HEATING
11....CONVERT TO CENTRAL BOILER
12....INSTALL PIPE INSULATION
13....INSTALL NEW BOILER(S)
14....REPL INCANDESCENT LIGHTING WITH HIGH PRESSURE SODIUM
15....REPL HANDFIRED W/AUTOFIRED BOILER
16....REPL H.W. STORAGE TANK
17....WEATHER SEAL WINDOWS
18....INSTALL CEILING FAN FOR HEAT RECOVERY
19....INSTALL SPACE THERMOSTAT
20....INSTALL FAN ON/OFF CONTROL
21....CONVERT FROM MANUAL OA HW RESET TO AUTOMATIC
22....INSTALL HEATING ON/OFF CONTROL
23....INSTALL NIGHT SETBACK WITH OA HW RESET
24....INSTALL MULTIPLE ZONE CONTROL

TABLE 6.1

ECIP/OMA PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	E/C RATIO	B/C RATIO	FY84 CWE $	ANNUAL ENERGY SAVINGS NO. 2 OIL MBTU	COAL MBTU	ELECT. MBTU	TOTAL MBTU	FY84 COST SAVINGS $
16	Office Building	ECIP H16	30.3	2.7	100,000	939	2,096	-	3,035	23,640
18	General Storage Warehouse	ECIP H18	23.7	2.7	128,800	3,047	-	-	3,047	39,700
-	Combined ECIP	ECIP HC1	23.1	3.4	376,126	7,180	1,150	(-)34	8,296	99,465
1	Barracks	ECIP H1	17	2.6	121,100	1,876	197	-	2,073	25,500
17	General Instruction	OMA H17-1	798	131	450	359	-	-	359	4,700
10	Exchange Warehouse (Laundry)	OMA H10	546	88	170	93	-	-	93	1,210
11	Motor Tank Repair Shop	OMA H11-1	192	19.3	38,400	6,032	1,350	-	7,382	85,900
12	Gymnasium	OMA H12	76	12.6	6,400	511		(-)24	487	6,414
19	Open Mess NCO	OMA H19-2	66	3.7	1,714	114	-	-	114	610
7	Dependent Grade School	OMA H7-1	40.5	6.6	2,400	97	-	-	97	1,267
16	Office Building	OMA H16	40.0	3.5	10,300	121	291	-	412	3,200

TABLE 6.1

ECIP/OMA PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	E/C RATIO	B/C RATIO	FY84 CWE $	ANNUAL ENERGY SAVINGS NO. 2 OIL MBTU	COAL MBTU	ELECT. MBTU	TOTAL MBTU	FY84 COST SAVINGS $
21	Dispensary	OMA H21-1	30.0	3.4	7,470	224	-	-	224	2,915
7	Dependent Grade School	OMA H7-3	22.8	1.7	7,400	-	169	-	169	915
20	Fire Station	OMA H20-1	20.5	2.3	8,370	87	84	-	171	1,000
8	Warehouse Refrigerated	OMA H8-1	19.0	2.2	1,900	36	-	-	36	470
5	Family Housing	OMA H5-1	15.0	1.1	1,090	8	9		17	149
3	Enlisted Persons Mess	OMA H3-1	11.0	2.7	120,600	1,323	-	-	1,323	17,240
19	Open Mess NCO	OMA H19-1	10.8	1.7	19,500	95	117	-	212	1,660
1	Barracks WO/Mess	OMA H1	10.5	1.1	73,900	694	79	-	773	9,042
11	Motor/Tank Repair Shop	OMA H11-2	9.3	2.1	149,100	1,279	184	(-)82	1,381	16,854
23	Library	OMA H23	8.9	2.2	1,625	15	-	-	15	190
20	Fire Station	OMA H20-2	8.4	1.0	4,900	41	-	-	41	540
7	Dependent Grade School	OMA H7-2	8.1	2.0	17,800	144	-	-	144	1,874
3	Enlisted Persons Mess	OMA H3-2	7.3	1.8	58,570	430	-	-	430	5,600

TABLE 6.1

ECIP/OMA PROJECT SUMMARY
HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	E/C RATIO	B/C RATIO	FY84 CWE $	ANNUAL ENERGY SAVINGS NO. 2 OIL MBTU	COAL MBTU	ELECT. MBTU	TOTAL MBTU	FY84 COST SAVINGS $
17	General Instruction	OMA H17-3	6.9	1.8	20,800	143	-	-	143	1,870
21	Dispensary	OMA H21-2	6.5	1.6	75,200	490	-	-	490	6,400
8	Warehouse Refrigerated	OMA H8-2	5.6	1.4	8,140	46	-	-	46	600
11	Motor/Tank Repair Shop	OMA H11-3	5.0	1.3	4,500	23	-	-	23	300
18	General Purpose Warehouse	OMA H18	4.9	1.2	517,000	2,550	-	-	2,550	33,200
5	Family Housing	OMA H5-2	4.5	1.1	277,000	1,248	-	-	1,248	16,300
2	Hutments	OMA H2	4.4	1.1	246,800	1,076	-	-	1,076	14,028
17	General Instruction	OMA H17-2	4.4	1.1	13,100	58	-	-	58	750
9	Theatre	OMA H9	4.0	1.0	93,900	371	-	-	371	4,830
	Subtotal	ECIP = 4			726,026	13,042	3,443	(-)34	16,451	188,305
		OMA = 29			1,788,499	17,880	2,283	(-)106	20,057	240,114
	Totals	33 Projects			2,514,525	30,922	5,726	(-)140	36,508	428,417

TABLE 6.1A

SUMMARY OF PROJECT ECOs

HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	ATTIC FLOOR INSULATION	ROOF INSULATION	WALL INSULATION	INSTALL STORM WINDOWS	WEATHER SEAL GARAGE DOORS	WEATHER SEAL ENTRANCE DOORS	INSTALL RADIATOR ATC VALVE	INSTALL O.A. RESET SYSTEM	INSTALL NIGHT SETBACK	CONVERT STEAM TO H.W. HEATING	CONVERT TO CENTRAL BOILER	INSTALL PIPE INSULATION	INSTALL NEW BOILER(S)	REPL. MERCURY VAPOR TO HIGH PRES. SODIUM	REPL. HANDFIRED W/AUTOFIRED BOILER	REPL. H.W. STORAGE TANK	WEATHER SEAL WINDOWS	INSTALL CEILING FAN FOR HEAT RECOVERY	INSTALL SPACE THERMOSTAT	INSTALL FAN ON/OFF CONTROL	CONVERT FROM MANUAL OA HW RESET TO AUTOMATIC	INSTALL HEATING ON/OFF CONTROL	INSTALL NIGHT SETBACK WITH OA HW RESET	INSTALL MULTIPLE ZONE CONTROL	INSTALL SHUTOFF VALVES		
16	Office Buildings	ECIP H16	●						●																				
18	General Storage Warehouse	ECIP H18	●					●	●																				
-	Combined ECIP	ECIP HC1	●			●		●	●		●									●						●			
1	Barracks	ECIP H1	●						●																				
17	General Instruction	OMA H17-1																			●								
10	Exch. Warehouse (Laundry)	OMA H10									●																		
11	Motor/Tank Repair Shop	OMA H11-1					●		●												●							●	
12	Gymnasium	OMA H12									●									●									
19	Open Mess NCO	OMA H19-2																								●			
7	Dependent Grade School	OMA H7-1							●																				

TABLE 6.1A

SUMMARY OF PROJECT ECOs

HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	ATTIC FLOOR INSULATION	ROOF INSULATION	WALL INSULATION	INSTALL STORM WINDOWS	WEATHER SEAL GARAGE DOORS	WEATHER SEAL ENTRANCE DOORS	INSTALL RADIATOR ATC VALVE	INSTALL O.A. RESET SYSTEM	INSTALL NIGHT SETBACK	CONVERT STEAM TO H.W. HEATING	CONVERT TO CENTRAL BOILER	INSTALL PIPE INSULATION	INSTALL NEW BOILER(S)	REPL. MERCURY VAPOR TO HIGH PRES. SODIUM	REPL. HANDFIRED W/AUTOFIRED BOILER	REPL. H.W. STORAGE TANK	WEATHER SEAL WINDOWS	INSTALL CEILING FAN FOR HEAT RECOVERY	INSTALL SPACE THERMOSTAT	INSTALL FAN ON/OFF CONTROL	CONVERT FROM MANUAL OA HW RESET TO AUTOMATIC	INSTALL HEATING ON/OFF CONTROL	INSTALL NIGHT SETBACK WITH OA HW RESET	INSTALL MULTIPLE ZONE CONTROL			
16	Office Building	OMA H16																								●			
21	Dispensary	OMA H21-1						●	●										●										
7	Dependent Grade School	OMA H7-3	●																							●			
20	Fire Station	OMA H20-1				●			●																	●			
8	Warehouse Refrigerated	OMA H8-1						●																					
5	Family Housing	OMA H5-1						●																					
3	Enlisted Persons Mess	OMA H3-1				●																							
19	Open Mess NCO	OMA H19-1				●																							
1	Barracks WO/Mess	OMA H1				●		●																					
11	Motor/Tank Repair Shop	OMA H11-2	●			●														●									
23	Library	OMA H23				●																							
20	Fire Station	OMA H20-2	●					●																					

TABLE 6.1A

SUMMARY OF PROJECT ECOs

HOHENFELS SUBCOMMUNITY

BUILDING TYPE NO.	BUILDING TITLE	PROJECT TYPE	ATTIC FLOOR INSULATION	ROOF INSULATION	WALL INSULATION	INSTALL STORM WINDOWS	WEATHER SEAL GARAGE DOORS	WEATHER SEAL ENTRANCE DOORS	INSTALL RADIATOR ATC VALVE	INSTALL O.A. RESET SYSTEM	INSTALL NIGHT SETBACK	CONVERT STEAM TO H.W. HEATING	CONVERT TO CENTRAL BOILER	INSTALL PIPE INSULATION	INSTALL NEW BOILER(S)	REPL. MERCURY VAPOR TO HIGH PRES. SODIUM	REPL. HANDFIRED W/AUTOFIRED BOILER	REPL. H.W. STORAGE TANK	WEATHER SEAL WINDOWS	INSTALL CEILING FAN FOR HEAT RECOVERY	INSTALL SPACE THERMOSTAT	INSTALL FAN ON/OFF CONTROL	CONVERT FROM MANUAL OA HW RESET TO AUTOMATIC	INSTALL HEATING ON/OFF CONTROL	INSTALL NIGHT SETBACK WITH OA HW RESET	INSTALL MULTIPLE ZONE CONTROL			
7	Dependent Grade School	OMA H7-2	●			●		●																					
3	Enlisted Persons Mess	OMA H3-2	●			●																							
17	General Instruction	OMA H17-3	●																										
21	Dispensary	OMA H21-2	●		●																								
8	Warehouse Refrigerated	OMA H8-2				●																							
11	Motor/Tank Repair Shop	OMA H11-3				●																							
18	General Purpose Warehouse	OMA H18			●	●																							
5	Family Housing	OMA H5-2			●																								
2	Huts ments	OMA H2				●																							
17	General Instruction	OMA H17-2	●																										
9	Theater	OMA H9			●																								

A new summary, Table 6.1A, Interim Submittal was created to indicate the types of ECOs included in each project. A copy of Table 6.1A is included hereafter.

If all these projects are implemented at a CWE FY 84 of $2,514,525, the subcommunity will save 36,508 MBtu of energy, which is approximately 16.4% of its total energy consumption. The annual dollar savings will be $428,417.

2.3 PROGRAM DOCUMENTS

A complete set of Program Documents, DD Form 1391s and PDB-1s, plus attachments, for each ECIP and OMA project are included in the Interim Submittal, Volume 5, Books 1 and 2.

3. INCREMENT B

3.1 REQUIREMENTS

Increment B requires the following:

a. Study the existing utilities and energy distribution systems, and existing energy plants; identify and analyze possible energy conservation projects.

b. Determine the feasibility of an EMCS for building electrical, and mechanical systems and utility distribution.

c. Develop a load profile for the past three years indicating the quantities of each energy source procured (heating oil, coal, electricity, etc.); and the peak demand loads, and essential loads.

d. Develop graphic presentation of hourly KW demand for peak load/demand days. Develop procedures to reduce peak demand by load shedding.

e. Project energy costs three years from the date of Contract award, and estimate the heating, lighting and other costs per square foot per year.

3.2 SUMMARY OF RESULTS

Our investigation of potential Increment B projects resulted in two recommendations: a Street Lighting OMA project and an EMCS ECIP project. The combined energy savings amounts to 11,028 MBtu/yr with an equivalent dollar savings of $168,040/yr. This represents a 5.4% reduction of FY 80 basewide energy consumption.

The major savings come from the EMCS recommendation. The Street Lighting project is documented in the Prefinal Submittal, Volume 5, OMA SL1. The EMCS is described in Volume 8 of this Pre-Final Submittal. A summary of the EMCS study is presented in Section 3.1 of this narrative.

The Interim Submittal describes our investigation of Increment B projects, excluding the EMCS study, and is summarized as follows:

a. We have obtained information on and studied in significant detail the subcommunities electrical system, street lighting system, potable water system, sewage collection and treatment system, hot water and steam distribution system; as well as existing energy plants consisting of Central Boiler Plants and Local-Building Boiler Plants.

b. We have recommended several projects that require the modification of boiler plant controls such as installation of OA HW reset control, night set-back control and installation of time-clock. These projects however, have been presented under Increments A or G.

c. We have developed electricity and fuel consumption load profiles for the past three years and presented them in Section 3 of the Interim Submittal.

d. Graphical profiles of hourly kw demand occuring on a weekday, weekend and peak demand day have been developed, presented and discussed in Paragrpah 7.2.4 of the Interim Submittal, for each month of FY 80. We have discussed existing peak demand limiting systems, and will investigate if the EMCS is feasible for further demand limiting.

e. Based on the AXCESS analysis of each building type, we have estimated the annual energy consumption and cost per square foot of each building type for Electricity, Fuel, Space Heating, Domestic Hot Water, Lighting and Miscellaneous Equipment. We have also projected these FY 80 to FY 84. Tabulated cost data has been presented in Section 5 of the Interim Submittal.

3.3 INCREMENT B - EMCS FEASIBILITY STUDY

3.3.1 PURPOSE

The purpose of this study is to determine the technical and economic feasibility of utilizing Energy Monitoring and Control system (EMCS) techniques at the Hohenfels Subcommunity, Hohenfels, West Germany.

This effort is to develop a systematic plan to reduce energy consumption in compliance with the objectives put forth in the Army Facilities Energy Plan. Within the scope of this study, recommendations for the possible implementation of those objectives will be investigated.

3.3.2 PARAMETERS OF THE FEASIBILITY STUDY

Of the 310 buildings in the subcommunity, 65 are considered. Inclusion is based on engineering judgment for potential economic payback.

3.3.3 SCOPE OF WORK

a. Supplement the site investigation with "as built" drawings, as well as sound engineering judgment.

b. Interview administrative personnel to determine operating hours and procedures relative to the surveyed buildings.

c. Identity EMCS energy conserving programs and strategies which might be appropriate for each of the buildings, listing the points required.

d. Evaluate by computer analysis, energy conserved by these programs as well as their implementation costs in accordance with Energy Conservation Investment Program (ECIP) requirements.

e. Make recommendations which may include in the EMCS some systems, points and/or programs which, while not directly related to energy savings, would provide management information and centralized control, making for more efficient facility operation.

3.3.4 SUMMARY

It was determined that 23 of the buildings in the Hohenfels Subcommunity are technically feasible while meeting the ECIP guidelines for EMCS installation. Total cost estimate for implementation is $799,966.

The estimated energy savings with the recommended EMCS are 764 MBtu of electricity (lighting) and 9,757 MBtu of heating fuel. This represents a 4.5% reduction of FY 80 basewide energy consumption.

ECIP Summary

CWE	$ 799,966
Design Cost	$ 24,961
Total	$ 824,927

Total Benefits	$ 1,335,897
Discounted Benefit/Cost Ratio (>1)	1.6
Total Annual Energy Savings	40,393 MBtu
E/C Ratio	13.2
Annual $ Savings	$ 105,980
Payback Period	7.5 yr

The proposed new EMCS equipment is to be designed to meet the requirements of the Inter-Agency Guide Specification, a document developed to standardize government procurement of strategies for centralized computer control for energy conservation. To meet this objective a small sized EMCS, according to Specification CEGS-13949, is recommended.

Buildings not recommended either did not meet initial criteria or were determined to be an ineffective application upon physical inspection.

3.3.5 EXCLUDED FROM SCOPE OF INVESTIGATION

The scope of the analysis and site investigation is limited only to those considerations which impact on energy. Excluded from consideration are all process, manufacturing or laboratory equipment and systems, as well as fire alarms and security.

3.3.6 CONCLUSIONS

In analyzing the 96 applicable buildings in the Hohenfels Subcommunity, the installation reflects a total Benefit/Cost ratio of 1.6, an Energy/Cost ratio of 13.2 and payback period of 7.5 years.

Results are in accordance with ECIP B/C >1 and E/C >13 prerequisites for ECO implementation and payback period of less than 15 years.

Strategies in order of cost effectiveness:

a. Reducing fuel consumption during the heating season by means of temperature setback during unoccupied hours.

b. Optimized control of boilers.

c. Lighting reduction/shutdown during unoccupied periods.

3.3.7 RECOMMENDATIONS

a. Implement the installation of an Energy Monitoring and Control System in the Hohenfels Subcommunity, Hohenfels, West Germany.

b. The system will consist of one control room to accommodate the facility.

c. Install the EMCS at the estimated construction cost of $824,900.

d. Provide a system configuration, programs, and strategies as described in this study.

e. Note that possible further savings can be realized by the use of EMCS to provide remote controlled space temperatures during normal occupancy periods. Additional savings may be achieved when the EMCS is used to its full potential to provide management reports and maintenance information. These have not been included in the ECIP calculations since they imply future changes in operating procedures which may not be realized.

4. INCREMENT F

4.1 OBJECTIVES

The objectives of Increment F are summarized as follows:

a. To recommend modifications and changes in system operation which are within the Facilities Engineer funding authority and management control. Recommendations shall be in the form of specific, practical instructions for the use of Facilities Engineer personnel.

b. To summarize and establish the priority of all energy conservation measures and projects from Increments A, B, F and G for use of the Community Commander and Facilities Engineer in developing their energy management plans.

The Scope of Work (Schedule of Title Services Rev) is included in Appendix 1-A, Volume 7 of the Prefinal Submittal.

4.2 MODIFICATIONS INVESTIGATED

4.2.1 A total of 28 potential modifications were investigated from which we developed twenty-four recommendation for Building and Maintenance/Operations systems.

Fourteen of the twenty-four recommendations relate to Building Equipment Systems and are based on an analysis of building field survey data.

Ten recommendations relate to the Maintenance and Operation (M/O) procedures in use by the Facilities Engineer Division of the Hohenfels Subcommunity. The analysis of existing M/O procedures is based on field data consisting of answers to questions put to the Facilities Engineer and members of his staff.

4.2.2 Two investigations were developed into recommendations concerning expendable equipment.

4.2.3 Two investigations developed into non-recommendations.

4.3 SUMMARY

The projects investigated are listed, as follows:

4.3.1 MODIFICATIONS TO BUILDING SYSTEMS

S&H PROJECT NO.	DESCRIPTION
F H1	Install Time Clock Controls on Shower Room Heating Units.
F H2	Replace 24-Hour Time Clock Heating Controls With 7-Day Type.
F H3	Install Waste Heat Recovery Form Refrigeration Equipment.
F H4	Implement Boiler Water Treatment Program.
F H5	Install Automatic-Vent Damper In Oil-Fired Boilers.
F H6	Use Cold Water Detergent For Washing Clothes.
F H7	Use Cold Water Detergent For Washing Dishes.
F H8	Install Underground Fuel Oil Transfer System.
F H9	Seal Unused Flue Openings.
F H10	Install Vehicle Exhaust System In Building No. 392.
F H11	Retrofit Existing Interior Fluorescent Lighting with Low Energy Lamps and Ballasts.
F H12	Modify Kitchen Range Hood Exhaust.
F H13	Lower Domestic Hot Water Temperature.
F H14	Replace Oil Fired Burner Nozzles For Summer Use.

4.3.2 MODIFICATIONS TO MAINTENANCE/OPERATIONS SYSTEMS

F H15	Preventive Maintenance Program.
F H16	Temperature Control Technician.
F H17	Reduction of Space Heating Temperatures.

F H18 Interior Lighting Control.

F H19 Window Operation.

F H20 Door Operation.

F H21 Cooking Equipment Warmup.

F H22 Upgrade Centratherm Control System.

F H23 DHW Circulating System.

F H24 Resize Primary Heating Equipment.

4.3.3 EXPENDABLE EQUIPMENT

F H25 Energy Saving Ovens.

F H26 Energy Saving Motors.

4.3.4 PROJECTS NOT RECOMMENDED

F H27 Installation of Low Energy Fluorescent Lamps and Ballasts to Replace Burned-Out Interior Lighting.

F H28 Use Warm Water Detergent.

The above projects are not recommended becasue they are alternative approaches to ECO's that are recommended. The recommended ECO's have higher E/C ratios. For a detailed analysis see the Energy Report, Final Submittal, Volume 2, Section 11.1. The recommended project for alternative F H27 is "Retrofit Existing Interior Fluorescent Lighting With Low Energy Lamps and Ballasts", F H11. The recommended project for alternative F H28 is "Use Cold Water Cleaning Chemical In Dishwasher Wash Cycle", F H7.

4.4 INVESTIGATION CONCLUSIONS

The effects, in energy and cost savings, of implementing the above listed modifications are summarized in Table 2-1 of Volume 6 of the Prefinal Submittal, a copy of which is included hereafter.

TABLE 2-1

SUMMARY OF PROJECTS
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	E/C RATIO	PAYBACK PERIOD (YEARS)	IMPLEMENTATION COST		ANNUAL SAVINGS	
					CWE FY84 (DOLLARS)	FE (MAN HOURS)	ENERGY (MBTU)	FY84 (DOLLARS)
F H15	Preventative Maintenance Program	All Buildings	-	Immediate	-	-	-	-
F H16	Temperature Control Technician	Various Buildings	-	Immediate	-	-	1,136	-
F H17	Reduction Of Space Heating Temperature	All Building Except Type 21 Dispensary	-	Immediate	-	-	9,657	114,562
F H18	Interior Lighting Control	Various Buildings	-	Immediate	-	-	-	-
F H19	Window Operation	All Buildings	-	Immediate	-	-	-	-
F H20	Door Operation	All Buildings	-	Immediate	-	-	-	-
F H21	Cooking Equipment Warm-up	Mess Halls	-	Immediate	-	-	-	-
F H23	Domestic Hot Water Circulating System	Various Buildings	-	Immediate	-	-	-	-
F H24	Resize Primary Heating Equipment	Various Buildings	-	Immediate	-	-	2,928	38,158
F H25	Energy Saving Ovens	Mess Halls	-	Immediate	-	-	-	-
F H26	Energy Savings Motors	Various Buildings	-	Immediate	-	-	-	-

TABLE 2-1

SUMMARY OF PROJECTS
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	E/C RATIO	PAYBACK PERIOD (YEARS)	IMPLEMENTATION COST		ANNUAL SAVINGS	
					CWE FY84 (DOLLARS)	FE (MAN HOURS)	ENERGY (MBTU)	FY84 (DOLLARS)
F H13	Lower Domestic Hot Water Temperature	Barracks, Mess Halls, Family Housings	617	Immediate	2,006	118	1,951	24,101
F H7	Use Cold Water Detergent To Wash Dishes	Mess Halls	494	0.2	2,835	96	1,400	11,668
F H6	Use Cold Water Detergent For Washing Clothes	Barracks, Launderette, Family Housing	492	0.2	620	21	305	3,900
F H2	Replace 24-Hour Time Clock Heating Controls With 7-Day Type	Various Buildings	201	0.5	1,400	-	282	3,665
F H14	Change Burner Nozzles For Off-Peak Operation	Various Buildings	178	0.4	2,100	88	375	4,885
F H1	Install Time Clock Controls On Shower Room Heating Units	Various Buildings	113	1	11,025	-	1,245	15,680
F H4	Implement Boiler Water Treatment Program	Various Buildings	87.6	1	35,234	-	3,088	35,540
F H9	Seal Unused Flue Openings	Hutments	77	1	1,980	-	145	1,890
F H22	Upgrade Centratherm Control System	Various Buildings	57	1.5	64,400	-	3,473	41,795

TABLE 2-1

SUMMARY OF PROJECTS
HOHENFELS SUBCOMMUNITY

PROJECT ID	MODIFICATION	APPLICABLE BUILDINGS	E/C RATIO	PAYBACK PERIOD (YEARS)	IMPLEMENTATION COST		ANNUAL SAVINGS	
					CWE FY84 (DOLLARS)	FE (MAN HOURS)	ENERGY (MBTU)	FY84 (DOLLARS)
F H5	Install Automatic Vent In Oil Fired Boilers	Various Buildings	38	2	95,640	-	3,640	47,430
F H11	Retrofit Existing Fluo. Ltg. With Low Energy Type	Various Buildings	30	3.3	246,360	3,307	7,450	74,128
F H3	Install Waste Heat Recovery From Refrigeration Equipment	H-3, H-10 & H-24	18.2	4.6	38,550	-	702	8,372
F H12	Modify Kitchen Range Hood Exhaust	H-24	13.1	5.9	25,875	-	339	4,410
F H10	Install A Vehicle Exhaust	H-392	9	8.8	9,725	-	85	1,108
F H8	Install Underground Fuel	Hutments	8.9	8.6	198,320	-	1,800	23,020
	Totals	26 Projects		1.6	736,070	3,630	40,001	454,312

4.4.1 BUILDING SYSTEMS

Building systems modifications would result in annual energy savings of 22,807 MBtu/yr. and equivalent annual dollars savings of $259,797/yr (FY 84 escalated). This represents a 10.3% reduction of FY 80 basewide energy consumption. Implementation costs would amount to $671,670. The overall payback period is 2.6 years.

4.4.2 MAINTENANCE/OPERATIONS SYSTEMS

Of the eleven M/O systems modifications five have calculable energy and cost savings, and the remaining six are recommendations without calculable savings.

The four modifications having calculated savings (F H16, F H17, F H22, F H24), if implemented, would yield a total annual energy savings of 17,197 MBtu/yr and equivalent annual dollar savings of $194,515/yr. This represents a 16.3% reduction in FY 80 basewide energy consumption.

The energy and cost savings for the six recommendations without calculable savings (F H15, F H18, F H19, F H20, F H21, F H23), are not easily defined. Exact factual data such as hours of occurrence (e.g. how many hours are lights left on in unoccupied spaces or rolling doors left open) could not be determined during a three week survey period. Therefore, these recommendations are general in nature and are made because of their obvious energy savings result.

Of the three modifications with calculable savings, F H17 is a no-cost implementation, F H22, has a calculable implementation cost, and F H24, has no calculable implementation costs. Therefore, an overall payback period cannot be calculated for these three recommendations.

The recommendation for a Temperature Control Tecnician (F H16) was based on an analysis of a single type of inoperative control condition. There, since more types of inoperative controls are normally encounterd, the calculated energy savings are minimal. The uncertainty of the type and amount of inoperative controls that could develop from year to year make it impossible to calculate exact savings.

4.4.3 MODIFICATION NOT UNDER FE MANAGEMENT CONTROL

4.4 EXPENDABLE EQUIPMENT

The energy savings for expendable equipment (F H25, F H26) are caluclated for a single piece of equipment since no one can predict how many pieces of equipment will fail at a given time. Implementation costs are also on a piece basis and are incremental costs since this is a replacement recommendation, not a retrofit.

4.5 ENERGY CONSERVATION MODIFICATIONS SINCE 1975

A complete listing of energy conservation related projects is given. The listing was updated in April 1982 and is current as of this date.

Many of the projects were not established as specific energy conservation projects. They were the result of normal repair projects that incorporated energy saving features. Therefore they qualified as energy conservation modifications.

The list contains two ECIP projects and thirty-seven OMA projects.

4.5.1 GENERAL

A visit was made to the Chief of Engineering and Plans and Services to discuss energy converation modifications at the Hohenfels Subcommunity since 1975. A review of records uncovered some additional projects and some deletions. These changes have modified the list of previous energy related projects compiled for the Interim Submittal, presented in Section 2.3.1, Volume 1. The modified listing is presented in the following section.

4.5.2 PROJECT LISTING

ECIP PROJECTS

7T-173-80*	Attic insulation/installation of thermostatic radiator valves in FH Facilities, 7ATC. Received 1391 Form.
7T-607-80	"Insulate Troop Billets". Received 1391 Form.

OMA PROJECTS

1975 to 1977:	Replaced deteriorated ceiling insulation with new in some Troop Billets.
7T-643-77	Replace wooden windows, Building No. 60.
7T-555-79*	Replace Heating System Building No. 7.
7T-587-79	Replace boiler, FH Building No. 62. Received job order request.
7T-517-80	Replace WW storage tank, Building No. 160. Received job order request.
7T-528-80	Install central heating system, Building No. 746. Received job order request.
7T-591-80	Modernize heating system, Building No. 3. Received work request.
7T-599-80*	Replace windows (triple glased) Buildings No. 662 and 670.
7T-598-80*	Replace windows (triple glased) TAC Site 29.
7T-569-80*	Replace Heating System and install attic insulation, office spaces of Building No. 702.
7T-604-80*	Replace windows and insulate walls, Building No. 51.
7T-605-80*	Replace windows and insulate attic Buildings No. 20 through 22, 26 through 28 and 30.
7T-606-80*	Replace Heating System, Insulate walls and ceiling, Heat Recovery System, 4 Mess Halls in Camp Albertshof.
7T-647-80	Insulate gymnasium, Building No. 47. Received work request.
7T-675-80	Heating centralization, Building No. 23. Received work request and specification.

7T-688-80	Replace heating system in Building No. 807.
7T-691-80	Modernization of heating system, Buildings No. 382, 383, and 386. Received drawing.
7T-530-81	Install central boilers, Building No. 3. Received work request and specification.
7T-531-81	Heat centralization at Camp Nainhof, Phase I. Received work request and specification.
7T-532-81	Heat centralization at Camp Nainhof, Phase II. Received work request and specification.
7T-541-81	Replace heating system in Buildings No. 745 and 747.
7T-619-81*	Exterior renovation of Building No. 8. (Replace windows, exterior wall insulation).
7T-638-81*	Insulate ceiling and replace windows, Buildings No. 14 and 40.
7T-666-81*	Install long distance lines from Heating
7T-667-81*	Plant in Building No. 23 (was 7T-675-80).
7T-675-81	Double glazed windows and insulate exterior walls in Buildings No. 244 through 258.
7T-676-81	Double glazed windows and insulate exterior walls in Buildings No. 189 through No. 208.
7T-677-81	Double glazed windows and insulate exterior walls in Buildings No. 224 through 243.
7T-685-81*	Replace windows, replace ext. metal side walls with masonry, Building No. 23.

7T-3004-82*	Replace windows insulate walls and ceilings, Building No. 703.
7T-3012-82*	Centralize Heating System, Camp Albertshof.
7T-2016-82*	Centralize Heating System, Camp Poellnricht.
7T-715-80	Modernization of heating system, Buildings No. 324, 327, 344, 351, 366. Received drawing.

* Project is unfunded or subject to available funds.

4.6 INCREMENT PROJECTS BY E/C RATIO

Table 10-1, Volume 6, ranks all the recommended Increment A, B, F and G projects by E/C ratio. A copy is included in this Summary.

4.7 FUTURE ENERGY CONSUMPTION

4.7.1 GENERAL

In this Section we have analyzed the effect of future facility changes on the energy consumption of the Hohenfels Subcommunity. Tables 11-1, 11-2 and 11-3 list the changes in construction in two categories: New Constructions and Demolitions. These tables are included in Appendix 11-B, Volume 7, Prefinal Submittal.

4.7.2 AVAILABLE DATA

Hohenfels did not have a formalized Master Plan so we developed our estimated future energy use from other data made available to us. The data consisted of:

a. 7ATC MCA Project Status Report, dated 10 February, 1982.

b. Building floor areas from 7ATC Master Planning Section, Grafenwoehr.

c. Design Energy Budgets listed in ETL 1110-3-295.

Since the average heating degree days (HDD) at Hohenfels is more than 7,000 per year, Climatic Region No. 1 was selected and used to determine the Design Energy budgets appropriate to the proposed facility changes.

4.7.3 ANALYSIS

The estimated energy usage of 289,597 sf of new construction is 20,905 MBtu/yr. This is equivalent to 9.4 of the total energy consumption of FY 80.

The estimated energy reduction from 75,296 sf of demolitions is 5,645 MBtu/yr. This is equivalent to 6.8% of the total energy consumption of FY 80.

Therefore, the net estimated future energy consumption for the Hohenfels Subcommunity is 40,228 MBtu/yr and results from all facilities changes planned up to and including FY 87. This is equivalent to a 2.5% increase in total energy consumption of FY 80.

It is assumed that all new construction will incorporate required energy conservative features in their designs.

4.8 TRAINING COURSES

We have presented in Section 12, Volume 6 of the Prefinal Submittal recommendations on Government and Commercial sponsored training courses. We recommend these courses as additional training for the Hohenfels Facilities Engineer Division.

It is not our intent to suggest that this additional training be considered as basic training but rather as refresher or familiarization courses. Training is required to update current knowledge and to learn new technology.

The one course we strongly recommend is the Preventive Maintenance Seminar.

5. ENERGY CONSUMPTION ANALYSIS USING AXCESS COMPUTER PROGRAM (INCREMENTS A & G ONLY)

5.1 MODELING OF SURVEYED BUILDINGS

Each of the surveyed buildings has been modeled on the AXCESS Input Data Sheets, using field survey data, weather data supplied by EUD, occupancy schedules, building construction data, etc; and the model verified against historical energy use (when available) and adjusted until reasonable agreement is obtained.

5.2 COMPUTER OUTPUT

Each Output consists of three parts:

a. Input data

b. Design day space heat gain calculation, (based on 18^{o}C outside air temperature).

c. Result of the hour-by-hour AXCESS energy consumption calculations. The Result consists of a two page output.

The first page shows the month-by-month consumption values of:

1.	Total Source Energy	: MBtu
2.	Electricity	: kwh
3.	Anthracite Coal	: m-tons
4.	Fuel Oil No. 2	: gal
5.	Fuel Oil No. 6	: gal
6.	Interior Lights	: kwh
7.	Equipment	: kwh
8.	Misc. Equipment	: kwh
9.	Fan Power	: kwh
10.	Domestic Hot Water	: MBtu (source energy)

The second page shows the month-by-month consumption values of all the above 10 quantities in kBtu/yr/sf of building area.

It also indicates the annual percent of total energy consumption by each of the above 10 quantities.

5.3 UTILIZATION OF AXCESS RESULTS

As a result of making an AXCESS analysis of buildings of every type, the average kBtu/yr/sf of each building type has been determined.

Knowing the square foot area of all buildings of each type, energy consumed by all buildings of a given type has been calculated by extrapolation.

By analyzing all types of buildings, the energy consumed by all the buildings in the Subcommunity has been estimated.

5.4 AVERAGE ENERGY CONSUMPTION PER BUILDING TYPE

Based on the analysis of the surveyed buildings, the weighted average values of annual source energy consumption per square foot by each of the building types for space heating, domestic hot water, lighting and miscellaneous electric power, are shown in Table 5-1. In Table 5-2, the above values have been expressed as percentages of the total source energy per building type.

5.4.1 GENERAL COMMENTS

We observe that the average total source energy consumption is 180 kBtu/yr/sf of which 49 units (27%) are electrical and 130 units (73%) are fuel.

On an average, a building consumes 114 units for space heating, 16 for DHW, 14 for lighting and 34 for miscellaneous electrical equipment.

Three building types consume more than 150 kBtu/yr/sf for space heating; and as a result of the recommended energy conservation projects, these values will be significantly lowered.

ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE 29-SEP-82

PROGRAM LIST7

ENERGY CONSUMPTION : SUMMARIZED RESULTS OF AXCESS PROGRAM Table 5-1

HOHENFELS SUBCOMMUNITY

- AVERAGE ENERGY CONSUMPTION BY BLDG TYPE -
- KBTU PER SQUARE FOOT PER YEAR -

DESCRP	TYP	GSF	TOTAL ENERGY	FUEL	ELEC	SPACE HEAT	DHW	LIGHT	MISC	MISC LT/EQP	BOILER AUX	ACTUAL FUEL	
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	
EM/BOQ	1	147818.	146.5	123.7	22.8	101.0	22.7	13.1	9.7	7.8	1.9	143.4	
HUTMENTS	2	459264.	106.1	93.3	12.8	93.3	0.0	6.7	6.1	2.6	3.5	28.2	
EM MESS	3	246020.	305.9	185.0	120.9	125.5	59.5	27.7	93.2	81.4	11.8	124.6	
FAM HSNG	5	155406.	225.7	127.1	98.6	104.8	22.3	17.1	81.4	77.4	4.0	143.0	
SCHOOL	7	12832.	121.1	102.5	18.6	95.6	6.9	12.3	6.3	0.8	5.4	121.4	
WRHSE RF	8	36414.	163.7	71.5	92.2	67.9	3.6	8.3	83.9	79.6	4.3	59.1	
THEATER	9	29392.	287.2	189.4	97.8	181.4	8.0	29.4	68.4	61.1	7.3	213.3	
LAUNDRY	10	6110.	269.0	209.0	60.0	108.1	100.9	23.1	36.9	30.0	6.9	276.8	
MOTR RPR	11	112160.	251.7	220.4	31.3	217.0	3.4	14.6	16.7	10.0	6.7	218.7	
GYMNASUM	12	10951.	179.2	153.2	26.0	148.0	5.2	6.8	19.2	0.0	19.2	184.4	
CHAPEL	13	7748.	241.2	222.1	19.1	211.6	10.5	6.4	12.7	0.0	12.7	210.8	
BOWLING	14	3877.	216.8	177.4	39.4	172.4	5.0	14.9	24.5	0.0	24.5	0.0	
ADMINISTRA	16	149656.	166.8	134.7	32.0	127.4	7.3	15.2	16.8	12.2	4.6	135.7	
APPL INS	17	41976.	136.5	125.9	10.6	125.4	0.5	6.2	4.4	0.0	4.4	64.5	
WAREHSE	18	93960.	106.8	85.3	21.4	81.4	3.9	8.5	12.9	3.9	9.1	113.0	
OFF MESS	19	49168.	199.1	122.2	76.9	111.9	10.3	28.1	48.8	47.2	1.5	72.8	
FIRE HSE	20	7724.	156.1	123.9	32.2	119.6	4.3	16.5	15.7	11.6	4.1	134.4	
DISPNSRY	21	22203.	138.3	101.5	36.8	91.3	10.2	11.6	25.2	21.7	3.5	134.5	
TELECOMM	22	4321.	447.0	194.0	253.0	194.0	0.0	28.0	225.0	132.0	93.0	198.0	
LIBRARY	23	3328.	121.7	77.3	44.4	75.7	1.6	38.6	5.8	2.8	3.0	105.0	
WEIGHTED AVERAGE			179.5	130.6	48.9	114.8	15.8	14.4	34.5	28.7	5.8	105.4	0.5

ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE 29-SEP-82

PROGRAM LIST7

ENERGY CONSUMPTION : SUMMARIZED RESULTS OF AXCESS PROGRAM Table 5-2

HOHENFELS SUBCOMMUNITY

- PERCENT ENERGY CONSUMPTION BY BLDG TYPE -

DESCRP -1-	TYP -2-	GSF -3-	TOTAL ENERGY -4-	FUEL -5-	ELEC -6-	SPACE HEAT -7-	D+W -8-	LIGHT -9-	MISC: -10-	MISC LT/EQP -11-	BOILER AUX -12-	ACTUAL FUEL -13-
EM/BOQ	1		100.0	84.4	15.6	68.9	15.5	8.9	6.7	5.3	1.3	97.9
HUTMENTS	2		100.0	87.9	12.1	87.9	0.0	6.4	5.7	2.4	3.3	26.5
EM MESS	3		100.0	60.5	39.5	41.0	19.5	9.1	30.5	26.6	3.9	40.7
FAM HSNG	5		100.0	56.3	43.7	46.4	9.9	7.6	36.1	34.3	1.8	63.4
SCHOOL	7		100.0	84.7	15.3	78.9	5.7	10.2	5.2	0.7	4.5	100.2
WRHSE RF	8		100.0	43.7	56.3	41.5	2.2	5.1	51.3	48.6	2.6	36.1
THEATER	9		100.0	65.9	34.1	63.2	2.8	10.2	23.8	21.3	2.5	74.3
LAUNDRY	10		100.0	77.7	22.3	40.2	37.5	8.6	13.7	11.2	2.6	102.9
MOTR RPR	11		100.0	87.6	12.4	86.2	1.4	5.8	6.6	4.0	2.6	86.9
GYMNASUM	12		100.0	85.5	14.5	82.6	2.9	3.8	10.7	0.0	10.7	102.9
CHAPEL	13		100.0	92.1	7.9	87.7	4.4	2.7	5.3	0.0	5.3	87.4
BOWLING	14		100.0	81.8	18.2	79.5	2.3	6.9	11.3	0.0	11.3	0.0
ADMNSTRA	16		100.0	80.8	19.2	76.4	4.4	9.1	10.1	7.3	2.8	81.4
APPL INS	17		100.0	92.2	7.8	91.9	0.4	4.5	3.2	0.0	3.2	47.3
WAREHSE	18		100.0	79.9	20.1	76.3	3.7	7.9	12.1	3.6	8.5	105.9
OFF MESS	19		100.0	61.4	38.6	56.2	5.2	14.1	24.5	23.7	0.8	36.6
FIRE HSE	20		100.0	79.4	20.6	76.6	2.8	10.6	10.1	7.4	2.6	86.1
DISPNSRY	21		100.0	73.4	26.6	66.0	7.4	8.4	18.2	15.7	2.5	97.3
TELECOMM	22		100.0	43.4	56.6	43.4	0.0	6.3	50.3	29.5	20.8	44.3
LIBRARY	23		100.0	63.5	36.5	62.2	1.3	31.7	4.8	2.3	2.5	86.3
AVERAGE PERCENT			100.0	72.7	27.3	64.0	8.8	8.0	19.2	16.0	3.3	58.7

PROGRAM LIST7

HEADING DEFINITIONS

Tables 5-1 and 5-2

COLUMN		EXPLANATION
-1-	DESCRP	: DESCRIPTION OF BUILDING TYPE
-2-	TYP	: DESIGNATED TYPE NUMBER FROM INCREMENT 'A'
-3-	GSF	: TOTAL GROSS SQUARE FOOTAGE FOR BUILDINGS OF THE PARTICULAR TYPE
-4-	TOTAL	: TOTAL ENERGY CONSUMPTION PER TYPE (KBTU/SF)PER YEAR COLUMN (5) + COLUMN (6)
-5-	FUEL	: TOTAL FUEL CONSUMPTION PER TYPE (KBTU/SF)PER YEAR COLUMN (7) + COLUMN (8)
-6-	ELEC	: TOTAL ELECTRICITY CONSUMPTION PER TYPE (KBTU/SF)PER YEAR COLUMN (9) + COLUMN (10)
-10-	MISC	: MISCELLANEOUS CONSUMPTION OF ELECTRICITY COLUMN (11) + COLUMN (12)
-11-	LT/EQP	: INCLUDES EXTERIOR LIGHTING AND EQUIPMENT SUCH AS LAUNDRY MACHINES, COOKING EQUIPMENT, AND MISCELLANEOUS HOUSEHOLD EQUIPMENT.
-12-	BOILER AUX	: INCLUDES BOILER PUMPS, BURNER MOTERS, UNIT HEATER FANS AND FURNACE FANS.
-13-	ACTUAL FUEL	: ACTUAL KNOWN FUEL CONSUMPTION. DOES NOT INCLUDE ELECTRICITY.

5.5 TOTAL ENERGY CONSUMPTION PER BUILDING TYPE AND BY ENTIRE SUBCOMMUNITY

The annual values of total fuel (coal or oil) consumption (MBtuF), electricity consumption (MWH and equivalent source (MBtuE)) as well as total energy (fuel and electricity consumption (MBtuT)) by each type of building have been determined, as shown in Table 5-3, using the average values per building type and the GSF area of the type.

The "miscellaneous" consumption consists of the consumption by items such as Street Lighting, Sewage Treatment Plant and Water Pump Station.

Table 5-3 also shows the percent of total fuel, total electricity and total energy, consumed by each of the building types.

5.5.1 GENERAL COMMENTS

5.5.1.1 FUEL CONSUMPTION

We observe that the topmost consumers of fuel (coal and oil) are the following building types:

Motor/Tank Repair	= 14.8%
EM Mess	= 14.0%
Hutments	= 12.8%
Administration	= 12.3%
Family Housing	= 11.8%
EM Barracks w/o Mess	= 10.9%

These building types consume 77% of the total fuel.

5.5.1.2 ELECTRICITY CONSUMPTION

The leading consumers of electricty are the following building types:

Family Housing	= 21.8%
EM Mess	= 21.8%
Warehouse	= 7.9%

ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE : BASEWIDE EXTRAPOLATED ENERGY CONSUMPTION
PROGRAM LIST55 30-SEP-82
HOHENFELS SUBCOMMUNITY Table 5-3

TYP	NO.	GSF	AVG PER SF/YR KBTUF	KBTUE	KBTUT	TOTAL PER YR MBTUF	MBTUE	MBTUT	PERCENTAGE FUEL	ELEC	TOTAL	GSF	DESCRIP
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-
1	22.	147818.	123.7	22.8	146.5	18281.	3373.	21654.	10.8	3.8	8.4	9.2	EM/BOQ
2	138.	459264.	93.3	12.8	106.1	23567.	5897.	29464.	13.9	6.7	11.4	28.4	HUTMENTS
3	49.	252130.	185.0	120.9	306.0	30320.	30493.	60813.	17.9	34.6	23.6	15.6	EM MESS
5	7.	155406.	127.1	98.6	225.7	19757.	15318.	35075.	11.7	17.4	13.6	9.6	FAM HSNG
7	2.	12832.	102.6	18.6	121.2	1316.	239.	1555.	0.8	0.3	0.6	0.8	SCHOOL
8	4.	36414.	71.5	92.2	163.7	2604.	3357.	5961.	1.5	3.8	2.3	2.3	WRHSE RF
9	1.	29392.	189.4	97.8	287.2	5567.	2875.	8441.	3.3	3.3	3.3	1.8	THEATER
10	1.	6110.	209.0	60.0	269.0	1277.	367.	1644.	0.8	0.4	0.6	0.4	LAUNDRY
11	14.	115019.	220.4	31.3	251.7	19016.	3595.	22612.	11.2	4.1	8.8	7.1	MOTR RPR
12	1.	10951.	153.2	26.0	179.2	1678.	285.	1962.	1.0	0.3	0.8	0.7	GYMNASUM
13	2.	7748.	222.1	19.1	241.2	1721.	148.	1869.	1.0	0.2	0.7	0.5	CHAPEL
14	1.	3877.	177.4	39.4	216.8	688.	153.	841.	0.4	0.2	0.3	0.2	BOWLING
16	31.	149656.	134.8	32.0	166.8	20166.	4790.	24957.	11.9	5.4	9.7	9.3	ADMNSTRA
17	9.	41976.	125.9	10.6	136.5	5285.	445.	5730.	3.1	0.5	2.2	2.6	APPL INS
18	17.	93960.	85.3	21.4	106.8	8019.	2013.	10032.	4.7	2.3	3.9	5.8	WRHSE
19	5.	49168.	122.2	76.9	199.1	6010.	3781.	9791.	3.5	4.3	3.8	3.0	OFF MESS
20	2.	7724.	123.9	32.2	156.1	957.	249.	1206.	0.6	0.3	0.5	0.5	FIRE HSE
21	1.	22203.	101.5	36.8	138.3	2254.	817.	3071.	1.3	0.9	1.2	1.4	DISPNSRY
22	1.	4321.	194.0	253.0	447.0	838.	1093.	1931.	0.5	1.2	0.7	0.3	TELECOMM
23	1.	3328.	77.3	44.4	121.7	257.	148.	405.	0.2	0.2	0.2	0.2	LIBRARY
25	0.	0.	0.0	0.0	0.0	0.	8816.	8816.	0.0	10.0	3.4	0.0	MISCELL
	310.	1615407.	105.0	54.6	159.6	169577.	88251.	257828.	100.0	100.0	100.0	100.0	EXTRAPO. VALUES
			92.3	44.9	137.1	149672.	72764.	222436.	100.0	100.0	100.0	100.0	FY 1980 VALUES

TYP	NO.	GSF	KBTUF	KBTUE	KBTUT	MBTUF	MBTUE	MBTUT	FUEL	ELEC	TOTAL	GSF	DESCRIP
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-

HEADING DEFINITIONS

1. TYP : BUILDING TYPE AS DEFINED BY INCREMENT 'A'

2. NO. : TOTAL NUMBER OF BUILDINGS PER TYPE

3. GSF : TOTAL GROSS SQUARE FOOTAGE PER TYPE

4. KBTUF : AVERAGE YEARLY CONSUMPTION OF FUEL (COAL/OIL) ON A PER SQUARE FOOT BASIS IN KBTU (BTU*1000)

5. KBTUE : AVERAGE YEARLY CONSUMPTION OF ELECTRICITY ON A PER SQUARE FOOT BASIS IN KBTU (BTU*1000)

6. KBTUT : AVERAGE YEARLY ENERGY CONSUMPTION ON A PER SQUARE FOOT BASIS IN KBTU (BTU*1000)
COLUMN (4) + COLUMN (5)

7. MBTUF : TOTAL YEARLY FUEL (COAL/OIL) CONSUMPTION IN MBTU (BTU*1000000)
COLUMN (3) X COLUMN (4)

8. MBTUE : TOTAL YEARLY ELECTRICITY CONSUMPTION IN MBTU (BTU*1000000)
COLUMN (3) X COLUMN (5)

9. MBTUT : TOTAL YEARLY ENERGY CONSUMPTION IN MBTU (BTU*1000000)
COLUMN (3) X COLUMN (6)

PERCENTAGE :

10. FUEL : PERCENT OF FUEL CONSUMED IN RELATION TO TOTAL BASE CONSUMPTION
COL. (7) X 100/COMMUNITY FUEL CONSUMPTION

11. ELEC : PERCENT OF ELECTRICITY CONSUMED IN RELATION TO TOTAL BASE CONSUMPTION
COL. (8) X 100/COMMUNITY ELEC. CONSUMPTION

12. TOTAL : PERCENT OF TOTAL ENERGY CONSUMED IN RELATION TO TOTAL BASE CONSUMPTION
COL. (9) X 100/TOTAL COMMUNITY ENERGY CONSUMPTION

13. GSF : PERCENT OF GROSS SQUARE FOOTAGE IN RELATION TO TOTAL BASE SQUARE FOOTAGE
COL. (3) X 100/COMMUNITY GSF

14. DESCRIP : DESCRIPTION OF BUILDING USE PER TYPE

Administration	=	6.9%
Officers Mess/Club	=	5.4%
Motor/Tank Repair	=	5.0%
EM Barracks w/o Mess	=	4.8%
Theatre-Cafeteria	=	4.0%

These building types consume 78% of the total electricity consumption.

5.6 PRESENT AND PROJECTED ENERGY COSTS

Based on the average energy consumption values obtained we have developed and shown the present FY 80 as well as projected FY 84 energy costs (if no energy conservation actions are implemented) for space heating, DHW, lighting, miscellaneous, and total energy for each building type in Tables 5-4A and 5-4B.

5.6.1 GENERAL COMMENTS

We observe that on an average, the annual energy cost is 110 cents per square foot, of which 74 cents is for space heating, 10 cents is for DHW, 7 cents for lighting and 10 cents for miscellaneous electrical equipment such as boiler pumps, unit heater fans, washing machines and stoves.

Between FY 1980 and FY 1984, the energy cost will increase by a factor of 1.63 if no energy conservation measures are implemented; i.e., the annual energy cost will increase from approximately $1.37 million to $2.23 million.

ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE 30-SEP-82
PROGRAM LIST6
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Table 5-4A

ENERGY COST-1980: CENTS/SQ FT

FUEL COST : $ 6.50/MBTU ELECTRIC COST : $ 5.17/MBTU

BLDG TYPE	BLDG DESC	GSF	FUEL SPACE HEAT	FUEL D+W	ELECTRICITY LIGHTS	ELECTRICITY MISC	TOTAL
			CENTS/SQ FT, 1980				
1	EM/BOQ	147818.	66.	15.	7.	5.	92.
2	HUTMENTS	459264.	61.	0.	3.	3.	67.
3	EM MESS	246020.	82.	39.	14.	48.	183.
5	FAM HSNG	155406.	68.	15.	9.	42.	134.
7	SCHOOL	12632.	62.	4.	6.	3.	76.
8	WRHSE RF	36414.	44.	2.	4.	43.	94.
9	THEATER	29392.	118.	5.	15.	35.	174.
10	LAUNDRY	6110.	70.	66.	12.	19.	167.
11	MOTR MPR	112160.	141.	2.	8.	9.	159.
12	GYMNASUM	10951.	96.	3.	4.	10.	113.
13	CHAPEL	7748.	138.	7.	3.	7.	154.
14	BOWLING	3877.	112.	3.	8.	13.	136.
16	ADMNSTRA	149656.	83.	5.	8.	9.	104.
17	APPL INS	41976.	82.	0.	3.	2.	87.
18	WRHSE	93960.	53.	3.	4.	7.	67.
19	OFF MESS	49168.	73.	7.	15.	25.	119.
20	FIRE HSE	7724.	78.	3.	9.	8.	97.
21	DISPNSRY	22203.	59.	7.	6.	13.	85.
22	TELECOMM	4321.	126.	0.	14.	116.	257.
23	LIBRARY	3328.	49.	1.	20.	3.	73.
	AVERAGE		75.	10.	7.	18.	110.

ENERGY ENGINEERING ANALYSIS PROGRAM, EUROPE 30-SEP-82
PROGRAM LIST6
HOHENFELS SUBCOMMUNITY Table 5-4B

ENERGY COST-1984: CENTS/SQ FT

FUEL COST : $ 10.59/MBTU ELECTRIC COST : $ 8.43/MBTU

BLDG TYPE	BLDG DESC	GSF	FUEL SPACE HEAT	FUEL D+W	ELECTRICITY LIGHTS	ELECTRICITY MISC	TOTAL
			CENTS/SQ FT, 1984				
1	EM/BOQ	147818.	107.	24.	11.	8.	150.
2	HUTMENTS	459264.	99.	0.	6.	5.	110.
3	EM MESS	246020.	133.	63.	23.	79.	298.
5	FAM HSNG	155406.	111.	24.	14.	69.	218.
7	SCHOOL	12632.	101.	7.	10.	5.	124.
8	WRHSE RF	36414.	72.	4.	7.	71.	153.
9	THEATER	29392.	192.	8.	25.	58.	283.
10	LAUNDRY	6110.	114.	107.	19.	31.	272.
11	MOTR RPR	112160.	230.	4.	12.	14.	260.
12	GYMNASUM	10951.	157.	6.	6.	16.	184.
13	CHAPEL	7748.	224.	11.	5.	11.	251.
14	BOWLING	3877.	183.	5.	13.	21.	221.
16	ADMINSTRA	149656.	135.	8.	13.	14.	170.
17	APPL INS	41976.	133.	1.	5.	4.	142.
18	WRHSE	93960.	86.	4.	7.	11.	108.
19	OFF MESS	49168.	119.	11.	24.	41.	194.
20	FIRE HSE	7724.	127.	5.	14.	13.	158.
21	DISPNSRY	22203.	97.	11.	10.	21.	139.
22	TELECOMM	4321.	205.	0.	24.	190.	419.
23	LIBRARY	3328.	80.	2.	33.	5.	119.
	AVERAGE		122.	17.	12.	29.	180.

6. INFORMATION RECEIVED FROM SUBCOMMUNITY

We have presented in Section 2 of the Energy Report details of the following:

a. Drawings

b. Utility and Fuel Bills

c. Information of Previous Studies

d. Building Information Schedule

e. Basic Utility System Maps

f. Facility Engineering Technical Data Report

g. Subcommunity Fixed Facility Energy Plan

h. Land Use Plan and Planned Physical Plant Expansion Data

i. Population Data

7. ENERGY CONSUMPTION DATA AND SUBCOMMUNITY GOALS

Presented herein are the following tables:

Table 3.3-1 Fuel and Electricity Prices

Table 3.3-2 Annual Energy Consumption and Cost Profile for FY 75, 78, 79 and 80

Table 3.2-1 Energy Consumption Goals for FY 85

Table 3.4 Hohenfels Typical building Energy Consumption

HOHENFELS

Table 3.3-1

FY 84 FUEL PRICES, BASED ON FUEL PRICES IN FY 81

FUEL	UNIT	FY 81		FY 84	
		$/UNIT	$/MBTU	$/UNIT	$/MBTU
ELECTRICITY	KWH	0.08	6.896	0.12	9.950
COAL	m-TON	127	4.071	169	5.419
NO. 2 OIL	GAL	1.22	8.796	1.81	13.032
NO. 6 OIL	GAL	--	--	--	--
ELECTRIC DEMAND	KVA	9.89	--	11.298	--

CONVERSION FACTORS: $(10)^6 \frac{BTU}{MBTU}$

$0.0116 \frac{MBTU\ ELECTRICITY}{KWH}$

$31.2 \frac{MBTU\ COAL}{m\text{-}TON}$

$0.1387 \frac{MBTU\ NO.\ 2\ OIL}{GAL}$

$0.1485 \frac{MBTU\ NO.\ 6\ OIL}{GAL}$

TABLE 3.3-2

ANNUAL ENERGY CONSUMPTION AND COST PROFILE-- HOHENFELS

FUEL	NON REIMB OR REIMB	ENERGY MBTU/UNIT	UNIT	CONSUMPTION IN UNITS				CONSUMPTION IN MBTU				CONSUMPTION COST IN U.S. DOLLARS			
				FY 75	FY 78	FY 79	FY 80	FY 75	FY 78	FY 79	FY 80	FY 75	FY 78	FY 79	FY 80
ELECTRICITY (TOTAL)	NON REIMB	0.0116	KWH												
	REIMB														
	TOTAL			5,585,060	7,463,880	6,303,880	6,272,800	64,787	86,581	73,125	72,764	262,429	412,936	369,295	376,368
ANTH COAL	NON REIMB	31.2	M-TON												
	REIMB														
	TOTAL			1,360	1,266	1,120	994	42,432	39,499	34,944	31,013	101068	107,068	93,643	88,942
OIL NO. 2	NON REIMB	0.1387	GAL												
	REIMB														
	TOTAL	898,846		878846	1,137,678	914,380	855,506	124,670	157,796	126,825	118,659	452,280	556,732	427,116	908.745
OIL NO. 6	NON REIMB	0.1485	GAL												
	REIMB														
	TOTAL														
TOTAL	NON REIMB														
	REIMB														
	TOTAL							231,889	283,876	234,894	222,436	816,322	1,016,736	890,054	1,374,055
ELECTRICITY PEAK DEMAND	NON REIMB		KW												
	REIMB														
	TOTAL			1,002	1,324	1,216	1,256					79,488	141,333	124,642	109,751
ELECTRICITY MINIMUM POWER FACTOR	NON REIMB														
	REIMB														
	TOTAL			0.918	0.863	0.894	0.868						857	420	1,333
GROSS Floor Area (KSF)								1,764			1,768				
KBTU/SF								131.5			126.1				
POPULATION								5071			4190				
KBTU/POPULATION								45,728			53,087				
DEGREE DAYS								6,906	7,310		7,149				

Notes:
1. Minimum permissible power factor = 0.9
2. Sum of total monthly peak demands for FY 80 = 12936 kw
3. 1 US Dollar = 2 DM

TABLE 3.2-1 ENERGY CONSUMPTION: PROGRESS AND GOALS FOR FY 85: HOHENFELS

		UNITS	FY75	FY80	FY85
1a.	Electricity	MBTU	64,787	72,764	
b.	Coal	MBTU	42,432	31,013	18,392 Goal (10%)
c.	Fuel Oil # 2	MBTU	124,670	118,659	
d.	Fuel Oil # 6	MBTU		-	
e.	Solar Energy	MBTU		-	1,839 Goal (1%)
f.	Total Energy	MBTU	231,889	222,436	-
2a.	Goal: Total Energy Reduced 25%: ($0.75 \times 1f_{FY75}$)	MBTU	-	-	173,917
b.	Goal: Energy Per Sq. Ft. Reduced 20% by ECIPS and Mgmt, and 5% by New Efficient Bldgs (3a x 3c) + (4a x 4b)	MBTU	-	-	183,925
3a.	Building Area in use, constructed before FY78	SQ.FT.	1,763,698	1,748,491	1,715,796
b.	Energy Per Sq. Ft. (1f ÷ 3a)	KBTU/SQ. FT.	131	-	-
c.	Goal: Energy Per Sq. Ft. Reduced 20% by ECIPS (12%), and Mgmt (8%): ($0.8 \times 3b_{FY75}$)	KBTU/SQ. FT.	-	-	105
d.	Total Energy	MBTU	231,889	-	180,158
4a.	Building Area in use, constructed after FY78	SQ.FT.	-	11,786	52,323
b.	Goal: Energy Per Sq. Ft. Reduced 45% by Efficient Design ($0.55 \times 3b_{FY75}$)	KBTU/SQ. FT.	-		72
c.	Total Energy	MBTU	-		3,767
5a.	Gross Floor Area (3a + 4a)	SQ.FT.	1,763,698	1,760,277	1,768,119
b.	Energy Per Sq. Ft (1f ÷ 5a)	KBTU/SQ. FT.	131	126	-
c.	Goal: 25% Reduction ($0.75 \times 5b_{FY75}$)	KBTU/SQ. FT.	-	-	98
d.	Goal: Army Facilities Energy Plan, Annex B-5	KBTU/SQ. FT.	-	-	134.9
6a.	Heating Degree Days	DEG F - DAYS	6,906	7,149	—
7a.	Population		5,071	4,190	4,406

TABLE 3.4
HOHENFELS TYPICAL BUILDING
ENERGY CONSUMPTION

TYPE	No.	DESCRIPTION	MBTU/YR ELEC	MBTU/YR FUEL
1	23	EM BARRACKS WO/MESS	573	2891
2	115	HUTMENTS	41	110
3	315	EM MESS	350	533
5	74	FAMILY HOUSING	224	2504
7	5	DEPENDENT GRADE SCHOOL	140	746
8	10	REFRIGERATED WAREHOUSE	4058	1465
9	3	THEATER	2874	6269
10	72	LAUNDRY	366	1691
11	392	MOTOR/TANK REPAIR	440	6175
12	47	GYMNASIUM	285	2019
13	2	CHAPEL	84	932
14	14	BOWLING	152	687
16	13	ADMINISTRATION	135	663
17	270	APPLIED INSTRUCTION	63	349
18	71	STOREHOUSE/WAREHOUSE	68	848
19	43	OPEN MESS/NCO	747	898
20	48	FIRE STATION	126	528
21	51	DISPENSARY	817	2986
22	54	TELEPHONE EXCHANGE	1093	855
23	49	LIBRARY	148	349

8. DATA COLLECTED BY BUILDING SURVEY AND SELECTION OF REPRESENTATIVE BUILDINGS (INCREMENTS A & G ONLY)

The following data has been presented in detail in the Energy report and was orignally presented in the Preliminary Submittal:

Building Envelope Construction Data.

Occupancy, Lighting, Equipment and DHW Data.

Terminal Heating Systems and Control Data.

Primary Heating Systems Data.

Possible Energy Conservation Opportunities.

We have presented in the following table an updated list of representative buildings of each type selected for detailed Energy Conservation Analysis. In some types, we have selected more than one building for analysis in order to obtain more realistic basewide extrapolated ECIP or OMA projects.

TABLE 4.8

REPRESENTATIVE BUILDINGS OF EACH TYPE

HOHENFELS

TYPE	BUILDING TYPE DESCRIPTION	BUILDING
1	EM BARRACKS W/O MESS, BOQ	22, 309
2	HUTMENTS	115
3	EM MESS	315, 809
5	FAMILY HOUSING	74
7	DEPENDENT GRADE SCHOOL	5, 44
8	WAREHOUSE-REFRIGERATED	10
9	THEATRE	3
10	LAUNDRY	72
11	MOTOR/TANK REPAIR SHOP	392, 807
12	GYMNASIUM	47
13	CHAPEL	2
14	BOWLING CENTER	14
16	ADMINISTRATION	13, 42, 805
17	APPLIED INSTRUCTION	270, 383
18	STOREHOUSE/WAREHOUSE	71
19	OPEN MESS NCO/CLUB	6, 43
20	FIRE STATION	48,
21	DISPENSARY	51
22	TELEPHONE EXCHANGE	54
23	LIBRARY	49