### PREFINAL REPORT

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

FOR

BOILER AND CHILLER PLANTS

ΑT

FORT MONMOUTH, NEW JERSEY

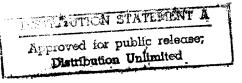
PREPARED FOR
U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT

UNDER
CONTRACT NO DACA-65-86-C-0101

PREPARED BY
SYSKA & HENNESSY INC. ENGINEERS
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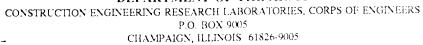
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PROVIDE FREE COOLING, INSTALL SMALLER PROJECT NO. 2:

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# 1.0 AUTHORIZATION

The Energy Engineering Analysis Program (EEAP) for selected boiler and chiller plants at Fort Monmouth was authorized by the Department of the Army, Corps of Engineers, Norfolk, Virginia, under Contract No. DACA65-86-C-0102 dated September 11, 1986 and subsequent Modification No. P00001 dated April 2, 1987.

# 2.0 OBJECTIVES OF THE STUDY

The objectives of this study are as follows:

- a. Perform an energy audit of selected boiler and chiller plants.
- 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 1391, 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.

# 3.0 SUBMISSION REQUIREMENTS

As outlined in the contract, included in Volume II, Appendix A, the study is divided into three major submissions:

- a. Interim Submittal
- b. Prefinal Submittal
- c. Final Submittal

# 4.0 WORK ACCOMPLISHED

Field surveys of boiler plants were carried out during the week of December 1, 1986, field surveys of steam and condensate distribution systems were carried out during the week of April 20, 1987 and the field surveys of chiller plants were performed during the week of July 27, 1987.

During the field surveys, a team of Syska & Hennessy carried out tests, observations, and interviews with Department of Engineering and Housing (DEH), operating and maintenance personnel, and various Building personnel. The operation and maintenance of all the boiler and chiller plants at Fort Monmouth is performed by an outside company under a contract.

Entrance and exit meetings were held with DEH personnel to discuss survey strategy work progress and obtain support information. As decided during the Entrance Meeting, the Interim Report with only Boiler Plants Energy Audit was submitted on June 15, 1987. Subsequently on July 15, 1987 an Interim Report with only Steam and Condensate Distribution System Energy Audit was submitted. Per comments from reviewers these two submittals were combined with the Chiller Plants Energy Audit and the combined Interim Submittal was submitted on November 6, 1987. The Interim Submittal Review Meeting was held in DEH offices at Fort Monmouth on February 10, 1988. The comments of the reviewers and the minutes of the meeting are included in Volume III, Appendix A.

This report consists of four volumes. The first volume is an Executive Summary, second volumes consists of narrative report describing in detail what was accomplished and the results of this study. The third volume includes appendices, detailed calculations and all back-up material. The fourth volume consists of programming and implementation documentation.

A prefinal review conference will be held at Fort Monmouth to review comments on this submittal. The review comments will be incorporated as revised pages, making the Prefinal Report into a Final Report, which will then complete the contract.

# 5.0 FACILITY DESCRIPTION

Fort Monmouth is a U.S. Army Material Development and Readiness Command (DARCOM) installation located in Monmouth County, New Jersey. The installation is located approximately 45 miles southwest of New York City.

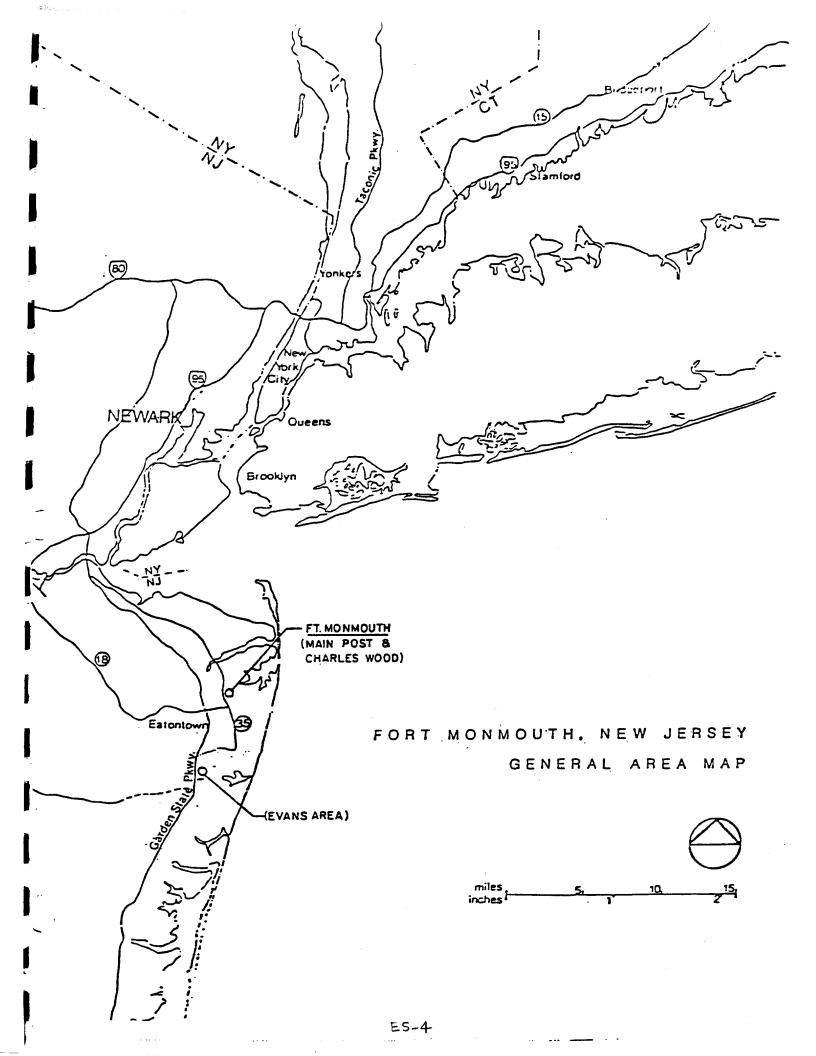
Fort Monmouth provides command, administrative and logistical support for Headquarters, U.S. Army Electronics Command. Seven major activities are located at or near Fort Monmouth; they are: the Army Electronics Command (ECOM), the US Military Academy Preparatory School, the Army Communications Office (TRI-TAC), the Army Satellite Communications Agency, the Army Communications Command Agency, the Health Service Command, Medical Department Activities, and Paterson Army Hospital.

The base consists of three areas: the Main Post, the Charles Wood Area, and the Evans Area.

There are about 610 buildings located on these areas of the base.

Majority of the buildings have dedicated boiler and/or chiller plants.

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### 6.0 PRESENT ENERGY CONSUMPTIONS

Majority of energy consumption at Fort Monmouth is electricity and fuel oil No. 2. Small amounts of natural gas and fuel oil No. 6 are also utilized at the facility.

The electricity used at the facility comes from Jersey Central Power and Light Company via the main substation and post grid of Fort Monmouth.

Ft. Monmouth is subject to billing under service classification GP-General Service Primary. The rate structure as of 12 November 1985 contains the following main provisions:

Customer Charge Per Month: \$125.00

Demand Charge Per kW: \$10.33 June - October

\$ 9.33 November - May

Energy Charge Per kWh: \$0.0709 On-Peak\*

\$0.0558 Off-Peak\*

Kilovolt-Ampere Charge: \$0.60 per kVa

Energy Adjustment Charge (EAC): All kWh supplied is

subject to Energy
Adjustment Clause
(Rider EAC). (Average EAC = \$0.0045/KWH).

\*On-peak time, 0800 to 2000 - Monday through Friday. Off-peak time - remaining hours.

Fuel Oil No. 2 and No. 6 are purchased from local suppliers and delivered by trucks to boiler plants, fuel oil storage tanks and individual buildings throughout the Main Post, Charleswood Area and Evans Area.

Natural gas for the facility is purchased from New Jersey Natural Gas Company and is distributed through the base by means of government owned gas lines.

# 7.0 HISTORICAL ENERGY CONSUMPTIONS

The annual energy consumptions\* for FY 85, 86 and 87 are shown in the table below.

Year	Fuel Oil No. 2 (Gals)	Fuel Oil No. 6 (Gals)	Natural Gas (Therms)	Electricity (kwh)
1985	1,984,955	781,582	963,367	69,835,602
1986	2,050,100	1,028,800	1,030,508	68,672,737
1987	2,117,383	1,354,214	1,135,712	72,669,763

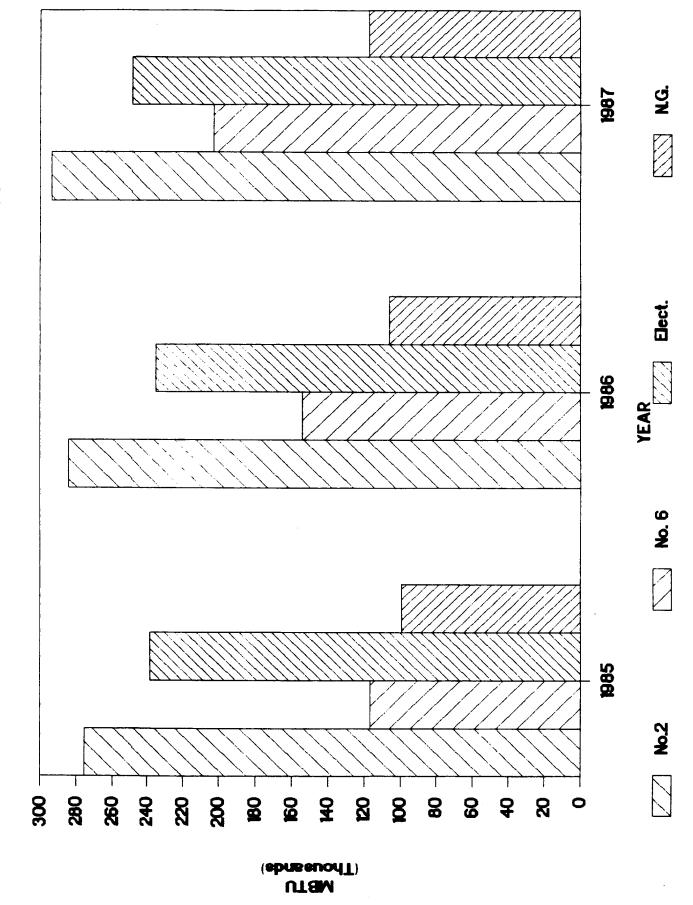
<sup>\*</sup> The energy consumption figures are obtained from DEH.

The energy conversion factors used in the study were as follows:

Electricity: 1 kwh = 3413 Btu

Fuel Oil No. 2: 1 Gallon = 138,700 Btu Fuel Oil No. 6: 1 Gallon = 149,700 Btu Natural Gas: 1 therm = 103,100 Btu

# HISTORICAL ENERGY CONSUMPTION



### 8.0 ENERGY CONSERVATION ANALYSIS

A total of 14 ECOs were evaluated to determine potential energy savings and operating cost savings. Based upon estimated construction costs, life cycle economics were evaluated. The results are summarized in Table 8.1 below. Table 8.2 lists the Prioritized Summary of all ECOs and Table 8.3 lists the Prioritized Summary of recommended ECOs.

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Fort Monsouth Table 8.1 Summary of Studied Energy Conservation Opportunities (800's)

Replace Burners	9	BCO	SIR	Simple			Ą	Annual Savings	cas		Total
Period   Cai)   Cai   Cai)	ċ	0 B 62		Amorti- Ention	Blectr-	Fuel	011	Matural	Total	Cost	
Peplace Boilers				Period	1010	No. 2	No. 6	•			
Replace Builers         2.67         5.40         - 17,110         57,491         1,496         11,130           Replace Burners         0.12         68.00         - 425         - 7,491         1,496         11,130           Install Oxygen         0.12         68.00         - 425         - 59.0         59.0           Tris Controls         0.68         23.40         - 19,150         - 2,887.0         59.0           Water Quantities         3.46         4.90         - 838         7,680         1,265.0           Nater Quantities         1.85         2.135         0.67         - 4,036         7,357         310         1,565.0           Install Blowdows         3.46         4.90         - 838         7,680         1,266.0         1,266.0           Provide Sumer         4.59         3.70         - 56,610         - 1,565.0         1,344.0           Boiler         2.764         0.66         - 2,314         6,865         - 1,344.0           Shut-off         2.30         5.40         81,284         - 56,610         - 3,695.0           Provide Pump         3.68         2.80         9,087         - 5,00         - 6,056         - 7,37         134.0           Provide Free <th></th> <th></th> <th></th> <th>(16)</th> <th>(##)</th> <th>(fsj)</th> <th>(12)</th> <th>(ccf)</th> <th>(MBtu)</th> <th>3</th> <th></th>				(16)	(##)	(fsj)	(12)	(ccf)	(MBtu)	3	
Replace Burners   0.12   68.00   425   59.0   59.0   1	-	00 00 00 00 00 00 00 00 00 00 00 00 00	7.61	9.40		17,110	57,491	1,496	11,129.0	59,555	684,486
Install Orgen   0.18   43.00   425   59.0	- ·	Designed Burners	0.12	68.00	•	125	•	•	9.69	378	
Pris Controls  Reduce Make-up  Water Quantities Install Blowdown  Nater Quantities Install Blowdown  Nater Quantities Install Blowdown  Nater Quantities Install Compressors  27.15  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.18  8.19  8.10	,	Install Oxygen	8	43.00	•	\$21	•	•	9.65	97.0	
Reduce Make-up         0.68         23.40         - 19,130         - 1,260           Mater quantities         1 4.90         - 838         7,680         - 1,260           Install Blowdown         3.46         4.90         - 838         7,680         - 1,260           Meat Recovery         27.35         0.67         - 6.61         - 8,479         - 8,479           Provide Sumer         4.59         3.70         - 56,610         - 8,479         - 8,479           Provide Sumer         27.64         0.66         - 2,314         6,865         - 1,344           Repair Steam Leak         27.64         0.29         - 6,705         18,470         - 3,695           Repair Steam Trap         63.18         0.29         - 6,705         18,470         - 3,695           Provide Pump         3.68         2.80         9,087         - 3,695         - 3,595           Shut-off         2.30         5.40         81,284         2,314         5.40         81,284         2,314           Install High Effic.         10.12         1.30         2,742         3,35         3,36           Motors         Install High Effic.         10.12         1.30         2,742 <td< td=""><td></td><td>Trie Controls</td><td></td><td></td><td></td><td>•</td><td></td><td></td><td>0 649 6</td><td>371 11</td><td>178 189</td></td<>		Trie Controls				•			0 649 6	371 11	178 189
Water quantities         3.45         4.90         -         838         7,680         -         1,266.0           Install Blowdown         3.45         4.90         -         4,035         7,580         -         1,266.0           Insulate Piping         27.15         0.67         -         -         56,610         -         8,479.0           Provide Sumer         4.59         3.70         -         -         56,610         -         8,479.0           Boiler         27.64         0.66         -         2,314         6,865         -         1,344.0           Repair Steam Leak         27.64         0.66         -         2,314         6,865         -         1,344.0           Provide Pump         3.68         2.80         9,087         -         5,650         -         3,695.0           Shut-off         2.30         5.40         81,284         -         -         277.4           Provide Pump         3.54         2.30         5,142         -         -         277.4           Provide Pump         3.54         2.30         91,489         -         -         277.4           Provide Pump         3.54         2.30		Reduce Hake-up	<b>89</b> .0	23.40	•	18,150	•	•	0.10017		
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Provide Sumer         4.59         3.70         -         -         56,610         -         0,473.0           Boiler         Boiler         27.64         0.66         -         2,314         6,865         -         1,344.0           Repair Steam Leak         27.64         0.66         -         6,705         18,470         -         3,635.0           Provide Pump         3.68         2.80         9,087         -         -         31.0           Shut-off         2.30         5.40         81,284         -         -         277.4           Provide Prec         2.30         5.40         81,489         -         -         277.4           Cooling Cycle         5.54         2.30         91,489         -         -         -         277.4           Install High Effic.         10.12         1.30         2,742         -	3.6	Insulate Piping	21.35	0.67		e	167'	910	9:450		161 671
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	<u>.</u>	Insulate CHW Piping	2.46	2·40	1,638	•	•			•	

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<u>و</u>	2 a a a a a a a a a a a a a a a a a a a		Amorti- sation	Blectr-	Fuel Oil	0i1	Matural	Total	Cost	
			Period	falet	No. 2	No. 6	8			
			(11)	( PAP )	( <b>[8</b> ])	([48]	(cef)	(MBtu)	•	3
	11 11 11 11 11 11 11 11 11 11 11 11 11	81 13	0.29	*** *** *** *** *** *** *** *** *** **	6.705	18.470		3,695.0	19,943	5,15
	Densit Steam Leak	21.61	99.0		2,314	6,865	•	1,344.0	1,254	4,287
	Inculate Dining	27.35	0.67	•	4,036	1,357	310	1,692.0	9,334	5,59
=	Install High Bffic.	10.12	1.30	2,142	•	•	•	9.36	210	248
	Hotors			;					100	
=	Install Compressors	5.54	2.30	91,489		•	•	316.3		
5.3.1	Provide Sumer	4.59	3.10	•	•	26,610	•		42,797	_
-	Boiler Drowide Dumm	89	2.80	9.087	•	•	•	31.0	100	1,741
3	Shut-off			-					•	•
5.3.5	Install Blowdown	3.46	4.90	•	æ æ	7,680	•	1,266.0	Ecc. 9	30,88
-	Beat Recovery	2.67	5.40		17,110	57,491	1, 496	11,129.0	59,555	684,486
: :	Inchiate CAM Dining	2.46	5.40	1.638	•		•	5.58	126	2
5.4.2	Provide Free	2.30	9.9	81,284	•	٠	•	277.4	6,259	32,451
	Cooling Cycle									•
7:	Reduce Make-up	0.68	23.40	ı	19,150	•	r	2,867.0	11,476	581'82
5.3.3	Install Oxygen	9.18	43.00	•	425		•	9. 9.	275	e .
	Trim Controls		;		:			9	176	11 941
5.3.2	Replace Burners	0.12	00.89	•	62)	•	•	>	;	

1 000	(8.009)
	n Opportunities
	Conservation
	RAPFET
Fort Monmouth Table 8.3	Summer of Becommended Repres Conservation

	Blectricity	No. 2 No. 2 (6al) 6,705	No. 6	Natura] Gas	Total	Coet	
Repair Steam Trap 63.18 Repair Steam Leak 27.64 Insulate Piping 27.55 Install High Effic. 10.12 Notors Install Compressors 5.54 Roll Compressors 4.59 Roller Boiler 10.12	101CF	(6a1) (6a1)	No. 6	;	KD C L T	Š	
Repair Steam Trap 63.18 Repair Steam Trap 63.18 Insulate Piping 27.54 Install High Bffic. 10.12 Notors Install Compressors 5.54 Provide Sumer 6.59 Boiler 10.13	(484)	(gal) 6,705	(fal)				
Repair Steam Trap 63.18 Repair Steam Leak 27.64 Insulate Piping 27.75 Install High Rffic. 10.12 Motors 1.64 Provide Summer 4.59 Roiler 2.64	11 11 11 11 11 11 11 11 11 11	6,705	!	(ccf)	(MBtu)	=	€
Repair Steam Trap 63.18 Repair Steam Leak 27.64 Insulate Piping 27.35 Install High Effic. 10.12 Motors Install Compressors 5.54 Provide Summer 4.59 Boiler			18.470	:: :: :: :: :: :: :: ::	3,695.0	19,943	5,157
Repair Steam Leak 27.64 Inculate Piping 27.35 Install High Rffic. 10.12 Hotors Install Compressors 5.54 Provide Sumer 4.59 Roller Boiler A.59	•		6 865	•	1,344.0	7,254	1,287
Insulate Piping 27.35 Install High Effic. 10.12 Motors Install Compressors 5.54 Provide Sumer 4.59 Boiler Comment 5.68	•	110'7	355	310	1.692.0	9, 334	5,59
Install bigh Billo.  Motors Install Compressors 5.54 Provide Sumer 4.59 Boiler 6.59	2,742	0.0	,	;	9.36	012	312
Notors Install Copressors 5.54 Provide Sumer 4.59 Boiler 1.59	<u>:</u>						
Install Compressors 5.54 Provide Sumer 4.59 Boiler	01 490	•	•		312.3	7,045	15, 157
Provide Sumer Boiler Boord Page 3.68	605,15		96,610	•	8,479.0	12,191	
Boiler Proceids Duan							
	9,087	•	•	•	31.0	100	1,74
		;			1 266 0	6,553	30,881
5.3.5 [matall Blowdown 3.46 4.90	•	20 27 20	1,080	•		<del>}</del>	
Beat Recovery		11 110	167 63	969	11,129.0	59,555	981,486
Replace Boilers 2.67		21.		:	85.58	126	
5.4.5 Insulate CHW Piping 2.46 5.40	1,638	•	•	•	711.1	6.259	
Provide Free 2.30		•	•			1	

### 9.0 PROJECTS IDENTIFIED

Based on the guidance from the Division of Engineering and Housing (DEH), Fort Monmouth, economically viable ECOs were grouped into the following projects for purposes of evaluation and preparation of Productivity Capital Investment Program (PCIP) funding documents. The following are the projects identified:

PROJECT NO.	ECO NO.	PROJECT DESCRIPTION
1. (QRIP)	5.3.6 5.3.8 5.3.9	Insulate Hot Piping Repair Steam Leaks Repair Steam Traps
2. (QRIP)	5.4.2 5.4.3	Provide Free Cooling Install Smaller Compressors
3.	5.3.5	Install Blowdown Heat
Recovery (QRIP)	5.3.7	Provide Summer Boiler
4. (ECIP)	5.3.1	Replace Boilers

ES-12 1175N