

EXECUTIVE SUMMARY

EEAP, NORFOLK DISTRICT

ABERDEEN PROVING GROUNDS, MARYLAND

**BoILER/CHILLER**



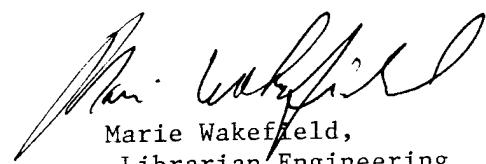


DEPARTMENT OF THE ARMY  
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
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FINAL REPORT  
EXECUTIVE SUMMARY  
EEAP, NORFOLK DISTRICT  
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**BoILER/CHILLER**

Prepared for:

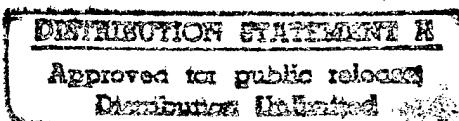
Department of the Army  
Norfolk District, Corps of Engineers  
Norfolk, Virginia 23510

Under Contract No. DACA-65-84-C-0105

November 1986

B. N. Gidwani

B. N. Gidwani, P.E.  
Project Manager



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W.O. #0335-72-01

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## SECTION 1

### EXECUTIVE SUMMARY

#### 1.1 INTRODUCTION

This report presents the results of the Energy Engineering Analysis Program conducted by Roy F. Weston, Inc. at the Aberdeen and Edgewood Areas of Aberdeen Proving Grounds under Contract No. DACA-65-84-C-0105. The study includes evaluation of boiler and chiller plant performance by tests, identification and analysis of specific efficiency improvements, evaluation of existing equipment condition and maintenance procedures, and project development and documentation preparation.

The report consists of six volumes-- one set of three for the Aberdeen Area and one set of three for the Edgewood Area. Each set consists of:

Volume I: Survey and Test Results

Volume II: Evaluation of Energy Conservation Opportunities

Volume III: Appendix

Volume I contains results of the field survey and tests performed on the boiler and chiller plants. The report evaluates the condition of existing equipment and highlights specific efficiency improvements. Volume II contains detailed calculations for the various energy conservation opportunities. Volume III contains the life cycle cost analysis for all applicable energy conservation opportunities.

#### 1.2 HISTORICAL ENERGY CONSUMPTION

Table 1.1 and 1.2 summarizes the total annual fuel oil and electric consumption for Aberdeen and Edgewood for FY 1984. A total of 15,272,456 gallons of fuel oil and 141,463,804 kWh electricity were required from October 1983 to September 1984. Fuel oil consumption for FY84 was 10.75% higher than for FY83 and electric consumption was up 6.59% over FY83. Since this study is restricted to specific boiler and chiller plants as mentioned in the scope of work, it is helpful to summarize the annual fuel oil consumption in those specific boiler plants. Table 1.3 lists the annual fuel consumption for Aberdeen Area and Table 1.4 lists the same for the Edgewood Area. No electric metering was available for individual buildings.

#### 1.3 FINDINGS

The work done was performed in two phases. The first phase involved site visits, data collection and performance tests on the boiler and chiller plants. Volume I summarizes these results. The second phase involved evaluation of various energy conservation opportunities (ECOs) and economic analysis.

TABLE 1.1

## TOTAL FUEL OIL (GALLONS) CONSUMPTION FOR FY '84

	Aberdeen Area	Edgewood Area	Total
Oct 83	270,295	556,665	826,960
Nov 83	615,322	806,840	1,422,162
Dec 83	1,021,628	1,106,545	2,128,173
Jan 84	1,398,540	1,331,365	2,729,905
Feb 84	946,110	1,039,982	1,986,092
Mar 84	1,005,035	1,043,346	2,048,381
Apr 84	673,390	697,809	1,371,199
May 84	67,850	753,928	821,778
Jun 84	50,101	414,336	464,437
Jul 84	104,747	434,349	539,096
Aug 84	67,462	373,406	440,868
Sep 84	<u>98,646</u>	<u>394,759</u>	<u>493,405</u>
TOTAL	6,319,126	8,953,330	15,272,456

Cost of Fuel Oil = \$1.03/gallon

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.2  
TOTAL ELECTRICITY CONSUMPTION FOR FY '84

		Aberdeen Area	Edgewood Area	Total	Cost
		KWH	MBTU	KWH	MBTU
Oct	83	6,179,968	71,688	4,682,259	54,314
Nov	83	5,782,175	67,073	3,890,416	45,129
Dec	83	6,775,160	78,592	4,395,239	50,985
Jan	84	6,233,886	72,313	3,844,291	44,594
Feb	84	6,197,098	71,887	3,861,221	44,790
Mar	84	6,505,451	75,463	4,061,672	47,115
Apr	84	6,282,703	72,879	4,091,976	47,467
May	84	6,292,975	72,999	4,753,010	55,135
Jun	84	8,123,913	94,237	6,261,532	72,634
Jul	84	8,355,669	96,926	6,486,103	75,239
Aug	84	8,693,892	99,805	6,514,776	75,571
Sep	84	<u>7,551,401</u>	<u>87,596</u>	<u>5,737,019</u>	<u>66,549</u>
TOTAL		82,884,291	961,458	58,579,513	679,522
				141,463,804	1,640,980
					\$ 6,726,982

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.3  
ANNUAL FUEL OIL CONSUMPTION FOR FY84  
FOR ABERDEEN AREA

<u>Building #</u>	<u>Tank Size</u>	Annual Fuel Oil Consumption (Gals.)
338	1-15,000	84,338.2
345A	1-100,000	220,032.9
345B	1-200,000	675,674.0
345C	1-70,000	759,972.1
455	1-10,000	68,344.8
507	1-10,000	101,009.1
525	1-15,000	119,629.4
629	1-10,000	25,087.4
1064	1-10,000	53,776.0
2312	1-10,000	67,994.2
2352	1-10,000	71,237.6
2377	1-10,000	29,826.0
2431	1-8,000	25,893.3
2457	1-8,000	31,582.6
2483	1-8,000	40,027.9
2502	1-15,000	153,740.7
2757	1-13,000	146,336.8
2915	1-10,000	163,726.7
3031	1-8,000	35,401.0
3062	2-10,000	147,150.2
3070A	1-25,000	113,020.7
3638	1-10,000	71,143.9
4119	1-15,000	151,377.2
4219	1-12,000	278,887.5
	1-15,000	
4304	1-10,000	59,515.7
4305	1-10,000	86,201.1
5033	1-10,000	113,650.6
5043	1-20,000	45,394.3
5206	1-10,000	105,739.5
5258	1-4,000	23,037.3
5413	1-2,000	10,815.2
5454	1-12,000	35,386.8
		4,114,950.7

Source: Utilities Division, Mr. Larry Taylor

TABLE 1.4  
 ANNUAL FUEL OIL CONSUMPTION FOR FY84  
 FOR EDGEWOOD AREA

<u>Building #</u>	<u>Tank Size</u>	<u>Annual Fuel Oil Consumption (Gals.)</u>
E1574	3-8,000	126,693.7
E2100	1-20,000	141,549.7
E3148	2-15,000	7,081.5
E3302	1-60,000	328,895.1
E3312	2-50,000	2,812,006.0
	1-100,000	
E4160	2-14,000	323,766.2
E5126	2-100,000	3,958,560.9
E5828A	2-8,000	124,671.8
E6560	1-15,000	249,918.7
		<hr/>
		8,073,143.6

Source: Utilities Division, Mr. Larry Taylor

A list of Energy Conservation Opportunities (ECOs) to be investigated is contained in the Scope of Work. This list, along with previous energy conservation retrofit experience and the observations and data obtained from the site visits, provided a basis for a list of ECOs to be quantitatively analyzed. The opportunities involved are:

Boiler Plant

- o Boiler Economizer
- o Boiler Trim Controls
- o Combustion Air from Ceiling
- o Blowdown Controls
- o Installation of New Burners
- o Boiler Operation Optimization
- o Reduce Steam Pressure
- o Reduction in Make-up Water
- o Variable Speed I.D. Fans/Blowers
- o Air vs. Steam Atomization
- o Boiler Replacement Study

Chiller Plant

- o Chilled Water Temperature Reset
- o Condenser Water Temperature Reset
- o Small Chiller Application
- o Free Cooling
- o Automatic Variable Pitch Tower Fans
- o Variable Speed Tower Fans
- o Chiller Operation Optimization
- o Cycling Circulating Pumps
- o Condenser Water Treatment
- o Variable Speed Chilled Water Pumps
- o Chiller Replacement Study

Tables 1.5 and 1.6 show dot matrices for the Aberdeen and Edgewood areas which illustrate the applicable buildings for each ECO. Based on the energy calculations and financial analysis, (Volume II and III), a list of all projects having SIR > 1 is summarized in Tables 1.7 and 1.8 for the Aberdeen and Edgewood areas, respectively. Some of the ECOs are synergistic with others and totalling all the savings figures will result in double-dipping. To avoid this, only those ECOs that will not lead to double-dipping are recommended. For example, condenser water temperature reset and variable speed tower fan drives result in similar savings and only the one with the higher SIR value is recommended. Also, projects having SIR value close to unity and projects having payback of more than 10 years are not recommended.

Volume II of the report also highlights the state of maintenance at the two bases and includes operation and maintenance recommendations that should be followed.

Energy Engineering Analysis Program  
 Location: APG, Aberdeen Area  
 Equipment: Chiller Plants  
 Updated: October 1985

Note: • Denotes ECO's Applicable  
 ▲ Building is Currently Served by a Temporary Chiller,  
 Therefore no ECO's Are Recommended

Installation	ENERGY CONSERVATION OPPORTUNITIES													Remarks
	Reset Chilled Water Temperature	Reset Cond. Water Temp.	Small Chiller Application	Free Cooling	Auto. Variable Pitch	Variable Speed Tower Fans	Shutting Off Chiller Fan Drives	Condenser Water Treatment	Variable Speed CHW Pumps	Chiller Replacement Study				
Building 30	•	•		•			•	•	•					
Building 120		•					•			•				
Building 314	•	•			•		•	•						
Building 390	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲			
Building 392	•									•				
Building 393	•	•					•	•						
Building 394	•	•						•	•					
Building 400	•								•	•	•			
Building 2207	•	•			•		•	•						
Building 2401	•	•			•		•	•						
Building 2501		•		•	•			•	•					
Building 3144										•				
Building 3147	•									•				
Building 3148	•	•						•	•	•				
Building 3326	•	•						•						
Building 4305	•								•					

TABLE 1.5 ENERGY CONSERVATION OPPORTUNITIES MATRIX  
 (ABERDEEN AREA)

Energy Engineering Analysis Program  
 Location: APG, Aberdeen Area  
 Equipment: Boiler Plants  
 Updated: October 1985

Note: ● Denotes ECO's Applicable  
 ▲Indicates Boiler is Either Obsolete or  
 New Boiler is Being Installed (See Remarks)

### ENERGY CONSERVATION OPPORTUNITIES

Installation	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans/Blowers	Air Vs. Steam Atomization	Boiler Replacement Study	Remarks
# 345 - Boiler No. 1	●	●	●	●	●	●	●	●	●		
Boiler No. 2	●	●	●	●	●	●	●	●	●		
Boiler No. 3	●	●	●	●	●	●	●	●	●		
# 525	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Three new boilers are being installed now.
# 507 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Obsolete unit.
Boiler No. 2	●	●	●								
Boiler No. 3	●	●	●								
# 2502 - Boiler No. 1	●	●	●			●					
Boiler No. 2	●	●	●			●					
Boiler No. 3	●	●	●			●					
# 3638 - Boiler No. 1	●	●	●								Status of building is unknown.
Boiler No. 2	●	●	●								
# 4119 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		
Boiler No. 3	●	●	●								
# 4219 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		
Boiler No. 3	●	●	●								
Boiler No. 4	●	●	●								
# 4305 - Boiler No. 1	●	●	●								
Boiler No. 2	●	●	●								
# 338 - Boiler No. 1	●	●	●						●		
Boiler No. 2	●	●	●						●		

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program  
 Location: APG, Aberdeen Area  
 Equipment: Boiler Plants  
 Updated: October 1985

Note: • Denotes ECO's Applicable  
 ▲Indicates Boiler is Either Obsolete  
 or New Boiler is Being Installed (See Remarks)

Installation	ENERGY CONSERVATION OPPORTUNITIES										Remarks
	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. ID Fans/Blowers	Air V.s. Steam Atomization	Boiler Replacement Study	
# 455 - Boiler No. 1	•	•	•								
Boiler No. 2	•	•	•								
# 629 - Boiler No. 1	•	•	•							•	
Boiler No. 2	•	•	•							•	May be replaced.
# 2377 - Boiler No. 1	•	•	•							•	
Boiler No. 2	•	•	•		•						
# 2312 - Boiler No. 1	•	•	•							•	
Boiler No. 2	•	•	•								
Boiler No. 3	•	•	•								
# 2483 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Obsolete unit is to be replaced.
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
# 2431 - Boiler No. 1	•	•	•		•						
Boiler No. 2	•	•	•								
# 2457 - Boiler No. 1	•	•	•		•						
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	Obsolete unit is to be replaced.
# 3062 - Boiler No. 1	•	•	•								
Boiler No. 2	•	•	•								
# 3031 - Boiler No. 1	•	•	•								
# 5033 - Boiler No. 1	•	•	•							•	
Boiler No. 2	•	•	•		•						
# 5206 - Boiler No. 1	•	•	•							•	
Boiler No. 2	•	•	•		•						
# 1064 - Boiler No. 1	•	•	•								
Boiler No. 2	•	•	•								

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program  
 Location: APG, Aberdeen Area  
 Equipment: Boiler Plants  
 Updated: October 1985

Note: • Denotes ECO's Applicable  
 Indicates Boiler is Either Obsolete or  
 New Boiler is Being Installed (See Remarks)

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans/Make-Up Water	Air Vs. Steam Blowers	Boiler Replacement	Boiler Atomization Study	
# 5258 - Boiler No. 1	•	•	•		•							
# 5454 - Boiler No. 1	•	•	•		•							
Boiler No. 2	•	•	•		•							
# 4304 - Boiler No. 1	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New boiler being installed.
Boiler No. 2	•	•	•								•	
# 2352 - Boiler No. 1	•	•	•									
# 3070 - Boiler No. 1	•	•	•									
Boiler No. 2	•	•	•									
# 5043 - Boiler No. 1	•	•	•		•							
# 5413 - Boiler No. 1	•	•	•								•	
# 2757 - Boiler No. 1	•	•	•		•							
Boiler No. 2	•	•	•		•							
# 2915 - Boiler No. 1	•	•	•		•							
Boiler No. 2	•	•	•		•							

TABLE 1.5 (CONTINUED)

Energy Engineering Analysis Program  
 Location: APG, Edgewood Area  
 Equipment: Chiller Plants  
 Updated: October 1985

Note: • Denotes ECO's Applicable

Installation	ENERGY CONSERVATION OPPORTUNITIES										Remarks
	Chilled Water Temperature Reset	Cond. Water Temp. Reset	Small Chiller Application	Free Cooling	Auto. Variable Pitch Tower Fans	Variable Speed Tower Fans	Cycling Chiller Operation Optimization	Condenser Water Treatment	Variable Speed CHW Pumps	Chiller Replacement Study	
Building E2100	•	•		•	•	•	•	•	•		
Building E3081	•	•			•	•	•	•	•		
Building E3100	•	•		•	•	•	•	•	•		
Building E3220	•	•			•	•	•	•	•		
Building E3244	•	•			•			•	•		
Building E3300	•	•	•		•	•	•	•	•		
Building E3580	•								•		
Building E5100	•	•		•	•	•	•	•	•		
Building E5101	•	•					•				
Building E5452	•	•					•				
Building E5951	•	•			•		•	•			

TABLE 1.6 ENERGY CONSERVATION OPPORTUNITIES MATRIX  
 (EDGEWOOD AREA)

Energy Engineering Analysis Program  
 Location: APG, Edgewood Area  
 Equipment: Boiler Plants  
 Updated: October 1985

Note: ● Denotes ECO's Applicable  
 ▲Indicates Boiler is Either Obsolete or  
 New Boiler is Being Installed (See Remarks)

Installation	ENERGY CONSERVATION OPPORTUNITIES											Remarks
	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. I.D. Fans/Make-Up Water	Air Vs. Steam Atomization	Boiler Replacement Study		
Building E3148 - Boiler No. 1	●	●	●			●						Standby plant
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		Boiler has been replaced.
Boiler No. 3	●	●	●			●						
Building E2100 - Boiler No. 1	●	●	●								●	Very old units.
Boiler No. 2	●	●	●									
Boiler No. 3	●	●	●									
Building E1574 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									
Boiler No. 3	●	●	●									
Building E3312 - Boiler No. 1	●	●	●		●	●	●					
Boiler No. 2	●	●	●			●	●					
Boiler No. 3	●	●	●			●	●					
Boiler No. 4	●	●	●		●	●	●	●	●	●		Very old units.
Boiler No. 5	●	●	●		●	●	●	●	●	●		Very old units.
Building E4160 - Boiler No. 1	●	●	●									
Boiler No. 2	●	●	●									
Boiler No. 3	●	●	●									
Building E5126 - Boiler No. 1	●	●	●		●	●	●	●	●	●		Very old units.
Boiler No. 2	●	●	●		●	●	●	●	●	●		Very old units.
Boiler No. 3	●	●	●		●	●	●	●	●	●		Very old units
Boiler No. 4	●	●	●		●	●	●	●	●	●		Very old units.
Boiler No. 5	●	●	●		●	●	●	●	●	●		Very old units.
Boiler No. 6	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		New unit being installed.

TABLE 1.6 (CONTINUED)

Energy Engineering Analysis Program  
 Location: APG, Edgewood Area  
 Equipment: Boiler Plants  
 Updated: October 1985

Note: • Denotes ECO's Applicable  
 ▲Indicates Boiler is Either Obsolete or  
 New Boiler is Being Installed (see Remarks)

Installation	Boiler Economizer	Boiler Trim Controls	Combustion Air from Ceiling	Blowdown Controls	Installation of New Burners	Boiler Operation Optimization	Reduce Steam Pressure	V.S. ID Fans/Make-Up Water	Air Vs. Steam Blowers	Boiler Replacement Study	Remarks
Building E3302 - Boiler No. 1	•	•	•								
Boiler No. 2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	New unit being installed
Building E5828 - Boiler No. 1	•	•	•	•							
Boiler No. 2	•	•	•	•							
Building E6560 - Boiler No. 1	•	•	•								
Boiler No. 2	•	•	•								

TABLE 1.6 (CONTINUED)

TABLE 1.7

PG 1 of 3

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS			ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity		Fuel Oil					
	KWH	MBTU						
<b>CHILLED WATER TEMPERATURE RESET</b>								
314	18285	212.1	-	1097	979	5926	1.16	NOTE 1
394	18277	212.0	-	1097	979	5926	1.54	NOTE 2
<b>VARIABLE SPEED DRIVE ON CONDENSING UNITS</b>								
4305	34930	405.2	-	2095	1928	16743	1.07	NR
<b>VARIABLE SPEED CHILLED WATER PUMPS</b>								
314	76220	884.2	-	4573	4353	21957	1.39	RECOM
394	22510	261.1	-	1350	1253	9769	1.19	NOTE 2

NOTE 1 : This project is not recommended since it is synergistic with the variable speed CHW pump ECO and greater savings could be achieved by the latter.

NOTE 2: New unit has been installed recently and therefore project is not recommended.

TABLE 1.7 CONTINUED)

Pg 2 of 3

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS			ANNUAL ENERGY COST	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	KWH	MBTU	Fuel Oil					
<b>BOILER ECONOMIZER</b>								
345 - # 1,2 & 3	-	-	-	16329	122302	119574	272767	3.67
2502 -# 1 & 2	-	-	-	965	7228	7000	44670	1.02
2502 -# 13	-	-	-	271.3	2032	1887	14470	1.32
4219 -# 4	-	-	-	291.8	2186	2041	14470	2.24
5206 -# 2	-	-	-	559.8	4193	3943	24986	1.33
2352 -# 1	-	-	-	245.9	1842	1663	15903	1.76
2915 -# 1	-	-	-	751.0	5625	5379	24626	2.02
2915 -# 2	-	-	-	725.0	5430	5184	24626	1.94
<b>BOILER TRIM CONTROLS</b>								
345 -# 1,2,3	-	-	-	11373.2	85185	82898	57176	12.14
2502 -# 1	-	-	-	1744.4	13066	12303	19058	4.35
-# 2	-	-	-	1212.9	9084	8322	19058	2.95
2352 -# 1	-	-	-	297.5	2228	1466	19058	1.46
2915 -# 2	-	-	-	1939.9	14530	13767	19058	6.68

TABLE 1.7 (CONTINUED)

Pg 3 of 3

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1 (ABERDEEN AREA)

BUILDING #	ANNUAL ENERGY SAVINGS			ANNUAL ENERGY COST	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity KWH	Fuel Oil MBTU	KWH MBTU					
<b>COMBUSTION AIR FROM CEILING</b>								
345 -# 1,2 & 3	-	-	-	1109.6	8311	7973	56324	1.2
2502 -# 1 & 2	-	-	-	234.9	1759	1650	10977	1.01
2915 -# 1 & 2	-	-	-	198.5	1487	1366	12125	1.05
<b>BOILER BLOWDOWN</b>								
345 -# 1,2,3	-	-	-	1121.0	8396	8238	15835	4.35 RECOM
<b>INSTALLATION OF NEW BURNER</b>								
2915 -# 1 & 2	-	-	-	3705.4	27754	28608	85378	3.05 RECOM
<b>TOTALS FOR RECOMMENDED PROJECTS</b>								
	76,220	884.2		40,568	308,426	299,646	648,426	

NOTE : NR indicates projects not recommended since SIR value is close to unity.

TABLE 1.8

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1 (EDGEWOOD AREA)

BUILDING #	ANNUAL ENERGY SAVINGS			ANNUAL SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity KWH	MBTU	MBTU					
<b>CHILLED WATER TEMPERATURE RESET</b>								
E2100	32699	379.3	-	1864	1726	6879	2.23	Note 1
E3081	32960	382.3	-	1879	1741	6879	2.35	Note 1
E3100	30937	358.9	-	1764	1626	6879	1.66	Note 1
E3220	23077	267.7	-	1315	1178	6879	1.59	Note 1
E3300	61075	717.8	-	3527	3369	6879	3.46	Recom
E5100	33348	386.8	-	1901	1763	6879	1.80	Note 1
<b>CONDENSER WATER TEMPERATURE RESET</b>								
E2100	25470	295.5	-	1452	1302	7516	1.54	Note 2
E3081	26040	302.1	-	1484	1334	7516	1.65	Note 2
E3220	77005	893.3	-	4389	4239	7516	5.24	RECOM
E3244	46770	542.5	-	2666	2536	6483	3.63	RECOM
E3300	42600	494.2	-	2428	2278	7516	2.13	Note 2
E5100	26720	310	-	1523	1373	7516	1.28	RECOM
<b>VARIABLE SPEED TOWER FAN DRIVES</b>								
E2100	72750	843.9	-	4147	3936	21099	1.66	RECOM
E3081	60540	748.7	-	3679	3468	21099	1.53	RECOM
E3100	100970	1171.3	-	5756	5514	24179	1.60	RECOM
E3220	40335	467.9	-	2299	2187	11259	1.80	NOTE 3
E3244	20195	234.3	-	1151	1054	9764	1.00	NOTE 3
E3300	161610	1874.7	-	9212	8934	27637	2.25	RECOM
E5100	60640	703.4	-	3457	3246	21099	1.08	NOTE 3
E5551	36370	421.9	-	2073	1968	10547	1.31	RECOM

TABLE 1.8 (CONTINUED)

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1

BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity KWH	Fuel Oil MBTU					
<b>VARIABLE SPEED CHILLED WATER PUMPS</b>							
E2100	72750	843.9	-	4147	4008	13919	2.56
E3081	85940	996.9	-	4899	4689	20933	2.08
E3100	101240	1174.4	-	5771	5540	23091	1.68
E3220	121280	1406.8	-	6913	6648	26543	2.33
E3300	161340	1871.5	-	9197	8918	27837	Note 4
E5100	121270	1406.7	-	6913	6678	23432	RECOM
<b>TOTALS FOR RECOMMENDED PROJECTS</b>							
	1,250,555.0	14,506.5	-	71,286.0	68,449.0	262,051.0	

NOTE 1: This project is not recommended since it is synergistic with the V. S. CHW pump ECO and greater savings could be achieved by the latter.

NOTE 2: This project is not recommended since it is synergistic with the V. S. Cond fan ECO and greater savings could be achieved by the latter.

NOTE 3: This project is not recommended since it is synergistic with the condenser reset ECO and greater savings could be achieved by the latter.

Note: This project is not recommended since it is synergistic with the chilled water temperature reset ECO and higher SIR value could be achieved by the latter.

TABLE 1.8 (CONTINUED)

pg 3 of 4

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1 (EDGEWOOD AREA)

BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	Electricity KWH	MBTU					
<b>BOILER ECONOMIZER</b>							
E3312 -11	-	-	2123.3	15904	15562	34194	4.90
-12	-	-	1274.0	9542	9029	51294	2.18
-13	-	-	1839.1	13775	13262	51294	3.19
E4160 -11	-	-	384.4	2879	2675	20375	1.63
-12	-	-	594.1	4450	4246	20375	2.57
-13	-	-	262.8	1968	1765	20375	1.09
E5828 -11	-	-	425.4	3186	2999	18746	2.64
-12	-	-	425.4	3186	2999	18746	2.10
E6560 -11	-	-	283.1	2120	1862	25869	1.07
-12	-	-	293.6	2199	1940	25869	1.11
<b>BOILER TRIM CONTROLS</b>							
E2100 -13	-	-	523.0	3917	3155	19058	2.01
E3312 -11	-	-	3058.8	22910	22148	19058	12.55
-12	-	-	1150.6	8618	7855	19058	5.15
-13	-	-	776.9	5819	5056	19058	3.36
E4160 -11	-	-	674.9	5055	4293	19058	2.87
-12	-	-	439.9	3295	2533	19058	1.74
E3302 -11	-	-	441.6	3307	2545	19058	2.37
E5828 -11	-	-	237.2	1776	1014	19058	1.07
-12	-	-	447.5	3352	2590	19058	1.69

TABLE 1.8 (CONTINUED)

## SUMMARY OF ALL ENERGY CONSERVATION OPPORTUNITIES HAVING SIR &gt; 1

pg 4 of 4

BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIR	REMARKS
	KWH	MBTU					
<b>COMBUSTION AIR FROM CEILING</b>							
E3312 -#1	-	-	203.3	1523	1445	7767	2.02
-#2	-	-	178.4	1336	1254	8269	1.88
-#3	-	-	220.9	1655	1572	8269	2.35
E4160 -#1,2,3	-	-	204.7	1533	1380	15336	1.13
E3302 -#1	-	-	183.9	1377	1300	7766	2.76
E5828 -#1	-	-	44.6	334	287	4664	1.05
<b>INSTALLATION OF NEW BURNER EQUIPMENT</b>							
E3312 -#1	-	-	2794.0	20927	22193	126632	1.86
<b>SMALL BOILER APPLICATION</b>							
E3302	-	-	4400.0	33000	28678	203911	2.75
<b>REDUCTION IN MAKEUP WATER QUANTITY</b>							
E5126	-29120	-337.8	13412.4	98800	97176	646900	2.79
<b>BOILER REPLACEMENT STUDY</b>							
E5126 -#1 TO 5	-	-	70343.3	526871	545077	1,820,569	5.46
<b>TOTALS FOR RECOMMENDED PROJECTS</b>							
(29,120.0)	(337.8)	92,902.7	695,884.0	702,666.0	2,550,671.0		
						252,566.0	\$,9

#### 1.4 RECOMMENDED PROJECTS

A list of all projects recommended is shown in Table 1.9.

The projects recommended are grouped into five PECIP projects and one locally funded project. These are:

PECIP #1: Boiler Trim Controls

PECIP #2: Boiler Economizer

PECIP #3: New Boiler Installation (E3302, E5126)

PECIP #4: Miscellaneous Boiler Projects  
(Boiler Blowdown, Installation of New Burner)

PECIP #5: Miscellaneous Chiller Projects

Locally funded project: Combustion air from ceiling

Each of the above five PECIP projects has total investment exceeding \$100,000 and a combined payback period of less than four years. The only project not meeting PECIP or ECIP guidelines is: Combustion Air from the Ceiling. This project has SIR value greater than one, but payback of more than four years and total investment below \$100,000. As suggested by the base, this project should be locally funded and no documentation is required.

The total savings resulting from these projects are:

o Total Annual Energy Savings, Electricity	= 1,326,775 KWH or 15,391 MBTU
Fuel Oil	= 133,173 MBTU
● Total Annual Source Energy Savings	= 148,564 MBTU
● Total Investment Required	= \$3,442,090
● Total Annual Energy Cost Savings	= \$1,073,367
● Annual Dollar Savings	= \$1,069,295
● Simple Payback	= 3.2 years
● Annual Base-wide Energy Cost	= \$22,457,600
● Percent Energy Cost Savings	= 4.8%

The five PECIP projects are separately documented and bound. The proposed operational date for these projects is October, 1988.

TABLE 1.9

## PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS			ANNUAL ENERGY COST	ANNUAL SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		KWH	MBTU	MBTU					
<b>PECIP PROJECT # 1 :</b>									
BLR TRIM CONTROLS	E 3312 -#1	-	-	-	3,059	22,910	22,148	19,058	0.9
	345 -#1,2,3	-	-	-	11,373	85,185	82,898	57,176	0.7
	2915 -#2	-	-	-	1,940	14,530	13,767	19,058	1.4
	E 3312 -#2	-	-	-	1,151	8,618	7,855	19,058	2.4
	2502 -#1	-	-	-	1,744	13,066	12,303	19,058	1.5
	E 3312 -#3	-	-	-	777	5,819	5,056	19,058	3.8
	2502 -#2	-	-	-	1,213	9,084	8,322	19,058	2.3
	E 4160 -#1	-	-	-	675	5,055	4,293	19,058	4.4
	E 3302 -#1	-	-	-	442	3,307	2,545	19,058	7.5
	E 2100 -#3	-	-	-	523	3,917	3,155	19,058	6.0
	E 5828 -#2	-	-	-	448	3,352	2,590	19,058	7.4
	E 4160 -#2	-	-	-	440	3,295	2,533	19,058	7.5
<b>TOTAL</b>									
		-	-	-	23,784	178,138	167,465	266,814	1.6

TABLE 1.9 (CONT'D)

## PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		KWH	MBTU					
<b>PECIP PROJECT # 2 :</b>								
BOILER ECONOMIZER	E 3312 -#1	-	-	2,123	15,904	15,562	34,194	2.2
	345 -#1,243	-	-	16,329	122,302	119,574	272,767	2.3
	E 3312 -#3	-	-	1,839	13,775	13,262	51,294	3.9
	E 5828 -#1	-	-	425	3,186	2,999	18,746	6.3
	E 4160 -#2	-	-	594	4,450	4,246	20,375	4.8
	4219 -#4	-	-	292	2,186	2,041	14,470	7.1
	E 3312 -#2	-	-	1,274	9,542	9,029	51,294	5.7
	E 5828 -#2	-	-	425	3,186	2,999	18,746	6.3
	2915 -#1	-	-	751	5,625	5,379	24,626	4.6
	-#2	-	-	725	5,430	5,184	24,626	4.8
	2352 -#1	-	-	246	1,842	1,683	15,903	9.4
	E 4160 -#1	-	-	384	2,879	2,675	20,375	7.6
	5206 -#2	-	-	560	4,193	3,943	24,986	6.3
	2502 -#3	-	-	271	2,032	1,887	14,470	7.7
<b>TOTAL</b>		-	-	26,240	196,532	190,463	606,872	3.2

TABLE 1.9 (CONT'D)  
PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		KWH	MBTU					
<b>PECIP PROJECT # 3 :</b>								
BLR REPLACEMENT	E5126 - # 1-5	-	-	70,343	526,871	545,077	1,820,569	3.3
SMALL BOILER APPL	E 3302	-	-	4,400	33,000	28,878	203,911	7.1
<b>TOTALS</b>				<b>74,743</b>	<b>559,871</b>	<b>573,955</b>	<b>2,024,460</b>	<b>3.5</b>
<b>PECIP PROJECT # 4 :</b>								
BOILER BLOWDOWN	345 -#1,2&3	-	-	1,121	8,396	8,238	15,835	1.9
NEW BURNER	2915 -#1&2 E 3312 -#1	-	-	3,705 2,794	27,754 20,927	28,608 22,193	85,378 126,632	3.0 5.7
<b>TOTALS</b>				<b>7,620</b>	<b>57,077</b>	<b>59,039</b>	<b>227,845</b>	<b>3.9</b>

TABLE 1.9 (cont'd)

PROBLEMS RECEIVED RECOMMENDED CONSIDERING SYMPOSIA

TOTAL

TABLE 1.9 (CONTD)

## PROJECTS RECOMMENDED CONSIDERING SYNERGISM

PROJECT NAME	BUILDING #	ANNUAL ENERGY SAVINGS		ANNUAL ENERGY COST SAVINGS (\$)	ANNUAL DOLLAR SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (YRS)	SIR
		Electricity	Fuel Oil					
		KWH	MBTU					
<b>LOCAL FUNDING :</b>								
COMB AIR FROM CLG E 3302 -#1	-	-	-	184	1,377	1,300	7,766	6.0
E 3312 -#3	-	-	-	221	1,655	1,572	8,269	5.3
E 3312 -#1	-	-	-	203	1,523	1,445	7,767	5.4
E 3312 -#2	-	-	-	178	1,336	1,254	8,269	6.6
<b>TOTALS</b>				<b>787</b>	<b>5,891</b>	<b>5,571</b>	<b>32,071</b>	<b>5.8</b>