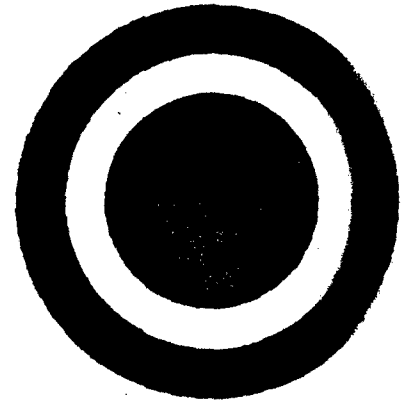


PREFINAL REPORT-AUGUST 1986
VOLUME 1-Executive Summary



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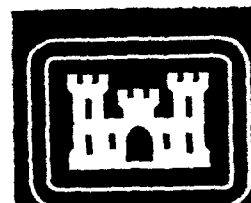
FORT LEWIS
ENERGY SAVINGS
OPPORTUNITY SURVEY

19971021 303

ENERGY ENGINEERING
ANALYSIS PROGRAM
(EEAP)
AT
FT. LEWIS, WASHINGTON
(A FORSCOM INSTALLATION)

DACA67-84-C-0064

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US Army Corps
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DEPARTMENT OF THE ARMY
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FORT LEWIS ESOS
PREFINAL REPORT
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1.0 EXECUTIVE SUMMARY

1.1 PURPOSE OF THE STUDY:

The purpose of this study has been to examine potential new energy conservation opportunities (ECO), as well as re-evaluate certain ECO previously studied on a comprehensive basis. Selected special studies have also been undertaken. The end product of this project will result in four (4) applications to the Federal "Energy Conservation Investment Program" (ECIP) for funding of energy improvements. Further, it is assumed that other energy conservation applications, on an annual basis, will be forthcoming in the future to further implement the Fort Lewis Energy Program.

1.2 HISTORY/CONTEXT:

A Base Wide Energy Plan was commenced by the John Graham Co. in 1978 at Fort Lewis, Yakima Firing Center, Vancouver Barracks and Camp Bonneville, reaching substantial completion in 1981. Several special studies, such as a Basewide Energy Monitoring and Control System study (EMCS) were submitted, as late as, 1983. The Base Wide Energy Plan is broad and comprehensive, looking at larger energy issues with several, more detailed concerns addressed. The Plan was the basis for approximately eight ECIP projects, of which half have been submitted for funding consideration by Fort Lewis.

1.3 RELATIONSHIP TO OTHER PLANS/PROJECTS:

The Fort Lewis Base Wide Energy Plan was considered as the basic overall document, from which specific, more detailed studies and implementation projects could be evolved. The plan to date, has been the basis for the Corps of Engineers, Project PN470 and a project by Associated Engineers. Both projects entailed 3 to 6 specific energy improvements, such as insulation, weather stripping, boiler controls, thermostats, and high bay fans for redistribution of warm air. Second, DEH, in its program of facilities upgrading, has instituted compliance to Washington State Energy Code Requirements. In the course of the Limited Building Survey most of this activity has appeared to be centered at the North Fort Lewis Enclave. Other cases of weatherstripping of entry doors have been observed over the larger Fort Lewis Area.

1.4 PRIMARY STUDY
ELEMENTS:

This Energy Savings Opportunity Survey (ESOS) comprehensively inventories, analyzes, evaluates, and makes recommendations from a list of 43 energy conservation opportunities (ECO) on a representative group of 91 buildings that represent a larger building population (1,400 buildings) at Fort Lewis. Family housing has been excluded from the study, having been covered under previous studies. In addition, four special areas of interest are being studied. The main blocks of this study are comprised of:

1. A limited building survey of 91 representative buildings, and extending the limited building survey results to approximately 1400 other buildings on the Post.
2. Re-evaluate two previously prepared, but unsubmitted ECIP projects.
3. Evaluate consolidation of Central Distribution Plants #9 and #10 to improve plant efficiency.
4. Re-evaluation of an Energy Monitoring & Control System (EMCS) for North Fort and the Logistics Center.
5. Evaluate the feasibility of limited hydropower at the Central Sewage Treatment Plant System site.
6. Preparation of 4 Project Development Brochures (PDB) for specific energy improvements for consideration of funding by ECIP.

1.5 STUDY AREAS/
LOCATION:

The study area for the Fort Lewis ESOS Study includes the Logistics Center, Main Fort, and North Fort areas, exclusive of family housing. The total study area comprises approximately 4600 acres, of which Main Fort is 2600 acres; Logistics Center, 700 acres; and North Fort, 1300 acres. There are 4,930 buildings and various types of structures on the Fort. Of this total, approximately 2090 buildings are used for family housing, 1400 buildings of various uses with full active occupancy, and about 1440 structures of various types that are not heated or heated so infrequently as not to be a factor for energy consumption. Excluded also are buildings with more or less full use as mess halls. DEH has begun a special energy analysis in the future on this building type, which are primarily located in North Fort.

For purposes of conducting the limited building survey and analysis/evaluation, the Fort was divided into three zones. These zones are characterized by distinct boundaries, such as Interstate 5, or separated by large areas of open space. In addition, the three zones have markedly different construction or use. See the Limited Building Survey Map on page 4 for the locations.

ZONE I is located at Main Fort, being characterized by large buildings constructed of brick, concrete, and steel. Type I permanent construction is common with a significant number having been constructed in the 1930's and 1940's. Buildings surrounding Gray Army Air Field appear to have been constructed between 1950 and 1970. Roughly 20% of the buildings in this zone are wood construction with some being listed as Temporary (T).

ZONE II is located at the Logistics Center, east of Main Fort. The dominant building type in the area are large warehouse structures between 100,000 and 250,000 square feet, with representations of concrete and heavy timber construction. Support buildings, a minority type, are dominantly W W II wood construction with several concrete buildings such as the ADP Building.

ZONE III is located at North Fort in the main troop enclave and is comprised mostly of W W II light wood frame buildings of small size. With the exception of some improved buildings, the structures have few energy improvements.

1.6 SUMMARY OF SIGNIFICANT FINDINGS:

1.61 LIMITED BUILDING SURVEY, ECIP PROJECTS SELECTED:

Using the detailed chart of applicable ECOs (section 2.4) DEH selected the following four ECIP Packages (Appendices A, B, C, and D contain the complete Project Development Brochures):

<u>ECIP</u>							
<u>PN</u>	<u>FY90 COST (THOUSANDS)</u>	<u>SQ.FT. (THOUSANDS)</u>	<u>ENERGY SAVINGS (MILLIONS)</u>	<u>DOLLAR SAVINGS (THOUSANDS)</u>	<u>SIMPLE PAYBACK (YEARS)</u>	<u>S.I.R.</u>	<u>ANALYSIS DATE</u>
704	3506	3931.08	131708.77	854.410	3.1	5.7	12/19/85
	(ECO 1A, 16)						
705	3952	4983.46	101112.91	676.720	4.7	3.8	12/19/85
	(ECO 1B)						
706	4480	6498.54	173046.54	1060.070	3.2	5.7	12/19/85
	(ECO 1C)						
707	2748	13511.68	80670.49	563.304	3.7	4.6	12/19/86
	(ECO 3, 4, 42)						

1.62 RE-EVALUATION OF EXISTING PROJECTS (GRAHAM):

There was insufficient data available to evaluate ECIP Projects T-566 and T-567. In addition, should these projects be funded, there would be insufficient information to develop bidding documents or for a contractor to implement the project. It is recommended that new ECIP Projects for similar improvements be developed with new, complete information. Refer to the Interim Submittal for complete discussion of this element.

1.63 CONSOLIDATION OF CENTRAL DISTRIBUTION PLANTS 9/10 TO IMPROVE PLANT EFFICIENCY:

This analysis indicates that intertieing Heating Plants #9 and #10 would result in a simple payback, using fuel savings only, or greater than 120 years. If maintenance and operation savings are counted, then the simple payback may be reduced to between 10 and 20 years. Planned construction of a small solid waste incinerator and waste heat boiler adjacent to Plant #9 would adversely impact this intertie if it contributes heat to the Plant #9 distribution system during low load periods. We recommend not proceeding with this intertie for ECIP funding. Refer to the Interim Submittal for complete discussion of this element.

not done in ETAP Program

1.64 RE-EVALUATION OF THE FEASIBILITY OF EMCS APPLICATIONS

North Fort Lewis: The application of an EMCS to control buildings which are unoccupied for long periods of time appears to be an attractive option with simple payback in the one year range. A modified load control area network EMCS was estimated as the most cost effective system. The system is based on 22 centrally located load control panels (LCP). Each LCP will control approximately 18 buildings via communication cable on telephone poles (requested as comment to Interim Submittal and included as Appendix I) connected to low voltage override thermostats in the buildings. A central micro computer would communicate with (call-up) the LCPs and initiate reset schedules via non-dedicated telephone lines.

Logistics Center: Due to the presence of digital setback thermostats and regular occupancy of these buildings, there does not appear to be an application for a central EMCS system in this area.

1.65 LIMITED HYDROPOWER FEASIBILITY EVALUATION:

The construction of a small hydroelectric facility on the sewage treatment plant outfall appeared to be a feasible option from Energy Savings only. The simple payback for this is about 14 years. This project became unfeasible due to legal and regulatory uncertainties. Refer to Interim Submittal for complete discussion.

1.66 BOILER SURVEY RESULTS:

The boiler plants surveyed revealed the following energy conservation opportunities:

Insulation of pipes, valves, boiler surfaces, tanks, and condensate receivers.

Burner replacement with more efficient oil-gas combination burners.

Regular preventive maintenance by boiler controls professionals.

Rebuilding and refurbishing oxygen trim controls as required.

Under Contract MOD 2 (Appendix I), additional "in-depth" studies of the boiler oxygen trim controls and boiler reset (on outdoor air temperatures) were performed. The small boilers show very poor paybacks due to the high cost of commercially available oxygen monitors. The outdoor reset control looks more promising for small hot water boilers, depending on the existing boiler control system and temperature setpoint.

1.7 SUMMARY OF CONTRACT MODIFICATIONS:

The following modifications were made to the base contract:

- MOD 1 - Schedule revision.
- MOD 2 - In-depth building studies - See Appendix I for results.
- MOD 3 - Schedule revision.
- MOD 4 - Computer generated chart - See Appendix I for results.

2.0 LIMITED BUILDING SURVEY:

- 2.1 SURVEY PROCESS: BC&S personnel conducted the Limited Building Survey on 91 buildings during October, November, and December, 1984 at Fort Lewis. The survey was conducted on a zone by zone basis, so the team members could gain solid familiarity with the survey zone, as well as the individual buildings. Each zone was further broken down into survey units, which was defined as the number of buildings that a 1-2 person team could survey in one day. Each 2 person team contained a senior professional; however, in the instance of complex buildings, two senior professionals were employed. Of the 91 buildings surveyed, 8 buildings were specially designated for investigation of boilers only. A senior engineer with special experience in boilers performed this work, in addition to the evaluation of Central Distribution Plants #9 and #10. A comprehensive list of 43 Energy Conservation Opportunities (ECO) developed by the Corps of Engineers (CE) formed the basis of the investigations. In some instances, all 43 ECO were investigated, while in other instances, fewer were studied at Seattle District Corps of Engineers' direction due to special characteristics of the buildings.
- 2.2 EXISTING CONDITIONS SUMMARY: Fort Lewis should be considered more or less fully developed, unless a dramatic change were to occur in its mission. The general average age of the structures is in the area of 30 years old. The fort, as a whole, is well maintained, considering the age of the buildings.
- 2.3 MAINTENANCE ITEMS SUBMITTED TO FORT LEWIS: Per agreement with DEH, Fort Lewis at the exit interview, BC&S forwarded a list of maintenance items for DEH action, which were contained in the ~~Interim Report Appendix~~, Section G. Most items contained in this list are minor in nature, with the exception of a defective rotating screen filter for the waste water heat recovery system at the Post Laundry. This item caused a significant energy use, which has since been repaired. There are some areas at Fort Lewis where maintenance and operations (M & O) is not clear and responsibilities appear to overlap. Single point responsibility for all M & O activity at the Fort would be desirable and should be considered. An active preventive maintenance program would result in considerable energy and mechanical and operations cost savings.
- 2.4 CHARTS OF APPLICABLE ECO: The ECO determined to be applicable were subjected to engineering analysis and Life Cycle Cost Studies performed per TM5-800-3, AR415-15, and associated ECIP guidance provided by the government. These ECO are listed in the following table by Savings-to-Investment Ratio (SIR):

ECO #	DESCRIPTION	# BLDGS.	(THOUSANDS)	
			TOTAL SQUARE FT.	SIR
22	Install low GPM showerheads	360	4462.29	108.5
17	Night setback/set up thermostats	428	4771.96	67.3
11	Reduce light level	64	456.17	39.4
46	Insulate Domestic Hot Water pipes	548	2636.96	29.8
32	Insulate condensate lines	3	41.38	20.7
25	Prevent air stratification	95	1004.37	13.8
48	Insulate supply ducts	388	1086.03	12.7
3 *	Weatherstripping and caulking	1177	6519.86	10.9
1A *	Insulate floors	863	3232.03	9.0
44	Pool covers	3	N/A	8.1
1C *	Insulate roofs	1200	6498.54	5.7
47	Insulate Domestic Hot Water tanks	224	2776.20	4.2
26	Install electronic timing devices	15	436.91	3.8
1B *	Insulate walls	1036	4983.46	3.8
12	Replace incandescent lighting	659	6061.75	3.8
4 *	Insulate panels	22	1579.44	2.8
20	Radiator controls	37	388.87	2.4
16 *	Radiant heat (Natural Gas)	72	699.05	1.6
2	Install storm windows	1014	5390.72	1.4
41	Heat pumps	796	3734.56	1.3
42 *	Instantaneous Hot Water Heaters	871	5412.38	1.2
28	Revise boiler controls	81	1173.13	1.01
19	Control Hot Water Circulation Pump	79	2311.60	.75
13	Use more efficient lighting source & light sensors	84	1477.39	.21
9	Shutdown energy to hot water heaters or modify controls		(Payback beyond acceptable range S.I.R. not calculated)	

* Selected by DEH for ECIP Application.

2.4 (cont'd): As a result of the Interim Submittal Review Conference, charts were prepared containing complete summary information for each ECO. These charts follow:

FLOOR INSTR.	C1 BUILDINGS				C1 BUILDING VARIABLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES			
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	SAVEZ/INVEST RATIO		
	1R2	4.81	2.3	238.00	3.675	1.620	6	22.28	27.19	2.3	1317.97	20.350	8.971			
	2R17	8.19	2.4	180.00	3.060	1.208	322	621.13	629.32	2.4	13831.21	236.730	92.922			
	3R35	14.65	3.0	546.00	10.990	3.720	2	26.72	41.38	3.0	1542.21	31.033	10.504			
	6R10	4.70	1.6	164.00	1.770	1.118	-	-	4.70	1.6	164.00	1.770	1.118			
	6R32	4.70	1.6	164.00	1.770	1.118	231	1036.80	1041.50	1.6	36341.70	392.224	247.700			
	5B8	4.70	1.6	164.00	1.770	1.118	-	-	4.70	1.6	164.00	1.770	1.118			
	5B31	4.70	1.6	164.00	1.770	1.118	-	-	4.70	1.6	164.00	1.770	1.118			
	5B32	4.70	1.6	164.00	1.770	1.118	-	-	4.70	1.6	164.00	1.770	1.118			
	10B8	14.65	2.4	463.00	7.625	3.154	12	31.06	45.71	2.4	1444.62	23.795	9.843			
	1E4	4.72	1.6	164.00	1.770	1.118	-	-	4.72	1.6	164.00	1.770	1.118			
	1E6	4.72	2.5	103.00	1.770	.702	162	724.50	729.22	2.5	15913.06	273.450	109.574			
	1E20	7.67	1.6	270.00	2.876	1.815	-	-	7.67	1.6	270.00	2.876	1.815			
	2E4	2.28	2.5	89.50	1.713	.680	-	-	2.28	2.5	89.50	1.713	.680			
	3E34	3.78	2.0	206.00	2.634	1.407	8	39.82	43.60	2.0	2376.08	32.699	16.234			
	F2	9.83	2.4	448.00	7.380	3.053	62	309.41	319.24	2.4	14549.29	239.647	99.138			
	1J6	2.00	2.4	89.90	1.500	.613	6	37.99	39.99	2.4	1787.55	29.992	12.257			
	1033	11.89	5.3	250.00	6.990	1.700	10	70.70	82.69	5.3	1724.14	62.011	11.726			
	2270	3.72	3.1	132.00	2.786	.900	5	19.89	23.70	3.1	840.86	17.774	5.742			
	2408	7.67	2.5	167.00	2.876	1.140	4	25.23	32.90	2.5	716.34	12.337	4.890			
	5038	13.32	1.6	926.00	9.988	6.308	12	120.63	133.94	1.6	9311.44	100.459	63.446			
	5209	8.18	1.6	568.00	6.134	3.870	-	-	8.18	1.6	568.00	6.134	3.870			
	TOTAL	146.78	2.2	5670.40	84.817	38.596	842	3086.26	3232.03	2.1	103464.07	1492.074	704.802	9.0		

BLDG #	C1 BUILDING VARIABLES					C2 BUILDINGS					C1 AND C2 BUILDING TOTAL VARIABLES						
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (RLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (RLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (RLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)
1R2	4-81	75-10	4-1	2-116	-511	6	22-28	4-1	415-60	11-710	2-828	210-19	4-1	415-60	11-710	2-828	
1R24	8-00	166-00	2-8	3-266	1-148	29	202-61	2-8	4517-81	87-808	30-863	210-61	2-8	4517-81	87-808	30-863	
2R17	8-19	170-00	4-6	5-325	1-160	322	621-13	4-6	13184-50	411-989	89-759	629-32	4-6	13184-50	411-989	89-759	
3R2	11-19	82-60	4-2	2-375	-562	1	11-71	4-2	169-05	4-961	1-150	22-89	4-2	169-05	4-961	1-150	
3R10	22-33	110-00	5-2	3-770	-720	-	-	5-2	110-00	3-770	-720	22-33	5-2	110-00	3-770	-720	
3R35	14-65	123-00	6-0	5-070	-840	2	26-72	6-0	347-32	14-316	2-372	41-38	6-0	347-32	14-316	2-372	
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5R31	4-70	117-00	2-8	2-267	-797	-	-	2-8	117-00	2-267	-797	4-70	2-8	117-00	2-267	-797	
5R32	4-70	117-00	2-8	2-267	-797	-	-	2-8	117-00	2-267	-797	4-70	2-8	117-00	2-267	-797	
10R8	14-65	241-00	4-3	7-125	1-642	12	31-06	4-3	752-08	22-235	5-124	45-71	4-3	752-08	22-235	5-124	
1C14	3-11	56-20	4-4	1-734	-397	11	99-46	4-4	1920-75	87-226	13-102	102-57	4-4	1920-75	87-226	13-102	
1E4	4-72	89-00	2-8	1-730	-608	-	-	2-8	89-00	1-730	-608	4-72	2-8	89-00	1-730	-608	
1E6	4-72	56-00	4-6	1-730	-360	162	724-50	4-5	9766-71	269-545	59-505	729-22	4-5	9766-71	269-545	59-505	
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3204	12-44	455-00	13-6	29-950	2-206	8	32-63	13-6	1648-48	108-510	7-992	45-07	13-6	1648-48	108-510	7-992	
3271	10-00	66-00	67-0	18-240	-320	2	18-53	67-0	186-28	52-033	-912	28-53	67-0	186-28	52-033	-912	
3277	2-58	150-00	14-2	10-330	-727	33	224-77	14-2	13227-90	910-963	64-060	227-34	14-2	13227-90	910-963	64-060	
3470	60-77	1290-00	1-7	10-483	6-256	6	355-08	1-7	11602-48	94-286	50-009	405-85	1-7	11602-48	94-286	50-009	
3653	50-77	1290-00	1-9	10-483	5-705	-	-	1-9	1290-00	10-483	5-705	50-77	1-9	1290-00	10-483	5-705	
4060	18-24	102-00	7-1	4-361	-696	22	123-79	7-1	734-25	38-630	5-420	142-03	7-1	734-25	38-630	5-420	
4076	22-12	208-00	5-3	7-553	1-420	7	72-04	5-3	885-35	32-149	6-044	94-16	5-3	885-35	32-149	6-044	
4290	74-36	540-00	2-3	8-539	3-680	1	14-57	2-3	648-72	10-258	4-433	88-32	2-3	648-72	10-258	4-433	
5102	15-73	101-00	3-2	1-920	-605	-	-	3-2	101-00	1-920	-605	15-73	3-2	101-00	1-920	-605	
6038	13-32	177-00	2-9	3-480	1-204	12	120-63	2-9	1780-26	35-002	12-110	133-94	2-9	1780-26	35-002	12-110	
6208	8-18	107-00	2-9	2-119	-735	-	-	2-9	107-00	2-119	-735	8-18	2-9	107-00	2-119	-735	
TOTAL	567-95	6806-30	4-3	225-048	52-463	996	4425-54	4-7	101112-91	2876-866	626-720	4893-46	4-7	101112-91	2876-866	626-720	3-8

BDO # 2 INSTALL STORM WINDOWS	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES				
	BLDG #	BLDG AREA (1000 SQ FT)	PRYBRCK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PRYBRCK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)
1R2	4.91	20.7	49.60	7.008	-338	6	22.28	27.19	20.7	274.67	38.808	1.870	
2R17	8.19	15.4	60.00	8.352	-544	322	621.13	629.32	15.4	6147.20	644.153	41.871	
3R35	14.65	17.8	30.40	3.728	-210	2	26.72	41.38	17.8	65.86	10.527	-593	
6R10	4.70	9.7	81.00	5.312	-550	-	-	4.70	9.7	81.00	5.312	-550	
6R32	4.70	9.7	76.40	5.024	-520	231	1036.80	1041.50	9.7	16929.91	1113.300	115.200	
1B16	3.11	15.4	13.00	1.312	-085	-	-	3.11	15.4	13.00	1.312	-085	
5B8	4.70	9.7	85.10	5.600	-580	-	-	4.70	9.7	85.10	5.600	-580	
5B31	4.70	9.7	80.80	5.310	-550	-	-	4.70	9.7	80.80	5.310	-550	
5B32	4.70	14.5	80.80	7.868	-550	-	-	4.70	14.5	80.80	7.868	-550	
10B8	14.65	14.7	137.00	13.760	-934	12	31.06	46.71	14.7	427.45	42.940	2.915	
1C14	3.11	14.8	14.20	1.440	-087	11	98.46	102.57	14.8	468.32	47.524	3.201	
1E4	4.72	9.7	71.50	4.704	-487	-	-	4.72	9.7	71.50	4.704	-487	
1E6	4.72	15.4	44.00	4.704	-305	162	724.50	729.22	15.4	6787.81	734.716	47.671	
1E20	7.67	9.6	120.00	7.800	-810	-	-	7.67	9.6	120.00	7.800	-810	
2E4	2.28	14.2	28.00	2.636	-190	-	-	2.28	14.2	28.00	2.636	-190	
3E34	3.78	18.4	27.50	3.465	-188	8	39.82	43.60	18.4	317.19	39.980	2.169	
F2	9.83	14.7	61.40	6.168	-419	62	308.41	319.24	14.7	1994.03	200.280	13.606	
IJ5	2.00	14.9	17.00	1.728	-116	6	37.99	39.99	14.9	339.91	34.551	2.319	
4301	20.69	15.4	79.50	8.320	-542	7	23.48	44.18	15.4	169.75	17.766	1.157	
4431	4.72	15.4	53.00	5.536	-360	31	158.03	163.75	15.4	1838.71	182.053	12.489	
1010	20.10	14.5	153.00	15.120	-1043	12	121.91	142.01	14.5	1080.97	106.825	7.400	
1020	18.74	15.2	355.00	35.650	-2418	3	59.79	78.53	15.2	1487.82	149.391	10.132	
1033	11.99	14.5	200.00	19.580	-1351	10	70.70	82.69	14.5	1379.31	134.920	9.317	
1212	10.16	14.6	41.60	4.104	-284	22	207.71	217.87	14.6	892.06	87.971	6.088	
1450	33.18	14.5	102.00	10.080	-695	2	3.98	37.16	14.5	114.23	11.289	.778	
2001	30.75	9.7	150.00	9.608	-995	1	2.83	33.59	9.7	163.85	10.493	1.087	
2050	5.85	9.6	60.50	3.984	-413	3	24.66	30.51	9.6	316.53	20.791	2.155	
2109	14.13	13.7	553.00	51.760	-3765	-	-	14.13	13.7	563.00	51.760	3.765	
2409	7.67	23.0	73.00	11.520	-500	4	25.23	32.90	23.0	313.13	48.417	2.145	
3277	2.58	13.4	54.00	3.520	-262	33	224.77	227.34	13.4	4758.28	310.415	23.086	
4290	74.35	9.7	1320.00	86.300	-8942	1	14.97	89.32	9.7	1585.77	103.674	10.742	
5038	13.32	9.6	63.00	4.176	-439	12	120.63	133.94	9.6	633.50	42.002	4.355	
5209	8.18	9.7	81.60	5.368	-555	-	-	8.18	9.7	81.60	5.368	-555	
6071	6.90	9.7	86.00	5.656	-586	1	15.40	22.30	9.7	277.94	18.280	1.894	
9630	285.38	13.1	1100.00	86.400	-6603	-	-	285.38	13.1	1100.00	86.400	-6603	
9640	281.73	26.2	1100.00	172.800	-6603	7	300.92	562.64	26.2	2364.67	371.467	14.195	
8641	45.68	9.6	153.00	10.080	-1045	5	43.43	89.11	9.6	289.46	19.663	2.039	
8085	38.89	11.6	289.89	19.730	-1700	-	-	38.89	11.6	289.89	19.730	-1700	
TOTAL	1022.11	14.3	7176.78	665.353	-46568	976	4368.62	5390.72	13.3	64050.82	4767.176	356.999	1.4

DO-3
WEATHER
CALCULATIONS

BLDD #	C1 BUILDING				C2 BUILDING				C1 NO C2 BUILDING				SAVE/INVEST RATIO
	BLDD #	BLOD AREA (1000 SQ FT)	PRYBACK (TR)	ENERGY SAVE (HLR BTU/HR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/HR)	* OF BLOD	BLOD AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PRYBACK (TR)	ENERGY SAVE (HLR BTU/HR)	CONST. COST (\$1000)	
1R2	4.91	8.19	2.8	28.80	.560	.196	6	22.20	27.19	2.8	159.48	31.010	1.085
2R17	8.19	11.19	2.8	44.00	.840	.302	322	621.13	623.32	2.8	3380.96	64.953	23.297
3R2	11.19	22.33	.7	71.60	.332	.488	1	11.71	22.88	.7	146.46	.678	.999
3R10	22.33	14.65	.2	110.00	.120	.730	-	-	22.33	.2	110.00	.120	.730
3R35	14.65	4.70	.8	74.00	.409	.505	2	26.72	41.36	.8	209.01	1.155	1.426
6R10	4.70	4.70	1.3	79.10	.724	.539	-	-	4.70	1.3	79.00	.724	.539
6R32	4.70	3.87	1.0	79.10	.564	.539	231	1036.80	1041.50	1.0	17528.22	124.980	119.400
7R11	3.87	3.11	.6	29.00	.129	.201	-	-	3.87	.6	29.00	.129	.201
1816	3.11	4.72	3.3	24.00	.551	.167	-	-	3.11	3.3	24.00	.551	.167
588	4.70	4.70	1.2	79.10	.628	.539	-	-	4.70	1.2	79.11	.628	.539
5831	4.70	4.70	1.1	79.10	.597	.539	-	-	4.70	1.1	79.11	.597	.539
5832	4.70	4.70	1.1	79.10	.597	.539	-	-	4.70	1.1	79.11	.597	.539
1088	14.65	3.11	2.7	80.40	1.488	.548	12	31.06	45.71	2.7	250.85	4.644	1.170
1C14	3.11	4.72	3.2	29.40	.649	.200	11	99.46	102.57	3.2	969.63	21.419	6.601
1E4	4.72	4.72	1.2	41.00	.344	.278	-	-	4.72	1.2	41.00	.344	.278
1E6	4.72	4.72	3.2	25.70	.557	.175	162	724.50	729.22	3.2	3970.54	86.651	27.676
1E20	7.67	2.00	1.9	66.00	.844	.450	-	-	7.67	1.9	66.00	.844	.450
2E4	2.28	3.78	4.3	16.00	.439	.103	-	-	2.28	4.3	16.00	.439	.103
3E34	3.78	9.83	1.1	49.70	.361	.340	8	39.82	43.60	1.1	573.25	4.294	4.124
F2	2.00	2.00	1.6	47.50	.513	.324	62	309.41	319.24	1.6	1542.61	16.858	10.522
1J5	2.00	20.69	2.4	20.30	.330	.139	6	37.99	39.99	2.4	405.89	6.598	2.779
4301	20.69	4.72	1.0	123.00	.805	.836	7	23.49	44.18	1.0	262.64	1.719	1.785
4431	4.72	4.72	5.8	13.00	.612	.090	31	159.03	163.75	5.8	451.01	21.231	3.122
1010	20.10	10.16	.4	174.00	.500	1.165	12	121.91	142.01	.4	1229.34	3.533	8.372
1033	11.98	10.16	1.5	113.00	1.150	.770	10	70.70	82.69	1.5	778.31	7.932	5.311
1212	10.16	12.63	1.2	112.00	.892	.762	22	207.71	217.87	1.2	2401.71	19.120	16.334
1263	34.73	46.61	2.9	72.60	1.445	.496	-	-	34.73	2.9	72.60	1.445	.496
2006	46.61	78.95	1.3	440.00	3.970	2.935	15	293.66	340.27	1.3	3212.16	34.468	26.940
2007	78.95	107.23	1.1	744.00	5.476	5.076	-	-	78.95	1.1	744.00	5.476	5.076
2020	107.23	14.95	2.8	1011.00	7.446	6.890	5	347.57	454.79	1.1	4287.91	31.582	29.224
2045	14.95	6.85	2.8	220.00	4.131	1.495	6	93.37	108.33	2.8	1594.15	29.929	10.831
2050	6.85	7.38	.7	66.00	.401	.564	3	24.66	30.51	.7	448.52	2.083	3.048
2063	7.38	28.67	5.2	70.00	2.465	.474	19	122.40	129.78	5.2	1230.87	43.330	8.332
2161	28.67	17.59	1.3	10.50	.089	.070	1	22.93	51.60	1.3	18.89	.160	.126
2163	17.59	3.72	7.4	2.50	.134	.018	-	-	17.59	7.4	2.50	.134	.018
2270	3.72	7.67	1.0	46.70	.310	.318	5	19.89	23.70	1.0	297.52	1.978	2.029
2409	7.67	2.58	4.2	45.00	.845	.305	4	25.23	32.90	4.2	193.02	3.625	1.308
3277	2.58	18.24	2.5	24.30	.300	.118	33	224.77	227.34	2.5	2141.22	26.466	10.397
4060	18.24	22.12	.8	172.00	.935	1.172	22	123.79	142.03	.8	1339.32	7.281	9.126
4076	22.12	74.35	.7	233.00	1.111	1.590	7	72.04	94.16	.7	981.83	4.729	6.768
4290	74.35	12.85	1.7	779.00	8.930	5.309	1	14.97	69.32	1.7	935.84	10.728	6.378
4291	12.85	15.73	3.3	70.60	1.601	.480	-	-	12.85	3.3	70.60	1.601	.480
5102	15.73	13.32	4.4	151.00	4.020	.910	-	-	15.73	4.4	151.00	4.020	.910
5038	13.32	8.56	1.5	140.00	1.491	.951	12	120.63	133.94	1.5	1407.77	14.996	9.565
6137	8.56	8.18	1.5	80.70	.805	.550	63	277.60	286.17	1.5	2687.69	26.905	18.382
6208	8.18	52.05	1.1	5.70	.045	.040	-	-	8.18	1.1	5.70	.045	.040
9500	52.05	23.05	.1	700.00	.300	3.000	-	-	52.05	.1	700.00	.300	3.000
9503	23.05	286.38	.08	220.00	.059	1.370	1	1.52	285.38	.08	234.41	.063	1.460
9630	286.38	46.68	.1	1700.00	1.500	10.146	-	-	286.38	.1	1700.00	1.500	10.146
9641	46.68	1147.61	5.9	2.80	.117	.020	5	43.43	69.11	5.9	5.46	.228	.039
TOTAL			1.1	8715.50	63.461	58.962	1127	5372.28	6519.86	1.7	59346.72	674.611	402.108

Bldg #	C1 BUILDING VARIABLES					C2 BUILDINGS					C1 RO C2 BUILDING TOTAL VARIABLES					
	Bldg #	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)	# of Bldg	Bldg Area (1000 sq ft)	Payback (Yr)	Total Area (1000 sq ft)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)
382	11-18	11.18	7.6	2-20	1.114	-0.16	1	11-71	22-89	7-6	-233	-0.31	4-50	-233	-0.31	
1088	14-65	14.65	7-9	22-30	1-200	-1.92	12	31-06	45-71	7-9	3-745	-4.74	69-57	3-745	-4.74	
1E4	4-72	4.72	5-2	42-90	1-512	-2.92	-	-	4-72	5-2	1-512	-2.92	42-90	1-512	-2.92	
1263	34-73	34.73	5-0	515-00	17-400	3-500	-	-	34-73	5-0	17-400	3-500	515-00	17-400	3-500	
2045	14-96	14.96	6-8	3-50	-162	-0.24	6	93-37	108-33	6-9	1-174	-1.70	25-36	1-174	-1.70	
2050	5-65	5.65	5-1	44-00	1-530	-3.00	3	24-66	30-51	5-1	7-984	-1-566	229-47	7-984	-1-566	
2063	7-38	7.38	5-1	9-20	-324	-0.63	19	122-40	129-78	5-1	5-695	-1-107	161-78	5-695	-1-107	
2161	28-67	28.67	6-9	168-00	7-926	1-145	1	22-93	51-60	6-9	14-266	-2-060	302-36	14-266	-2-060	
3063	42-09	42.09	8-0	640-00	22-560	2-635	2	24-20	66-29	8-0	39-531	-4-955	1007-97	39-531	-4-955	
3041	20-97	20.97	8-2	110-70	4-000	-4.90	-	-	20-97	8-2	4-000	-4.90	110-70	4-000	-4.90	
3170	3-17	3.17	11-0	10-30	-552	-0.50	-	-	3-17	11-0	-552	-0.50	10-30	-552	-0.50	
3271	10-00	10.00	7-2	230-00	6-040	1-116	2	18-53	28-53	7-2	22-936	-3-183	656-18	22-936	-3-183	
3277	2-58	2.58	7-1	20-10	-685	-0.97	33	224-77	227-34	7-1	61-289	-8-547	1771-14	61-289	-8-547	
3750	37-15	37.15	12-9	6-00	-335	-0.26	7	50-68	87-83	12-9	-792	-0.61	14-18	-792	-0.61	
3911	17-96	17.96	8-0	31-80	1-122	-1.41	4	25-00	42-96	8-0	2-684	-3.37	76-06	2-684	-3.37	
4060	18-24	18.24	5-2	240-00	8-400	1-625	22	123-79	142-03	5-2	65-409	-12-650	1868-82	65-409	-12-650	
4076	22-12	22.12	11-0	60-70	4-536	-4.14	7	72-04	94-16	11-0	19-307	-1-762	258-39	19-307	-1-762	
5102	15-73	15.73	8-8	9-90	-528	-0.60	-	-	15-73	8-8	-528	-0.60	9-90	-528	-0.60	
5038	13-32	13.32	5-1	23-00	-810	-1.58	12	120-63	139-94	5-1	8-147	-1-589	231-28	8-147	-1-589	
6209	8-18	8.18	5-2	69-00	2-430	-4.70	-	-	8-18	5-2	2-430	-4.70	68-00	2-430	-4.70	
6071	6-80	6.80	4-9	41-80	1-406	-2.85	1	15-40	22-30	4-9	4-545	-9.21	135-09	4-545	-9.21	
6580	857-74	857.74	4-2	82-1	2-340	-5.60	-	-	257-74	4-2	2-340	-5.60	82-10	2-340	-5.60	
TOTAL	598-29	598.29	6-4	2382-50	87-922	13-818	132	981-17	1579-44	6-4	286-488	-44-835	7652-06	286-488	-44-835	2-8

Bldg #	C1 BUILDING VARIABLES					C2 BUILDINGS					C1 RO C2 BUILDING TOTAL VARIABLES					
	Bldg #	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)	# of Bldg	Bldg Area (1000 sq ft)	Payback (Yr)	Total Area (1000 sq ft)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)	Energy Save (HLN BTU/Yr)	Const Cost (\$1000)	ECost Save (\$1000/Yr)
182	4-91	4.91	94-0	-29	-250	-0.03	6	22-28	27-18	94-0	1-384	-0.16	1-60	1-384	-0.16	
2817	6-19	6.19	94-0	-29	-250	-0.03	322	621-13	629-32	94-0	19-210	-2.30	22-28	19-210	-2.30	
382	11-19	11.19	94-0	-29	-250	-0.03	1	11-71	22-89	94-0	-511	-0.06	-59	-511	-0.06	
3810	22-33	22.33	94-0	-29	-250	-0.03	-	-	22-33	94-0	-260	-0.03	-29	-260	-0.03	
7811	3-87	3.87	94-0	-29	-250	-0.03	-	-	3-87	94-0	-250	-0.03	-29	-250	-0.03	
5832	4-70	4.70	94-0	-29	-250	-0.03	-	-	4-70	94-0	-250	-0.03	-29	-250	-0.03	
1088	14-65	14.65	195-0	-29	-250	-0.01	12	31-06	45-71	195-0	-780	-0.03	-91	-780	-0.03	
1C14	3-11	3.11	94-0	-29	-250	-0.03	11	99-46	102-57	94-0	8-251	-0.98	9-56	8-251	-0.98	
1E4	4-72	4.72	94-0	-29	-250	-0.03	-	-	4-72	94-0	-250	-0.03	-29	-250	-0.03	
1E6	4-72	4.72	94-0	-29	-250	-0.03	162	724-50	729-22	94-0	98-823	-4.63	44-80	98-823	-4.63	
1E20	7-67	7.67	94-0	-29	-250	-0.03	-	-	7-67	94-0	-250	-0.03	-29	-250	-0.03	
2E4	2-28	2.28	94-0	-29	-250	-0.03	-	-	2-28	94-0	-250	-0.03	-29	-250	-0.03	
F2	9-83	9.83	94-0	-29	-250	-0.03	62	309-41	319-24	94-0	8-119	-0.07	9-42	8-119	-0.07	
4431	4-72	4.72	94-0	-29	-250	-0.03	31	159-03	163-75	94-0	8-673	-1.04	10-06	8-673	-1.04	
2109	14-13	14.13	195-0	-29	-260	-0.01	-	-	14-13	195-0	-250	-0.01	-29	-250	-0.01	
2161	28-67	28.67	94-0	-29	-250	-0.03	1	22-93	51-60	94-0	-624	-0.07	-72	-624	-0.07	
2270	3-72	3.72	195-0	-29	-250	-0.01	5	19-99	23-70	195-0	1-595	-0.06	1-85	1-595	-0.06	
3236	6-63	6.63	195-0	-29	-250	-0.01	3	16-42	25-05	195-0	-726	-0.03	-84	-726	-0.03	
3271	10-00	10.00	195-0	-29	-250	-0.01	2	18-53	28-53	195-0	-713	-0.03	-83	-713	-0.03	
4280	74-35	74.35	94-0	-29	-250	-0.03	1	14-97	68-32	94-0	-300	-0.04	-35	-300	-0.04	
9630	285-38	285.38	195-0	-29	-250	-0.01	-	-	285-38	195-0	-250	-0.01	-29	-250	-0.01	
TOTAL	531-77	531.77	103-0	6-08	5-250	-0.51	619	2071-42	2603-17	86-3	81-509	-1-060	106-13	81-509	-1-060	

■ PAYBACK BEYOND ACCEPTABLE RANGE. S. I. R. NOT CALCULATED.

ECO • II REDUCE LEVEL	C1 BUILDINGS				C1 BUILDING VARIABLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES			
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST SAVE (\$1000/YR)	SAVE/INVEST RATIO		
	2163	17.59	1.4	65.80	.550	-.405	-	17.59	1.4	65.80	.550	-.405				
	2272	36.26	-2	740.00	-.160	-.955	-	36.26	-2	740.00	-.160	-.955				
	3114	33.46	3-1	54.20	.360	-.117	-	33.46	3-1	54.20	.360	-.117				
	3277	2.58	-2	163.00	-.060	-.340	33	224.77	-2	14362.95	5.291	29.983				
	3750	37.15	7-2	34.80	-.540	-.075	7	87.83	7-2	82.87	1.277	-.177				
	9504	8.91	3-6	60.00	-.702	-.194	18	53.69	3-6	301.29	4.229	1.169				
	TOTAL	135.95	1-1	1107.80	2.372	2.086	58	456.17	0.36	15607.11	11.867	32.806	39-4			

200-12 REPLACE INCANDESCENT LIGHTS	C1 BUILDINGS					C2 BUILDINGS					C1 AND C2 BUILDING TOTAL VARIABLES				
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (HLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (HLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	SAVE/INVEST RATIO	
3A2	11-19	109-00	3-4	109-00	-670	-200	1	11-71	22-89	3-4	222-97	1-371	-409		
3A10	22-33	42-00	6-1	42-00	1-308	-211	-	-	22-33	6-1	42-00	1-330	-211		
3A35	14-65	957-00	2-8	957-00	7-255	2-550	2	26-72	41-38	2-8	2703-11	20-486	7-200		
6A10	4-70	30-70	3-7	30-70	-330	-088	-	-	4-70	3-7	30-70	-330	-088		
6A32	4-70	18-80	3-0	18-80	-150	-050	231	1036-80	1041-60	3-0	4188-16	33-239	11-079		
5B8	4-70	30-70	3-9	30-70	-330	-085	-	-	4-70	3-9	30-70	-330	-085		
5B31	4-70	12-00	5-1	12-00	-180	-035	-	-	4-70	5-1	12-00	-180	-035		
5B32	4-70	11-80	7-5	11-80	-270	-036	-	-	4-70	7-5	11-80	-270	-036		
10B8	14-65	31-90	3-6	31-90	-275	-077	12	31-06	45-71	3-6	19-53	-868	-240		
1C14	3-11	22-10	2-9	22-10	-170	-059	11	99-46	102-57	2-9	728-87	5-610	1-947		
1E4	4-72	8-60	6-1	8-60	-110	-018	-	-	4-72	6-1	8-57	-110	-018		
1E20	7-67	63-00	4-7	63-00	1-030	-216	-	-	7-67	4-7	63-00	1-030	-216		
2E4	2-28	2-30	6-7	2-30	-040	-006	-	-	2-28	6-7	2-30	-040	-006		
3E34	3-78	70-80	2-8	70-80	-540	-193	8	39-82	43-60	2-8	816-69	6-231	2-227		
4301	20-69	20-50	4-6	20-50	-280	-061	7	23-49	44-18	4-6	43-77	-588	-130		
4431	4-72	12-50	7-2	12-50	-280	-039	31	159-03	163-75	7-2	433-66	8-714	1-353		
1450	33-18	253-30	2-4	253-30	2-595	1-071	2	3-98	37-16	2-4	263-66	2-906	1-189		
2022	37-99	61-30	5-0	61-30	1-040	-210	-	-	37-99	5-0	61-30	1-040	-210		
2045	14-95	34-00	3-6	34-00	-235	-065	6	93-37	108-33	3-6	246-36	1-703	-471		
2109	14-13	50-30	3-3	50-30	-440	-135	-	-	14-13	3-3	50-30	-440	-135		
2161	26-67	250-00	2-3	250-00	1-065	-473	1	22-93	51-60	2-3	449-84	1-917	-851		
2163	17-59	75-00	4-3	75-00	-670	-155	-	-	17-59	4-3	75-00	-670	-155		
2270	3-72	1-90	4-1	1-90	-070	-017	5	19-99	23-70	4-1	12-10	-447	-108		
2409	7-67	6-80	9-1	6-80	-410	-045	4	25-23	32-90	9-1	29-17	1-769	-193		
3119	42-65	18-90	3-5	18-90	-180	-051	-	-	42-65	3-5	18-90	-180	-051		
3114	33-46	18-90	3-5	18-90	-180	-051	-	-	33-46	3-5	18-90	-180	-051		
3161	33-46	18-90	3-5	18-90	-180	-051	52	1627-20	1660-70	3-5	938-05	9-284	2-531		
3204	12-44	61-90	5-3	61-90	-810	-152	8	32-63	45-07	5-3	224-26	2-935	-551		
3238	8-63	31-40	3-1	31-40	-240	-077	3	16-42	25-05	3-1	91-14	-697	-224		
3271	10-00	15-80	3-8	15-80	-160	-042	2	18-53	28-53	3-8	45-07	-456	-120		
3277	2-58	12-70	6-5	12-70	-255	-039	33	224-77	227-34	6-5	1119-08	22-487	3-439		
3470	50-77	50-30	3-3	50-30	-440	-135	6	355-08	405-85	3-3	402-09	3-557	1-214		
3653	50-77	50-30	3-3	50-30	-440	-135	-	-	50-77	3-3	50-30	-440	-135		
3750	37-15	433-70	4-1	433-70	4-055	-991	7	50-68	87-83	4-1	1025-35	9-588	2-343		
4060	18-24	355-00	3-7	355-00	2-680	-725	22	123-79	142-03	3-7	2764-29	20-868	5-645		
4076	22-12	45-00	4-8	45-00	-600	-125	7	72-04	94-16	4-8	191-56	2-644	-532		
4290	74-35	171-60	2-3	171-60	1-175	-510	1	14-97	89-32	2-3	206-03	1-412	-613		
5038	13-32	67-00	2-6	67-00	-465	-176	12	120-63	133-94	2-6	673-72	4-677	1-770		
5137	8-56	18-90	3-5	18-90	-180	-051	83	277-60	286-17	3-5	631-85	6-016	1-705		
5209	8-18	6-40	5-2	6-40	-200	-038	-	-	8-18	5-2	6-40	-200	-038		
6071	6-90	11-40	2-9	11-40	-070	-024	1	15-40	22-30	2-9	36-84	-226	-078		
9503	23-05	14-00	9-2	14-00	-330	-036	1	1-52	24-56	9-2	14-92	-352	-038		
9504	8-91	27-00	3-0	27-00	-180	-060	18	44-78	53-69	3-0	162-69	1-085	-361		
9641	45-68	663-70	5-2	663-70	5-775	1-115	5	43-43	89-11	5-2	1294-70	11-266	2-175		
9660	207-52	65-50	4-6	65-50	-740	-162	2	42-68	250-21	4-6	76-98	-892	-195		
9665	250-91	279-00	56-70	279-00	6-050	-142	27	79-96	330-87	56-7	367-91	10-615	-187		
8989	6-08	11-60	4-4	11-60	-180	-041	-	-	6-08	4-4	11-60	-180	-041		
8085	38-89	781-00	2-3	781-00	6-685	2-812	-	-	38-89	2-3	781-00	6-685	2-812		
TOTAL	1306-02	5406-20	3-8	5406-20	63-893	13-938	611	4755-70	6061-76	3-8	21721-24	209-841	65-653	3-8	

EQUITY USE EFF. LIGHT SOURCE	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES									
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
	3R10	22.33	78.7	-200	22.6	-290	-	-	22.33	78.7	22.825	-290	22.33	78.7	22.825	-290		
	2022	37.99	108.3	101.00	14.190	-131	-	-	37.99	108.3	14.190	-131	37.99	108.3	14.190	-131		
	2161	28.67	86.9	84.00	9.560	-110	1	22.93	51.60	86.9	17.207	-198	51.60	86.9	17.207	-198		
	3434	6.40	7.3	42.5	1.040	-143	38	190.79	197.19	7.3	32.043	4.406	197.19	7.3	32.043	4.406		
	8603	23.05	39.5	16.5	.830	-021	1	1.52	24.56	39.5	17.68	-022	24.56	39.5	17.68	-022		
	8640	261.73	253.4	224.0	73.500	-290	7	300.92	562.64	253.4	156.006	-623	562.64	253.4	156.006	-623		
	9660	207.62	253.4	224.0	73.500	-290	2	42.68	250.21	253.4	88.620	-349	250.21	253.4	88.620	-349		
	8665	250.81	253.4	224.0	73.500	-290	27	79.96	330.87	253.4	88.922	-382	330.87	253.4	88.922	-382		
	TOTAL	838.60	171.89	916.200	268.920	1.565	76	638.80	1477.39	67.286	430.698	6.401	1477.39	67.286	430.698	6.401		.21

EQUITY USE EFF. LIGHT SOURCE	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES									
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
	1816	3.11	9.2	136.0	5.6	-602	-	-	3.11	9.2	5.6	-602	3.11	9.2	5.6	-602		
	1C14	3.11	9.2	136.0	5.6	-602	11	99.46	102.57	9.2	184.7	19.85	102.57	9.2	184.7	19.85		
	1212	10.16	8.5	311.4	11.8	1.383	22	207.71	217.87	8.5	28.66	29.66	217.87	8.5	28.66	29.66		
	3063	42.09	8.5	1290.0	49.1	5.730	2	24.20	66.29	8.5	77.3	9.024	66.29	8.5	77.3	9.024		
	3041	20.97	7.7	754.0	25.7	3.338	-	-	20.97	7.7	25.7	3.338	20.97	7.7	25.7	3.338		
	4060	18.24	5.6	1315.0	50.1	8.961	22	123.79	142.03	5.6	390.1	69.78	142.03	5.6	390.1	69.78		
	4076	22.12	13.6	769.0	46.2	3.404	7	72.04	94.16	13.6	196.6	14.49	94.16	13.6	196.6	14.49		
	8600	52.05	5.7	647.0	16.2	2.864	-	-	52.05	5.7	16.2	2.864	52.05	5.7	16.2	2.864		
	TOTAL	171.86	7.82	5358.4	210.30	26.864	64	527.20	699.05	7.68	1149.2	148.608	699.05	7.68	1149.2	148.608		1.6

■ BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

Bldg #	C1 BUILDING				C2 BUILDING				C1 AND C2 BUILDING TOTAL					
	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (Mln Btu/Yr)	Const Cost (\$1000)	# of Bldg	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (Mln Btu/Yr)	Const Cost (\$1000)	Total Area (1000 sq ft)	Total Payback (Yr)	Total Energy Save (Mln Btu/Yr)	Total Const Cost (\$1000)	Save/Invest Ratio
3R2	11.19	-08	562.0	-300	1	11.71	0.08	1149.61	-614	22.84	0.08	1149.61	-614	7.839
3R35	14.66	-08	545.0	-300	2	26.72	-08	1539.39	-847	41.38	-08	1539.39	-847	10.476
10B8	14.65	-08	715.0	-300	12	31.06	-08	2230.89	-936	45.71	-08	2230.89	-936	15.213
1C14	3.11	-40	112.0	-300	11	99.46	-40	3693.93	9.901	102.57	-40	3693.93	9.901	25.230
1E20	7.67	-50	86.8	-300	-	-	-50	86.8	-300	7.67	-50	86.8	-300	-591
F2	9.93	-30	499.0	-650	62	309.41	-30	16205.57	27.602	319.24	-30	16205.57	27.602	110.406
4301	20.68	-08	1159.0	-300	7	23.49	-08	2474.95	-641	44.18	-08	2474.95	-641	16.869
1010	20.10	-10	405.0	-300	12	121.91	-10	2661.39	2.120	142.01	-10	2661.39	2.120	19.621
1033	11.99	-08	760.0	-300	20	70.70	-08	82.69	2.069	82.69	-08	82.69	2.069	35.661
1212	10.16	-08	580.0	-300	12	207.71	-08	12437.50	6.431	217.87	-08	12437.50	6.431	84.691
1263	34.73	-08	1481.0	-300	-	-	-	1481.00	-300	34.73	-08	1481.00	-300	10.090
2001	30.76	-36	369.0	-900	1	2.83	-36	403.08	-993	33.59	-36	403.08	-993	2.747
2006	46.81	-08	715.0	-300	15	293.66	-08	5219.76	2.190	340.27	-08	5219.76	2.190	43.118
2007	76.96	-08	652.0	-300	-	-	-	652.0	-300	76.96	-08	652.0	-300	7.566
2022	37.99	-08	637.0	-300	4	3.40	-08	637.0	-300	37.99	-08	637.0	-300	4.340
2063	7.36	-20	242.0	-300	19	122.40	-20	4255.65	5.275	129.78	-20	4255.65	5.275	28.934
2161	28.67	-10	364.0	-300	1	22.93	-10	655.12	-540	51.60	-10	655.12	-540	4.464
2270	3.72	-30	152.0	-300	5	19.99	-30	969.39	1.914	23.70	-30	969.39	1.914	6.603
2272	36.26	-40	106.2	-300	-	-	-40	106.20	-300	36.26	-40	106.20	-300	-725
3063	42.08	-08	1280.0	-300	2	24.20	-08	2015.94	3.472	66.29	-08	2015.94	3.472	11.154
3041	20.97	1.3	507.0	3.000	-	-	1.3	507.0	3.000	20.97	1.3	507.0	3.000	2.243
3119	42.85	-085	721.0	-300	-	-	-085	721.0	-300	42.85	-085	721.0	-300	3.497
3161	33.46	-085	721.0	-300	52	1627.20	-08	36784.86	15.189	1660.70	-08	36784.86	15.189	173.564
3204	12.44	-08	721.0	-300	8	32.63	-08	2612.17	1.067	45.07	-08	2612.17	1.067	12.669
3271	10.00	-35	176.0	-300	2	18.53	-35	502.12	-856	28.53	-35	502.12	-856	2.436
3277	2.58	-66	155.0	-500	33	224.77	-70	13658.02	44.093	227.34	-70	13658.02	44.093	66.263
3811	17.96	-086	793.0	-300	4	25.00	-08	1896.84	-718	42.86	-08	1896.84	-718	8.399
5036	13.32	0.10	393.0	-300	12	120.63	-10	3951.83	3.017	133.94	-10	3951.83	3.017	26.955
5137	8.56	-10	331.0	-300	83	277.60	-10	11065.69	10.027	286.17	-10	11065.69	10.027	75.402
5209	8.18	1.5	370.0	2.400	-	-	1.5	370.00	2.400	8.18	1.5	370.00	2.400	1.625
9500	52.05	0.3	241.6	-300	-	-	0.3	241.60	-300	52.05	0.3	241.60	-300	1.070
9603	23.06	-08	600.0	-300	1	1.62	-08	532.75	-320	24.56	-08	532.75	-320	3.634
8641	45.68	0.10	358.2	-300	5	43.43	-10	698.76	-565	89.11	-10	698.76	-565	4.762
9660	207.62	0.10	667.90	-300	2	42.68	-10	684.72	-362	250.21	-10	684.72	-362	3.032
TOTAL	969.81	-14	17877.29	16.350	384	3802.17	0.17	137543.03	149.289	4771.96	0.17	137543.03	149.289	67.3

Bldg #	C1 BUILDING				C2 BUILDING				C1 AND C2 BUILDING TOTAL					
	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (Mln Btu/Yr)	Const Cost (\$1000)	# of Bldg	Bldg Area (1000 sq ft)	Payback (Yr)	Energy Save (Mln Btu/Yr)	Const Cost (\$1000)	Total Area (1000 sq ft)	Total Payback (Yr)	Total Energy Save (Mln Btu/Yr)	Total Const Cost (\$1000)	Save/Invest Ratio
10B8	14.66	15.0	27.8	-540	12	31.06	15.0	86.73	1.684	45.71	15.0	86.73	1.684	-112
1E20	7.67	37.5	6.0	-300	-	-	37.5	6.0	-300	7.67	37.5	6.0	-300	-022
2001	30.75	13.6	17.0	-300	1	2.83	13.6	18.57	-328	33.59	13.6	18.57	-328	-024
2020	107.23	13.0	17.5	-300	5	347.57	13.0	74.22	1.272	454.79	13.0	74.22	1.272	-098
3063	42.09	8.3	27.8	-300	2	24.20	8.3	43.78	-472	66.29	8.3	43.78	-472	-067
3119	42.85	3.3	70.0	-300	-	-	3.3	70.0	-300	42.85	3.3	70.0	-300	-091
3161	33.46	23.8	9.7	-300	52	1627.20	23.8	481.43	15.189	1660.70	23.8	481.43	15.189	-645
TOTAL	278.70	10.2	175.8	2.340	72	2032.66	18.63	780.73	19.545	2311.60	18.63	780.73	19.545	-75

BDO # 20 REGULATORY CONTROLS	C1 BUILDING VARIABLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES					
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
	1A2	4.91	3.4	61.0	1.400	.413	6	22.28	27.19	3.4	337.80	7.762	2.286	
	3A35	14.65	1.2	291.0	2.400	1.981	2	26.72	41.38	1.2	621.85	6.777	5.594	
	3063	42.09	9.6	424.0	18.000	1.875	2	24.20	66.29	9.6	667.79	28.349	2.853	
	3750	37.15	26.9	5.9	.700	.026	7	50.68	67.33	26.9	13.82	1.655	.061	
	5038	13.32	5.4	198.0	7.300	1.351	12	120.63	133.94	5.4	1891.00	73.423	13.585	
	5209	6.18	3.7	98.7	2.500	.670	-	-	8.18	3.7	98.70	2.500	.670	
	9503	23.05	10.3	142.0	10.00	.970	1	1.52	24.56	10.3	151.30	10.658	1.034	
	TOTAL	149.36	5.80	1220.6	42.300	7.286	30	246.03	388.67	5.0	4082.46	131.114	26.183	2.4

BDO # 22 LUX. UPK HERDS	C1 BUILDING VARIABLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES					
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
	1A24	8.00	0.4	46.5	.120	.335	28	202.81	210.61	0.4	1224.17	3.159	9.309	
	3A10	22.33	.08	484.1	.160	3.460	-	-	22.33	.08	484.1	.160	3.460	
	6A10	4.70	.20	100.8	.130	.720	-	-	4.70	.20	100.80	.130	.720	
	6A32	4.70	.20	100.8	.130	.720	231	1036.80	1041.50	.20	22336.85	28.607	159.549	
	5B8	4.70	.20	100.8	.130	.720	-	-	4.70	.20	100.80	.130	.720	
	5B31	4.70	.20	100.8	.130	.720	-	-	4.70	.20	100.80	.130	.720	
	5B32	4.70	.20	100.8	.130	.720	-	-	4.70	.20	100.80	.130	.720	
	1E4	4.72	.10	65.9	.070	.470	-	-	4.72	.10	65.91	.070	.470	
	1E20	7.67	.30	70.0	.150	.490	-	-	7.67	.30	70.0	.150	.490	
	1020	18.74	.80	55.8	.315	.400	3	59.79	78.53	.80	233.83	1.320	1.676	
	2006	46.61	.20	143.0	.200	1.845	15	293.66	340.27	.20	1043.95	1.880	11.814	
	2007	78.95	.10	590.8	.420	4.185	-	-	78.95	.10	590.8	.420	4.185	
	2020	107.23	.10	887.3	.650	6.227	5	347.57	454.79	.10	3763.27	2.767	26.412	
	3119	42.85	.08	573.7	.245	2.907	-	-	42.85	.08	573.7	.245	2.907	
	3114	33.46	.18	299.5	.280	1.537	-	-	33.46	.18	229.5	.280	1.537	
	3161	33.46	.12	317.5	.190	1.640	52	1627.20	1660.70	.12	15759.29	9.955	81.387	
	3470	50.77	.18	487.7	.425	2.365	6	355.08	405.85	.18	3898.62	3.337	18.905	
	3653	60.77	.25	372.9	.460	1.775	-	-	60.77	.25	372.9	.460	1.775	
	4292	10.49	.90	80.6	.490	.575	-	-	10.49	.90	80.6	.490	.575	
	TOTAL	539.55	0.15	4979.3	4.825	31.011	341	3922.71	4462.29	0.16	51129.69	64.070	327.341	108.5

BDO # 25 PREVENT AIR STRATIF.	C1 BUILDING VARIABLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES					
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST. COST (\$1000)	ECOST. SAVE (\$1000/YR)	SAVE/INVEST RATIO
	3A10	22.33	1.4	326.0	3.050	2.116	-	-	22.33	1.4	326.0	3.050	2.116	
	3A35	14.65	0.87	273.0	1.550	1.755	2	26.72	41.38	0.87	771.10	4.377	4.957	
	1B16	3.11	3.1	35.0	.620	.197	-	-	3.11	3.1	35.0	.620	.197	
	1C14	3.11	0.77	55.0	.310	.354	11	89.46	102.57	0.87	1813.93	10.231	11.675	
	3E34	3.78	1.0	63.5	.620	.390	8	39.82	43.60	1.6	732.433	7.151	4.498	
	F2	9.83	0.5	184.0	.610	1.210	62	309.41	319.24	0.5	5875.60	19.808	39.292	
	2022	37.99	0.5	483.0	1.860	3.165	-	-	37.99	0.5	483.0	1.860	3.165	
	3271	10.00	.92	208.0	.930	1.008	2	18.53	28.53	.87	593.42	2.875	3.067	
	9670	120.24	0.80	547.5	1.860	2.300	-	-	120.24	.80	547.5	1.860	2.300	
	9630	285.38	1.6	1530.0	24.800	15.360	-	-	285.38	1.6	1530.0	24.800	15.360	
	TOTAL	510.42	1.2	3705.00	36.210	27.865	85	493.94	1004.37	0.8	12807.983	76.632	86.627	13.8

Bldg #	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOTAL VARIABLES					
	Bldg #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	FCOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	FCOST SAVE (\$1000/YR)	SAVE/INVEST RATIO
2R17	8-19	4.70	7-9	409-0	18-8	2-391	322	-	629-32	7-9	31427-5	1444-5	183-7	
6R10	4-70	4-70	7-9	409-0	18-8	2-391	-	-	4-70	7-9	409-0	18-8	2-391	
6R32	4-70	4-70	7-9	409-0	18-8	2-391	231	1036-80	1041-50	7-9	90632-6	4166-0	529-8	
1B16	3-11	3-11	23-0	170-0	10-9	-469	-	-	3-11	23-0	170-0	10-9	-469	
5B8	4-70	4-70	7-9	409-0	18-8	2-391	-	-	4-70	7-9	409-0	18-8	2-391	
6B31	4-70	4-70	7-9	409-0	18-8	2-391	-	-	4-70	7-9	409-0	18-8	2-391	
5B32	4-70	4-70	7-9	409-0	18-8	2-391	-	-	4-70	7-9	409-0	18-8	2-391	
1C14	3-11	3-11	23-0	170-0	10-9	-469	11	99-46	102-57	23-0	5606-7	362-4	15-467	
1E4	4-72	4-72	7-9	409-0	18-8	2-391	-	-	4-72	7-9	409-0	18-8	2-391	
1E6	4-72	4-72	7-9	409-0	18-8	2-391	162	724-50	729-22	7-9	63186-7	2904-5	369-4	
1E20	7-67	7-67	7-9	409-0	18-8	2-391	-	-	7-67	7-9	409-0	18-8	2-391	
2E4	2-28	2-28	13-7	214-0	17-1	1-247	-	-	2-28	13-7	214-0	17-1	1-247	
3E34	3-78	3-78	13-7	214-0	17-1	1-247	8	39-82	43-60	13-7	2468-3	197-23	14-38	
4431	4-72	4-72	13-7	214-0	17-1	1-247	31	159-03	163-75	13-7	7424-2	593-25	43-26	
2020	107-23	107-23	20-4	487-0	67-1	3-288	5	347-57	454-79	20-4	2065-5	284-6	13-94	
3470	50-77	50-77	28-2	298-0	55-9	1-982	6	355-08	406-85	28-2	2382-1	446-86	15-843	
3653	50-77	50-77	28-2	298-0	55-9	1-982	-	-	50-77	28-2	298-0	55-9	1-982	
9500	52-05	52-05	125-0	567-0	116-2	-929	-	-	52-05	125-0	567-0	116-2	-929	
9803	23-05	23-05	22-0	915-0	119-2	5-396	1	1-52	24-56	22-0	974-9	127-0	6-749	
TOTAL	348-67	348-67	16-5	7228-0	656-78	39-78	777	3384-91	3734-56	8-9	209873-56	10639-33	1210-510	1-3

■ BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

BDO # 42 DOMESTIC PH	C1 BUILDING VARIABLES				C2 BUILDINGS				C1 RO C2 BUILDING TOTAL VARIABLES				
	BLOO #	BLOO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLOO	BLOO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	SAVE/INVEST RATIO
	1A24	8.00	32.	4.6	1.36	-042	29	202.62	32.	121.1	35.6	1.105	
	2A17	8.19	2.6	24.0	.62	-238	322	621.13	2.6	1644.16	47.64	18.287	
	3A10	22.33	93.	35.7	19.6	-210	-	-	93.	35.7	19.6	.210	
	3A35	14.65	21.	24.4	3.1	-151	2	26.72	21.	69.9	8.75	.426	
	6A10	4.70	32.	4.6	1.36	-042	-	-	32.	4.6	1.36	.042	
	6A32	4.70	32.	4.6	1.36	-042	231	1036.80	32.	1019.34	301.37	9.307	
	7A11	3.87	2.6	24.0	.62	-238	-	-	2.6	24.0	.62	.238	
	5B8	4.70	32.	4.6	1.36	-042	-	-	32.	4.6	1.36	.042	
	5B31	4.70	32.	4.6	1.36	-042	-	-	32.	4.6	1.36	.042	
	5B32	4.70	32.	4.6	1.36	-042	-	-	32.	4.6	1.36	.042	
	10B6	14.65	48.	8.9	2.1	-044	-	-	48.	27.76	6.552	.137	
	1E4	4.72	32.	4.6	1.36	-042	12	31.06	32.	4.6	1.36	.042	
	1E20	7.67	32.	4.6	1.36	-042	-	-	32.	4.6	1.36	.042	
	2E4	2.28	2.6	24.0	.62	-238	-	-	2.6	24.0	.62	.238	
	3E34	3.78	2.6	24.0	.62	-238	8	99.82	2.6	276.82	7.151	2.745	
	4431	4.72	2.6	24.0	.62	-238	31	159.03	2.6	832.82	21.509	8.256	
	1010	20.10	11.	84.5	6.9	-605	12	121.91	11.	597.00	48.75	4.274	
	1020	18.74	11.	84.5	6.9	-605	3	59.79	11.	364.09	28.914	2.535	
	1450	33.18	11.	84.5	6.9	-605	2	3.98	11.	94.84	7.727	.677	
	2022	37.99	93.	35.7	19.6	-210	-	-	93.	35.7	19.6	.210	
	2161	28.67	93.	35.7	19.6	-210	1	22.93	93.	64.25	35.64	.378	
	2272	36.26	21.	24.4	3.1	-151	-	-	21.	24.4	3.1	.151	
	2409	7.67	2.6	24.0	.62	-238	4	25.23	2.6	102.95	2.659	1.020	
	3119	42.85	11.	84.5	6.9	-605	-	-	11.	84.5	6.9	.605	
	3114	33.46	11.	84.5	6.9	-605	-	-	11.	84.5	6.9	.605	
	3161	33.46	11.	84.5	6.9	-605	52	1627.20	11.	4193.93	342.46	30.027	
	3204	12.44	48.	8.9	2.1	-044	8	32.63	48.	32.24	7.61	.159	
	3277	2.58	2.6	24.0	.62	-238	39	224.77	2.6	2114.79	64.63	20.971	
	3553	50.77	11.	84.5	6.9	-605	-	-	11.	84.5	6.9	.605	
	3470	50.77	11.	84.5	6.9	-605	6	365.08	11.	678.48	55.16	4.836	
	5137	8.66	2.6	24.0	.62	-238	83	277.60	2.6	802.34	20.73	7.956	
	5209	8.18	21.	24.4	3.1	-151	-	-	21.	24.4	3.1	.151	
	TOTAL	544.04	17.4	1102.90	143.94	8.251	839	4866.29	9.5	13671.71	1108.952	116.361	1.2

■ BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

BDO # 44 POOL COVERS	C1 BUILDING VARIABLES				C2 BUILDINGS				C1 RO C2 BUILDING TOTAL VARIABLES				
	BLOO #	BLOO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLOO	BLOO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	SAVE/INVEST RATIO
	2161		4.85	303.0	10.000	2.065	-	-	4.85	303.0	10.000	2.065	
	3236		2.70	604.0	9.65	3.565	-	-	2.70	604.0	9.65	3.565	
	9893		1.27	1320.0	9.86	7.781	-	-	1.27	1320.0	9.86	7.781	
	TOTAL	NR	2.19	2227.0	29.510	13.421	NR	NR	2.19	2227.0	29.510	13.421	8.1

■ BUILDINGS STUDIED UNDER CONTRACT SCOPE MODIFICATION.

BDO #	C1 BUILDINGS				C1 BUILDING WRAPLES				C2 BUILDINGS				C1 AND C2 BUILDING TOTL WRAPLES				
	BDO #	BDO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (KWH BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	BDO #	BDO AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (KWH BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (KWH BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)
1A24	8-00	0.7	36.01	.200	.250	29	202.61	0.7	948.00	5.265	6.581	210.61	0.7	948.00	5.265	6.581	
2A17	8-19	2.0	5.8	.080	.040	322	621.13	2.0	445.67	6.175	3.103	629.32	2.0	445.67	6.175	3.103	
5B8	4.70	1.4	3.5	.035	.025	-	-	1.4	3.50	.035	.025	4.70	1.4	3.50	.035	.025	
5B31	4.70	0.7	14.0	.070	.100	-	-	0.7	14.02	.070	.100	4.70	0.7	14.02	.070	.100	
5B32	4.70	1.0	4.4	.030	.030	-	-	1.0	4.4	.030	.030	4.70	1.0	4.4	.030	.030	
1E4	4.72	1.1	12.3	.085	.085	-	-	1.1	12.26	.085	.085	4.72	1.1	12.26	.085	.085	
1E20	7.67	0.8	36.0	.200	.250	-	-	0.8	36.0	.200	.250	7.67	0.8	36.0	.200	.250	
2E4	2.28	1.0	4.7	.031	.031	-	-	1.0	4.7	.031	.031	2.28	1.0	4.7	.031	.031	
4A31	4.72	0.8	3.5	.020	.025	31	159.03	0.8	121.42	.684	.687	163.75	0.8	121.42	.684	.687	
1010	20.10	1.0	9.3	.066	.065	12	121.91	1.0	65.70	.459	.459	142.01	1.0	65.70	.459	.459	
1263	34.73	1.1	35.9	.280	.245	-	-	1.1	34.73	.280	.245	34.73	1.1	34.73	.280	.245	
2001	30.75	1.1	4.7	.031	.027	1	2.83	1.1	5.13	.034	.029	33.59	1.1	5.13	.034	.029	
2007	78.95	0.08	288.5	.121	1.866	-	-	0.08	288.5	.121	1.866	78.95	0.08	288.5	.121	1.866	
2020	107.23	0.4	11.7	.035	.080	5	347.57	0.4	49.62	.333	.333	454.79	0.4	49.62	.333	.333	
2022	37.88	0.7	8.3	.040	.080	-	-	0.7	8.32	.060	.060	37.88	0.7	8.32	.060	.060	
2045	14.95	0.7	12.1	.080	.080	6	93.37	0.7	87.67	.435	.435	108.33	0.7	87.67	.435	.435	
2409	7.67	.11	131.4	.100	.895	4	25.23	.11	563.63	.429	.429	32.90	.11	563.63	.429	.429	
3204	12.44	.07	481.8	.155	2.337	8	32.63	.07	1745.56	.562	.562	45.07	.07	1745.56	.562	.562	
3238	8.63	2.07	1.5	.015	.007	3	16.42	2.07	4.35	.044	.020	25.05	2.07	4.35	.044	.020	
4291	12.85	0.4	35.0	.105	.240	-	-	0.4	35.04	.105	.240	12.85	0.4	35.04	.105	.240	
5137	8.55	0.9	13.1	.080	.030	83	277.50	0.9	437.95	2.674	3.008	286.17	0.8	437.95	2.674	3.008	
5209	8.18	0.4	98.1	.250	.670	-	-	0.4	98.1	.250	.670	8.18	0.4	98.1	.250	.670	
8504	8.81	1.5	28.0	.190	.123	18	44.78	1.5	168.72	1.145	.741	53.69	1.0	168.72	1.145	.741	
9560	207.52	1.5	9.3	.060	.041	2	42.68	1.5	11.21	.072	.049	250.21	1.5	11.21	.072	.049	
TOTL	649.14	0.30	1288.91	2.346	7.752	524	1987.79	0.61	5195.37	19.393	31.777	2636.96	0.61	5195.37	19.393	31.777	29.8

BDO # 47 INSUL. DHW FRANKS	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOIR. VARIABLES				SAVE/INVEST RATIO
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	
3A2	11-19	2-1	3-2	-052	-025	1	11-71	22-89	2-1	6-54	-106	-051	
1E4	4-72	3-2	2-3	-052	-016	-	-	4-72	3-2	2-34	-052	-016	
1E20	7-67	2-9	3-4	-052	-018	-	-	7-67	2-9	3-4	-052	-018	
4431	4-72	7-4	1-0	-052	-007	31	169-03	163-75	7-4	34-69	1-804	-243	
1263	34-73	3-5	1-8	-052	-015	-	-	34-73	3-5	1-8	-052	-015	
2001	30-75	3-9	4-7	-104	-027	1	2-83	33-59	3-9	5-13	-114	-029	
2006	46-61	5-2	2-3	-104	-020	15	293-66	340-27	5-2	16-79	-789	-146	
2020	107-23	1-8	4-3	-052	-029	5	347-57	454-79	1-8	16-23	-221	-123	
2272	36-26	4-7	1-6	-052	-011	-	-	36-26	4-7	1-6	-052	-011	
3238	8-63	9-7	1-1	-052	-005	3	16-42	25-05	9-7	3-19	-151	-015	
4282	10-49	3-2	2-3	-052	-016	-	-	10-49	3-2	2-30	-052	-016	
6038	13-32	3-5	2-0	-052	-015	12	120-63	133-94	3-5	20-11	-523	-151	
6137	8-56	3-5	2-1	-052	-015	83	277-60	296-17	3-5	70-21	1-738	-501	
9503	23-05	7-4	1-0	-052	-004	1	1-62	24-56	7-4	1-07	-055	-004	
9504	8-91	6-0	1-9	-052	-008	18	44-78	53-69	6-0	11-45	-313	-048	
9640	281-73	8-6	1-3	-052	-006	7	300-92	562-64	8-6	2-79	-112	-013	
9660	207-52	4-3	2-7	-052	-012	2	42-68	250-21	4-3	3-25	-063	-014	
8666	250-91	4-3	2-7	-052	-012	27	79-36	330-87	4-3	3-56	-068	-016	
TOTAL	1077-00	3-98	41-7	1-040	0-261	206	1689-31	2776-2	4-39	208-45	6-287	1-430	4-2

BDO # 48 INSUL. DHW FRANKS	C1 BUILDINGS				C2 BUILDINGS				C1 AND C2 BUILDING TOIR. VARIABLES				SAVE/INVEST RATIO
	BLDG #	BLDG AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	ECOST SAVE (\$1000/YR)	# OF BLDG	BLDG AREA (1000 SQ FT)	TOTAL AREA (1000 SQ FT)	PAYBACK (YR)	ENERGY SAVE (MLN BTU/YR)	CONST COST (\$1000)	
1R24	8-00	-9	21-3	-125	-145	29	202-61	210-61	-9	560-75	3-291	3-817	
2R17	8-19	1-0	14-0	-080	-090	322	621-13	629-32	1-0	1075-76	7-137	7-162	
6R10	4-70	-9	21-3	-125	-145	-	-	4-70	-9	21-3	-125	-145	
1B16	3-11	1-0	18-0	-125	-130	-	-	3-11	1-0	19-0	-125	-130	
5B8	4-70	-9	21-3	-130	-145	-	-	4-70	-9	21-3	-130	-145	
5B81	4-70	-9	21-3	-125	-145	-	-	4-70	-9	21-3	-125	-145	
1C14	3-11	-9	19-4	-125	-132	11	99-46	102-57	-9	639-82	4-125	4-356	
2E4	2-28	-9	35-6	-225	-240	-	-	2-28	-9	35-6	-225	-240	
3E34	3-78	-9	21-0	-130	-144	8	39-82	43-60	-9	242-2	1-500	1-662	
4301	20-69	1-0	51-7	-360	-350	7	23-49	44-18	1-0	110-39	-747	-747	
2272	36-26	1-3	87-1	-460	-695	-	-	36-26	1-3	87-10	-460	-695	
TOTAL	99-52	0-88	332-9	2-010	2-261	377	986-5	1086-03	0-94	2834-42	17-990	19-134	12-7

2.5 SUMMARY OF OTHER ECO: The ECO which were not found to be applicable for further analysis are summarized as follows:

ECO NO.

- 7. Reduction of glass area - treated as insulated panels, ECO 4.
- 8. Replace kitchen light fixtures - included under ECO 12, Replace Incandescent Lighting.
- 10. Heating oil flow meters - do not save energy in themselves.
- 15. Electric radiant heat - see ECO 16
- 18. Economizer cycles - all air systems investigated have and are utilizing economizer cycles.
- 24. Reduce air flow - in air systems surveyed, excessive air flow was not encountered.
- 29. Chiller replacement - the only chillers encountered were those serving computer areas and are kept in good condition.
- 30. Replace absorption chiller - not applicable.
- 31. Insulate steam lines - found adequate in most buildings. DEH has active policy for steam pipe insulation.
- 35. Transformer over voltage - deleted from contract. Negotiated Scope P.5.
- 36. Transformer loading - deleted from contract. Same as ECO #35.
- 37. Revise or replace building HVAC controls - treated as ECO 17, Night Setback.
- 40. High efficiency pumps on a replacement basis - Pumps encountered were of small size (less than 5 HP) and not appropriate for change to higher efficiency.
- 43. Reduce street lights - deleted from contract. Scope p.5.
- 5. Vestibules - found applicable in eight buildings with simple paybacks ranging from 5 to 17 years. Vestibules are specific in their building application and their paybacks did not warrant extension into the general population list.

6. Loading dock seals - found to be applicable in three buildings with a range of payback of from 6 to 8-1/2 years. DEH has installed seals on nearly all of frequently used loading doors.
14. High efficiency motor replacement - motors of sufficient size and operating hours to warrant consideration occurred in four buildings with a simple payback ranging from 12 to 29 years (sufficient size is greater than 5 HP with significant hours of operation).
49. Laundry dryer heat recovery - applicable only to the main Post laundry (1401) with a simple payback of 11 years.

3.0 TRAINING AND EXPENDABLE EQUIPMENT RECOMMENDATIONS:

3.1 TRAINING:

3.2 TRAINING COURSES AND SEMINARS:

* CORPS OF ENGINEERS - under the Government Employees Training Act the Corps of Engineers have provided a number of courses that meet unique Corps training needs. Appropriate courses are:

- ELECTRICAL INSPECTION - #042/ECE-E, NO. T1MEIN
- ENERGY CONSERVATION IN EXISTING BUILDINGS - #055/2CF-U, NO. P3MECB
- ENVIRONMENTAL ENGINEERING WORKSHOP - #102/ECE-B, NO. P1MSEC
- GENERAL CONSTRUCTION INSPECTION - #054/ECC-Q, NO. T1MGIN
- MECHANICAL INSPECTION - #074/ECE, NO. T1MMIN
- REFRIGERATION & AIR CONDITIONING INSPECTION - #096/ECE-E, NO. T1MRACIN
- WATER SUPPLY AND WATER CONSERVATION PLANNING - #041/CWP-D, NO. P1MESIAWS

AUDIOVISUAL:

- TEST AND MAINTENANCE EQUIPMENT (For further information contact Industrial Training Corp.)
- PUMP DOWN, EVACUATION, AND CHARGING (For further information contact Industrial Training Corp.)

For further information on the above C.O.E. Courses, the address is: Division Engineer

U.S. Army Engineer Division, Huntsville
Attention: HNDTD-SB, Registrar
Post Office Box 1600
Huntsville, AL 35807

Phone: (205) 895-5032

OTHER APPLICABLE NON-GOVERNMENT TRAINING INCLUDES:

* WESCO - Courses in the latest advancements in Electromechanical and Solid State Control.
CONTACT: 2233 6th Ave. S. Seattle, WA 98134

* CENTER FOR PROFESSIONAL ADVANCEMENTS - Short course format for Scientists, Engineers and Technical Managers. Emphasis is placed on applied and practical aspects of science and engineering. (HVAC, Feedwater Heaters, etc.)
CONTACT: P.O. Box H, East Brunswick, NJ 08816-0257
PHONE: (201) 238-1600

* COLLEGE OF ENGINEERING, UNIVERSITY OF WISCONSIN, MADISON - Many courses offered in skill building, problem solving, technical update, career development, or whatever your continuing education needs may be. Videocassette courses are also available.
CONTACT: Department of Engineering, Professional Development, 432 North Lake St., Madison, WI 53791-9943
PHONE: 1-800-262-6243

- * ASD, INC. - Adjustable Frequency Motor Control (3 day seminar and workshop), Turbomachinery - pumps, fans and compressors (2 day seminar), Power Line Harmonics (1 day seminar and workshop).
CONTACT: 910 Sherwood Drive, Lake Bluff, IL 60044
PHONE: (312) 362-6640
- * TECHPRO - Intensive course on finding, fixing and preventing most problems.
CONTACT: 326 Hurricane Shoals Rd., Lawrenceville, GA 30245
PHONE: (404) 963-6076
- * ELECTRO TEST, INC. - Effective Electrical Preventive Maintenance and Testing.
CONTACT: 3470 Fostoria Way, P.O. Box 159, San Ramon, CA 94583
PHONE: (415) 866-8566 ext. 304
- * BIDDLE INSTRUMENT - Electrical Insulation Testing.
- * MULTI-AMP INSTITUTE - Protective Devices Maintenance.
- * INSTRUMENT SOCIETY OF AMERICA - Boiler Control for Energy Efficiency.
- * AICHE - Pump Technology.
- * MARSHALL MAINTENANCE - Centrifugal Pump Maintenance.
- * GMI ENGINEERING AND MANAGEMENT INSTITUTE - Industrial Energy Management.
- * INTERNATIONAL PROGRAMMABLE CONTROLLERS, INC. - Introduction to Programmable Controllers.
- * TEL-A-TRAIN, INC. - Programmable Controller Training Package.
- * GREEN RIVER COMMUNITY COLLEGE - Basic Hydraulics, Water/Wastewater Training, Lubricants, etc.
CONTACT: 12401 S.E. 320th St., Auburn, WA 98002
PHONE: (206) 833-9111
- * LOCTITE CORPORATION - Maintenance and Repair Seminar.
CONTACT: 705 North Mountain Rd., Newington, CT 06111
- * NATIONAL TECHNOLOGY TRANSFER, INC. - Hydraulic Systems.
CONTACT: P.O. Box 110397, Aurora, CO 80011
PHONE: (303) 360-0101
- * TACOMA COMMUNITY COLLEGE - Energy Management.
CONTACT: 5900 So. 12th St., Tacoma, WA 98465
PHONE: (206) 756-5000
- * HONEYWELL - Winter Changeover Training Workshop
- Pneumatic Temperature Control
- Burner/Boiler Start Up
CONTACT: Building Services Division, Honeywell Plaza, Minneapolis, MN 55408
PHONE: (612) 870-5200

- * GEORGE WASHINGTON UNIVERSITY - Electrical Equipment Testing and Maintenance.
CONTACT: School of Engineering & Applied Science,
Washington, D.C. 20052 PHONE: (202) 676-6106
TOLL FREE: 1-800-424-9773 (in the USA)
- * UNIVERSITY OF WASHINGTON, COLLEGE OF ENGINEERING - Engineering Management Courses, Project Cost Control.
CONTACT: 353 Loew Hall, FH-18, Seattle, WA 98195
PHONE: (206) 543-5539
- * NORTH SEATTLE COMMUNITY COLLEGE - Heating, Air Conditioning and Refrigeration Technology.
- * AEE ENERGY SEMINARS - Energy Auditing for Buildings and Industry
- Waste Heat Recovery
CONTACT: 4025 Pleasantdale Rd., Suite 340, Atlanta, GA
30340 PHONE: (404) 447-6452
- * PACIFIC LUTHERAN UNIVERSITY - Professional Development Guide 1985
CONTACT: Tacoma, WA 98447 PHONE: (206) 535-7330

3.3 AUDIOVISUAL TRAINING:

- * DUPONT - Videotapes and self-study courses in various fields.
(Some examples: Forklift Truck Operator Training,
Pipe-Fitting, Basic Rigging, Safety Training Programs,
etc.)
CONTACT: Training Services, Barley Mill 19-1210,
Wilmington, DE 19898 PHONE: (302) 992-3620
- * NUSTC - Power Principles Programs (Basics & Practice)
- Chemical Plant Operations Training Program
- Boiler Training
CONTACT: 910 Clopper Rd., Gaithersburg, MD 20878-1399
PHONE: 1-800-848-1717
- * NATIONAL EDUCATION TRAINING CORPORATION - Electrical Technology,
Hydraulics, etc.
- * INDUSTRIAL TRAINING CORPORATION - Air Conditioning and
Refrigeration Training Program.

3.4 REFERENCE MATERIALS:

- * PLANT ENGINEERING - Reference file reprints on controllers,
software, electrical controls, flowmeters, etc.
- * AEE ENERGY BOOKS - Reference catalog to help improve Operational
and Energy Efficiency. (Waste Heat Recovery, Photovoltaic
Applications, Energy Analysis, Nomograms for Steam
Generation, Boiler Operations Sourbooy, etc. Cogeneration
and Energy Management videotape courses are also
available).
CONTACT: 4025 Pleasantdale Rd., Suite 340, Atlanta, GA
30340

- * PLANT ENGINEERING - Nine (9) volumes of a Plant Engineer's Proven Problem Solvers (Electrical, Fluid Power and Mechanical Power Transmission, Material Handling, Construction, Maintenance, Pollution Control, Plant Protection and Energy Management).
CONTACT: Reprint Department, 1301 So. Grove Ave., P.O. Box 1030, Barrington, IL 60010
- * APPA - Resources in Facilities Management.
CONTACT: 1446 Duke St., Alexandria, VA 22314-3492
- * L.H. BATES VOCATIONAL - TECHNICAL INSTITUTE - Catalog of classes 1983/1984/1985
CONTACT: 1101 So. Yakima, Tacoma, WA 98405
PHONE: (206) 597-7220
- * FORT STEILACOOM COMMUNITY COLLEGE - Catalog 1984 - 1985
CONTACT: 9401 Farwest Drive SW, Tacoma, WA 98498-1999
PHONE: (206) 964-6500

3.5 EXPENDABLE EQUIPMENT: The following list of energy consuming or related repair/replacement parts with a potential life expectancy of 5 years or less (see negotiated Scope of Work for criteria) was observed at Fort Lewis during the building surveys. These parts could be replaced with more energy efficient equipment as a normal maintenance procedure.

1. Thermostats
2. Aquastats
3. Oil Burner Nozzles
4. Fan Belts
5. Fan and Motor Sheaves
6. Fluorescent Light Ballasts
7. Incandescent Light Bulbs
8. Fluorescent Light Bulbs
9. Steam Traps

ENERGY SAVING PRODUCT & INSTALLATION SPECIFICATIONS

1. Thermostats (room): Adjustable electronic over a 60 - 80 degree range (+/- 1 degree F) Mercury or Bimetallic Thermometer; Tamper proof screws; Removable adjustment nob, locking cover. Comply with Federal and Military Standards and Specification 15805-13.5.2 and 15805-13.5.3.
Manufacturers: Johnson Controls, Barber Coleman, Powers
2. Aquastats: Electronic immersion type with averaging bulb; snap action electric switch; manual surface setpoint adjustment.
Manufacturers: Johnson Controls, Powers, Honeywell
3. Oil Burner Nozzles: High efficiency turbulator type nozzle; circular spray pattern; integral filter/strainer. Comply with Corps of Engineers Guide Specification 15602.2-9.1.
Manufacturers: Monarch, Cleaver Brooks, Kiwanee

4. Fan Belts: Notched V-Belt type, match pitch of sheaves provided; belt shall not slip under full load start conditions; belt shall ride with at least 7/8" of belt radius below the wall of the sheave.
Manufacturers: Gates, Browning, Dayton
5. Fan and Motor Sheaves: Preventive Maintenance sheave replacements; remove adjustable sheaves and replace with fixed sheave. Provide the number of grooves as recommended by fan Manufacturer or as required to keep belts from slipping under full load start conditions.
Manufacturer: Gates, Browning, Dayton
- 6 & 7. Fluorescent light ballasts and bulbs: Comply with ANSI C82.1 and UL 935; UL and Certified Ballast Manufacturers (CBM) approved; for service without the use of starters. Ballasts shall be high power factor type and shall produce full light output with 430 milliampere circuits and 40 watt lamps. All ballasts shall be energy saving design that does not use more than 74 watts for bare lamp fixtures and 74 watts in enclosed fixtures for two standard 34 watt rapid start lamps with 277 volt ballasts, and 83 watts and 75 watts with 120 volt ballasts. Ballasts shall not contain any PCB. Comply with Federal Specification W-B-30A & AM-2, W-L-00116D.
Manufacturers: General Electric, Westinghouse, Jefferson, Universal or Advance mfr; rapid start circuit.
8. Incandescent Light Bulbs: Inside frosted, dual service 125 - 130 volt, krypton type or energy saving equivalent. Comply with Federal Specification W-L-101H.
Manufacturers: General Electric, Sylvania, Phillips, Westinghouse
9. Steam Traps: Energy saving float type with integral thermostatic air bypass. Provide traps for use at pressure of steam system being modified. Comply with Federal Specification W-W-T-696 for type, style and class as applicable.
Manufacturers: Sarco, Armstrong, Reliance