

ENERGY ENGINEERING ANALYSIS PROGRAM

FORT RUCKER, ALABAMA

DINING FACILITIES

FINAL REPORT

JUNE 1986

EXECUTIVE SUMMARY

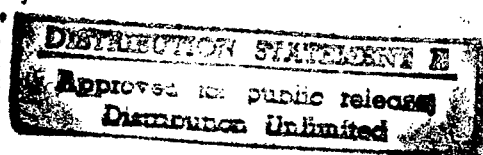
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1. INTRODUCTION

This report presents the results of an energy audit performed under the Energy Engineering Analysis Program (EEAP) for three permanent Dining Facilities at Fort Rucker, Alabama, specifically buildings 4501, 4508 and 5914. Temporary buildings 3914 and 3915 were originally included in this energy audit. In accordance with ECIP guidance, documentation was requested from the base showing a minimum 10 year continuing need for these buildings. No documentation was provided. In addition, the function of these two buildings has changed from that of dining facilities to classroom facilities. In view of this, buildings 3914 and 3915 are not included in the report.

The study included on-site investigation, engineering analysis and produced recommendations for project implementation. All of the Energy Conservation Opportunities listed in the ECO checklist (Figure ES-1, page ES-8) were considered in accordance with the scope of work. Other Energy Conservation Opportunities were added to the original ECO checklist as they were discovered.

This report is organized into three separate volumes and an executive summary.

Volume I includes the following five sections.

Section 1 describes the general features of the energy study, the scope of work and the methods of approach used to accomplish the work.

Section 2 provides a general description of the present conditions of the facilities considered in this EEAP study. In addition, site maps, building floor plans, photographs and other pertinent information is included.

Section 3 summarizes prior energy studies for energy conservation opportunities investigated, recommended and documented.

Section 4 describes methods of analysis used to evaluate the energy conservation opportunities.

Section 5 contains the recommendations and conclusions of the energy audit investigation.

Appendix A provides a copy of the the energy audit scope of work.

Volume II includes a description of projects considered and corresponding calculations. This volume is organized first, by the specific dining facility, then by the discipline involved and finally by the ECO project number.

Volume III, Appendix B, includes the required project documentation.

2. DESCRIPTION OF FACILITIES

ARCHITECTURAL

The three dining facilities are of brick veneer/concrete block wall construction with concrete floor slabs and built-up roofs on steel trusses. Ceilings are suspended. Windows in the dining areas constitute a significant portion of the total wall area. The windows are metal frame awning type with clear single glazing. Each window has a porcelainized panel at the top. A crawl space is provided below the kitchen service areas only. Typical building construction data is provided in Table ES-1 (page ES-5).

MECHANICAL

The kitchen, food preparation and staff support areas are heated and ventilated only. The dining, food service and cloak room areas are heated and cooled by a mechanical system separate from the kitchen heat and vent units. Chilled water is supplied by large air cooled chillers. Steam is used both for space heating and domestic hot water generation. Air curtains are utilized at the vestibule entrances and at the kitchen exterior doors.

Each building is connected to the basewide EMCS system. At the time of the survey many of the EMCS points were in alarm status or deleted.

ELECTRICAL

Lighting, in general, is a combination of fluorescent and incandescent. Incandescent lighting is used in the dining, entry foyer and food service areas and fluorescent lighting in the kitchen and food prep areas. Fluorescent fixtures have standard core type ballasts.

UTILITY SERVICES

Each building is equipped with water, steam, electricity and gas from the Fort Rucker basewide distribution systems.

TABLE ES-1

TYPICAL BUILDING CONSTRUCTION DATA

BUILDINGS 4501, 4508 AND 5914

<u>COMPONENT</u>	<u>LOCATION</u>	<u>CONSTRUCTION FEATURES</u>
FLOOR	FOYER	5" CONCRETE SLAB ON GRADE, W.P. MEMBRANE, V.A. TILE, NO INSULATION.
	DINING	5" CONCRETE SLAB ON GRADE, W.P. MEMBRANE, V.A. TILE, NO INSULATION.
	FOOD PREP & SERVING	6" STRUCTURAL CONCRETE SLAB ON PIERS, 3 FT CRAWL SPACE, NO INSULATION, TILE FLOOR.
MEZZANINE	KITCHEN	7" STRUCTURAL CONCRETE SLAB ON COLUMNS, NO INSULATION.
CEILING	FOYER	SUSPENDED ACOUSTICAL CEILING, NO INSULATION.
	DINING	SUSPENDED ACOUSTICAL CEILING, INSULATION.
	KITCHEN	CEMENT PLASTER ON METAL LATH ATTACHED TO STEEL FRAME, INSULATED.
ROOF	FOYER	BUILT-UP, METAL DECK, STEEL BAR JOISTS, RIGID INSULATION.
	DINING	BUILT-UP, METAL DECK, STEEL TRUSS FRAME, RIGID INSULATION.
	KITCHEN	BUILT-UP, METAL DECK, STEEL TRUSS FRAME, RIGID INSULATION.
WALLS	FOYER	BRICK ON CONCRETE BLOCK, CAST STONE TREATMENT, NO INSULATION.
	DINING	BRICK ON CONCRETE BLOCK, NO INSULATION
	KITCHEN	BRICK ON CONCRETE BLOCK, NO INSULATION
WINDOWS	FOYER	FIXED SINGLE CLEAR GLASS WITH PORCELAIN OR CAST STONE PANELS.
	DINING	SINGLE CLEAR GLASS WITH PORCELAIN OR CAST STONE PANELS.
	KITCHEN	SINGLE CLEAR GLASS.
DOORS	EXTERIOR	METAL HOLLOW CORE, 50% GLASS, PLATE OR WIRE REINFORCED.

3. PROJECT APPROACH

The field survey was accomplished by a multi-discipline team from the Engineering Division at the Mobile District. Milestones for the dining facilities energy audit were established and a project schedule was developed. They are as follows:

Mobilization and Development Planning.

Initial Site and Fieldwork at Base Facilities.

Interim Report and Energy Projects Identification.

Follow-up Fieldwork at Base Facilities.

Pre-final Report and Recommended Projects Documentation.

Final Report and Projects Documentation.

Selections for the study team were based on the ECO task distribution given on the checklist provided with the scope of work. The field study team consisted of three journeyman level and two senior level engineers and a team leader. Each team member was provided with available information on assigned tasks prior to the actual site visits. Recommended ECO's provided on the checklist were grouped by discipline for investigation and project development. For discipline grouping refer to the ECO checklist shown in Figure ES-1 (page ES-8).

Upon arrival at the site, a meeting was held with the DEH and his utility/energy staff to discuss specific requirements for gathering field data, to coordinate activities and to introduce the study team

to the staff. Areas of potential energy savings opportunities were discussed in order to plan strategy and procedures. Each ECO was investigated by team members in accordance with the checklist provided. Data was collected by direct investigation and measurement. Photographs were also made of each to use on the development of projects. Available construction drawings were obtained for in depth evaluation and analysis of applicable ECO's.

FIGURE ES-1
ECO CHECKLIST

DISCIPLINE		BUILDING		
		4501	4508	5914
ARCHITECTURAL	1. Reduce Glass Areas	X	X	X
	2. Vestibules	X	X	X
	3. Solar Films	X	X	X
	4. Insulated Panels	X	X	X
	5. Caulking	X	X	X
	6. Weather Strip	X	X	X
	7. Double Glazing	X	X	X
	8. Storm Windows	X	X	X
	9. Insulation	X	X	X
ELECTRICAL	10. Electric Motors			
	10.1 Reduce Motor Size	X	X	X
	10.2 High Efficiency Motors	X	X	X
	11. Efficient Lighting	X	X	X
	12. Reduce Lighting Levels	X	X	X
	13. Fluorescent Lighting	X	X	X
MECHANICAL	14. Energy Monitoring Control System	X	X	X
	15. Heat Recovery Systems			
	15.1 Existing Walk-In Coolers	X	X	X
	15.2 New & Existing Coolers	X	X	X
	15.3 Chiller & Walk-In Coolers	X	X	X
	15.4 Heat Wheel	X	X	X
	16. Range Hood Shutoff	X	X	X
	17. Kitchen Makeup Air	X	X	X
	18. Positive Kitchen Pressure	X	X	X
	19. Air Curtains	X	X	X
	20. Variable Air Volumes			
	20.1 Variable Spd Fan Controllers	X	X	X
	20.2 Discharge Dampers	X	X	X
	21. Balance HVAC System	X	X	X
	22. Dining Room Operations	X	X	X
	23. HVAC Operations	X	X	X
	24. Upgrade HVAC System Controls			
	24.1 Fix Control Deficiencies	X	X	X
	24.2 Rewire Chilled Water Pump	X	X	X
	25. Lower Domestic H.W. Temperature	X	X	X
26. Hot Water Boosters	X	X	X	
27. Water Heater Control	X	X	X	
28. Water Heater Insulation	X	X	X	
29. Water Heater Shutoff	X	X	X	
30. Dishwasher Heat Recovery	X	X	X	
31. Pipe Insulation	X	X	X	
32. Kitchen Exhaust Heat Recovery	X	X	X	
33. Economizer Cycles				
33.1 Using Existing Vent Air	X	X	X	
33.2 Using Reduced Vent Air	X	X	X	
34. Infrared Heaters	X	X	X	
35. Night Setback Control	X	X	X	
36. High Efficiency Exhaust Hoods	X	X	X	
37. Solar Applications	X	X	X	
38. Reduce Outside Air Quantity	X	X	X	

4. PRESENT ENERGY CONSUMPTION

Actual energy consumption for the dining facilities has been unmetered and/or unrecorded in the past. Therefore, energy uses and consumption were developed using a computer model generated by BLAST (Building Loads Analysis and System Thermodynamics) version 3.0. The present energy consumption is estimated to be 7379 MBTU/year each for buildings 4501 and 4508 and 7855 MBTU/year for building 5914. This is demonstrated graphically in the pie chart shown in Figure ES-2 (page ES-10). Based on the above energy consumption and the energy unit cost factors (Table ES-2, page ES-11) the annual energy cost is \$30,368 each for buildings 4501 and 4508 and \$32,534 for building 5914.

PRESENT ENERGY CONSUMPTION (MBTU/YEAR)
FIGURE ES-2

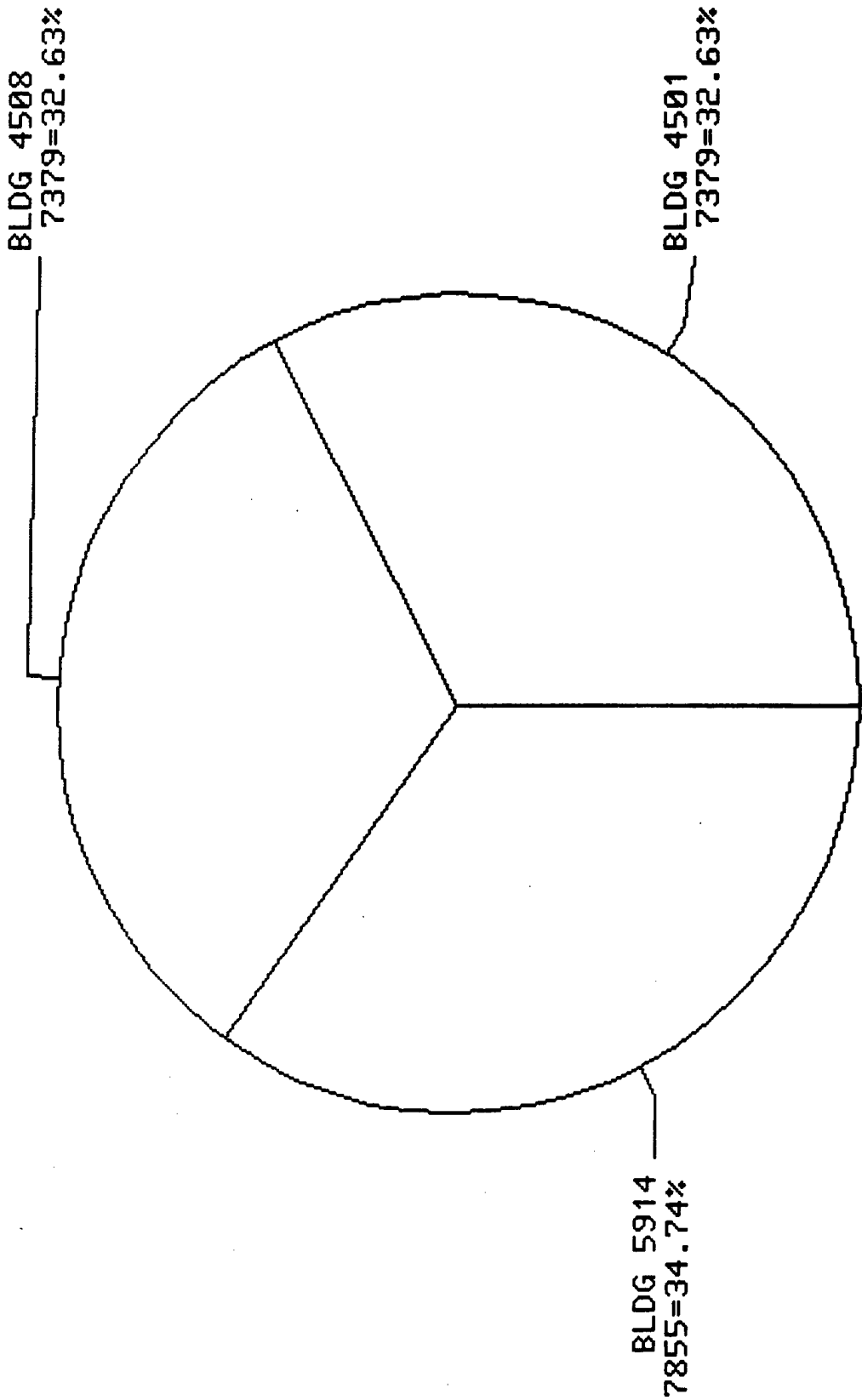


TABLE ES-2

ANNUAL ENERGY CONSUMPTION
FOR DINING FACILITIES

BUILDINGS 4501 AND 4508

<u>ENERGY TYPE</u>	<u>MBTU **</u>	<u>DOLLARS</u>
ELECTRICITY	4,333	\$16,509
GAS	3,046	\$13,859
TOTALS	7,379 *	\$30,368 *

BUILDING 5914

<u>ENERGY TYPE</u>	<u>MBTU **</u>	<u>DOLLARS</u>
ELECTRICITY	4,333	\$16,509
GAS	3,522	\$16,025
TOTALS	7,855	\$32,534

DERIVATION OF ENERGY UNIT COST FACTORS

1. UNIT COST BY ITEM: ***

PURCHASED ELECTRICAL POWER	- \$0.0442/KWH
NO 2 FUEL OIL (DISTILLATE)	- \$0.95/GAL
NO 5 FUEL OIL (RESIDUAL)	- \$0.80/GAL
NATURAL GAS	- \$4.69/MCF

2. UNIT COST PER MBTU:

PURCHASED ELECTRICAL POWER-	$(\$0.0442) (1 \times 10^6) / 11,600 = \$3.81/\text{MBTU}$
NO 2 FUEL OIL (DISTILLATE)-	$(\$0.95) (1 \times 10^6) / 138,700 = \$6.84/\text{MBTU}$
NO 5 FUEL OIL (RESIDUAL)	$- (\$0.85) (1 \times 10^6) / 148,000 = \$5.74/\text{MBTU}$
NATURAL GAS	$- (\$4.69) (1 \times 10^6) / 1,031,000 = \$4.55/\text{MBTU}$

NOTE: * Per building.
 ** Energy consumption figures are based on BLAST 3.0 simulations.
 *** Energy costs listed are actual figures extracted from base records.

5. CONCLUSIONS AND RECOMMENDATIONS

Table ES-4 (page ES-18) lists all projects considered. Annual energy savings, annual dollar savings, simple payback in years, SIR and total contract costs are all listed in this table. A brief explanation is given for those projects rejected without engineering evaluation. The projects are ranked according to SIR, from highest to lowest.

Table ES-3 (page ES-15) is a condensed ECO summary that lists only those projects used to compile the information which determined the total energy savings. Total dollar savings per year and total contract costs are listed as well. The combined energy savings for all three buildings are 5,690 MBTU/year. The combined dollar savings are \$26,123 per year. The total annual energy consumption was reduced from 22,613 MBTU to 16,923 MBTU (a 25 percent reduction). This is demonstrated graphically in the pie chart representation of energy savings (Figure ES-3, page ES-14).

Some overlap occurred in savings with regard to projects 20.1, 20.2, 33.2, and 38. Each of these projects incorporated the use of "reduced ventilation air" to achieve energy savings. To rectify this situation, project 38, "Reduce Outside Air Quantity", was chosen to represent the savings associated with reducing ventilation air quantities. Although projects 20.1, 20.2 and 33.2 were not

included in the total energy savings they remain recommended as individual energy conservation opprotunities.

Volume III includes all project documentation required in the Scope of Work. There were three Quick Return on Investment Program (QRIP) projects and 33 Low Cost/No Cost Projects recommended for implementation.

ENERGY USAGE INCORPORATING ECOS
FIGURE ES-3

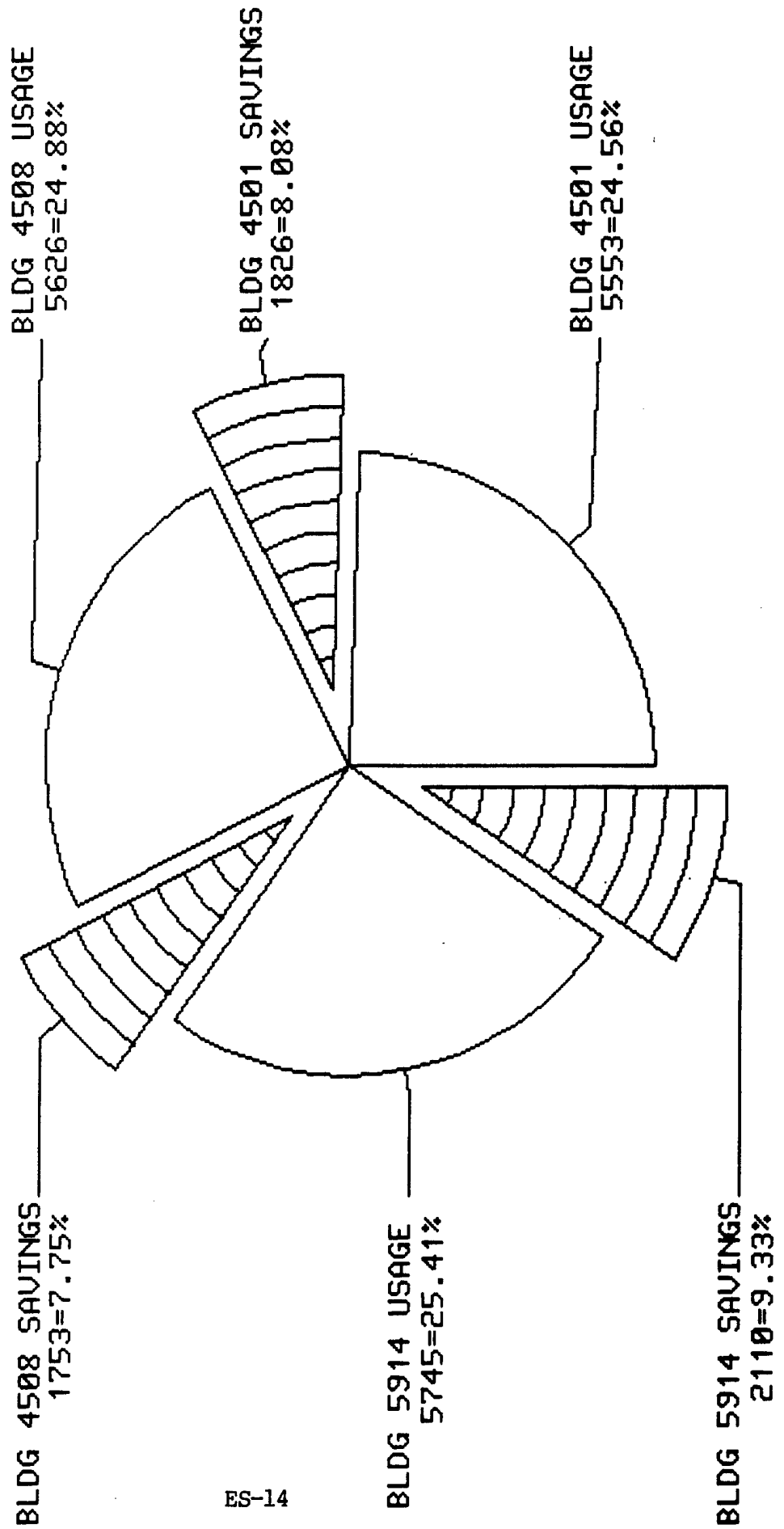


TABLE ES-3
TOTAL SAVINGS
BUILDING 4501

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	171	
24.2	UPGRADE HVAC-REWIRE OW PUMP	295.000	\$1,124	0.60	19.70	\$680	109	
11.2	EFF. LIGHTING - PL FIXTURES	162.000	\$1,180	1.17	9.82	\$1,378	48A	
31	PIPE INSULATION	11.000	\$50	3.26	7.26	\$163	122	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	33	PULLEY CONNECTED
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	33	DIRECT CONNECTED
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	70	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	141.780	\$654	9.60	1.39	\$6,280	52	
6	WEATHER STRIP	0.710	\$3	13.67	1.04	\$41	17	
		<u>1,826.490</u>	<u>\$8,581</u>			<u>\$29,583</u>		

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE ES-3
TOTAL SAVINGS
BUILDING 4508

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	228	
24.2	UPGRADE HVAC-REWIRE ON PUMP	295.000	\$1,124	0.60	19.70	\$680	207	
11.2	EFF. LIGHTING - PL FIXTURES	152.000	\$999	1.16	9.85	\$1,161	189A	
31	PIPE INSULATION	6.000	\$25	4.52	5.20	\$113	214	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	187	FULLEY CONNECTED
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	187	DIRECT CONNECTED
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	195	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	83.000	\$396	15.86	1.39	\$6,280	193	
6	WEATHER STRIP	1.420	\$6	13.67	1.13	\$82	179	
		<u>1753.420</u>	<u>\$8,120</u>			<u>\$29,357</u>		

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE
TOTAL SAVINGS
BUILDING 5914

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	302	
24.2	UPGRADE HVAC-REWIRE CW PUMP	295.000	\$1,124	0.60	19.70	\$680	276	
27	WATER HEATER CONTROL	476.000	\$2,166	0.83	18.08	\$1,800	279	
31	PIPE INSULATION	5.000	\$21	3.33	7.28	\$70	288	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	252	PULLEY CONNECTED
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	252	DIRECT CONNECTED
3	SOLAR FILMS	35.280	\$145.00	7.73	1.76	\$1,121	231	630 SF GLASS, NORTHEAST SIDE
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	262	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	83.000	\$396	15.86	1.39	\$6,280	260	
		<u>2110.280</u>	<u>\$9,422</u>			<u>\$30,992</u>		
	STUDY TOTAL	5690.190	\$26,123			\$89,932		

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE B
 ECO SUMMARY
 BUILDING 4501

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	171	
24.2	UPGRADE HVAC-REWIRE ON PUMP	295.000	\$1,124	0.60	19.70	\$680	109	
11.2	EFF. LIGHTING - FL FIXTURES	162.000	\$1,180	1.17	9.82	\$1,378	48A	
31	PIPE INSULATION	11.000	\$50	3.26	7.26	\$163	122	
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	73.000	\$278	2.14	5.28	\$596	33	PULLEY CONNECTED
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	49.000	\$185	3.22	3.52	\$596	33	DIRECT CONNECTED
20.1	VARIABLE SPEED FAN-VAV	226.000	\$962	5.94	3.43	\$5,716	96	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	33	FULLEY CONNECTED
20.2	DISCHARGE DAMPER-VAV	100.000	\$487	10.75	2.55	\$5,234	102	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	33	DIRECT CONNECTED
33.2	ECONO CYCLE-REDUCED VENT AIR	271.000	\$1,149	7.86	2.25	\$9,035	143	
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	70	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	141.780	\$654	9.60	1.39	\$6,280	52	
6	WEATHER STRIP	0.710	\$3	13.67	1.04	\$41	17	
33.1	ECONO CYCLE-EXISTG VENT AIR	196.000	\$750	12.05	0.87	\$9,035	138	
37	SOLAR APPLICATIONS	181.700	\$695	22.99	0.87	\$15,980	166	
3	SOLAR FILMS	0.048	\$0.18	9.78	0.79	\$2	6	PER SQ FT GLASS AREA
36	HIGH EFFICIENCY EXHAUST HOODS	739.000	\$3,364	18.65	0.78	\$62,755	151	
32	KITCHEN EXHST HEAT RECOVERY	112.000	\$732	32.77	0.77	\$23,986	128	

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE ES-4
EEO SUMMARY
BUILDING 4501

PROJECT NUMBER	PROJECT	ENERGY SAVINGS MBTU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
15.2	HEAT RECOVERY-NEW & EXISTING COOLERS	260.000	\$1,110	26.43	0.68	\$29,334	61	
15.4	HEAT RECOVERY-HEAT WHEEL	297.000	\$1,302	20.11	0.47	\$26,189	81	
9	INSULATION	11.000	\$52	61.42	0.42	\$3,194	28	
1	REDUCE GLASS AREAS	29.000	\$118	73.54	0.21	\$8,678	2	
7	DOUBLE GLAZING	0.032	\$0.14	99.93	0.19	\$14	21	PER SQUARE FOOT
4	INSULATED PANELS	21.000	\$84	97.45	0.15	\$8,186	12	
29	WATER HEATER SHUTOFF	0.310	\$1	294.00	0.07	\$294	116	
17	KITCHEN MAKEUP AIR	(434)	(\$2,180)	-0.21	-137.47	\$467	90	
2	VESTIBULES						5	ALREADY IN USE
5	CAULKING						16	NONE REQUIRED AT THIS TIME
10.1	REDUCE MOTOR SIZE						32	MOTORS ARE 80-100% LOADED
11	EFFICIENT LIGHTING						47	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
12	REDUCE LIGHTING LEVELS						49	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
13	FLUORESCENT LIGHTING						50	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
14	EMCS						51	ENERGY MONITORING SYSTEM ALREADY IN USE
16	RANGE HOOD SHUTOFF						89	CURRENT MANUAL OPERATION IS SATISFACTORY
18	POSITIVE KITCHEN PRESSURE						93	NEGATIVE PRESSURE IS DESIRED
19	AIR CURTAINS						95	ALREADY IN USE
21	BALANCE HVAC SYSTEM						105	NOT REQUIRED
22	DINING ROOM OPERATIONS						106	ALREADY AT MINIMUM REQUIRED FOR FUNCTION
23	HVAC OPERATIONS						107	ALREADY AT MINIMUM REQUIRED FOR FUNCTION

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE
 ECO SUMMARY
 BUILDING 4501

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAVBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
24.1	FIX CONTROL DEFICIENCIES						108	WOULD CAUSE AN INCREASE IN ENERGY USE
25	LOWER DOMESTIC HW TEMPERATURE						112	HW TEMPERATURE IS 140 F
26	HW BOOSTERS						113	BOOSTERS ALREADY IN USE
27	WATER HEATER CONTROL						114	WOULD CAUSE AN INCREASE IN ENERGY USE
28	WATER HEATER INSULATION						115	INSULATION IS SATISFACTORY
30	DISHWASHER HEAT RECOVERY						121	NOT PRACTICABLE
34	INFRARED HEATERS						147	CEILING HEIGHT TOO LOW
35	NIGHT SETBACK CONTROL						150	ALREADY IN USE

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE ES-21
 ECO SUMMARY
 BUILDING 4508

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	228	
24.2	UPGRADE HVAC-REWIRE ON PUMP	295.000	\$1,124	0.60	19.70	\$680	207	
11.2	EFF. LIGHTING - PL FIXTURES	152.000	\$999	1.16	9.85	\$1,161	189A	
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	73.000	\$278	2.14	5.28	\$596	187	FULLEY CONNECTED
31	PIPE INSULATION	6.000	\$25	4.52	5.20	\$113	214	
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	49.000	\$185	3.22	3.52	\$596	187	DIRECT CONNECTED
20.1	VARIABLE SPEED FAN-VAV	226.000	\$962	5.94	3.43	\$5,716	201	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	187	FULLEY CONNECTED
20.2	DISCHARGE DAMPER-VAV	100.000	\$487	10.75	2.55	\$5,234	202	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	187	DIRECT CONNECTED
33.2	ECONO CYCLE-REDUCED VENT AIR	271.000	\$1,149	7.86	2.25	\$9,035	222	
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	195	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	83.000	\$396	15.86	1.39	\$6,280	193	
6	WEATHER STRIP	1.420	\$6	13.67	1.13	\$82	179	
33.1	ECONO CYCLE-EXISTG VENT AIR	196.000	\$750	12.05	0.87	\$9,035	221	
37	SOLAR APPLICATIONS	181.700	\$695	22.99	0.87	\$15,980	227	
3	SOLAR FILMS	0.048	\$0.18	9.78	0.79	\$2	176	PER SQ FT GLASS AREA
36	HIGH EFFICIENCY EXHAUST HOODS	739.000	\$3,364	18.65	0.78	\$62,755	225	
32	KITCHEN EXHST HEAT RECOVERY	112.000	\$732	32.77	0.77	\$23,986	220	
15.2	HEAT RECOVERY-NEW & EXISTING COOLERS	260.000	\$1,110	26.43	0.68	\$29,334	194	

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE E-4
 ECO SUMMARY
 BUILDING 4508

PROJECT NUMBER	PROJECT	ENERGY SAVINGS MBTU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
15.4	HEAT RECOVERY-HEAT WHEEL	297.000	\$1,302	20.11	0.47	\$26,189	196	
9	INSULATION	11.000	\$52	61.42	0.42	\$3,194	185	
1	REDUCE GLASS AREAS	29.000	\$118	73.54	0.21	\$8,678	174	
7	DOUBLE GLAZING	0.032	\$0.14	99.93	0.19	\$14	183	PER SQUARE FOOT
4	INSULATED PANELS	21.000	\$84	97.45	0.15	\$8,186	177	
29	WATER HEATER SHUTOFF	0.310	\$1	294.00	0.07	\$294	212	
17	KITCHEN MAKEUP AIR	(434)	(\$2,180)	-0.21	-137.47	\$467	198	
2	VESTIBULES						175	ALREADY IN USE
5	CAULKING						178	NONE REQUIRED AT THIS TIME
10.1	REDUCE MOTOR SIZE						186	MOTORS ARE 80-100% LOADED
11	EFFICIENT LIGHTING						188	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
12	REDUCE LIGHTING LEVELS						190	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
13	FLUORESCENT LIGHTING						191	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
14	EMCS						192	ENERGY MONITORING SYSTEM ALREADY IN USE
16	RANGE HOOD SHUTOFF						197	CURRENT MANUAL OPERATION IS SATISFACTORY
18	POSITIVE KITCHEN PRESSURE						199	NEGATIVE PRESSURE IS DESIRED
19	AIR CURTAINS						200	ALREADY IN USE
21	BALANCE HVAC SYSTEM						203	NOT REQUIRED
22	DINING ROOM OPERATIONS						204	ALREADY AT MINIMUM REQUIRED FOR FUNCTION
23	HVAC OPERATIONS						205	ALREADY AT MINIMUM REQUIRED FOR FUNCTION
24.1	FIX CONTROL DEFICIENCIES						206	WOULD CAUSE AN INCREASE IN ENERGY USE
25	LOWER DOMESTIC HW TEMPERATURE						208	HW TEMPERATURE IS 140 F

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE
 ECO SUMMARY
 BUILDING 4508

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
26	HW BOOSTERS						209	BOOSTERS ALREADY IN USE
27	WATER HEATER CONTROL						210	WOULD CAUSE AN INCREASE IN ENERGY USE
28	WATER HEATER INSULATION						211	INSULATION IS SATISFACTORY
30	DISHWASHER HEAT RECOVERY						213	NOT PRACTICABLE
34	INFRARED HEATERS						223	CEILING HEIGHT TOO LOW
35	NIGHT SETBACK CONTROL						224	ALREADY IN USE

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE ES-4
EEO SUMMARY
BUILDING 5914

PROJECT NUMBER	PROJECT	ENERGY SAVINGS MBTU/YEAR	DOLLAR SAVINGS PER YEAR	PAVBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
38	REDUCE O.A. QUANTITY	786.000	\$3,644	0.27	89.00	\$978	302	
24.2	UPGRADE HVAC-REWIRE ON PUMP	295.000	\$1,124	0.60	19.70	\$680	276	
27	WATER HEATER CONTROL	476.000	\$2,166	0.83	18.08	\$1,800	279	
31	PIPE INSULATION	5.000	\$21	3.33	7.28	\$70	288	
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	73.000	\$278	2.14	5.28	\$596	252	PULLEY CONNECTED
10.2	HIGH EFFICIENCY MOTORS 40 HP REPLACE ON FAILURE	49.000	\$185	3.22	3.52	\$596	252	DIRECT CONNECTED
20.1	VARIABLE SPEED FAN-VAV	226.000	\$962	5.94	3.43	\$5,716	270	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	48.000	\$184	3.30	3.39	\$608	252	PULLEY CONNECTED
20.2	DISCHARGE DAMPER-VAV	100.000	\$487	10.75	2.55	\$5,234	271	
10.2	HIGH EFFICIENCY MOTORS 5 HP REPLACE ON FAILURE	8.000	\$30	5.07	2.26	\$152	252	DIRECT CONNECTED
33.2	ECONO CYCLE-REDUCED VENT AIR	271.000	\$1,149	7.86	2.25	\$9,035	296	
3	SOLAR FILMS	35.280	\$145.00	7.73	1.76	\$1,121	231	630 SF GLASS, NORTHEAST SIDE
15.3	HEAT RECOVERY-CHILLER AND EXISTING WALK-IN COOLERS	374.000	\$1,712	11.28	1.56	\$19,303	262	
15.1	HEAT RECOVERY-EXISTING WALK-IN COOLERS	83.000	\$396	15.86	1.39	\$6,280	260	
33.1	ECONO CYCLE-EXISTING VENT AIR	196.000	\$750	12.05	0.87	\$9,035	295	
37	SOLAR APPLICATIONS	181.700	\$695	22.99	0.87	\$15,980	301	
36	HIGH EFFICIENCY EXHAUST HOODS	739.000	\$3,364	18.65	0.78	\$62,755	299	
32	KITCHEN EXHST HEAT RECOVERY	112.000	\$732	32.77	0.77	\$23,986	294	
15.2	HEAT RECOVERY-NEW & EXISTING COOLERS	260.000	\$1,110	26.43	0.68	\$29,334	261	

TABLE ES-4
EEO SUMMARY
BUILDING 5914

PROJECT NUMBER	PROJECT	ENERGY SAVINGS MBTU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
15.4	HEAT RECOVERY-HEAT WHEEL	297,000	\$1,302	20.11	0.47	\$26,189	263	
9	INSULATION	11,000	\$52	61.42	0.42	\$3,194	250	
7	DOUBLE GLAZING	0.032	\$0.14	99.93	0.19	\$14	243	PER SQUARE FOOT
1	REDUCE GLASS AREAS	29,000	\$118	73.54	0.21	\$8,678	229	
4	INSULATED PANELS	21,000	\$84	97.45	0.15	\$8,186	237	
29	WATER HEATER SHUTOFF	0.310	\$1	294.00	0.07	\$294	286	
17	KITCHEN MAKEUP AIR	(434)	(\$2,180)	-0.21	-137.47	\$467	265	
2	VESTIBULES						230	ALREADY IN USE
5	CAULKING						241	NONE REQUIRED AT THIS TIME
6	WEATHER STRIP						242	WEATHER STRIPPING IS SATISFACTORY
10.1	REDUCE MOTOR SIZE						251	MOTORS ARE 80-100% LOADED
11	EFFICIENT LIGHTING						253	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
12	REDUCE LIGHTING LEVELS						254	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
13	FLUORESCENT LIGHTING						258	EXISTING LIGHTING LEVELS ARE BELOW RECOMMENDED LEVELS
14	EMCS						259	ENERGY MONITORING SYSTEM ALREADY IN USE
16	RANGE HOOD SHUTOFF						264	CURRENT MANUAL OPERATION IS SATISFACTORY
18	POSITIVE KITCHEN PRESSURE						268	NEGATIVE PRESSURE IS DESIRED
19	AIR CURTAINS						269	ALREADY IN USE
21	BALANCE HVAC SYSTEM						272	NOT REQUIRED
22	DINING ROOM OPERATIONS						273	ALREADY AT MINIMUM REQUIRED FOR FUNCTION
23	HVAC OPERATIONS						274	ALREADY AT MINIMUM REQUIRED FOR FUNCTION

NOTE: Reference page indicated is in Volume II - Calculations.

TABLE ES-4
 ECO SUMMARY
 BUILDING 5914

PROJECT NUMBER	PROJECT	ENERGY SAVINGS METU/YEAR	DOLLAR SAVINGS PER YEAR	PAYBACK YEARS	SIR	CONTRACT COST	REFERENCE PAGE	REMARKS
24.1	FIX CONTROL DEFICIENCIES						275	WOULD CAUSE AN INCREASE IN ENERGY USE
25	LOWER DOMESTIC HW TEMPERATURE						277	HW TEMPERATURE IS 140 F
26	HW BOOSTERS						278	BOOSTERS ALREADY IN USE
28	WATER HEATER INSULATION						285	INSULATION IS SATISFACTORY
30	DISHWASHER HEAT RECOVERY						287	NOT PRACTICABLE
34	INFRARED HEATERS						297	CEILING HEIGHT TOO LOW
35	NIGHT SETBACK CONTROL						298	ALREADY IN USE

NOTE: Reference page indicated is in Volume II - Calculations.