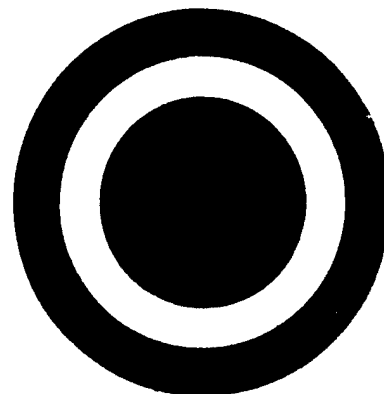
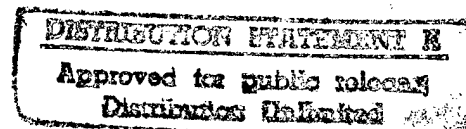


**FINAL REPORT - JANUARY 1987**  
**VOLUME 1- Executive Summary**



19971021 306



**FORT LEWIS**  
**ENERGY SAVINGS**  
**OPPORTUNITY SURVEY**

**ENERGY ENGINEERING**  
**ANALYSIS PROGRAM**  
**(EEAP)**  
**AT**  
**FORT LEWIS, WASHINGTON**  
**(A FORSCOM INSTALLATION)**

**DACA67-84-C-0064**

(DATE QUALITY INSPECTED 2)



**US Army Corps**  
**of Engineers**  
**Seattle District**




DEPARTMENT OF THE ARMY  
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
P.O. BOX 9005  
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO  
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited.  
Distribution A. Approved for public release.

  
Marie Wakefield,  
Librarian Engineering

## 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.
- 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, including 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 (8) eight ECIP projects, some of which 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, including insulation, weather stripping, boiler controls, thermostats, and high bay fans for redistribution of warm air. The Directorate of Engineering and Housing (DEH), in its program of facilities upgrading, has instituted compliance to Washington State Energy Code Requirements. In the course of this Limited Building Survey most of this activity 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), plus an additional six suggested by the A/E, 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. 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 (T-566 and T-567).
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. Appendices A, B, C, D.

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 on these building types, 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 and use. See the Limited Building Survey Map in Appendix K 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

91 buildings were surveyed and their results extended to a population of 1400 buildings at Ft. Lewis. 49 Energy Conservation Opportunities (ECO) were evaluated in each building. Those found applicable were analyzed for their energy savings. The results of this analysis are presented in the ECO Summary Chart on the following page.

1.62 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):

Appendix A contains PN 704 which will provide floor insulation in 863 buildings including those with open floor joists over unheated crawl spaces.

Appendix B contains PN 705 which will provide wall insulation in 1037 buildings.

Appendix C contains PN 706 which will provide roof/attic insulation in 1200 heated buildings where little or no insulation exists.

Appendix D contains PN 707 which will provide weatherstripping and caulking to 1177 buildings throughout the Fort; insulate panels to reduce heat loss through uninsulated walls and excessive expanses of single pane glass in 154 buildings; Domestic HW Systems will be modified to reduce energy consumption in 871 buildings.

The ECIP Chart on the following page summarizes significant data for these 4 ECIPs.

1.63 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.

NDIP

EN (THOUSANDS)	EST (THOUSANDS)	SP.FT. (THOUSANDS)	ENERGY SAVINGS (MILLIONS)	DOLLAR SAVINGS (THOUSANDS)	SIMPLE PAYBACK	S.I.R.	ANALYSIS DATE
704	3506	2931.08	131708.77	654.410	3.1	5.7	12/19/85
705	3952	4983.46	101111.91	676.731	4.7	3.8	12/19/85
706	4480	6498.54	173046.54	1060.070	3.2	5.7	12/19/85
707	3748	13311.68	80570.49	563.304	3.7	4.6	12/19/86

ECC SUMMARY CHART

Item	DESCRIPTION	\$/SQ. FT.	S.I.R.	INVESTMENT COST (\$ 1000)	ANNUAL ENERGY SAVINGS (\$/YEAR)	ANNUAL DOLLAR SAVINGS (\$1000)	SIMPLE PAYBACK
10	Install Low GPM Showerheads	462.29	108.5	54.070	51129.69	327.341	16.16
11	Light Covers/Set-Up T-Stats	4771.96	57.3	145.389	137543.03	331.789	0.17
12	Reduce Light Level	456.17	39.4	11.867	13607.11	32.805	0.36
13	Insulate Sew Pipes	2636.96	29.8	19.393	5195.37	31.777	0.61
14	Insulate Condensate Lines	41.28	20.7	.282	67.79	.480	0.60
15	Prevent Air Stratification	1004.37	13.8	76.632	13607.923	36.637	0.80
16	Insulate Supply Ducts	1066.03	12.7	17.990	3634.42	19.134	0.94
17*	Weatherstripping/Sealing (707)	6510.50	10.9	674.611	59346.92	403.108	1.7
18*	Insulate Floors (704)	3232.03	9.0	1492.074	102464.07	794.802	2.1
19	Pool Covers	N/A	6.1	25.510	2237.00	13.421	2.19
20*	Insulate Boilers (706)	6490.54	5.7	3374.965	173045.54	1660.070	3.2
21	Insulate CHW Tanks	3776.20	4.2	6.237	503.45	1.430	4.39
22	Install Electronic Timing Devices	436.91	3.8	2.692	155.59	.900	2.99
23*	Insulate Walls (705)	4993.46	3.8	2376.866	10113.51	626.730	4.7
24	Replace Incandescent Lighting	6611.95	3.8	209.841	21721.24	55.532	3.8
25	Install Panels (701)	1579.44	3.8	286.433	7832.00	44.335	6.4
26	radiator Controls	358.87	2.4	121.114	4082.36	26.183	5.0
27	Install Heat (Natural Gas)	333.05	1.6	1149.2	26244.7	149.608	7.68
28	Install Storm Windows	5330.72	1.4	4757.176	54059.82	356.999	13.3
29	Heat Pumps	3734.56	1.3	10836.33	209373.56	1310.510	8.3
30*	Instantaneous HW Heaters (707)	5412.36	1.2	1163.952	13671.71	116.361	9.3
31	Revise Boiler Controls	1773.13	1.01	394.68	2303.63	18.430	19.1
32	Control HW Circ. Pump	2311.60	.76	19.545	780.75	1.049	18.63
33	Use Efficient Lig. Source & Lig. Sensors	1477.39	.21	430.698	2332.332	6.401	67.0
34	Shutdown Energy to HW Heaters/Modul. Ctrl. (619)	2695.17	(PAYBACK BEYOND ACCEPTABLE RANGE)				----

\* SELECTED BY DEH FOR ECIP APPLICATION.

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

This analysis indicates that intertying Heating Plants #9 and #10 would result in a simple payback, using fuel savings only, of 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.

1.65 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.

1.66 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.

1.67 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 has a better payback for small hot water boilers than oxygen trim, 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.