BARNES BUILDING
BOSTON, MASSACHUSETTS

ENERGY ENGINEERING ANALYSIS PROGRAM
ENERGY AUDIT

CONTRACT NO. DACA 65-86-C-0123

VOLUME 2 -- EXECUTIVE SUMMARY

NOVEMBER 1987

Syska & Hennessy

Energy Engineering Analysis Program

Energy Audit

For

Barnes Building at

Boston, Massachusetts

Contract No. DACA 65-86-C-0123

November 1987

Syska & Hennessy, Inc., Engineers

1000 Massachusetts Avenue

Cambridge, Massachusetts 02138

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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VOLUME 2

SECTION 2

EXECUTIVE SUMMARY

2.1 Authorization

The Energy Engineering Analysis Program for the Barnes Building, Boston, MA was authorized by the Department of the Army, Corps of Engineers, under Contract No. DACA65-86-C-0123 dated November 3, 1986.

2.2 Objectives of The Energy Study

The objectives of this contract, as explained in Section 1.0 of the contract are as follows:

a. Perform a complete energy audit and analysis of the Barnes Building.

b. Review, use and incorporate applicable data and results of related energy conservation studies, past and current.

c. Perform a site survey to insure that all methods of energy conservation which are practical have been considered.

d. Identify all Energy Conservation Opportunities (ECOs), including low cost/no cost ECOs, and perform a complete evaluation of each.

e. Prepare programming documentation for all Energy Conservation Investment Program (ECIP) projects (DD Form 1390, Life Cycle Cost Analysis Summary Sheet with backup calculation and Project Development Brochure (PDB)).

f. Prepare implementation documentation for all justifiable ECOs.

g. List and prioritize all recommended ECOs.

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

2.3 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 the building.

Increment B - Energy conservation investigations of utilities, energy distribution systems and existing energy plant.

Increment F - Facilities Engineer conservation measures.

Increment G - Projects identified in Increments A and B that do not meet the ECIP criteria but may qualify as QRIP, OSD PIF, or PECIP projects.

2.4 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 Life Cycle Cost Analysis forms. During this phase, all potential projects which produce energy and/or dollar savings will be identified and evaluated as to their technical and economic feasibility. Projects will be ranked according to the highest SIR value.

Phase III Preparation of DD Form 1391 and Project Development Brochures (PDB) where feasibility and project documentation are indicated. DD Form 1391 and PDBs are not required for Increment F. For Increment G, type of documentation will be as directed by the Contracting Officers Representative.

2.5 Submission Requirements

As outlined in the contract, the study is divided into three major submissions:

a. Interim Submittal

b. Prefinal Submittal

c. Final Report

2.6 Work Accomplished

Field surveys of the building were carried out from November 3 through 14, 1986. During that time, a team from Syska and Hennessy carried out tests, observations and interviews with building personnel. Occupational and traffic patterns were established and analyzed. Energy use and patterns were obtained from suppliers, building records, Fort Devens and also measured, recorded and analyzed. Building equipment was examined and its performance investigated. Lighting, HVAC and other energy uses were carefully checked for energy conservation opportunities. Interviews were conducted with building personnel with regard to operating and maintenance program training needs.

Entrance and exit meetings were held with building and DOA personnel to discuss work progress, plans and clarify contractural details. These meetings were held at the Barnes Building on October 28, 1986 and December 4, 1986. The Interim Submittal Report was mailed on February 2, 1987. A review meeting was held at the Barnes Building on April 8, 1987. The Interim Submittal Report was revised to incorporate the comments of the reviewers at the meeting as recorded in the minutes included with this report.

The revised Interim Submittal report was mailed on May 28, 1987. A review meeting was held at the Barnes Building on September 16, 1987. The comments of the reviewers and the meeting minutes are incorporated in this report. Permission was granted at the meeting to prepare this Prefinal Submittal report.

This report contains all of the information required in the contract. The report is made up of four volumes. The first volume contains the data of Increments A, B, F and G. The second volume contains the EXECUTIVE SUMMARY. The third volume contains the Appendices A through H, and the fourth volume contains QRIP and ECIP projects. All documentation for Low Cost/No Cost Projects is included in the first volume as required by the contract.

A Prefinal review conference will be held at the Barnes Building to review comments on this report. The results of this conference will be incorporated as revised pages, making the Prefinal Report into a Final Report, which will then complete the contract.

2.7 Building Description

The Barnes Building was designed for the Fargo Real Estate Trust in 1909, and was originally called the Fargo Building. The Government purchased the building in the early 1940's and extensive modifications were made for use by the Navy. In 1942, two stairwells were added along with extensive interior outfitting. In 1957-58 extensive structural revision of the building was undertaken. The building was gutted and completely rebuilt in 1978-82, and renamed the Barnes Building.

It houses a number of Federal and Armed Forces tenants; Navy, Army and Marine. It is occupied during the week as an office building and on Saturday and Sunday for Reserve drills. Table 1 provides an Occupancy Listing with Agency name, area occupied, hours of use and normal occupancy.

The location is shown in Figure 1. A typical floor plan is shown on Figure 2.

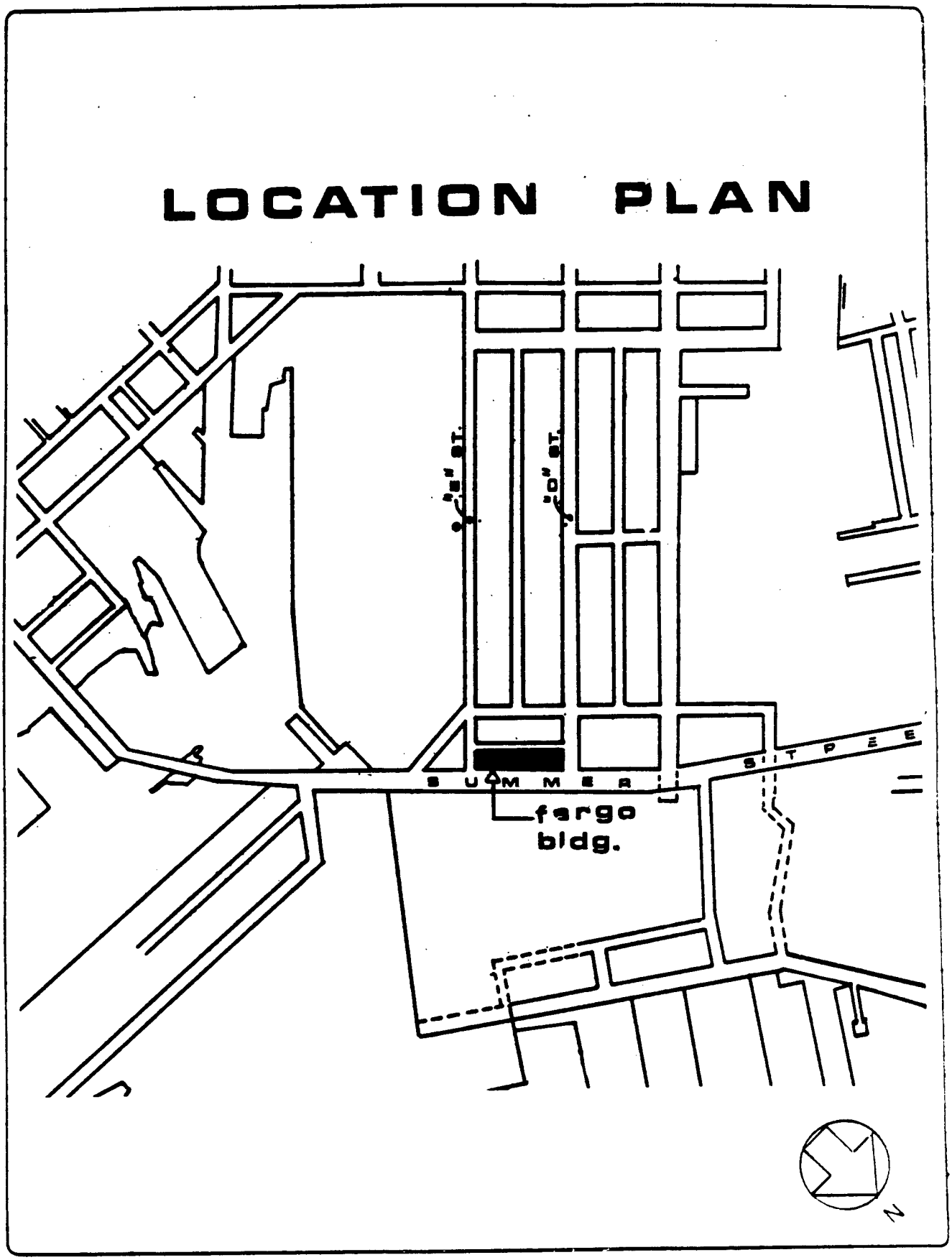
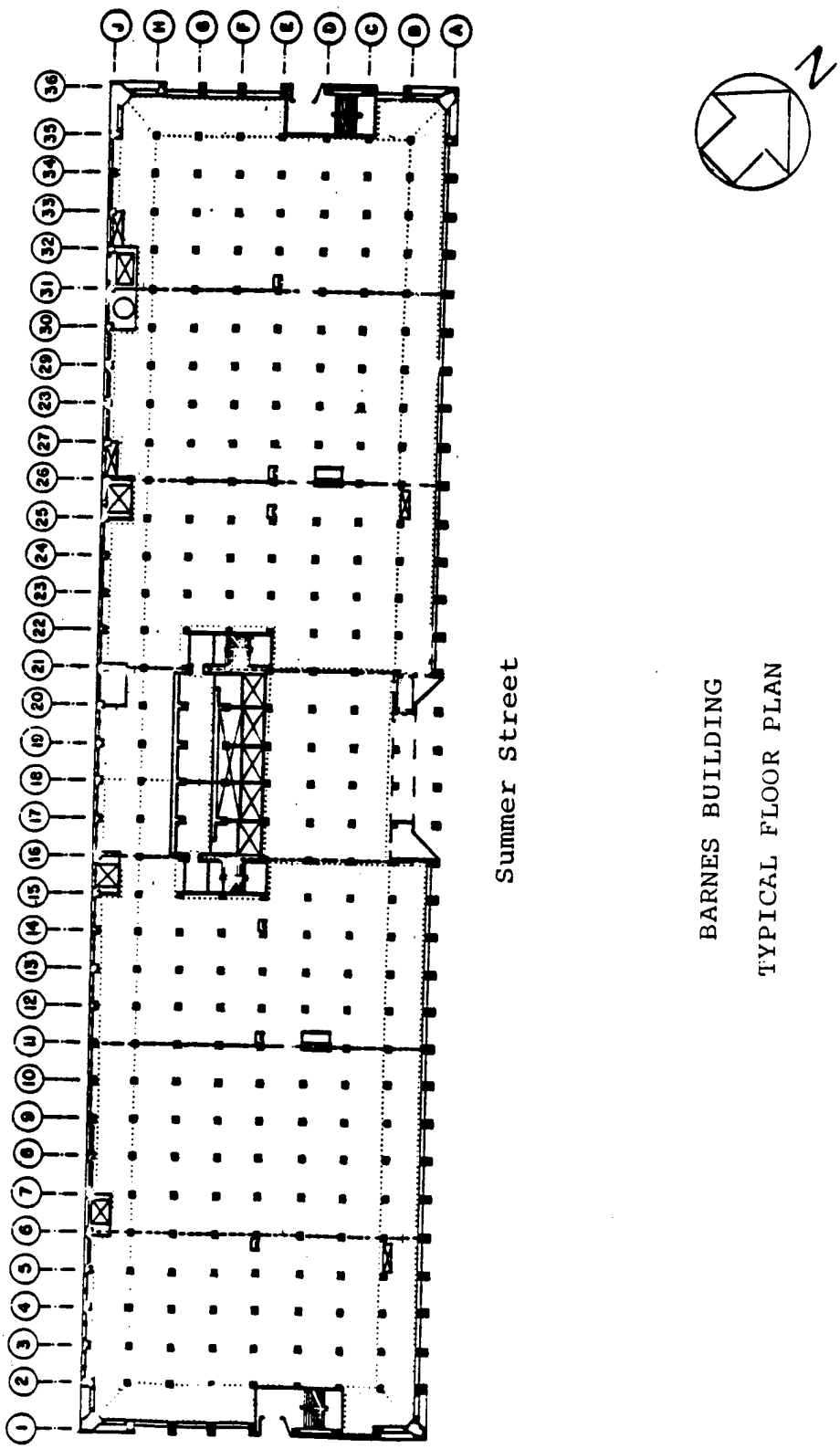


FIGURE 1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7
6
5
4
3
2
1
Summer Street
N
BARNES BUILDING
TYPICAL FLOOR PLAN

FIGURE 2

TABLE 1
OCCUPANCY LISTING

Name of Agency	Area Occupied	Hours of Use	Normal Occupancy	Measured Winter Indoor Temp.
1. US Army Recruiting Battalion	Part of 1st Floor	0630-1800 Mon thru Fri	60	72
2. Credit Union	Part of 1st Floor	0730-1600 Mon thru Fri	4	72
3. Office of Naval Research	Part of 1st Floor	Variable Mon thru Fri	Varied	70
4. Orthopedic Footwear Clinic	Part of 1st Floor	0600-1700 Mon thru Fri	13	74
5. Scheduled Airline Traffic Office	Part of 1st Floor	0730-1800 Mon thru Fri	3	70
6. Dispensary	Part of 1st Floor	0730-1630 Mon thru Fri	6	74
7. Naval Printing and Publications	Part of 1st and 3rd Floors	0700-1930 Mon thru Fri	5	78
8. U.S. Marine Recruiting	Part of 1st and 4th Floors	0630-1900 Mon thru Fri 0800-1500 Sat. 1300-1600 Sun.	23	74
9. U.S. Navy Recruiting (USNR)	Part of 1st and 6th Floors	0800-1630 Mon thru Fri One Sat. per month	67	72
10. U.S. Army Reserve Units 94th ARCOM	2nd Floor	0700-1800 Mon thru Fri One Sat. per month	45	72
11. Defense Investigative Service (DIS)	Part of 3rd Floor	0700-1800 Mon thru Fri	76	72
12. Defense Criminal Investigative Service (DCIS)	Part of 3rd Floor	0700-2300 Mon thru Fri	7	72

13.	Military Entrance Processing Station (MEPS)	4th floor	0600-1800 Mon thru Fri One Sat. per month	55	72
14.	Supervisor of Ship-building Conversion and Repair (SUPSHIP)	Half of 3rd Floor, 5th and 6th Floors	0700-2000 Mon thru Fri Every 3rd & 5th Sat. 8 hrs.	400	70
15.	U.S. Naval Investigative Service (NIS)	Part of 6th Floor	0700-1730 Mon thru Fri	10	72
16.	Defense Contract Services Administration Region (DCASR)	7th, 8th, & 9th Floors	0630-1730 Mon thru Fri	900	70

Designed to serve as a wool warehouse, the building consists of nine stories plus the basement. It has a gross floor area of 571,500 sq ft with typical ceiling heights of 8 ft. The building frame is protected structural steel. The exterior is now an insulated porcelain enamel steel panel system with double-pane windows. The exterior wall has 2 in. insulation and a U factor of 0.0615 But/hr-sf-F. In a typical bay, glass occupies about 16% of the total area. The 1 in. insulating glass has an average U factor of 0.515 Btu/hr-sf-F. Most windows have venetian blind shading. All windows and doors are well weatherproofed. Doors are sliding vestibule doors, each 7 ft by 3 ft, on three sides of the building. The concrete slab roof has a built-up construction with 6 in. of insulation for a U factor of 0.0455 Btu/hr-sf-F.

The building is heated by three steam boilers and cooled by a centrifugal chiller producing chilled water for the 35 air handling systems located throughout the building. The computer complex and computer paper storage room are served by seven separate units which receive water from two rooftop reciprocating chillers during the non-cooling season. Control is by a zone thermostat.

There are five passenger elevators and one freight elevator. The building has fire alarms, sprinklers and standpipes, and a complete security system.

A double-ended substation contains two 13,800 volt transformers fed by separate feeders which drop the voltage to 480/277 volts, 3 phase, 4 wire grounded wye.

Distribution panel boards are located on each floor and transformer No. 1 is backed up by a diesel generator.

Approximately 95% of the lighting fixtures are 4 ft fluorescent type, either 3 or 4 lamps per fixture. The remainder are incandescent. No. 4 fuel is used.

The largest concentrated building loads are:

Third floor printing	26 kw
Computer complex	198 kw
Cooking equipment - steam	368.7 lbs/hr
gas	360 cfh
electricity	115 kw

2.8 Present Energy Consumption

The present energy consumption of the Barnes Building was analyzed using our AXCESS Computer program. The model is based on FY 1985, the latest year for which a complete weather tape was available. Figure 3 shows the percent energy consumption by system. The data is summarized in Table 2. The largest energy use is for lighting (28.5%), followed by heating (25.8%) and HVAC (14.8%).

2.9 Present Utility Consumption

Figure 4 shows the present utility consumption. The largest utility consumption is electricity (67.32%),

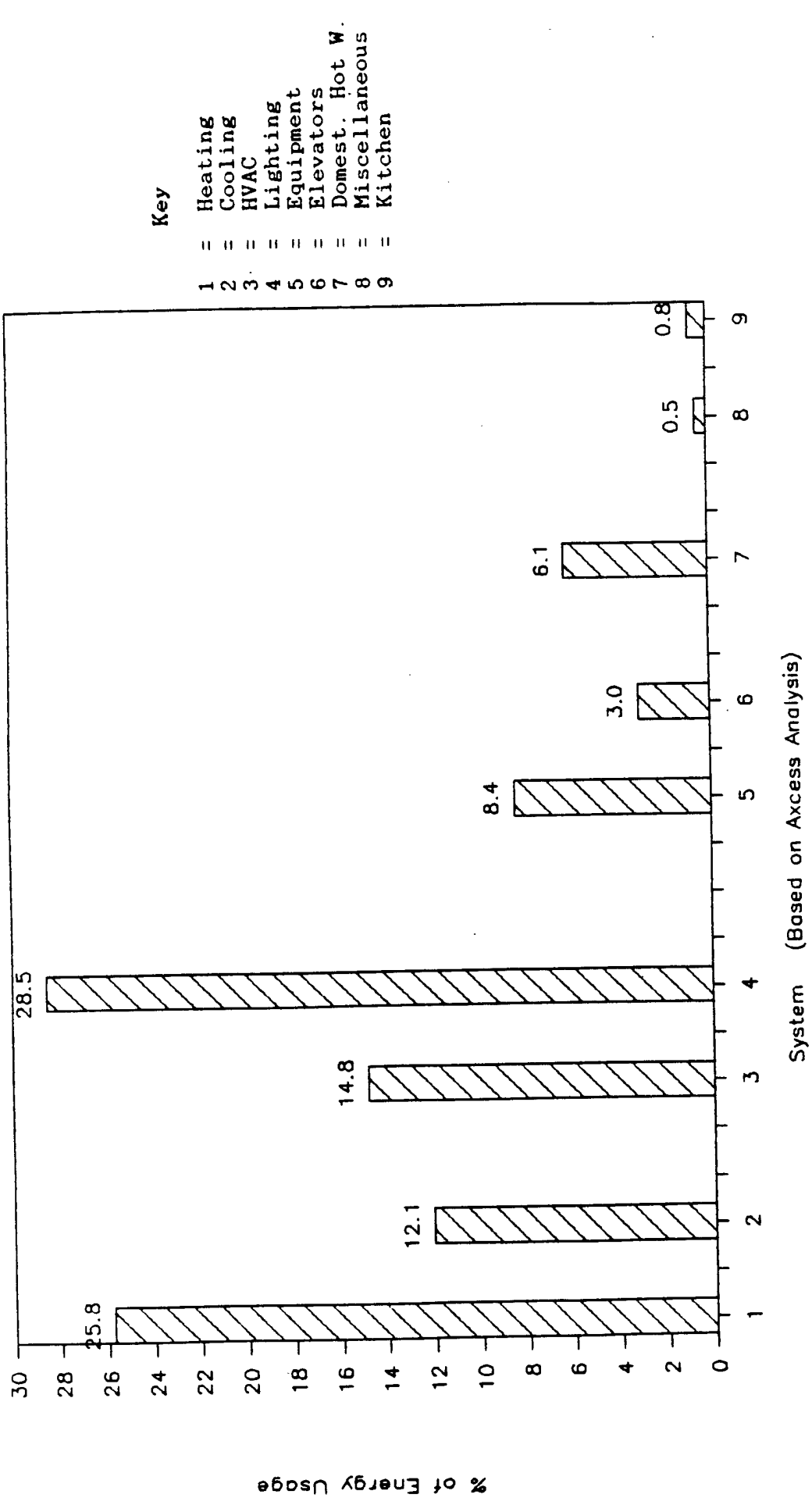
Annual Energy Usage Breakdown
Key
1 = Heating
2 = Cooling
3 = HVAC
4 = Lighting
5 = Equipment
6 = Elevators
7 = Domest. Hot W.
8 = Miscellaneous
9 = Kitchen
% of Energy Usage
System (Based on Axcess Analysis)
25.8
12.1
14.8
28.5
8.4
3.0
6.1
0.5
0.8
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
1
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Figure 3

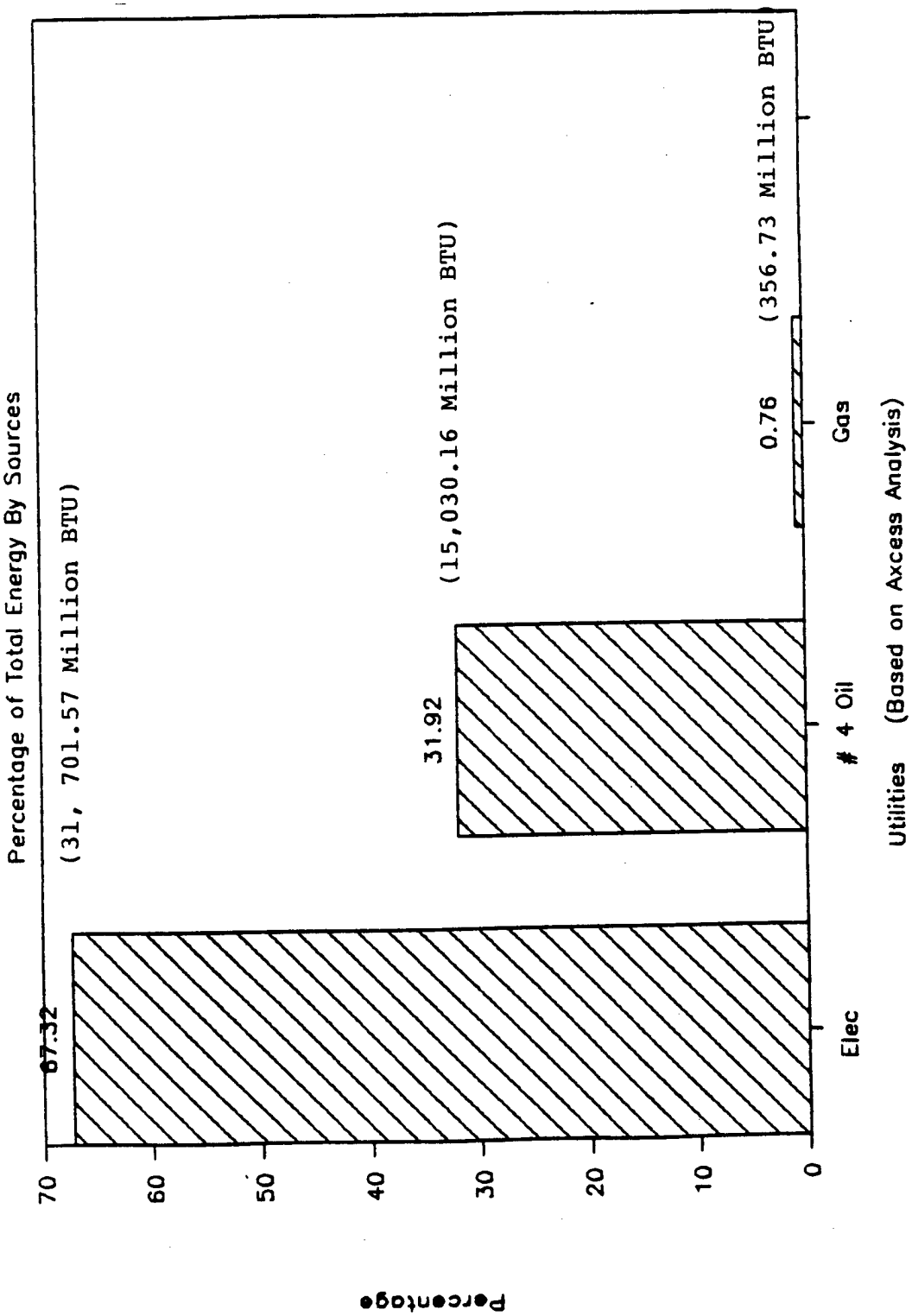
Percentage of Total Energy By Sources
(31, 701.57 Million BTU)
(15,030.16 Million BTU)
(356.73 Million BTU)
67.32
31.92
0.76
70
60
50
40
30
20
10
0
Percentage
Elec
4 Oil
Gas
Utilities (Based on Axcess Analysis)

FIGURE 4

TABLE 2

BARNES BUILDING AT BOSTON MASSACHUSETTS

ANNUAL ENERGY USAGE BREAKDOWN
(BASED ON AXCESS ANALYSIS)

FISCAL YEAR 1984 - 1985

SYSTEM	CONSUMPTION	Btu X 10E6	Btu/Sq.Ft./Yr	% OF TOTAL
Heating	84,871 Gals	12,136.55	21,255	25.8
Cooling	1,665,323 Kwh	5,683.75	9.937	12.1
HVAC Fans & Pumps	2,044,503 Kwh	6,977.89	12.199	14.8
Lighting	3,932,315 Kwh	13,420.99	23,463	28.5
Equipment (Office & Computer)	1,161,828 Kwh	3,965.32	6,932	8.4
Elevators	419,851 Kwh	1,432.95	2,505	3.0
Domestic Hot Water	20,235 Gals	2,893.61	5,059	6.1
Miscellaneous	64,655 Kwh	220.67	386	0.5
Kitchen Gas	3,460 CCF	356.73	204	0.8
TOTAL	9,288,475 Kwh	31,701.57	81,940	
	105,106 Gals	15,030.16		
	3,460 CCF	356.73		
TOTAL IN Btu X 10E6 ===>		47,088.45		

ACTUAL CONSUMPTION FOR F.Y. 1985:		% OF DIFFERENCE	
ELECTRICITY :	9,474,669 KWH	(+)	1.97 %
No 4 OIL :	106,284 Gals	(+)	1.11 %
NATURAL GAS :	3,332 CCF	(-)	3.84 %

followed by No. 4 oil (31.92%) and gas (0.76%). The actual FY 1985 data is electricity, 9,474,669 kwhr, oil, 106,284 gals and gas 3,332 ccf.

2.10 Present and Historical Utility Costs

Present and historical energy costs are shown in Figures 5 and 6. The data is presented for FY1984 through 1990, using energy escalation factors provided by Fort Devens, and assuming all recommended ECO's are implemented in 1988 for ease of showing the differing effects of energy conservation and price escalation. All data in 1988 and after is calculated.

2.12 Historical Energy Consumption

The historical monthly energy consumption for the Barnes Building is shown for FY 1984, 1985 and 1986 in Figures 7, 8 and 9. Each of the figures shows electricity as kwhr, and also plots total energy use of all utilities as MBtu (millions Btu) and Btu/sq ft. As expected, the utility use peaks in the summer as cooling load increases. The use increases in each of the years.

2.12 Energy Conservation Opportunities (ECOs) Investigated

A total of 24 ECOs were studied and are listed in Table 3. These ECOs were a result of our survey combined with those of Annex A and Annex B of the contract and those suggested by Barnes Building personnel. Of the 24, 19 had an SIR of 1 or more. Eighteen of these are recommended for implementation and one, No. 11, modify the Chiller Control, falls under the EMCS contract. The 18 recommended ECOs have a maximum SIR of 90.3, and produce a total energy savings of 5,792 MBtu, or 17.1 percent of the annual energy consumption. The total simple amortization period is 4.2 years. Those not recommended had an SIR less than 1. Table 4 presents the recommended ECOs prioritized according to highest SIR value.

2.13 Programmed Projects

The recommended ECOs have been divided into three types of energy conservation projects. The construction cost, annual energy savings, annual dollar savings, the SIR and the simple amortization period are shown on Table 4. All analysis were performed in 1987. The following Table 5 presents projects by type, listing ECO No., title, year of implementation and programmed year cost.

YEARLY ENERGY USE

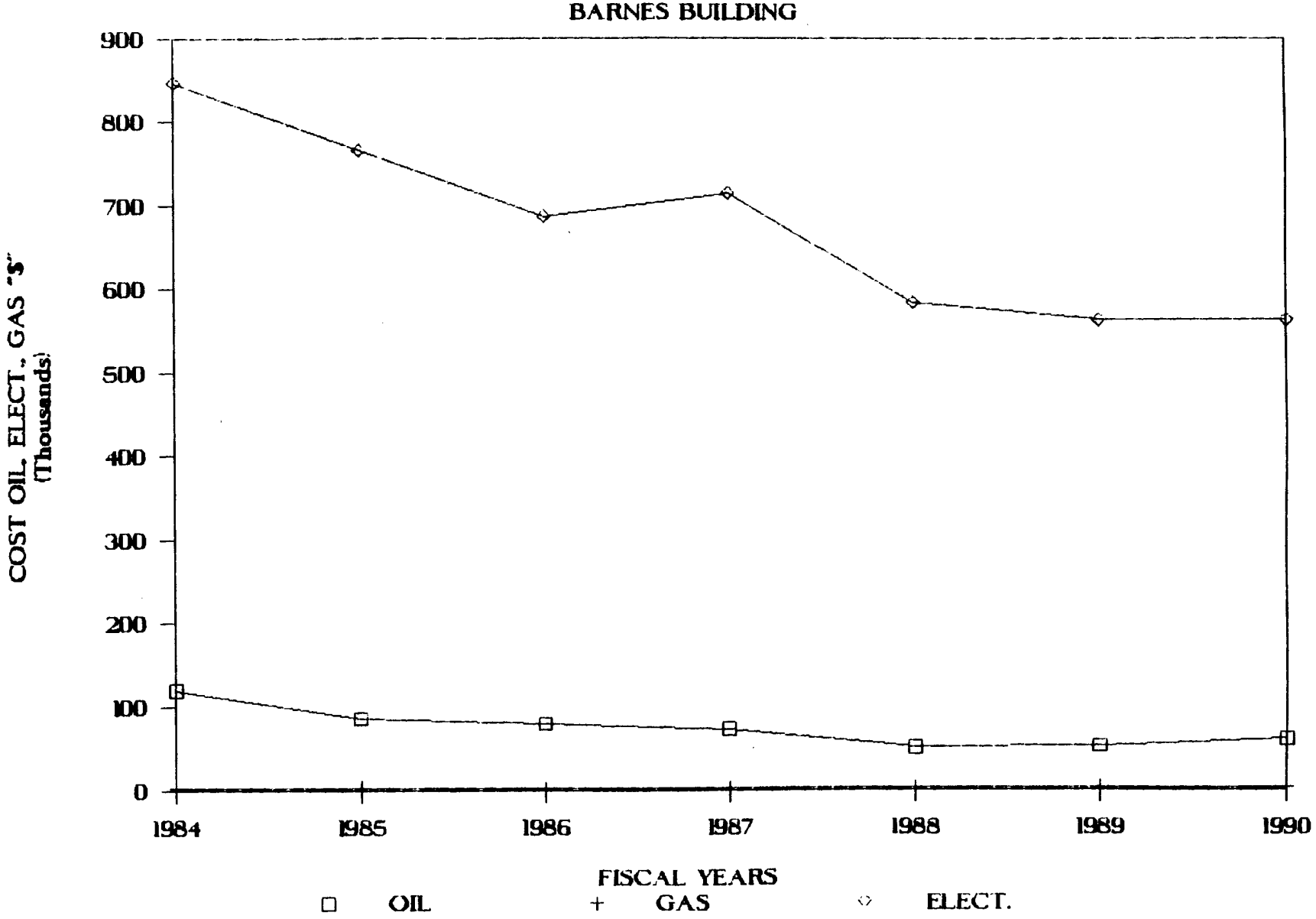

FIGURE 5

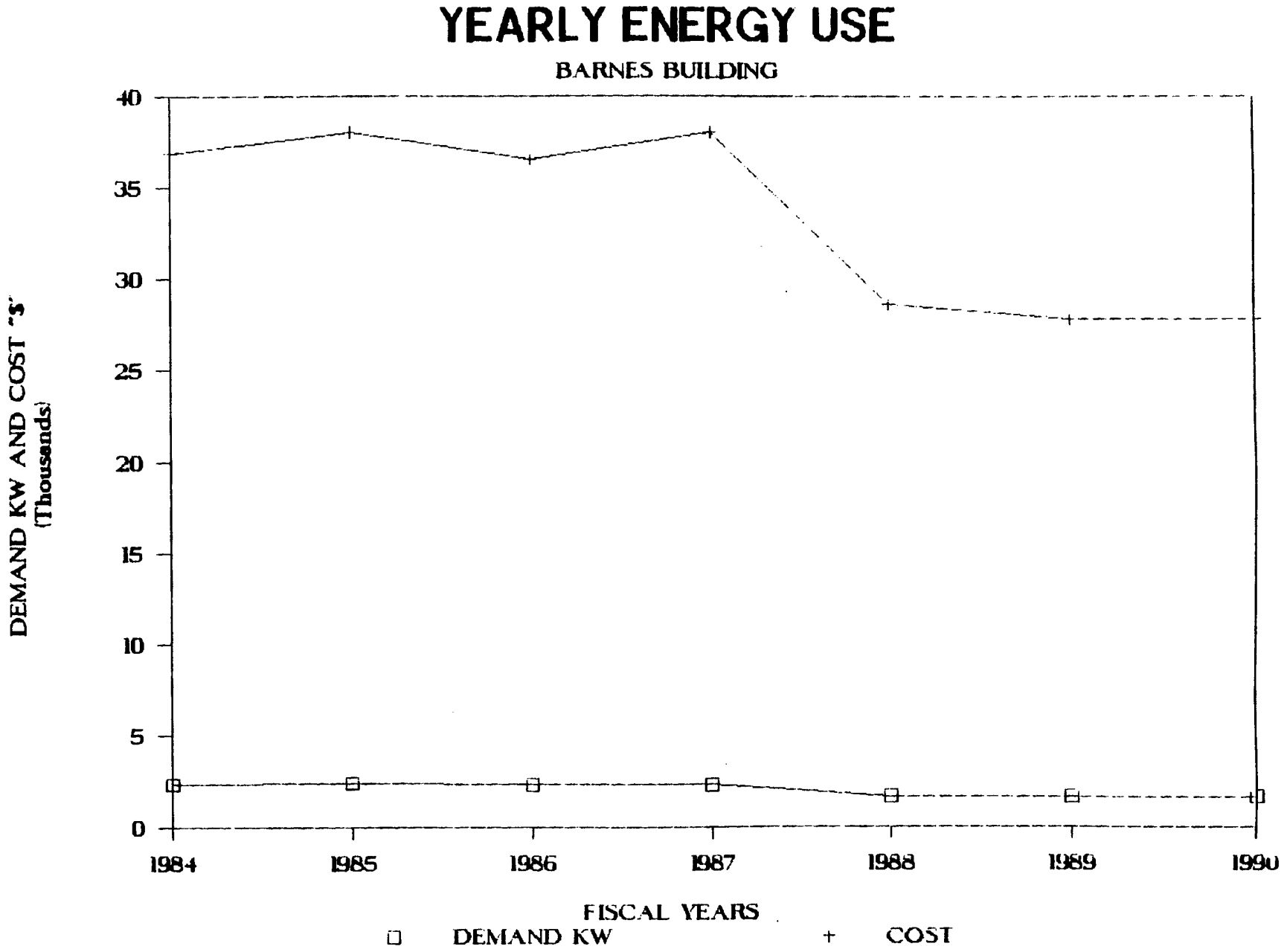
YEARLY ENERGY USE
BARNES BUILDING
DEMAND KW AND COST "$"
(Thousands)
40
35
30
25
20
15
10
5
0
1984
1985
1986
1987
1988
1989
1990
FISCAL YEARS
DEMAND KW
COST

FIGURE 6

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MONTHLY ENERGY CONSUMPTION

BARNES BUILDING

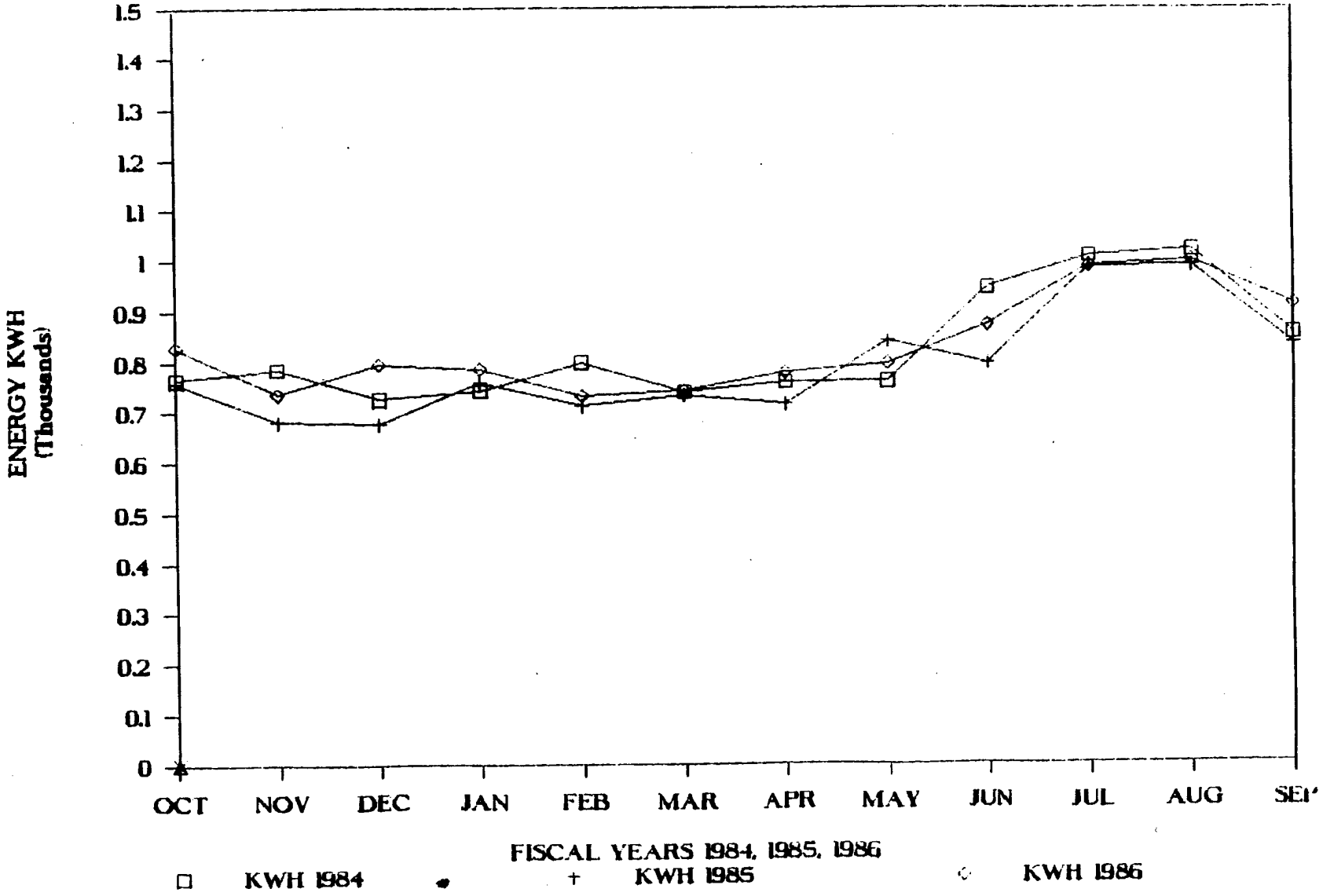

FIGURE 7

MONTHLY ENERGY CONSUMPTION

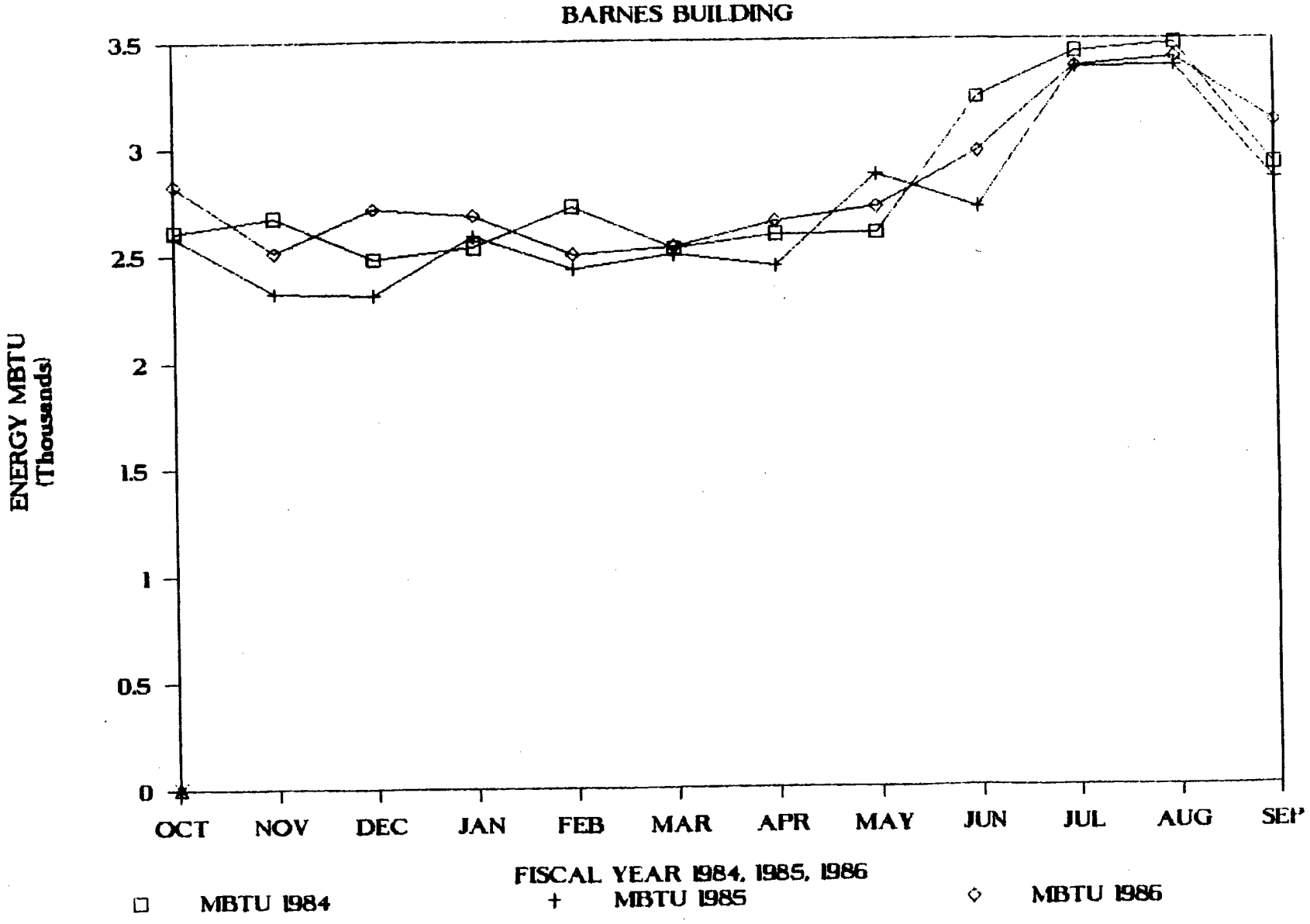

FIGURE 8

MONTHLY ENERGY CONSUMPTION

BARNES BUILDING

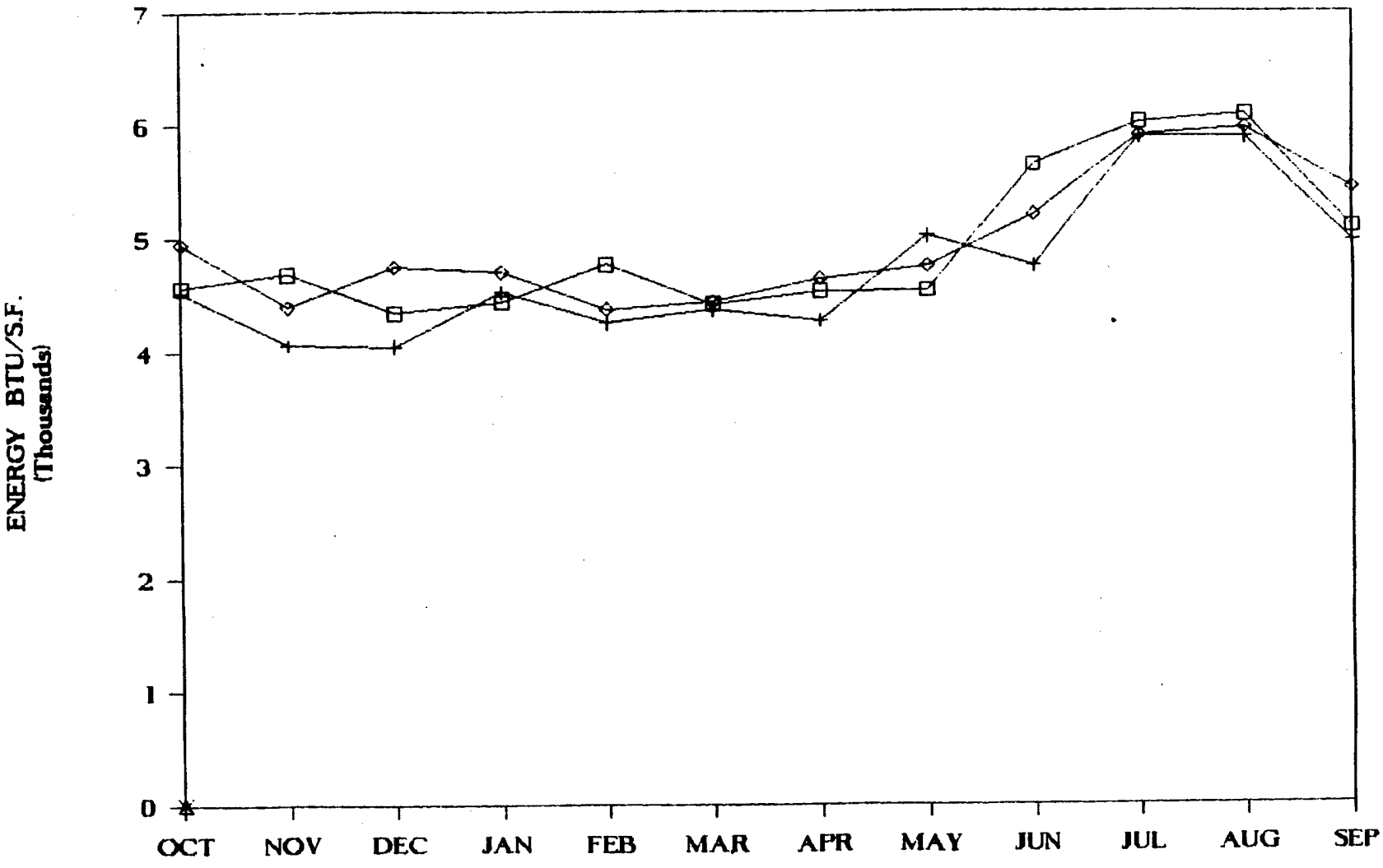

FIGURE 9

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TABLE 3
PROGRAMMED ENERGY CONSERVATION PROJECTS

ECO No.	Title Name	SIR	SAP* Years	Estimated Annual Savings Total MBTU	Estimated Annual Savings Total ($)	Total Investment ($)
			LOW COST/NO COST PROJECTS			
3	Install Vestibule On South Side Entrance	1.1	14.0	51.7	530	7,416
5	Use High Efficiency Motor	5.8	2.5	40.1	1,438	3,551
6	Provide Boiler Oxygen Trim Control	1.2	15.8	634.0	3,107	49,089
7	Insulate Steam Lines	10.7	1.7	122.0	598	1,021
8	Recover Heat From Boiler Flue Gases	2.5	7.4	1,356.5	6,167	45,669
10	Provide Free Cooling In Computer Room	6.1	2.4	749.6	12,035	28,664
12	Install Small Boiler For Summer DHW And Kitchen Use	2.8	6.5	669.0	3,278	21,236
14	Shut Down the DHW Circulating Pump	90.3	0.2	6.6	196	31
15	Provide New High Efficiency Motors As Needed	2.1	6.9	687.2	12,410	85,688
16	Reduce Lighting Levels In Computer Rooms	44.5	0.3	194.4	3,797	1,215

TABLE 3
PROGRAMMED ENERGY CONSERVATION PROJECTS

ECO No.	TITLE Name	SIR	SAP* Years	Estimated Annual Savings Total MBTU	Estimated Annual Savings Total ($)	Total Investment ($)
17	Reduce Lighting Level In 2nd Floor Reserve Dining Area	1.8	7.0	12.3	266	1,860
18	Use Energy Efficient Fluorescent Lamps	3.0	1.9	430.3	27,387	52,236
23	Replace Incandescent Lights With Fluorescent Lamps	34.4	0.4	24.8	993	391
	Totals		4.1	4,978.5	72,207	298,047
			QRIP PROJECT NO. 1			
19	Provide Time Clock For Lighting On 5, 7, 8, 9 Floors	15.7	0.8	448.4	10,216	8,187
20	Same In 'Reserve Dining Area'	32.1	0.4	28.9	1,816	784
	Totals		0.7	477.3	12,032	8,971
			QRIP PROJECT NO. 2			
21	Improve Power Factor	9.1	1.4	-	14,854	21,187

TABLE 3
PROGRAMMED ENERGY CONSERVATION PROJECTS

ECO No.	TITLE Name	SIR	SAP* Years	Estimated Annual Savings Total MBTU	Estimated Annual Savings Total ($)	Total Investment ($)
			ECIP PROJECT			
24	Modify Fluorescent Fixtures	2.2	6.1	1,338.5	92,857	582,672
	Totals		4.7	6,794.3	191,950	910,877

*Simple Amorization Period.

TABLE 4
SUMMARY OF STUDIED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	Simple Amortization Period (Yrs)	Estimated Annual Savings				Total Investment ($)	Disposition
				Electricity (KwHrs)	Fuel Oil (Gals)	Energy (MBtu)	Cost Savings($)		
1	Insulate the Wall Adjacent to Air Shaft	0.6	28.9	45	36	5.4	33	953	Not Recommended
2	Install Solar Window Film	0.7	11.7	38,034	2,467	482.6	6,635	77,313	Not Recommended
3	Install Vestibule on South Side Entrance	1.1	14.0	2,450	303	51.7	530	7,416	Recommended
4	Provide Loading Dock Enclosure	0.4	51.3	-	227	32.5	159	8,151	Not Recommended
5	Use High Efficiency Motor	5.8	2.5	13,013	-	40.1	1,438	3,551	Recommended
6	Provide Boiler Oxygen Trim Control	1.2	15.8	-	4,432	634.0	3,107	49,089	Recommended
7	Insulate Steam Lines	10.7	1.7	-	853	122.0	598	1,021	Recommended
8	Recover Heat From Boiler Flue Gases	2.5	7.4	-	9,486	1,356.5	6,167	45,669	Recommended
9	Utilize Solar Energy to Preheat the DHW	0.1	135.3	-	840	120.0	588	79,528	Not Recommended

TABLE 4
SUMMARY OF STUDIED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	Simple Amortization Period (Yrs)	Estimated Annual Savings				Total Investment ($)	Disposition
				Electricity (KwHrs)	Fuel Oil (Gals)	Energy (MBtu)	Cost Savings($)		
10	Provide Free Cooling in Computer Room	6.1	2.4	219,620	-	749.6	12,035	28,644	Recommended
11	Modify the Chiller Control	7.8	1.3	140,626	-	480.0	18,144	22,908	Recommended
12	Install A Small Boiler for Summer DHW & Kitchen Use	2.8	6.5	-	4,678	669.0	3,278	21,236	Recommended
13	Shut Down the Domestic Cold Water Booster Pump During Unoccupied Periods	0.6	23.6	14,258	-	48.6	531	12,555	Not Recommended
14	Shut Down the DHW Circulating Pump	90.3	0.2	1,935	-	6.6	196	31	Recommended
15	Provide New High Efficiency Motors As Needed	2.1	6.9	201,348	-	687.2	12,410	85,688	Recommended
16	Reduce Lighting Levels in Computer Rooms	44.5	0.3	56,955	-	194.4	3,797	1,215	Recommended

TABLE 4
SUMMARY OF STUDIED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	Simple Amortization Period (Yrs)	Estimated Annual Savings: Electricity (KwHrs)	Fuel Oil (Gals)	Energy (MBtu)	Cost Savings($)	Total Investment ($)	Disposition
17	Reduce Lighting Level in 2nd Floor Reserve Dining Area	1.8	7.0	9,172	(-)133	12.3	266	1,860	Recommended
18	Use Energy Efficient Fluorescent Lamps	3.0	1.9	321,289	(-)4,660	430.3	27,387	52,236	Recommended
19	Provide Time Clock Control for Lighting on 5, 7, 8 & 9 Floors	15.7	0.8	393,120	(-)6,247	448.4	10,216	8,187	Recommended
20	Provide Timer Control for Lighting in 2nd Fl. Reser. Dining Area	32.1	0.4	21,623	(-)314	28.9	1,816	784	Recommended
21	Improve Power Factor	9.1	1.4	127 kw Demand/Mo.	-	-	14,854	21,187	Recommended
22	Use Standby Generator for Peak Shaving	(-)8.9	1.6	513,000 kwh 205.2 kw Demand/Mo.	(-)38,750 (No. 2 oil)	(-)3,674	5,382	8,575	Not Recommended

TABLE 4

SUMMARY OF STUDIED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	Simple Amortization Period (Yrs)	Estimated Annual Savings				Total Investment ($)	Disposition
				Electricity (KwHrs)	Fuel Oil (Gals)	Energy (MBtu)	Cost Savings($)		
23	Replace Incandescent Lights With Fluorescent Lamps	34.4	0.4	18,954	(-)279	24.8	993	391	Recommended
24	Modify Fluorescent Fixtures	2.2	6.1	997,747	(-)14,501	1,338.5	92,857	582,672	Recommended

TABLE 5

PRIORITIZED SUMMARY OF RECOMMENDED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	SAP**	Estimated Annual Savings						Total Investment ($)
				Electricity		Fuel Oil		Total		
				(MBTU)	($)	MBTU	($)	MBTU	($)	
14	Shut Down the DHW Circulating Pump	90.3	0.2	6.6	196	-	-	6.6	196	31
16	Reduce Lighting Level in Computer Rms.	44.5	0.3	194.4	3,584	-	-	194.4	3,797	1,215
23	Replace Incandescent Lights with Fluorescent Lamps	34.4	0.4	64.7	1,189	(-)39.9	(-)196	24.8	993	391
20	Provide Time Control for Lighting in 2nd Floor Reserve Dining Area	32.1	0.4	73.8	2,036	(-)44.9	(-)220	28.9	1,816	784
19	Provide Time Clock Control for Lighting on 5, 7, 8 & 9 Floors	15.7	0.8	1,341.7	14,593	(-)893.3	(-)4,377	448.4	10,216	8,187
7	Insulate Steam Lines	10.7	1.7	-	-	122.0	598	122.0	598	1,021
21	Improve Power Factor	9.1	1.4	127 kw Demand/Mo.	14,854	-	-	127 kw Demand/Mo.	14,854	21,187
11	Modify the Chiller Control	7.8	1.3	480.0	18,144	-	-	480.0	18,144	22,908

*Total estimated annual cost savings may include non-energy savings.

**Simple Amortization Period, Years.

TABLE 5

PRIORITIZED SUMMARY OF RECOMMENDED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	SAP**	Estimated Annual Savings						Total Investment ($)
				Electricity		Fuel Oil		Total		
				(MBTU)	($)	MBTU	($)	MBTU	($)	
10	Provide Free Cooling in Computer Room	6.9	2.4	749.6	13,267	-	-	749.6	12,035	23,644
5	Use High Efficiency Motor	5.8	2.5	40.1	1,438	-	-	40.1	1,438	3,551
18	Use Energy Efficient Fluorescent Lamps	3.0	1.9	1,096.7	30,652	(-)666.4	(-)3,265	430.3	27,387	52,236
12	Install a small Boiler for Summer DHW & Kitchen Use	2.8	6.5	-	-	669.0	3,278	669.0	3,278	21,236
8	Recover Heat from Boiler Flue Gases	2.5	7.4	-	-	1,356.5	6,647	1,356.5	6,167	45,669
24	Modify Fluorescent Fixtures	2.2	6.1	3,412.1	95,387	(-)2,073.6	(-)10,160	1,338.5	92,857	582,672
15	Provide New High Efficiency Motors As Needed	2.1	6.9	687.2	12,410	-	-	687.2	12,410	85,688
17	Reduce Lighting Level in 2nd Floor Reserve Dining Area	1.8	7.0	31.3	332	(-)19.0	(-)93	12.3	266	1,860
6	Provide Boiler Oxygen Trim Control	1.2	15.8	-	-	634.0	3,107	634.0	3,107	49,089

TABLE 5

PRIORITIZED SUMMARY OF RECOMMENDED ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECO No.	ECO Name	SIR	SAP**	Estimated Annual Savings						Total Investment ($)
				Electricity		Fuel Oil		Total		
				(MBTU)	($)	MBTU	($)	MBTU	($)	
3	Install Vestibule on South Side Entrance	1.1	14.0	8.4	318	43.3	212	51.7	530	7,416
	Total **			7,706.6	190,256	(-)912.3	(-)1,362	6,794.3	191,945	905,877

*Total estimated annual cost savings may include non-energy savings.

**ECO No. 17 is not included. Savings in ECO No. 17 included in ECO No. 24.
ECO No. 11 is not included. Savings in ECO No. 11 part of EMCS contract.

***Simple Amorization Period, Years.

2.14 TRAINING

Data on available courses is provided to meet the needs of building personnel. These courses are given by the Corp of Engineers and private groups. They are concerned with equipment and building operation, maintenance procedures, scheduling and energy conservation.

2.15 Operating, Maintenance and Expendable Equipment

Expendable Equipment

ECO No. 18 calls for the use of energy efficient fluorescent lamps in place of the existing lamps. These 34 watt lamps are purchased as part of the normal stores program from local suppliers, and are made by such companies as General Electric, Sylvania, Phillips or Westinghouse.

Maintenance Stores

Building personnel recommend that the maintenance stories facilities at the Barnes Building be enlarged. Currently, maintenance items are mostly stored at Fort Devens. The time to pick up an item is over two hours plus the cost of transportation. If the items were stored at the Barnes Building, it would result in more usage staff time, less cost and faster service.

Operations

Elsewhere in this report, recommendations have been made for changes in building operation. These are summarized in Table 25.

Operating and Maintenance Problems

Operating and maintenance problems listed in this report are recommended below.

- Enthalpy economizer controls are not functioning properly.
- Domestic hot water temperature should be reduced to 105 F.
- Winter night setback controls are not in use.
- The wall adjacent to the air shaft in the Health Clinic area in cold and should be insulated.