PROGRAMMING DOCUMENTS

ENERGY ENGINEERING ANALYSIS PROGRAM

LIMITED ENERGY STUDY

FORT HUNTER LIGGETT, CALIFORNIA 1993

VOLUME IV

PREPARED FOR

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

PREPARED BY

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CONTRACT NO. DACA 05-C-92-0155

DEPARTMENT OF THE ARMY
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Marie Wakefield,
Librarian Engineering

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1. COMPONENT	FY 1995 MILITARY CONSTRUCTION PROJECT DATA	2. DATE
Army		June 1993

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Fort Hunter Liggett, California	ECIP Facility Energy Improvements

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
	80000		900.6

9. COST ESTIMATES

Item	U/M	Quantity	Unit Cost	Cost ($000)
Primary Facility				717.79
Insulate ceilings and roofs	LS	–	–	(18.9)
Install duty cycling controls	LS	–	–	(26.2)
Replace heating system pipe insulation	LS	–	–	(2.1)
Install programmable thermostats	LS	–	–	(60.7)
Replace inefficient chillers	LS	–	–	(363.8)
Install automatic-draft dampers on space heating boilers	LS	–	–	(11.9)
Retrofit to variable air volume	LS	–	–	(111.2)
Replace inefficient boilers	LS	–	–	(25.5)
Insulate domestic hot water piping	LS	–	–	(0.6)
Insulate hot water storage tanks	LS	–	–	(4.1)
Install metering faucets and flow restrictors	LS	–	–	(1.2)
Recover heat from dishwasher hot water	LS	–	–	(5.3)
Install automatic draft dampers on DHW heaters	LS	–	–	(1.6)
Replace incandescent lighting with fluorescent	LS	–	–	(34.2)
Improve power factor	LS	–	–	(50.4)
Supporting Facilities				0
Estimated Contract Cost				717.7
Contingency (10%)				71.8
Subtotal				789.5
Supervision, Inspect and Overhead (5.5%)				43.4
Unescalated CWE				832.9
Escalation to FY 1995				67.7
Total Request				900.6

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Perform the following energy conservation and cost saving retrofits:

a. Install batt insulation in ceilings of 9 bldgs (Energy Conservation Opportunity [ECO] A4).
b. Install duty cycling controls (programmable controllers) in 9 buildings (ECO B1).
c. Insulate hot water heating and cooling water piping in 12 buildings (ECO B4).
d. Install 24-hour programmable thermostats in 28 buildings (ECO B6/B7).
e. Replace chillers with more efficient systems in 10 buildings (ECO B8).
f. Install automatic-draft dampers on space heating equipment in 20 buildings (ECO B10).
g. Convert multizone air-handling system to variable air volume in 5 barracks bldgs (ECO B15).
h. Replace boilers with high-efficiency units in 7 buildings (ECO B21).
i. Insulate domestic hot water piping in 6 buildings (ECO C2).
j. Insulate 16 domestic hot water storage tanks in 13 buildings (ECO C3).
k. Install self-metering lavatory faucets in 3 buildings; and install lavatory and shower flow restrictors in 2 buildings (ECO C5).
l. Install dishwasher heat recovery unit in Building 206 (ECO C8).
m. Install automatic-draft dampers on domestic hot water heaters in 3 buildings (ECO C9).
n. Replace incandescent lighting fixtures with fluorescent fixtures in 9 buildings (ECO D4).
o. Install automatic power factor correction equipment at utility metering point. Install power factor correction capacitors on 10 HP and larger motors in 6 buildings (ECO D8).

DD FORM 1391

11. REQUIREMENT: N.A.	ADEQUATE: N.A.	SUBSTANDARD: N.A.

PROJECT: Implement energy conservation retrofits in 44 buildings. (Current mission)

REQUIREMENT: This project will contribute toward achieving Department of Defense facility energy goals of a 20-percent reduction in energy use per gross square feet by FY2000 versus FY1985 baseline levels.

This project will save $124,184 annually, resulting in a 5.9-year simple payback and a savings to investment ratio of 2.25. The annual energy savings is 2,188 MBTU of electricity, 3,277 MBTU of fuel oil and 4,242 MBTU of propane. All buildings and retrofit actions will be in active use throughout the amortization period.

CURRENT SITUATION: Unnecessary energy is currently being consumed for space heating and cooling systems, lighting systems, and generation of domestic hot water in facilities.

IMPACT IF NOT PROVIDED: If this project is not accomplished, an annual energy and operations and maintenance expense of $124,184 that could be avoided will be incurred.

ADDITIONAL: This project has been coordinated with the installation physical security plan, and no security improvements are required. This project incorporates recommendations of an Energy Engineering Analysis Program Limited Energy Study performed under Contract No. DACA05-92-C-0155.

Estimated Construction Start: July 1995	Index: 2049
Estimated Midpoint of Construction: September 1995	Index: 2062
Estimated Construction Completion: November 1995	Index: 2075

Detailed Justification

1. GENERAL: The project is a significant part of Fort Hunter Liggett's effort to achieve a 20-percent reduction in energy consumption by FY2000 versus FY1985 baseline levels.

2. ACCOMMODATIONS NOW IN USE: Not applicable.

3. ANALYSIS OF DEFICIENCY: Present system designs within the facilities proposed for retrofits account for a 14-percent loss of the total energy supplied to Fort Hunter Liggett. This translates into an additional annual cost of $124,184.

4. CONSIDERATION OF ALTERNATIVES: The retrofits included in this project represent all of the economically justified actions potential energy conservation opportunities (ECO's) evaluated in the Limited Basewide Energy Study that comply with ECIP criteria.

5. CRITERIA FOR PROPOSED CONSTRUCTION: Design and construction will be in accordance with criteria established in DOD 4270.1-M and TM810-5.

6. PROGRAM FOR RELATED FURNISHINGS AND EQUIPMENT: Not applicable.

7. DISPOSAL OF PRESENT ASSETS: Not applicable.

8. SURVIVAL MEASURES: Not applicable.

9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES: Atmospheric emissions will be reduced because less fuel will be burned as a result of implementation of this project.

10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS: Not applicable.

11. ECONOMIC JUSTIFICATION: In accordance with Energy Conservation Investment Program (ECIP) Guidance dated November 1992, an economic analysis has been prepared. Life-cycle cost analysis results are summarized as follows:

    - Estimated Construction Cost (including SIOH) $832,900
    - Annual Energy Savings ..... 9,707 MBTU
    - Total First Year Dollar Savings $124,184
    - Discounted Energy Savings $1,526,854
    - Discounted Nonenergy Savings $366,821
    - Total Net Discounted Savings $1,893,675
    - Savings-to-Investment Ratio 2.25

Refer to "Detailed Calculations" for backup data.

12. UTILITY AND TELECOMMUNICATIONS SUPPORT: Not applicable.

13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES: Review procedures have been implemented for this project in accordance with 36 CFR 800. The review has established that there will be no effect.

14. PROJECT DEVELOPMENT BROCHURE: A Project Development Brochure (PDB-1) dated July 1993 has been prepared.

15. ENERGY REQUIREMENTS: Not applicable.

16. PROVISION FOR THE HANDICAPPED: Not applicable.

17. REAL PROPERTY MAINTENANCE ACTIVITY ANALYSIS: Not applicable.

18. COMMERCIAL ACTIVITIES: This project involves replacement or modification of existing systems for energy conservation. Under these conditions, the provisions of AR 5-XX do not apply, and a "new start or expansion" is not required.

DETAILED CALCULATIONS

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

TOTAL PROJECT

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: Total Project
Analysis Date: June 1993 | Economic Life: 20 YEARS and 15 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$789,542		
B. SIOH	$43,425		
C. Design Cost	$47,373		
D. Total Cost (1A+1B+1C)	$880,339		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($38,033)	
G. Total Investment (1D-1E-1F)			$842,306

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	N Yrs	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	20 Yr	$21.84	82.1		$1,792	14.53	$26,036
	15 Yr	$21.84	1,200.5		$26,217	11.70	$306,735
	15 Yr	$18.23	905.7		$16,510	11.70	$193,168
B. Dist	20 Yr	$4.98	0.0		$0	17.63	$0
	15 Yr	$4.98	3,276.8		$16,318	13.78	$224,864
C. Propane	20 Yr	$7.87	211.7		$1,666	18.59	$30,979
	15 Yr	$7.87	4,030.0		$31,716	14.16	$449,092
D. Demand	20 Yr	$108.60	2.3	kW	$247	14.53	$3,593
	15 Yr	$108.60	230.1	kW	$24,990	11.70	$292,383
E. Other							
F. Total			9,706.7		$119,456		$1,526,854

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$6,480	20 Year Life	
	($1,752)	15 Year Life	
(1) Discount Factor (Table A)		13.59	20 Year Life
		11.12	15 Year Life
(2) Discounted Savings/Cost (3A x 3A1)		20 Year Life:	$88,063
		15 Year Life:	($19,486)

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

TOTAL PROJECT

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.	$107,993	3	0.89	$96,114
b.	$221,264	5	0.82	$181,437
c.	$30,885	10	0.67	$20,693
d. Total	$360,142			$298,243

C Total Non Energy Discounted Savings (3A2+3Bd4) $366,821

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	5.9	Years
5. Total Net Discounted Savings (2F5+3C):	$1,893,675	
6. Savings to Investment Ratio (SIR) 5/1G:	2.25	
7. Adjusted Internal Rate of Return (AIRR):	9.78%	

SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Energy Savings (Million BTU/Year)					Annual Energy Cost Savings ($/Year)				
No.	Elec Use	Elec kW	Fuel Oil	Propane	Total	Elec Use	Elec Dem	Fuel Oil	Propane	Total
A4	35.4	0.0	0.0	211.7	247.1	$774	$0	$0	$1,666	$2,441
B1	0.0	43.5	0.0	0.0	0.0	$0	$4,729	$0	$0	$4,729
B4	0.1	0.0	60.6	32.2	92.9	$1	$0	$302	$253	$556
B6/B7	686.9	0.0	2,460.0	3,223.3	6,370.2	$15,001	$0	$12,251	$25,367	$52,619
B8	353.7	164.1	0.0	0.0	353.7	$7,724	$17,821	$0	$0	$25,545
B10	0.0	0.0	282.8	174.3	457.1	$0	$0	$1,408	$1,372	$2,780
B15	863.6	0.0	0.0	0.0	863.6	$15,743	$0	$0	$0	$15,743
B21	0.0	0.0	0.0	506.1	506.1	$0	$0	$0	$3,983	$3,983
C2	0.0	0.0	35.1	14.9	50.0	$0	$0	$175	$117	$292
C3	9.2	0.0	48.3	46.1	103.6	$168	$0	$240	$363	$771
C5	32.9	0.0	0.0	2.1	35.0	$600	$0	$0	$17	$617
C8	0.0	0.0	339.0	0.0	339.0	$0	$0	$1,688	$0	$1,688
C9	0.0	0.0	51.0	31.0	82.0	$0	$0	$254	$244	$498
D4	159.8	22.5	0.0	0.0	159.8	$3,491	$2,439	$0	$0	$5,930
D8	46.6	2.3	0.0	0.0	46.6	$1,018	$247	$0	$0	$1,265
Total	2,188	232	3,277	4,242	9,707	44,519	25,237	16,318	33,382	119,456

Descriptions of ECO's

A4	Insulate Ceilings and/or Roofs
B1	Install Duty Cycling Controls
B4	Replace Heating System Pipe Insulation
B6/B7	Install Time Clocks & Programmable Thermostats
B8	Replace Inefficient Chillers
B10	Install Automatic Flue Dampers on Heating System Boilers
B15	Convert Multizone HVAC Systems to Variable Air Volume
B21	Replace Inefficient Boilers
C2	Replace Pipe Insulation on Domestic Hot Water Systems
C3	Insulate Hot Water Storage Tanks
C5	Reduce Domestic Hot Water Flow at Shower Heads and Faucets
C8	Dishwasher Heat Recovery
C9	Install Automatic Flue Dampers on DHW Systems
D4	Replace Incandescent Lighting with Fluorescent
D8	Improve Power Factor

SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Life Cycle Energy Cost Savings					Non-Energy Savings		Other
No.	Elec Use	Elec Dem	Fuel Oil	Propane	Total	Annual $/Yr	LCC $	LCC Savings
A4	$11,248	$0	$0	$30,979	$42,226	$0	$0	$0
B1	$0	$55,334	$0	$0	$55,334	($536)	($5,960)	$0
B4	$13	$0	$4,157	$3,583	$7,754	($38)	($420)	$0
B6/B7	$175,512	$0	$168,816	$359,202	$703,533	($1,689)	($18,781)	$0
B8	$90,371	$208,508	$0	$0	$298,880	$0	$0	$298,243
B10	$0	$0	$19,408	$19,423	$38,830	$0	$0	$0
B15	$184,188	$0	$0	$0	$184,188	($1,000)	($11,120)	$0
B21	$0	$0	$0	$56,397	$56,397	$0	$0	$0
C2	$0	$0	$2,409	$1,660	$4,069	$0	$0	$0
C3	$1,962	$0	$3,311	$5,134	$10,407	$0	$0	$0
C5	$7,017	$0	$0	$239	$7,256	$0	$0	$0
C8	$0	$0	$23,263	$0	$23,263	($160)	($1,779)	$0
C9	$0	$0	$3,500	$3,455	$6,954	$0	$0	$0
D4	$40,839	$28,542	$0	$0	$69,381	$1,671	$18,578	$0
D8	$14,788	$3,593	$0	$0	$18,381	$6,480	$88,063	$0
Total	$525,939	$295,976	$224,864	$480,071	$1,526,854	$4,728	$68,581	$298,243

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D8	Improve Power Factor

SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Investment Costs				Economic Evaluation		
No.	Construction	Total	PG&E Rebate	Investment	Payback	SIR	AIRR
A4	$20,777	$23,166	$0	$23,166	9.5	1.82	7.17%
B1	$28,795	$32,106	($200)	$31,906	7.6	1.55	7.03%
B4	$2,359	$2,630	$0	$2,630	5.1	2.79	11.36%
B6/B7	$66,786	$74,467	($13,500)	$60,967	1.2	11.23	22.20%
B8	$400,158	$446,176	($19,688)	$426,488	8.6	1.40	6.36%
B10	$13,059	$14,561	$0	$14,561	5.2	2.67	11.03%
B15	$122,292	$136,355	$0	$136,355	9.2	1.27	5.67%
B21	$28,061	$31,288	$0	$31,288	7.9	1.80	8.17%
C2	$655	$730	$0	$730	2.5	5.57	16.62%
C3	$4,578	$5,105	$0	$5,105	6.6	2.04	9.06%
C5	$1,326	$1,478	$0	$1,478	2.4	4.91	15.64%
C8	$5,839	$6,510	$0	$6,510	4.3	3.30	12.62%
C9	$1,712	$1,909	$0	$1,909	3.8	3.64	13.36%
D4	$37,630	$41,957	($4,645)	$37,312	4.9	2.36	10.12%
D8	$55,515	$61,899	$0	$61,899	8.0	1.72	6.86%
Total	$789,542	$880,339	($38,033)	$842,306	5.9	2.25	-

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FACILITY AND RETROFIT SUMMARY

Fac No.	Installation Name	Category Code	Area (SF)	ENERGY CONSERVATION OPPORTUNITY NUMBER														
				A-4	B-1	B-4	B-6/7	B-8	B-10	B-15	B-21	C-2	C-3	C-5	C-8	C-9	D-4	D-8
S 79	Post Office, Main	73073	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P 80	Exchange, Main Retail	74053	9,093	-	-	●	●	-	-	-	-	-	●	-	-	-	●	-
P 81	Theater with Dressing Rm's	74076	6,719	-	-	-	-	-	-	-	-	-	●	-	-	-	●	-
P 101	Hacienda	74046	22,211	-	●	-	●	●	●	-	●	-	●	-	-	●	-	-
P 116	Exchange Service Station	74052	1,788	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T 120	Fire Station	74034	9,600	-	-	-	-	-	●	-	-	-	●	-	-	-	●	-
T 121	Bowling Center	74011	5,580	-	-	-	●	-	-	-	-	-	-	-	-	-	●	-
T 127	Officers Quarters Military	72410	2,250	●	-	-	-	-	-	-	-	-	●	●	-	-	●	-
P 128	Officers Quarters Military	72410	20,196	-	-	-	●	●	●	-	-	-	-	-	-	●	●	-
S 144	Gymnasium	74034	7,172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 146	FE Facility	21920	4,042	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 156	FE Facility - Shop/Office	21920	2,250	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-
T 158	Vehicle Storage	44262	1,859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T 161	Admin General Purpose	61050	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 162	Elec Maint. Shop	21710	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 163	Officers Quarters Military	72410	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 164	Admin General Purpose	61050	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 165	Admin General Purpose	61050	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 166	Officers Quarters Military	72410	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
T 167	Officers Quarters Military	72410	2,250	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-
S 168	General Purp Warehouse	44220	6,560	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T 172	Cold Storage Warehouse	43210	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P 177	Technical Library	61065	3,599	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
P 178	Child Development Cntr	74047	3,599	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
S 182	Commissary	74021	3,000	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
S 186	Sup Svc Admin Bldg	61023	1,920	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
P 190	Post Chapel	73017	2,720	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-
S 197	Admin Bldg R&D	61060	7,728	-	-	-	-	-	●	-	-	-	●	●	-	-	●	-
S 198	General Inst Bldg	171120	1,090	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P 205	Admin General Purpose	61050	40,981	-	●	-	●	●	●	●	-	-	-	-	-	-	●	●
P 206	Enlisted Pers Dining Fac	72210	16,768	-	●	●	-	-	●	-	-	-	●	-	●	-	-	-
P 207	Enl Barracks w/o Dining	72111	35,820	-	●	●	●	●	●	●	-	●	-	-	-	-	●	●
P 208	Enl Barracks w/o Dining	72111	40,981	-	●	●	●	●	●	●	-	-	-	-	-	-	●	●
P 209	AAFES Snack Bar	74062	3,320	-	-	●	●	-	-	-	-	-	-	-	-	-	●	●
P 210	Hlth/Dntl Clinic w/ Beds	55040	10,973	-	-	-	-	-	●	-	-	-	●	-	-	●	-	●
P 211	Outdoor Swimming Pool	75030	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-
P 212	Gymnasium	74034	8,907	-	-	-	●	-	●	-	-	-	-	-	-	-	-	-
P 219	Physical Fitness Center	74028	3,212	-	-	●	-	-	●	-	-	-	●	-	-	-	-	-

● ECO recommended for this building

FACILITY AND RETROFIT SUMMARY

Fac No.	Installation Name	Category Code	Area (SF)	ENERGY CONSERVATION OPPORTUNITY NUMBER													
				A-4	B-1	B-4	B-6/7	B-8	B-10	B-15	B-21	C-2	C-3	C-5	C-8	C-9	D-4	D-8
P 229	Enl Barracks w/o Dining	72111	40,915	-	●	●	●	●	●	●	-	●	-	-	-	-	●	●
P 230	Enl Barracks w/o Dining	72111	40,981	-	●	●	●	●	●	●	-	●	-	-	-	-	●	●
S 235	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 236	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 237	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 238	Sig Photo Lab	14130	14,548	-	●	●	-	-	●	-	-	●	●	-	-	●	●	-
P 240	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 241	GM Facility	31220	10,000	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-
S 243	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 244	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 246	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 247	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P 252	Vehicle Maint Shop DS	21420	12,299	-	-	-	-	-	●	-	-	-	●	-	-	-	●	-
P 256	Vehicle Maint Shop ORG	21410	5,294	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-
P 259	Vehicle Maint Shop ORG	21410	13,667	-	-	-	-	-	●	-	-	-	-	-	-	-	●	-
S 283	FE Maintenance Shop	44220	4,000	-	-	-	●	-	-	-	-	-	-	-	-	-	●	-
S 286	Admin General Purpose	61050	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P 287	Recreation Building	74069	5,584	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-
S 288	General Purpose Warehous	44220	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S 290	Electron Equip Facility	31740	14,856	-	-	-	●	●	●	-	●	●	●	-	-	-	-	-
S 291	Cont Humid Warehouse	44230	7,400	-	-	●	●	-	●	-	-	-	-	-	-	-	●	-
P 295	Enl Barracks w/o Dining	72111	46,593	-	-	-	●	●	●	-	-	-	-	-	-	●	●	-
P 301	ADP Building	61031	10,800	-	-	-	●	●	-	-	-	-	-	-	-	-	-	-
P 642	Detached Latrine/Shower	72324	995	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-
S 220	Control Tower - Range SPT	17123	891	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ECO Number / Description

A-4 Insulate Ceilings and/or Roofs
B-1 Install Duty Cycling Controls
B-4 Replace Heating System Pipe Insulation
B-6/7 Install Time Clocks & Programmable Thermostats
B-8 Replace Inefficient Chillers
B-10 Install Automatic Flue Dampers on Heating System Boilers
B-15 Convert Multizone HVAC Systems to Variable Air Volume
B-21 Replace Inefficient Boilers
C-2 Replace Pipe Insulation on Domestic Hot Water Systems
C-3 Insulate Hot Water Storage Tanks
C-5 Reduce Domestic Hot Water Flow at Shower Heads and Faucets
C-8 Dishwasher Heat Recovery
C-9 Install Automatic Flue Dampers on DHW Systems
D-4 Replace Incandescent Lighting with Fluorescent
D-8 Improve Power Factor

● ECO recommended for this building

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO A4

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO A4 Insulate Ceilings and/or Roofs
Analysis Date: June 1993 Economic Life: 20 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$20,777		
B. SIOH	$1,143		
C. Design Cost	$1,247		
D. Total Cost (1A+1B+1C)	$23,166		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$23,166

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	35.4		$774	14.53	$11,248
B. Dist	$4.98	0.0		$0	17.63	$0
C. Propane	$7.87	211.7		$1,666	18.59	$30,979
D. Demand	$108.60	0.0	kW	$0	14.53	$0
E. Other						
F. Total				$2,441		$42,226

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		13.59	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	9.5	Years
5. Total Net Discounted Savings (2F5+3C):	$42,226	
6. Savings to Investment Ratio (SIR) 5/1G:	1.82	
7. Adjusted Internal Rate of Return (AIRR):	7.17%	

ECO A4: INSULATE CEILINGS AND/OR ROOFS

Buildings without ceiling or roof insulation are considered. Buildings considered are listed in the attached calculations.

Energy savings are based on a TRANE-TRACE computer simulation run on a 1,000 SF "Model" structure for Fort Hunter Liggett. (See attached) Energy savings are determined on a roof/ceiling square foot basis as follows:

Cooling Load and Electric Savings

Baseline =	68,596	BTUH, Load
ECO A-4 Insulation =	57,922	BTUH, Load
Savings =	10,674	BTUH, Load

Assume an EER = 10.0, thus, Electric Energy Savings for buildings with Air Conditioning are =

1.067 Watts / SF

Results are extended on a roof/ceiling SF basis, using the building cooling degree-hour calculation, design inside and outside temperatures as follows:

[Roof/Ceiling SF] x [1.067 W/SF] / [1,000 W/kW] x [Bldg CDHr/Yr] / [Design Delta T] = kWH/Yr Saved

Heating Load and Energy Savings

Baseline =	34,440	BTUH, Load
ECO A-4 Insulation =	28,447	BTUH, Load
Savings =	5,993	BTUH, Load

Load Savings are, thus =	5.99	BTUH / SF

Energy Savings are based on the building heating system efficiency. Fuel oil or propane savings are determined by dividing the load savings by the system efficiency and multiplying by the building full load hours per year (determined by dividing the building heating degree hours by the design inside-outside temperature difference).

Construction Cost

Construction costs are estimated based on "Means Construction Cost Estimating Guide 1993" for fiberglass type batt insulation with moisture barrier.

Trane Air Conditioning Economics
By: Trane Customer Direct Service Network

System 1 Peak PTAC - PACKAGED TERMINAL AIR COND.

	COOLING COIL PEAK					CLG SPACE PEAK			HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/17					Mo/Hr: 7/18			Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 96/ 70/ 70.0					OADB: 91			OADB: 27		
	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Percnt Of Tot (%)
Envelope Loads										
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	14,919		14,919	21.75	0	0.00	0	-7,898	22.93
Glass Solar	15,120	0		15,120	22.04	16,940	35.17	0	0	0.00
Glass Cond	2,421	0		2,421	3.53	2,002	4.16	-6,291	-6,291	18.27
Wall Cond	23,987	6,143		30,130	43.92	24,108	50.05	-16,474	-20,252	58.80
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	0			0	0.00	0	0.00	0	0	0.00
Sub Total==>	41,528	21,062		62,590	91.24	43,050	89.37	-22,765	-34,440	100.00
Internal Loads										
Lights	1,707	0		1,707	2.49	1,707	3.54	0	0	0.00
People	4,300			4,300	6.27	1,800	3.74	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	6,007	0	0	6,007	8.76	3,506	7.28	0	0	0.00
Ceiling Load	1,961	-1,961		0	0.00	1,614	3.35	-1,109	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				0	0.00		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	49,496	19,100	0	68,596	100.00	48,170	100.00	-23,873	-34,440	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB Deg F	Entering WB Deg F	Entering HR Grains	Leaving DB Deg F	Leaving WB Deg F	Leaving HR Grains
Main Clg	5.7	68.6	66.1	3,219	81.1	64.5	66.9	61.2	57.5	67.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	5.7	68.6								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	1,000		
Part	0		
ExFlr	0		
Roof	1,000	0	0
Wall	1,400	140	10

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-50.6	3,219	60.3	74.8
Aux Htg	0.0	0	0.0	0.0
Preheat	-1.5	3,219	60.7	61.2
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-50.6			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	0	0
Supply	3,219	3,219
Mincfm	0	0
Return	3,219	3,219
Exhaust	0	0
Rm Exh	0	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	3.22
Clg Cfm/Ton	563.16
Clg Sqft/Ton	174.94
Clg Btuh/Sqft	68.60
No. People	10
Htg % OA	0.0
Htg Cfm/SqFt	3.22
Htg Btuh/SqFt	-50.61

TEMPERATURES (F)

Type	Clg	Htg
SADB	61.2	74.8
Plenum	81.2	59.9
Return	81.1	60.7
Ret/OA	81.1	60.7
Runarnd	75.0	68.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AFTER ECO A4 IMPLEMENTED

Trane Air Conditioning Economics
By: Trane Customer Direct Service Network

V 600
PAGE 5

System 1 Peak PTAC - PACKAGED TERMINAL AIR COND.

	COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK		
Peaked at Time ==>	Mo/Hr: 7/18					Mo/Hr: 7/18		Mo/Hr: 13/ 1		
Outside Air ==>	OADB/WB/HR: 91/ 68/ 70.0					OADB: 91		OADB: 27		
	Space Sens.+Lat. (Btuh)	Ret. Air Sensible (Btuh)	Ret. Air Latent (Btuh)	Net Total (Btuh)	Percnt Of Tot (%)	Space Sensible (Btuh)	Percnt Of Tot (%)	Space Peak Space Sens (Btuh)	Coil Peak Tot Sens (Btuh)	Percnt Of Tot (%)
Envelope Loads										
Skylite Solr	0	0		0	0.00	0	0.00	0	0	0.00
Skylite Cond	0	0		0	0.00	0	0.00	0	0	0.00
Roof Cond	0	2,272		2,272	3.92	0	0.00	0	-1,468	5.16
Glass Solar	16,940	0		16,940	29.25	18,550	39.05	0	0	0.00
Glass Cond	2,002	0		2,002	3.46	1,523	3.21	-6,291	-6,291	22.11
Wall Cond	24,108	6,594		30,702	53.01	23,224	48.89	-16,474	-20,688	72.72
Partition	0			0	0.00	0	0.00	0	0	0.00
Exposed Floor	0			0	0.00	0	0.00	0	0	0.00
Infiltration	0			0	0.00	0	0.00	0	0	0.00
Sub Total==>	43,050	8,865		51,915	89.63	43,297	91.14	-22,765	-28,447	100.00
Internal Loads										
Lights	1,707	0		1,707	2.95	1,707	3.59	0	0	0.00
People	4,300			4,300	7.42	1,800	3.79	0	0	0.00
Misc	0	0	0	0	0.00	0	0.00	0	0	0.00
Sub Total==>	6,007	0	0	6,007	10.37	3,506	7.38	0	0	0.00
Ceiling Load	812	-812		0	0.00	704	1.48	-515	0	0.00
Outside Air	0	0	0	0	0.00	0	0.00	0	0	0.00
Sup. Fan Heat				0	0.00		0.00		0	0.00
Ret. Fan Heat		0		0	0.00		0.00		0	0.00
Duct Heat Pkup		0		0	0.00		0.00		0	0.00
OV/UNDR Sizing	0			0	0.00	0	0.00	0	0	0.00
Exhaust Heat		0	0	0	0.00		0.00		0	0.00
Terminal Bypass		0	0	0	0.00		0.00		0	0.00
Grand Total==>	49,868	8,054	0	57,922	100.00	47,507	100.00	-23,280	-28,447	100.00

COOLING COIL SELECTION

	Total Capacity (Tons)	Total Capacity (Mbh)	Sens Cap. (Mbh)	Coil Airfl (cfm)	Entering DB/WB/HR Deg F	Entering DB/WB/HR Deg F	Entering DB/WB/HR Grains	Leaving DB/WB/HR Deg F	Leaving DB/WB/HR Deg F	Leaving DB/WB/HR Grains
Main Clg	4.8	57.9	55.4	3,170	77.5	63.3	66.9	61.2	57.3	66.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	4.8	57.9								

AREAS

	Gross Total	Glass (sf)	(%)
Floor	1,000		
Part	0		
ExFlr	0		
Roof	1,000	0	0
Wall	1,400	140	10

HEATING COIL SELECTION

	Capacity (Mbh)	Coil Airfl (cfm)	Ent Deg F	Lvg Deg F
Main Htg	-37.2	3,170	63.9	74.8
Aux Htg	0.0	0	0.0	0.0
Preheat	-0.0	3,170	64.2	61.2
Reheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-37.2			

AIRFLOWS (cfm)

Type	Cooling	Heating
Vent	0	0
Infil	0	0
Supply	3,170	3,170
Mincfm	0	0
Return	3,170	3,170
Exhaust	0	0
Rm Exh	0	0
Auxil	0	0

ENGINEERING CHECKS

Clg % OA	0.0
Clg Cfm/Sqft	3.17
Clg Cfm/Ton	656.65
Clg Sqft/Ton	207.18
Clg Btuh/Sqft	57.92
No. People	10
Htg % OA	0.0
Htg Cfm/SqFt	3.17
Htg Btuh/SqFt	-37.22

TEMPERATURES (F)

Type	Clg	Htg
SADB	61.2	74.8
Plenum	77.6	63.7
Return	77.5	64.2
Ret/OA	77.5	64.2
Runarnd	75.0	68.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

ECO A4 INSULATE CEILINGS / ROOFS

Bldg	Area (SF)	Heating Degree Hours	Cooling Degree Hours	Heating Efficienc	Energy Use W/Previous EC			Energy Use W/ECO-A4			Energy Savings			Energy Cost Savings			
					Electric Kwh/Yr	Propane MBTU/Y	Fuel Oil MBTU/Y	Electric Kwh/Yr	Propane MBTU/Y	Fuel Oil MBTU/Y	Electric Kwh/Yr	Propane MBTU/Y	Fuel Oil MBTU/Y	Electric $/YR	Propane $/YR	Fuel Oil $/YR	Total
127	2,250	85,120	21,833	64.0%	2,783	193.1		1,036	154.1	-	1,747	39.0	0.0	$130	$307	$0	$437
161	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
162	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
163	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
164	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
165	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
166	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
167	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	-	1,234	24.7	0.0	$92	$194	$0	$286
TOTLAS											10,385	212	0	$774	$1,666	$0	

ECO A4 COST SAVINGS

Building Number	Construction Cost Cost (CC) $	Gen Cond CC x 1.08	OH & P GC x 1.30	Bond OHP x 1.01	Contingency B x 1.10	Investment $	LCC Energy Savings $	SIR
127	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$7,603	2.6
161	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
162	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
163	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
164	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
165	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
166	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
167	$1,665	$1,798	$2,338	$2,361	$2,597	$2,896	$4,946	1.7
TOTALS					$20,777	$23,166	$42,226	1.8

Construction Cost....Bare cost (see cost estimates)

General Conditions.....8% of total plus Construction Cost

OH & P.....Contractors overhead and profit 30% of Gen Cond plus Gen Cond

Bond.....1% of OH&P plus OH&P

Contingency.....Estimators contingency 10% of Bond plus Bond

Investment.....Total Construction Cost (Contingency) plus 5.5% SIOH & 6% for Design

LCC Savings.....Yearly energy savings multiplied by UPW factor for 20 years:

Electricity = 14.53

Propane = 18.59

Fuel Oil = 17.63

SIR.....LCC Savings/Investment

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993

Sheet Of

Project: EEAP Limited Energy Study

Project No.

Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO A-4 Insulate Ceilings/Roofs

Estimator

Checked By

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 127							
R-19 Batt Insulation	2250	SF	$0.24	$540	$0.50	$1,125	$1,665
Subtotal Building 127							$1,665
Building 161							
R-19 Batt Insulation	2250	SF	$0.24	$540	$0.50	$1,125	$1,665
Subtotal Building 161							$1,665
Building 162 through 167							
R-19 Batt Insulation	2250	SF	$0.24	$540	$0.50	$1,125	$1,665
Subtotal Building 162 through 167							$1,665
Building 252							
R-19 Batt Insulation	12300	SF	$0.24	$2,952	$0.50	$6,150	$9,102
Subtotal Building 252							$9,102

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO B-1

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO B1 Install Duty Cycling Controls
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$28,795		
B. SIOH	$1,584		
C. Design Cost	$1,728		
D. Total Cost (1A+1B+1C)	$32,106		
E. Salvage Value of Existing Equipment			
F. Public Utility Company Rebate		$200	
G. Total Investment (1D-1E-1F)			$31,906

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84			$0	11.70	$0
B. Dist	$4.98			$0	13.78	$0
C. Propan	$7.87			$0	14.16	$0
D. Other						
E. Demand @ $108/kW-Yr		43.5	kW	$4,729	11.70	$55,334
F. Total				$4,729		$55,334

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($536)		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			($5,960)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	($5,960)	
4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	7.6	Years
5. Total Net Discounted Savings (2F5+3C):	$49,374	
6. Savings to Investment Ratio (SIR) 5/1G:	1.55	
7. Adjusted Internal Rate of Return (AIRR):	7.07%	

ECO B1: INSTALL DUTY CYCLING CONTROLS

Duty cycling controls are installed to reduce the electrical demand charges. HVAC system equipment with fairly constant loading are selected for control. Duty cycling controls are assumed to turn off each device for a period of 10 minutes during each hour. Thus, energy demand charge cost savings are based on 1/6 th of the connected load. Savings are calculated as follows:

Motor Size: HP
Motor Efficiency: Eff%
Motor kW: HP x 0.746 kW/HP / Eff%
New kW (with Duty Cycling): Motor kW x 5 / 6
Electrical Demand Cost Savings per Year: $108.60 / kW x (Motor kW - New kW)
Economic Life (N): 15 Years
Life Cycle Electrical Demand Cost Savings:
(Cost Savings per Year) x (UPW for Electricity for N = 15 Years)
Added O&M Cost: Assumes 2 MH per year at $33.50/Hr per controller
LCC Added O&M Costs: Added O&M Cost per Year x Non-Energy UPW for N = 15 Years
Construction Costs: Based on "Means Construction Cost Estimating Guide 1993"
Investment: Construction Cost plus 5.5% SIOH and 6% Design allowance less PG&E Rebate of $25 per Timer Device. Note, controller and point wiring costs are estimated separately. One controller (with rebate) is expensed per building and one point per controlled drive is expensed).

ECO B-1 (Duty Cycling) Cost Savings

Building	Item to be Controlled	No. Ea.	HP	Mtr Eff	KW	Total kW	New kW	Demand kW Saved	Demand $/Yr	Demand $LCC	O&M Saved $/Yr	O&M Saved LCC $	Invest $	Simple Payback	SIR
Summary of Building Analysis Factors															
101	Elec Res Heaters (1)	1	-	100%	58.0	58.0	48.3	9.67	$1,050	$12,283	($67)	($745)	$4,080	4.15	2.83
205	Supply Fan Motor	1	25	87%	21.4	21.4	17.9	3.6	$388	$4,540					
	Return Fan Motor	1	10	85%	8.8	8.8	7.3	1.5	$159	$1,859					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total					31.1		5.2	$563	$6,589	($67)	($745)	$4,080	8.22	1.43
206	Supply Fan Motor	2	10	85%	8.8	17.6	14.6	2.9	$318	$3,717					
	Return Fan Motor	2	3	83%	2.7	5.4	4.5	0.9	$98	$1,142					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total					23.8		4.0	$432	$5,050	($67)	($745)	$4,080	11.19	1.06
207	Supply Fan Motor	1	25	87%	21.4	21.4	17.9	3.6	$388	$4,540					
	Return Fan Motor	1	10	85%	8.8	8.8	7.3	1.5	$159	$1,859					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total					31.1		5.2	$563	$6,589	($67)	($745)	$4,080	8.22	1.43
208	Supply Fan Motor	1	25	87%	21.4	21.4	17.9	3.6	$388	$4,540					
	Return Fan Motor	1	10	85%	8.8	8.8	7.3	1.5	$159	$1,859					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total				31.1	31.1	25.9	5.2	$563	$6,589	($67)	($745)	$4,080	8.22	1.43
229	Supply Fan Motor	1	25	87%	21.4	21.4	17.9	3.6	$388	$4,540					
	Return Fan Motor	1	10	85%	8.8	8.8	7.3	1.5	$159	$1,859					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total				31.1	31.1	25.9	5.2	$563	$6,589	($67)	($745)	$4,080	8.22	1.43
230	Supply Fan Motor	1	25	87%	21.4	21.4	17.9	3.6	$388	$4,540					
	Return Fan Motor	1	10	85%	8.8	8.8	7.3	1.5	$159	$1,859					
	Hot Water Pump	1	1	83%	0.9	0.9	0.7	0.1	$16	$190					
	Total				31.1	31.1	25.9	5.2	$563	$6,589	($67)	($745)	$4,080	8.22	1.43
238	Fan Coil Unit SA Fan	1	20	87%	17.1	17.1	14.3	2.86	$310	$3,632					
	Fan Coil Unit RA Fan	1	7.5	83%	6.74	6.7	5.6	1.12	$122	$1,428					
	Total				23.89	23.9	19.91	3.98	$432	$5,059	($67)	($745)	$3,349	9.17	1.29
Total								43.55	$4,729	$55,334	($536)	($5,960)	$31,906	7.61	1.55

NOTES: 1. Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and assume a 90% room occupancy rate. (The Hacienda is usually filled year-round.) Thus, load is 90 x .60 x .90 = 58 kW. Hacienda electric resistance heaters assumed controlled by 3 panel , each as "one" contact control point.

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet Of
Project: EEAP Limited Energy Study					Project No.		Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.		Estimator: RJB			Checked By: BIH		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Programmable Controller	1	EA	$350	$350	$750	$750	$1,100
General Conditions @ 8%							$88
Subtotal							$1,188
Contractor OH & Profit @ 30%							$356
Subtotal							$1,544
Bond @ 1%							$15
Subtotal							$1,560
Estimating Contingency @ 10%							$156
Total Probable Construction Cost							$1,716
Digital Output Control w/Wiring	1	EA	$100	$100	$320	$320	$420
General Conditions @ 8%							$34
Subtotal							$454
Contractor OH & Profit @ 30%							$136
Subtotal							$590
Bond @ 1%							$6
Subtotal							$596
Estimating Contingency @ 10%							$60
Total Probable Construction Cost							$655

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO B4

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO B-4 Replace Heating System Pipe Insulation
Analysis Date: March 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$2,358		
B. SIOH	$130		
C. Design Cost	$142		
D. Total Cost (1A+1B+1C)	$2,630		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$2,630

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.1		$1.15	11.70	$13
B. Dist	$4.98	60.6		$301.68	13.78	$4,157
C. Propane	$7.87	32.2		$253.04	14.16	$3,583
D. Demand	$108.60	0.0	kW	$0.00	11.70	$0
E. Other						
F. Total				$555.87		$7,754

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($38)		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			($420)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) ($420)

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	5.1	Years
5. Total Net Discounted Savings (2F5+3C):	$7,333	
6. Savings to Investment Ratio (SIR) 5/1G:	2.79	
7. Adjusted Internal Rate of Return (AIRR):	11.36%	

ECO B4: REPLACE HEATING SYSTEM PIPE INSULATION

efficiency; boiler efficiency for heating systems and the EER (Watts/BTUH) for cooling systems.

Energy Cost Savings

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Electricity	kWH/Yr Saved x 0.003413 MBTU/kWH x $21.84/MBTU = $/Yr Saved
Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved
Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Operation and Maintenance Cost Savings

Maintenance costs are expensed at 2.5% of the bare costs of installation per year. Note that as "Savings", entries are negative, or in parentheses.

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B4: REPLACE HEATING SYSTEM PIPE INSULATION

Steam, Hot Water and Chilled Water piping needing replacement insulation is listed by building on the attached tabular summary.

Thermal losses result from uninsulated steam, hot or chilled water piping. Energy savings are achieved when such pipes are insulated.

Energy savings are determined for each pipe size and service type by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980.

Use of the nomographs results in a heat loss (gain) rate of: BTUH per LF for "Bare" pipe and for various thicknesses of insulation on piping. For the purposes of these calculations, it is assumed that 1-inch of insulation is applied.

The attached tabular calculations are performed as follows:

Pipe Heat Loss (Gain) Calculations

Size In-Dia.:	Nominal pipe size, diameter in inches
Length LF:	Pipe length needing insulation, linear feet
Type HW/CHW:	Type of service STM (Steam), HW (Hot Water) and CHW (Chilled Water)

Heat Loss Rate BTU/Hr-LF (from Nomographs)

Bare Pipe:	Rate of heat loss or gain in BTUH/LF for bare pipe determined from the DOE nomograph
Insulated Pipe:	Rate of heat loss or gain in BTUH/LF for insulated pipe (1-inch thickness) determined from the DOE nomograph
Heating Degree Hr/Yr:	Heating Degree Hours determined for the building based on meteorologic data, the building usage schedule and inside thermostatic set points.
Boiler Efficiency:	Heating system boiler efficiency determined based on measurements of combustion efficiency and a field assessment of existing conditions. For cooling systems, an EER of 10.0 is assumed.

Energy Savings Calculations

Thermal Loss/Gain:	The thermal loss/gain "Load" is determined by multiplying the difference between BTUH/LF for bare and insulated pipe by the linear feet of piping to be insulated.
Annual Loss/Gain:	The annual load loss/gain is determined by multiplying the rate of loss (BTUH) by full load system hours per year. Full load system hours per year is determined by dividing the heating/cooling degree hours per year by the design winter/summer temperature difference.
Annual Energy Savings:	Annual energy savings is the annual load loss/gain divided by the system

ECO1 B-4 REPLACE PIPE INSULATION

Bldg	Pipe Heat Loss Calcs			BTU/Hr-LF		Heating	Boiler	Savings			Annual Energy Cost Savings			
	Size In Dia	Length LF	Type HW/CH	Bare pipe	Insl'd Pipe	Degree Hr / Yr	Eff. %	Elec KWH/Y	Propane MBTU/YR	Oil MBTU/YR	Elec $/YR	Propane $/YR	Oil $/YR	Annual $ Saved
80	1.5	50	HW	150	25	59,325	68.5%	NA	11.8	NA	NA	$93	NA	$93
190	1.25	15	HW	125	20	82,596	73.7%	NA	NA	3.8	NA	NA	$19	$19
206	4	10	HW	300	75	115,562	70.8%	NA	NA	8.0	-	-	-	
206	3	15	HW	250	60	115,562	70.8%	NA	NA	10.1	-	-	-	
206	1.5	10	HW	150	25	115,562	70.8%	NA	NA	4.4	-	-	-	
206 TOTAL	-	-	-	-	-	-	-	NA	NA	22.5	NA	NA	$112	$112
207	2.5	20	HW	200	35	85,120	71.4%	NA	NA	8.6	NA	NA	$43	$43
208	2.5	20	HW	200	35	85,120	71.4%	NA	NA	8.6	NA	NA	$43	$43
209	1.25	10	HW	125	20	71,537	61.2%	NA	2.7	NA	NA	$21	NA	$21
219	1.5	10	HW	150	25	85,120	67.0%	NA	3.5	NA	-	-	-	
219	0.75	10	HW	85	15	85,120	67.0%	NA	1.9	NA	-	-	-	
219 TOTAL	-	-	-	-	-	-	-	NA	5.4	NA	NA	$42	NA	$42
229	2.5	20	HW	200	35	85,120	71.4%	NA	NA	8.6	NA	NA	$43	$43
230	2.5	20	HW	200	35	85,120	71.4%	NA	NA	8.6	NA	NA	$43	$43
238	1.5	10	HW	150	25	60,531	68.9%	NA	2.4	NA	NA	$19	NA	$19
241	2.5	10	STM	325	50	60,531	66.6%	NA	5.4	NA	-	-	-	
241	2	10	CHW	35	5	15,420	EER=10	15.4	NA	NA	-	-	-	
241 TOTAL	-	-	-	-	-	-	-	15.4	5.4	NA	$1	$43	NA	$44
291	2	10	STM	280	75	60,531	59.8%	NA	4.5	NA	NA	$36	NA	$36
TOTALS	-	-	-	-	-	-	-	15.4	32.2	60.6	$1.14	$253	$302	$556

ECO1 B-4 REPLACE PIPE INSULATION

Bldg	LCC Energy Cost Savings				Construction Cost Estimate			O&M Savings		Economic Analysis		
	Elec LCC $	Propane LCC $	Oil LCC $	Total LCC $	Bare Cost $	Constr Cost $	Investment Total $	Annual $/Yr	LCC Total $	Total LCC Saved $	Simple Payback	SIR
80	NA	$1,311	NA	$1,311	$225	$351	$391	($6)	($63)	$1,249	4.50	3.19
190	NA	NA	$263	$263	$68	$106	$118	($2)	($19)	$244	6.79	2.07
206	NA	NA	NA	NA	-	-	-	-	-	-	-	-
206	NA	NA	NA	NA	-	-	-	-	-	-	-	-
206	NA	NA	NA	NA	-	-	-	-	-	-	-	-
206 TOTAL	NA	NA	$1,546	$1,546	$269	$420	$468	($7)	($75)	$1,471	4.44	3.15
207	NA	NA	$587	$587	$140	$218	$243	($4)	($39)	$548	6.23	2.25
208	NA	NA	$587	$587	$140	$218	$243	($4)	($39)	$548	6.23	2.25
209	NA	$297	NA	$297	$45	$70	$78	($1)	($13)	$285	3.94	3.64
219	NA	NA	NA	NA	-	-	-	-	-	-	-	-
219	NA	NA	NA	NA	-	-	-	-	-	-	-	-
219 TOTAL	NA	$600	NA	$600	$90	$140	$157	($2)	($25)	$575	3.90	3.67
229	NA	NA	$587	$587	$140	$218	$243	($4)	($39)	$548	6.23	2.25
230	NA	NA	$587	$587	$140	$218	$243	($4)	($39)	$548	6.23	2.25
238	NA	$266	NA	$266	$45	$70	$78	($1)	($13)	$254	4.43	3.24
241	NA	NA	NA	NA	-	-	-	-	-	-	-	-
241	NA	NA	NA	NA	-	-	-	-	-	-	-	-
241 TOTAL	$13	$606	NA	$619	$140	$218	$243	($4)	($39)	$580	6.03	2.38
291	NA	$503	NA	$503	$70	$109	$122	($2)	($19)	$483	3.61	3.97
TOTALS	$13	$3,583	$4,157	$7,754	$1,512	$2,358	$2,630	($38)	($420)	$7,333	5.08	2.79

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet of
Project: EEAP Limited Energy Study					Project No.		Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO B4: Replace Pipe Insulation			Estimator: RJB			Checked By: BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Building 80							
1-1/2" Pipe Insulation	50	LF	$2.50	$125	$2.00	$100	$225
Subtotal Bldg 80							$225
Building 190							
1-1/4" Pipe Insulation	15	LF	$2.50	$38	$2.00	$30	$68
Subtotal Bldg 190							$68
Building 206							
1-1/2" Pipe Insulation	10	LF	$2.50	$25	$2.00	$20	$45
3" Pipe Insulation	15	LF	$3.50	$53	$5.00	$75	$128
4" Pipe Insulation	10	LF	$3.60	$36	$6.00	$60	$96
Subtotal Bldg 190							$269
Building 207							
2-1/2" Pipe Insulation	20	LF	$3.00	$60	$4.00	$80	$140
Subtotal Bldg 207							$140
Building 208							
2-1/2" Pipe Insulation	20	LF	$3.00	$60	$4.00	$80	$140
Subtotal Bldg 208							$140
Building 209							
1-1/4" Pipe Insulation	10	LF	$2.50	$25	$2.00	$20	$45
Subtotal Bldg 209							$45
Building 219							
3/4" Pipe Insulation	10	LF	$2.50	$25	$2.00	$20	$45
1-1/2" Pipe Insulation	10	LF	$2.50	$25	$2.00	$20	$45
Subtotal Bldg 219							$90
Building 229							
2-1/2" Pipe Insulation	20	LF	$3.00	$60	$4.00	$80	$140
Subtotal Bldg 229							$140

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet of
Project: EEAP Limited Energy Study					Project No.		Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO B4: Replace Pipe Insulation			Estimator: RJB			Checked By: BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Building 230							
2-1/2" Pipe Insulation	20	LF	$3.00	$60	$4.00	$80	$140
Subtotal Bldg 230							$140
Building 238							
1-1/2" Pipe Insulation	10	LF	$2.50	$25	$2.00	$20	$45
Subtotal Bldg 238							$45
Building 241							
2-1/2" Pipe Insulation	10	LF	$3.00	$30	$4.00	$40	$70
2" Pipe Insulation	10	LF	$3.00	$30	$4.00	$40	$70
Subtotal Bldg 241							$140
Building 291							
2" Pipe Insulation	10	LF	$3.00	$30	$4.00	$40	$70
Subtotal Bldg 291							$70

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO B6 & 7

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO B6 & B7 Install Time Clocks & Programmable Thermostats
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$66,786		
B. SIOH	$3,673		
C. Design Cost	$4,007		
D. Total Cost (1A+1B+1C)	$74,467		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($13,510)	
G. Total Investment (1D-1E-1F)			$60,957

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	686.9		$15,001	11.70	$175,515
B. Dist	$4.98	2,460.0		$12,251	13.78	$168,816
C. Propane	$7.87	3,223.3		$25,367	14.16	$359,202
D. Demand	$108.60		kW	$0	11.70	$0
E. Other						
F. Total				$52,619		$703,533

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($1,689)		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			($18,781)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) ($18,781)

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	1.2	Years
5. Total Net Discounted Savings (2F5+3C):	$684,752	
6. Savings to Investment Ratio (SIR) 5/1G:	11.23	
7. Adjusted Internal Rate of Return (AIRR):	22.20%	

ECO B6 & B7: INSTALL TIME CLOCKS & PROGRAMMABLE THERMOSTATS

Installation of controls for HVAC systems will reduce energy consumption by scheduling heating and cooling service for times when it is needed and control temperatures depending on building use. Time clocks and programmable thermostats are recommended for installation in buildings which are listed in the following tabular calculations.

Energy savings are achieved by providing use-appropriate temperature control. For example, shops and warehouses are not heated to the same temperatures as are offices and dwellings. Energy savings are also achieved by controlling building HVAC systems to provide heat and cooling only during the days and times of day when it is needed. Setback temperature control is also made possible, i.e., the reduction of space heating temperature setpoints when spaces are not scheduled for use. The simultaneous operation of heating and cooling systems is also prevented by installation of these controls.

Time clocks are specified whenever building occupants do not have direct access to HVAC controls. Programmable thermostats are used for buildings and zones which require occupant control of HVAC functions.

Energy Savings Calculations

Energy savings calculations are a function of the building operating schedule, present controls, the building heating and cooling loads, site weather data, present and authorized space temperatures and operating schedules.

Heating and cooling loads are determined using either the TRANE-TRACE building energy use computer program or manual calculations for both the "Baseline" and proposed control conditions. Energy savings are calculated by applying building HVAC system operating parameters to calculated load savings. Calculations depend, in large part, on heating and cooling degree hours calculated for time and temperature schedules of each building.

Degree hours are calculated based on simulated bin temperature data (refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993). The design temperature difference during each temperature period and time-of-year are used to calculate total annual heating and cooling degree hours. Full load hours are determined and multiplied by the building block load and divided by HVAC device efficiencies to determine energy use with and without proposed controls.

Annual energy cost savings are based on energy savings calculations and energy costs:

Electricity	kWH/Yr Saved x 0.003413 MBTU/kWH x $21.84/MBTU = $/Yr Saved
Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved
Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

ECO B6 & B7: INSTALL TIME CLOCKS & PROGRAMMABLE THERMOSTATS

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

PG&E rebates of $40 per thermostat are subtracted to determine the final investment.

Operation and Maintenance Cost Savings

Additional O&M costs are expensed to provide initial and annual follow-up training and instructions concerning the operation of the proposed control systems. The additional annual O&M cost is $6.05 per thermostat (or time clock).

Life cycle additional O&M costs are determined by multiplying the annual additional O&M costs by the non-energy UPW factor of 11.12 (15 year economic life).

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B6/7 TIME CLOCKS AND PROGRAMMABLE THERMOSTATS

Fac No.	Installation Name	Existing Schedule		Heating Season		Cooling	Degree Hours per Year, 7 Days/Wk					FULL LOAD HOURS/YEAR	
		Time HVAC ON	Time HVAC OF	Setpoint Deg F	Setback Deg F	Setpoint Deg F	Heating ON	Heating Set-Back	Htg Setbk 7 Day/Wk	Total Heating	Total Cooling	Heating FLHr/Yr	Cooling FLHr/Yr
P 80	**Exchange, Main Retail**	900	1700	68	55	72	18,715	40,610	44,615	59,325	18,106	425	604
P 101	**Open Din Cons (Hacienda)**	1000	1600	70	55	72	14,616	42,688	44,615	57,304	15,420	318	514
	Club (Bar)	1600	2200	70	55	72	21,855	40,134	44,615	61,989	9,650	475	322
	Hacienda, East Rooms	1700	800	70	55	NA	98,616	7,025	44,615	105,641	NA	2,144	0
	Hacienda, West Rooms												
T 121	**Bowling Center**	800	2200	68	55	72	42,842	33,140	44,615	67,020	21,833	911	520
P 128	**Officers Quarters Military**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
S 146	**FE Facility**	700	1600	55	40	78	10,781	3,537	5,161	11,702	9,003	281	268
T 161	**Admin General Purpose**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 162	**Elec Maint. Shop**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 163	Officers Quarters Military	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 164	Admin General Purpose	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 165	Admin General Purpose	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 166	Officers Quarters Military	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 167	Officers Quarters Military	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 177	**Technical Library**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 178	**Child Development Cntr**	600	1800	72	55	72	56,886	29,446	44,615	74,412	19,953	1,022	475
S 182	**Commissary**	900	1700	68	55	72	18,715	40,610	44,615	55,122	18,106	568	431
S 186	**Sup Svc Admin Bldg**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 205	Admin General Purpose	600	2200	68	55	72	60,015	25,104	44,615	73,547	21,833	1,137	520
P 205A	**Company HQ Building**												
P 207	**Enl Barracks w/o Dining**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 207A	**Company HQ Building**												
P 208	**Enl Barracks w/o Dining**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 208A	Company HQ Building												
P 209	**AAFES Snack Bar**	600	1600	68	55	72	41,952	29,585	44,615	71,537	15,420	953	514
P 212	**Gymnasium**	1000	2100	65	40	72	18,590	5,161	5,161	23,751	21,833	453	728
P 229	**Enl Barracks w/o Dining**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 229A	Company HQ Building												
P 230	**Enl Barracks w/o Dining**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 230A	Company HQ Building												
S 283	**FE Maintenance Shop**	700	1700	55	40	72	10,781	4,287	5,161	12,238	15,420	288	367
S 290	**Electron Equip Facility**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
S 291	**Cont Humid Warehouse**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 295	**Enl Barracks w/o Dining**	600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 301	**ADP Building Office**	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
	Computer Room	0	2400	68	68	74	115,562	0	0	115,562	17,007	2,626	607

ECO B6/7 TIME CLOCKS AND PROGRAMMABLE THERMOSTATS

Fac No.	ECO B6/B7 Energy Savings			ECO B6/B7 Energy Cost Savings				Non-Energy Saving		Construction Cost					Life Cycle Cost Analysis		
	Electric kWH/Yr	Propane Mil BTU/Yr	Fuel Oil Mil BTU/Yr	Electric $/Year	Propane $/Year	Fuel Oil $/Year	Total $/Year	Non-Egy $/Yr	LCC $ Total	Bare Cost	Constr Cost	Total Cost	PG&E Rebate	Total Invest	LCC,N=15 Savings	Simple Payback	SIR
P 80	9,589	92.5	0.0	$715	$728	$0	$1,442	($1)	($7)	$171	$267	$297	$40	$257	$18,659	0.18	72.489
P 101	28,041	0.0	0.0	$2,090	$0	$0	$2,090	($194)	($2,159)	$5,463	$8,521	$9,501	$1,280	$8,221	$22,296	4.34	2.712
T 121	186	6.0	0.0	$14	$47	$0	$61	($1)	($7)	$274	$427	$477	$90	$387	$820	6.42	2.122
P 128	22,574	682.9	0.0	$1,683	$5,375	$0	$7,057	($279)	($3,103)	$6,302	$9,830	$10,961	$2,070	$8,891	$92,690	1.31	10.426
S 146	1,022	12.2	0.0	$76	$96	$0	$172	($6)	($67)	$308	$480	$536	$85	$451	$2,183	2.71	4.845
T 161	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 162	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 163	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 164	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 165	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 166	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
T 167	2,006	12.3	0.0	$150	$97	$0	$246	($1)	($7)	$274	$427	$477	$90	$387	$3,113	1.57	8.054
P 177	3,526	16.7	0.0	$263	$132	$0	$394	($6)	($67)	$137	$214	$238	$45	$193	$4,871	0.50	25.203
P 178	5,588	22.4	0.0	$417	$176	$0	$593	($6)	($67)	$21	$33	$37	$0	$37	$7,302	0.06	199.929
S 182	2,522	29.4	0.0	$188	$231	$0	$419	($6)	($67)	$137	$214	$238	$45	$193	$5,405	0.47	27.965
S 186	3,197	35.8	0.0	$238	$282	$0	$520	($1)	($7)	$274	$427	$477	$90	$387	$6,771	0.74	17.516
P 205 P 205A	105	0.0	492.0	$8	$0	$2,450	$2,458	($85)	($944)	$1,918	$2,992	$3,336	$630	$2,706	$32,910	1.14	12.163
P 207 P 207A	105	0.0	492.0	$8	$0	$2,450	$2,458	($85)	($944)	$1,918	$2,992	$3,336	$630	$2,706	$32,910	1.14	12.163
P 208 P 208A	105	0.0	492.0	$8	$0	$2,450	$2,458	($85)	($944)	$1,918	$2,992	$3,336	$630	$2,706	$32,910	1.14	12.163
P 209	11,449	6.9	0.0	$853	$54	$0	$908	($1)	($7)	$274	$427	$477	$90	$387	$10,747	0.43	27.803
P 212	1,238	321.0	0.0	$92	$2,526	$0	$2,619	($1)	($7)	$274	$427	$477	$90	$387	$36,845	0.15	95.318
P 229 P 229A	105	0.0	492.0	$8	$0	$2,450	$2,458	($85)	($944)	$1,918	$2,992	$3,336	$630	$2,706	$32,910	1.14	12.163
P 230 P 230A	105	0.0	492.0	$8	$0	$2,450	$2,458	($85)	($944)	$1,918	$2,992	$3,336	$630	$2,706	$32,910	1.14	12.163
S 283	57	23.0	0.0	$4	$181	$0	$185	($6)	($67)	$137	$214	$238	$45	$193	$2,545	1.08	13.170
S 290	9,292	305.4	0.0	$693	$2,403	$0	$3,096	($24)	($270)	$548	$855	$953	$180	$773	$41,864	0.25	54.151
S 291	5,142	105.7	0.0	$383	$832	$0	$1,215	($1)	($7)	$274	$427	$477	$90	$387	$16,261	0.32	42.067
P 295	74,049	1,159.5	0.0	$5,520	$9,125	$0	$14,645	($728)	($8,095)	$16,440	$25,644	$28,593	$5,400	$23,193	$185,695	1.67	8.007
P 301	9,212	317.9	0.0	$687	$2,502	$0	$3,188	($1)	($7)	$274	$427	$477	$90	$387	$43,451	0.12	112.407
Totals	201,252	3,223	2,460	$15,001	$25,367	$12,251	$52,619	($1,689)	($18,781)	$42,816	$66,786	$74,467	$13,510	$60,957	$684,752	1.20	11.233

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		SHEET OF
Project EEAP Limited Energy Study					Project No.	Basis for Estimate Code A (no design competed)	
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO-B6/7 (T-Clock / Programmable Tstat)		Estimator RJB			Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Building 80							
Time Clock & Wiring	1	EA	$51	$51	$120	$120	$171
Subtotal (Bldg 80)							$171
Building 101 Dining & Lounge Areas and Dwelling Units							
Time Clock & Wiring - Din/Lng	2	EA	$51	$102	$120	$239	$341
Time Clock & Wiring - Dwellings	30	EA	$51	$1,534	$120	$3,587	$5,121
Subtotal (Bldg 101 Dining & Lounge Areas and Dwelling Units)							$5,463
Building 121							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 121)							$274
Building 128							
24 Hour Auto T-Stat	46	EA	$32	$1,472	$105	$4,830	$6,302
Subtotal (Bldg 128)							$6,302
Building 146							
24 Hour Auto T-Stat	1	EA	$32	$32	$105	$105	$137
Time Clock & Wiring	1	EA	$51	$51	$120	$120	$171
Subtotal (Bldg 146)							$308
Buildings 161, 162, 163, 164, 165, 166 & 167, each							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldgs 161, 162, 163, 164, 165, 166 & 167, each)							$274
Building 177							
24 Hour Auto T-Stat	1	EA	$32	$32	$105	$105	$137
Subtotal (Bldg 177)							$137
Building 178							
Reset Existing Timer	1	EA	$16	$16	$5	$5	$21
Subtotal (Bldg 178)							$21
Building 182							
24 Hour Auto T-Stat	1	EA	$32	$32	$105	$105	$137
Subtotal (Bldg 182)							$137
Building 186							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 186)							$274
Subtotal, this Sheet, including all buildings							$15,004

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		SHEET OF
Project: EEAP Limited Energy Study					Project No.		Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO-B6/7 (T-Clock / Programmable Tstat)			Estimator: RJB			Checked By: BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Buildings 205, 207, 208, 229 & 230, each							
24 Hour Auto T-Stat	14	EA	$32	$448	$105	$1,470	$1,918
Subtotal (Bldgs 205, 207, 208, 229 & 230, each)							$1,918
Building 209							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 209)							$274
Building 212							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 212)							$274
Building 283							
24 Hour Auto T-Stat	1	EA	$32	$32	$105	$105	$137
Subtotal (Bldg 283)							$137
Building 290							
24 Hour Auto T-Stat	4	EA	$32	$128	$105	$420	$548
Subtotal (Bldg 290)							$548
Building 291							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 291)							$274
Building 295							
24 Hour Auto T-Stat	120	EA	$32	$3,840	$105	$12,600	$16,440
Subtotal (Bldg 295)							$16,440
Building 301							
24 Hour Auto T-Stat	2	EA	$32	$64	$105	$210	$274
Subtotal (Bldg 301)							$274
Subtotal, this sheet							$27,811
Subtotal (ECO B-6/7), all sheets							$42,815
General Conditions 8%							$3,425
Subtotal							$46,240
Contractor O.H. & P. 30%							$13,872
Subtotal							$60,112
Bond 1%							$601
Subtotal							$60,713
Estimating Contingency 10%							$6,071
Total Probable Construction Cost							$66,785

Life Cycle Cost Analysis Summary ECO B-8
Energy Conservation Investment Program (ECIP)

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO B-8 Replace Inefficient Chillers
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$400,158		
B. SIOH	$22,009		
C. Design Cost	$24,009		
D. Total Cost (1A+1B+1C)	$446,176		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$19,688	
G. Total Investment (1D-1E-1F)			$426,488

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	353.7		$7,724	11.70	$90,371
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	164.1	kW	$17,821	11.70	$208,508
E. Other						
F. Total				$25,545		$298,880

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.	$107,993	3	0.89	$96,114
b.	$221,264	5	0.82	$181,437
c.	$30,885	10	0.67	$20,693
d. Total	$360,142			$298,243

C Total Non Energy Discounted Savings (3A2+3Bd4) $298,243

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	8.6	Years
5. Total Net Discounted Savings (2F5+3C):	$597,123	
6. Savings to Investment Ratio (SIR) 5/1G:	1.40	
7. Adjusted Internal Rate of Return (AIRR):	6.36%	

ECO B8: REPLACE INEFFICIENT CHILLERS

Many HVAC refrigeration devices (chillers and air conditioners) at Fort Hunter Liggett are inefficient. Energy savings can be achieved by replacing the original systems installed with newer, high efficiency devices. Most of the existing systems were constructed before new efficiency standards were in place. They are aging and many are at the ends of their economic lives.

Replacing existing units with new, high efficiency units is proposed.

Energy Savings

Electric power consumption of existing units is based on field measurements of equipment operating efficiencies and on computer and manual simulations of building cooling energy use. Refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993 for baseline energy use calculations. Energy savings are determined by considering coefficients of performance (COP) and energy efficiency ratios (EER) of proposed new equipment against those of existing equipment. The electrical power needed to satisfy the same cooling loads with new vs. existing devices is compared. The differences constitute electric power savings.

The COP's and EER's of proposed replacement units are provided by equipment manufacturers for the design conditions at Fort Hunter Liggett.

Both electric power use and demand are lowered by the proposed equipment replacements. Refer to the attached tabular calculations.

Energy Cost Savings

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Electric Use	kWH/Yr Saved x 0.003413 MBTU/kWH x $21.84/MBTU = $/Yr Saved
Electric Demand	kW Saved x $108.60/Year-kW = $/Yr Saved from demand charges

Life Cycle Energy Cost Savings for economic life of 15 years:

Electric Use	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved
Electric Demand	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on equipment manufacturer quotes and on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

ECO B8: REPLACE INEFFICIENT CHILLERS

Total Cost is determined by adding the following line items to the Construction Cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

It is assumed that existing units to be removed have salvage values equal to their disposal costs.

PG&E, the utility company supplying electric power offers a rebate for replacement of inefficient cooling equipment with high efficiency equipment. The rebate depends on device efficiency improvement; rebates for each proposed replacement are shown on the attached tabular calculations.

Investment is determined by subtracting the utility company rebate from the Total Cost.

Operation and Maintenance Cost Savings

Maintenance costs are assumed the same as for existing equipment.

Avoided Cost of Equipment Replacement

The economic life of HVAC equipment is set at 15 years for ECIP project evaluations. All the refrigeration devices proposed for replacement will need to be replaced before the end of the project life cycle analysis period. Thus, equipment replacement costs are expensed as a single year cash flow (savings) discounted for the year of occurence. Remaining equipment lifetimes used in economic analysis calculations are based on discussions with maintenance personnel at Fort Hunter Liggett. Refer to the attached tabular calculations.

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and avoided cost savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B8 - Replace Inefficient Chillers

Fac No.	Installation Name	Unit Nominal Tonnage	Existing Clng Usage (KWH/YR)	Existing Unit EER	New Unit EER	New Clng Usage (KWH/YR)	Savings (KWH/YR)	Demand Savings (KW)
P 101	Open Din Cons (Hacienda)	20	3,549	7.5	9.7	2,744	805	7.3
P 128	Officers Quarters Military	25	37,747	7.5	9.7	29,186	8,561	9.1
P 205	Admin General Purpose	80	75,112	8.5	10.6	60,231	14,881	22.4
P 207	Enl Barracks w/o Dining	80	75,112	8.5	10.6	60,231	14,881	22.4
P 208	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
P 229	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
P 230	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
S 290	Electron Equip Facility	25	4,843	7.5	9.3	3,906	937	7.7
P 295	Enl Barracks w/o Dining	54	93,825	8.5	9.8	81,379	12,446	10.1
P 301	ADP Building	60	18,832	8.5	10.8	14,821	4,011	18.0
	TOTALS		546,770			443,147	103,623	164

ECO B8 - Replace Inefficient Chillers

Fac No.	Annual Cost Savings ($)	Life Cycle Cost Savings ($)	Capitol Costs ($)	PG&E Rebate	Total Invest $	Single Year Savings (1)			Savings Investment Ratio (SIR)
						Savings $	Year Saving Occurs	LCC Savings $	
P 101	$848	$9,924	$22,852	$1,760	$23,720	$20,567	3	$18,304	1.19
P 128	$1,623	$18,994	$24,544	$2,200	$25,167	$22,090	5	$18,113	1.47
P 205	$3,539	$41,408	$44,261	$1,120	$48,231	$39,835	5	$32,665	1.54
P 207	$3,539	$41,408	$44,261	$1,120	$48,231	$39,835	5	$32,665	1.54
P 208	$3,600	$42,123	$44,261	$1,120	$48,231	$39,835	5	$32,665	1.55
P 229	$3,600	$42,123	$44,261	$1,120	$48,231	$39,835	5	$32,665	1.55
P 230	$3,600	$42,123	$44,261	$1,120	$48,231	$39,835	5	$32,665	1.55
S 290	$911	$10,655	$24,451	$1,800	$25,463	$22,006	3	$19,585	1.19
P 295	$2,026	$23,704	$72,689	$2,808	$78,240	$65,420	3	$58,224	1.05
P 301	$2,258	$26,419	$34,317	$5,520	$32,743	$30,885	10	$20,693	1.44
	$25,545	$298,880	$400,158	$19,688	$426,488	$360,142	-	$298,243	1.40

NOTE:

1. Single year (Non-recurring, non-energy) cost savings represent the avoided cost of replacing units at the ends of their useful lifetimes. Remaining lifetimes, shown by "year of savings" are DEH maintenance worker opinions based on years of experience maintaining the equipment.

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet of
Project: EEAP Limited Energy Study					Project No.	Basis for Estimate: Code A (no design competed)	
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO B-8 REPLACE COOLING EQUIP.		Estimator: JCC			Checked By: BIH		
Line Item	Quantity: No. Units	Quantity: Unit Meas.	Labor: Per Unit	Labor: Total	Material: Per Unit	Material: Total	Total Cost
BUILDING 101							
Demolish existing unit	1	EA	$750	$750	-	$0	$750
Install 20 ton Air Cooled Unit	1	EA	$2,400	$2,400	$11,500	$11,500	$13,900
Subtotal							$14,650
General Conditions @ 8%							$1,172
Subtotal							$15,822
Contractor OH & Profit @ 30%							$4,747
Subtotal							$20,569
Bond @ 1%							$206
Subtotal							$20,774
Estimating Contingency @ 10%							$2,077
TOTAL PROBABLE CONSTRUCTION COST							$22,852
BUILDING 128							
Demolish existing unit	1	EA	$810	$810	-	$0	$810
Install 25 ton Air Cooled Unit	1	EA	$2,625	$2,625	$12,300	$12,300	$14,925
Subtotal							$15,735
General Conditions @ 8%							$1,259
Subtotal							$16,994
Contractor OH & Profit @ 30%							$5,098
Subtotal							$22,092
Bond @ 1%							$221
Subtotal							$22,313
Estimating Contingency @ 10%							$2,231
TOTAL PROBABLE CONSTRUCTION COST							$24,544

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		Sheet of
Project EEAP Limited Energy Study					Project No.	Basis for Estimate Code A (no design competed)	
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO B-8 REPLACE COOLING EQUIP.			Estimator JCC			Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
BUILDING 205, 207, 208, 229 & 230 (EACH)							
Demolish existing unit	1	EA	$750	$750	-	$0	$750
Install 80 ton Air Cooled Unit	1	EA	$2,625	$2,625	$25,000	$25,000	$27,625
Subtotal							$28,375
General Conditions @ 8%							$2,270
Subtotal							$30,645
Contractor OH & Profit @ 30%							$9,194
Subtotal							$39,839
Bond @ 1%							$398
Subtotal							$40,237
Estimating Contingency @ 10%							$4,024
TOTAL PROBABLE CONSTRUCTION COST							$44,261
BUILDING 290							
Demolish existing unit	1	EA	$750	$750	-	$0	$750
Install 80 ton Air Cooled Unit	1	EA	$2,625	$2,625	$12,300	$12,300	$14,925
Subtotal							$15,675
General Conditions @ 8%							$1,254
Subtotal							$16,929
Contractor OH & Profit @ 30%							$5,079
Subtotal							$22,008
Bond @ 1%							$220
Subtotal							$22,228
Estimating Contingency @ 10%							$2,223
TOTAL PROBABLE CONSTRUCTION COST							$24,451

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet of
Project: EEAP Limited Energy Study					Project No.	Basis for Estimate: Code A (no design competed)	
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO B-8 REPLACE COOLING EQUIP.		Estimator: JCC			Checked By: BIH		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
BUILDING 295							
Demolish existing unit	1	EA	$1,250	$1,250	-	$0	$1,250
Install 80 ton Air Cooled Unit	1	EA	$6,450	$6,450	$38,900	$38,900	$45,350
Subtotal							$46,600
General Conditions @ 8%							$3,728
Subtotal							$50,328
Contractor OH & Profit @ 30%							$15,098
Subtotal							$65,426
Bond @ 1%							$654
Subtotal							$66,081
Estimating Contingency @ 10%							$6,608
TOTAL PROBABLE CONSTRUCTION COST							$72,689
BUILDING 301							
Demolish existing unit	1	EA	$1,000	$1,000	-	$0	$1,000
Install 80 ton Air Cooled Unit	1	EA	$2,100	$2,100	$18,900	$18,900	$21,000
Subtotal							$22,000
General Conditions @ 8%							$1,760
Subtotal							$23,760
Contractor OH & Profit @ 30%							$7,128
Subtotal							$30,888
Bond @ 1%							$309
Subtotal							$31,197
Estimating Contingency @ 10%							$3,120
TOTAL PROBABLE CONSTRUCTION COST							$34,317

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO B10

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: ECO B10 Install Automatic Flue Dampers on Heating System Boilers
Analysis Date: June 1993 | Economic Life: 15 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$13,059		
B. SIOH	$718		
C. Design Cost	$784		
D. Total Cost (1A+1B+1C)	$14,561		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$14,561

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.0		$0	11.70	$0
B. Dist	$4.98	282.8		$1,408	13.78	$19,408
C. Propane	$7.87	174.3		$1,372	14.16	$19,423
D. Demand	$108.60	0.0	kW	$0	11.70	$0
E. Other						
F. Total		457.1		$2,780		$38,830

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	5.2	Years
5. Total Net Discounted Savings (2F5+3C):	$38,830	
6. Savings to Investment Ratio (SIR) 5/1G:	2.67	
7. Adjusted Internal Rate of Return (AIRR):	11.03%	

ECO B10: INSTALL AUTOMATIC FLUE DAMPERS ON HEATING SYSTEM BOILERS

This measure is developed to evaluate the potential energy savings created by the installation of an automatic damper which closes off the flue whenever the burner has completed a firing cycle.

During normal operations, about 2% to 3% of boiler fuel use is lost through the flue between burner firing cycles.

Energy Savings Calculations

Energy savings are achieved by raising the boiler/heater efficiency by about 1.5%. Fuel savings are determined based on baseline fuel use and existing boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

$$Qs = Qo - Qo \times Efficiency / (Efficiency + 1.5\%)$$

where:
- Qs = Fuel Savings
- Qo = Baseline fuel use (after reduction of domestic hot water temperatures to authorized levels)
- Efficiency = Baseline system efficiency

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.
Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.
Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B10 INSTALL AUTOMATIC FLUE DAMPERS ON HEATING SYSTEM BOILERS

Fac No.	Installation Name	No. of Flues & Dia	ECO B10 Energy Savings: Automatic Flue Dampers										
			Electric kWH/Yr	Propane Mil BTU/Y	Fuel Oil Mil BTU/Y	Electric $/Yr	Propane $/Yr	Fuel Oil $/Yr	LCC $ Saved	Constr Cost	Investment	Payback Years	SIR
P 101	Open Din Cons (Hacienda) Club (Bar)	2 x 8"	-	23.5	-	-	$184.99	-	$2,619	$1,136	$1,267	6.85	2.07
T 120	Fire Station - Office Fire Station - Dorm Fire Station - Garage	2 x 6"	-	15.7	-	-	$123.44	-	$1,748	$1,082	$1,206	9.77	1.45
P 128	Officers Quarters Military	8"	-	13.1	-	-	$102.99	-	$1,458	$568	$633	6.15	2.30
S 197	Admin Bldg R&D - Office Admin Bldg R&D - Electronics	6"	-	5.7	-	-	$44.87	-	$635	$541	$603	13.44	1.05
P 205 P 205A	Admin General Purpose Company HQ Building	8"	-	-	28.2	-	-	$140.25	$1,933	$582	$649	4.63	2.98
P 206	Enlisted Pers Dining Fac Kitchen Area - Scullery	2 x 8"	-	-	81.8	-	-	$407.38	$5,614	$1,164	$1,298	3.19	4.33
P 207 P 207A	Enl Barracks w/o Dining Company HQ Building	8"	-	-	28.3	-	-	$140.90	$1,942	$582	$649	4.61	2.99
P 208 P 208A	Enl Barracks w/o Dining Company HQ Building	8"	-	-	28.0	-	-	$139.49	$1,922	$582	$649	4.65	2.96
P 210	Hlth/Dntl Clinic w/ Beds	8"	-	-	21.5	-	-	$106.94	$1,474	$582	$649	6.07	2.27
P 211	Outdoor Swimming Pool	8"	-	27.2	-	-	$214.28	-	$3,034	$568	$633	2.96	4.79
P 212	Gymnasium	6"	-	16.5	-	-	$129.83	-	$1,838	$541	$603	4.65	3.05
P 219	Physical Fitness Center	8"	-	9.4	-	-	$74.16	-	$1,050	$568	$633	8.54	1.66
P 229 P 229A	Enl Barracks w/o Dining Company HQ Building	8"	-	-	28.1	-	-	$139.87	$1,927	$582	$649	4.64	2.97
P 230 P 230A	Enl Barracks w/o Dining Company HQ Building	8"	-	-	28.4	-	-	$141.35	$1,948	$582	$649	4.59	3.00
S 238	Sig Photo Lab Process	4"	-	10.8	-	-	$85.17	-	$1,206	$531	$592	6.95	2.04
P 252	Vehicle Maint Shop DS	8"	-	-	18.5	-	-	$92.11	$1,269	$582	$649	7.05	1.96
P 259	Vehicle Maint Shop ORG	8"	-	-	20.1	-	-	$100.11	$1,379	$582	$649	6.48	2.13
S 290	Electron Equip Facility	8"	-	17.4	-	-	$137.19	-	$1,943	$568	$633	4.62	3.07
S 291	Cont Humid Warehouse	8"	-	9.4	-	-	$74.03	-	$1,048	$568	$633	8.55	1.66
P 295	Enl Barracks w/o Dining	8"	-	25.5	-	-	$200.71	-	$2,842	$568	$633	3.16	4.49
TOTALS			0.0	174.3	282.8	$0	$1,372	$1,408	$38,830	$13,059	$14,561	5.24	2.67

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		Sheet OF
Project EEAP Limited Energy Study					Project No.		Basis for Estimate Code A (no design competed)
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO-B10 Install Automatic Flue Dampers			Estimator RJB				Checked By BIH
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
GAS FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	$32	$134	$134	$166
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 4-inch Flue, Gas Fired							$346
General Conditions 8%							$28
Contractor O.H. & P 30%							$104
Sub Total							$478
Bond 1%							$5
Sub Total							$483
Estimating Contingency 10%							$48
Total Probable Construction Cost							$531
6-inch Diameter Auto-Damper	1	Ea	34.90	$35	$138	$138	$173
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 6-inch Flue, Gas Fired							$353
General Conditions 8%							$28
Contractor O.H. & P 30%							$106
Sub Total							$487
Bond 1%							$5
Sub Total							$492
Estimating Contingency 10%							$49
Total Probable Construction Cost							$541
8-inch Diameter Auto-Damper	1	Ea	38.40	$38	$152	$152	$190
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 8-inch Flue, Gas Fired							$370
General Conditions 8%							$30
Contractor O.H. & P 30%							$111
Sub Total							$511
Bond 1%							$5
Sub Total							$516
Estimating Contingency 10%							$52
Total Probable Construction Cost							$568

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		Sheet OF
Project EEAP Limited Energy Study					Project No.	Basis for Estimate Code A (no design competed)	
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO-B10 Install Automatic Flue Dampers		Estimator RJB			Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
OIL FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	$32	$156	$156	$188
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 4-inch Flue, Oil Fired							$368
General Conditions 8%							$29
Contractor O.H. & P 30%							$29
Sub Total							$426
Bond 1%							$4
Sub Total							$431
Estimating Contingency 10%							$43
Total Probable Construction Cost							$474
6-inch Diameter Auto-Damper	1	Ea	34.90	$35	$161	$161	$196
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 6-inch Flue, Oil Fired							$376
General Conditions 8%							$30
Contractor O.H. & P 30%							$113
Sub Total							$519
Bond 1%							$5
Sub Total							$524
Estimating Contingency 10%							$52
Total Probable Construction Cost							$576
8-inch Diameter Auto-Damper	1	Ea	38.40	$38	$161	$161	$199
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 8-inch Flue, Oil Fired							$379
General Conditions 8%							$30
Contractor O.H. & P 30%							$114
Sub Total							$524
Bond 1%							$5
Sub Total							$529
Estimating Contingency 10%							$53
Total Probable Construction Cost							$582

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO B15

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: ECO B15 Convert Multizone HVAC Systems to Variable Air Volume
Analysis Date: June 1993 | Economic Life: 15 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$122,292		
B. SIOH	$6,726		
C. Design Cost	$7,338		
D. Total Cost (1A+1B+1C)	$136,355		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$136,355

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$18.23	863.6	$15,743	11.70	$184,188
B. Dist	$4.98	0	$0	13.78	$0
C. Propane	$7.87	0	$0	14.16	$0
D. Other	NA	0	$0	NA	NA
E. Demand Savings			$0	11.70	$0
F. Total		864	$15,743		$184,188

3. Non Energy Savings (+) or Cost (-):			
A. Annual Recurring (+/-)	($1,000)		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			($11,120)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.	$0	15	0.56	$0
b.	$0	15	0.56	$0
c.	$0	15	0.56	$0
d. Total	$0	0	0.00	$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($11,120)	
4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	9.25	Years
5. Total Net Discounted Savings (2F5+3C):	$173,068	
6. Savings to Investment Ratio (SIR) 5/1G:	1.27	
7. Adjusted Internal Rate of Return (AIRR):	5.67%	

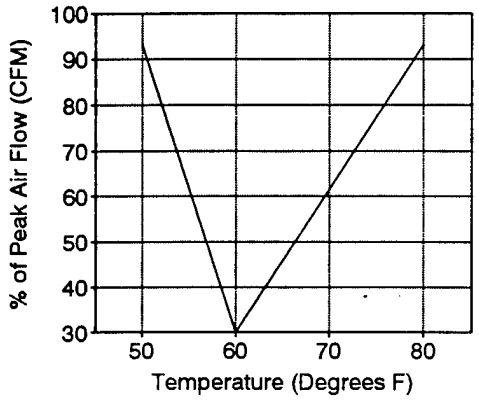
ECO B15: CONVERT MULTIZONE HVAC SYSTEMS TO VARIABLE AIR VOLUME

Large barracks buildings 205, 207, 208, 229 and 230 are served by dual duct, multizone central HVAC systems. Operation of hot and cold decks simulataneously has been precluded by a past controls modification. The existing controls allow simultaneous operation in only the heating or cooling mode.

Energy Savings Calculations

Energy savings can be achieved by removing existing dual duct mixing boxes and controls and replacing them with variable air volume boxes and controls. Energy savings are achieved by scheduling constant temperature supply air at air flow rates corresponding to the heating or cooling load.

As shown below, the variable air volume system saves fan energy during all times of the year except when the system is at full load heating or cooling mode. (Note: Air flow rates are proportional to fan power.)



Barracks buildings are assumed to be dominated by external HVAC loads. Thus, the required air flow will track with the outside air temperature.

The following schedule is derived from local weather data to approximate the air flow rates to be provided by the VAV system during different outside air temperatures ranges.

Temperature Range	Percent of Total CFM	Percent of Year at Load	VAV Fan Load per Temp Range
over 80 Degrees	100%	7%	7%
60 to 80 Degrees	80%	52%	42%
30 to 50 Degrees	40%	40%	16%
below 30 Degrees	100%	1%	1%
Weighted average VAV Fan Energy of Existing Use:			66%

Only fan energy is saved, thus, baseline fan energy use is reduced to 66% of the existing system use. Refer to attached tabular calculations.

Annual energy cost savings are based on fuel savings calculations as explained above:

Electricity kWH/Yr Saved x 0.003413 MBTU/kWH x $18.23/MBTU = $/Yr Saved

ECO B15: CONVERT MULTIZONE HVAC SYSTEMS TO VARIABLE AIR VOLUME

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.
Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.
Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO - B15 Convert Multizone HVAC System to Variable Air Volume

Fac.	Fan Amps		Full Load	VAV System	Savings	Energy Cost Saved		O&M Cost Saved		Constr.	Investment	Pay-	SIR
No.	SA Fan	RA Fan	kW hr / Yr	kW hr / Yr.	kW hr / Yr	$/Yr	LCC$	$/Yr	LCC$	Cost $	$	Back	
205	55	23	153,424	101,260	52,164	$3,246	$37,973	($200)	($2,224)	$24,458	$27,271	8.95	1.31
207	54	21	147,523	97,365	50,158	$3,121	$36,513	($200)	($2,224)	$24,458	$27,271	9.34	1.26
208	54	21	147,523	97,365	50,158	$3,121	$36,513	($200)	($2,224)	$24,458	$27,271	9.34	1.26
229	59	23	161,292	106,453	54,839	$3,412	$39,921	($200)	($2,224)	$24,458	$27,271	8.49	1.38
230	46	22	134,410	88,710	45,699	$2,843	$33,267	($200)	($2,224)	$24,458	$27,271	10.32	1.14
		Totals	744,171	491,153	253,018	$15,743	$184,188	($1,000)	($11,120)	$122,292	$136,355	9.25	1.27

Annual Full Load Energy Consumption was calculated from measured phase voltage readings and operating hours of the building.

Full load kWHr / Year consumption of supply and return fans are reduced to 66% of existing usage due to the proposed VAV retrofit.

Energy cost savings are based on the year-round, continuous usage rate for power.

Annual O&M efforts for VAV system components are expeced to require an additional 5 MH per year of effort. At $40 per hour, annual cost per building VAV sytem is $200.

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet Of

Project: EEAP Limited Energy Study | Project No. | Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO-B9 Convert Multizone to VAV | Estimator: JCS | Checked By: BIH

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Buildings 205, 207, 208, 229 & 230 (Typical for Each)							
Double-Duct VAV Box with T-stat	8	EA	$300	$2,400	$650	$5,200	$7,600
and duct static pressure sensor							
20 HP Variable Frequency Drive	1	LS	-	$1,200	-	$3,000	$4,200
installed w/ actuator							
Remove Constant Volume Mixing Boxe	8	LF	$250	$2,000	-	$0	$2,000
Testing and Balancing	1	LS	-	-	-	-	$1,880
Subtotal							$15,680
General Conditions @ 8%							$1,254
Subtotal							$16,934
Contractor OH & Profit @ 30%							$5,080
Subtotal							$22,015
Bond @ 1%							$220
Subtotal							$22,235
Estimating Contingency @ 10%							$2,223
Total Probable Construction Cost							$24,458

Life Cycle Cost Analysis Summary — ECO B21
Energy Conservation Investment Program (ECIP)

Location: Fort Hunter Liggett, California — Region No. 4 — Project No.
Project Title: ECIP Facility Energy Improvements — Fiscal Year FY95
Discrete Portion Name: ECO B21 Replace Inefficient Boilers
Analysis Date: June 1993 — Economic Life: 15 YEARS — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$28,061		
B. SIOH	$1,543		
C. Design Cost	$1,684		
D. Total Cost (1A+1B+1C)	$31,288		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$31,288

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.0		$0	11.70	$0
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	506.1		$3,983	14.16	$56,397
D. Demand	$108.60	0.0	kW	$0	11.70	$0
E. Other						
F. Total		506		$3,983		$56,397

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	7.9	Years
5. Total Net Discounted Savings (2F5+3C):	$56,397	
6. Savings to Investment Ratio (SIR) 5/1G:	1.80	
7. Adjusted Internal Rate of Return (AIRR):	8.17%	

ECO B21: REPLACE INEFFICIENT BOILERS

This measure is developed to evaluate the potential energy savings created by the replacement of older, low efficiency boilers with new, high efficiency boilers.

Energy Savings Calculations

Energy savings are achieved by raising the boiler/heater efficiency. Fuel savings are determined based on baseline fuel use and the difference between existing and proposed new boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

$$Qs = Qo \times (Existing\ Efficiency / (New\ Efficiency)$$

where: Qs = Fuel Savings
Qo = Baseline fuel use (after implimentation of envelope and HVAC ECO's with SIR's over 1.0)
Efficiency System efficiencies for existing and new boilers

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B21: REPLACE INEFFICIENT BOILERS

Fac No.	nstallation Name	Boiler System Data			Existing Boiler System Losses						
		Fuel Used	System Type	Capacity BTUH	Firing Eff	Auxil-liary	Radiant	Convec-tion	Shut Down	Genrl Cond	Net Eff
P 101	Open Din Cons Hacienda Clu Bar	Propane	AHU-HWB/C	300,000	82.9%	-	6.0%	4.0%	2.0%	3.0%	67.9%
	Hacienda, Dwellings	Electric	ER-PH	30 x 3kW	-	-	-	-	-	-	-
S 290	Electron E uip Facility	Propane	AHU-PROP/C	1,020,000	80.8%	-	8.0%	4.0%	2.0%	3.0%	63.8%
P 642	Detached Latrine/Shower	Propane	HWH/TK-Circ	180,000	75.2%	-	7.0%	4.0%	2.0%	3.0%	59.2%

ECO B21: REPLACE INEFFICIENT BOILERS

Fac No.	Installation Name	New Boiler System Losses							Economic Analysis							
		Firing Eff	Auxil-liary	Radiant	Convec-tion	Shut Down	Genrl Cond	Net Eff	Eff Added	Energy Usage MBtu/Yr	Energy Savings MBtu/Yr	Annual Cost Saved $	LCC Saved $	Constr Cost $	Invest-ment $	SIR
101	en Din Cons acienda Clu Bar acienda, Dwellings	94.0% -	- -	4.0% -	2.0% -	2.0% -	1.0% -	85.0% -	17.1%	1,064.0	214	$1,685	$23,854	$6,941	$7,739	3.1
S 290	Electron E ui Facility	94.0%	-	4.0%	2.0%	2.0%	1.0%	85.0%	21.2%	741.5	185	$1,455	$20,609	$15,793	$17,609	1.2
642	Detached Latrine/Shower	0.94		0.04	0.02	2.0%	1.0%	85.0%	25.9%	116.7	107	$843	$11,934	$5,327	$5,940	2.0
							Totals				506	$3,983	$56,397	$28,061	$31,288	1.8

CONSTRUCTION COST ESTIMATE					Date Prepared: June 1993		Sheet Of
Project: EEAP Limited Energy Study					Project No.	Basis for Estimate: Code A (no design competed)	
Location: Fort Hunter-Liggett, California							
Engineer-Architect: Keller & Gannon							
Drawing No.: ECO B21 REPLACE INEFFICIENT BOILERS			Estimator		Checked By		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
BUILDING 101							
Demolish existing boiler	1	EA	$750	$750		$0	$750
Provide & Install 300,000 BTUH Boiler	1	EA	$1,050	$1,050	$2,650	$2,650	$3,700
Subtotal							$4,450
General Conditions @ 8%							$356
Subtotal							$4,806
Contractor OH & Profit @ 30%							$1,442
Subtotal							$6,248
Bond @ 1%							$62
Subtotal							$6,310
Estimating Contingency @ 10%							$631
Total Probable Construction Cost							$6,941
BUILDING 290							
Demolish existing boiler	1	EA	$1,200	$1,200		$0	$1,200
Provide & Install 1,020,000 BTUH Boile	1	EA	$1,675	$1,675	$7,250	$7,250	$8,925
Subtotal							$10,125
General Conditions @ 8%							$810
Subtotal							$10,935
Contractor OH & Profit @ 30%							$3,281
Subtotal							$14,216
Bond @ 1%							$142
Subtotal							$14,358
Estimating Contingency @ 10%							$1,436
Total Probable Construction Cost							$15,793

CONSTRUCTION COST ESTIMATE							Date Prepared: June 1993	Sheet Of
Project: EEAP Limited Energy Study							Project No.	Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California								
Engineer-Architect: Keller & Gannon								
Drawing No.: ECO B21 REPLACE INEFFICIENT BOILERS			Estimator				Checked By	
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total		
BUILDING 642								
Demolish existing boiler	1	EA	$750	$750		$0		$750
Provide & Install 180,000 BTUH Boiler	1	EA	$840	$840	$1,825	$1,825		$2,665
Subtotal								$3,415
General Conditions @ 8%								$273
Subtotal								$3,688
Contractor OH & Profit @ 30%								$1,106
Subtotal								$4,795
Bond @ 1%								$48
Subtotal								$4,843
Estimating Contingency @ 10%								$484
Total Probable Construction Cost								$5,327

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C2

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO C2 Replace Pipe Insulation on Domestic Hot Water Systems
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$655		
B. SIOH	$36		
C. Design Cost	$39		
D. Total Cost (1A+1B+1C)	$730		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$730

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.0		$0.00	11.70	$0
B. Dist	$4.98	35.1		$174.80	13.78	$2,409
C. Propane	$7.87	14.9		$117.26	14.16	$1,660
D. Demand	$108.60	0.0	kW	$0.00	11.70	$0
E. Other						
F. Total				$292.06		$4,069

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	2.5	Years
5. Total Net Discounted Savings (2F5+3C):	$4,069	
6. Savings to Investment Ratio (SIR) 5/1G:	5.57	
7. Adjusted Internal Rate of Return (AIRR):	16.62%	

ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Domestic hot water (DHW) system piping needing replacement insulation is listed by building on the attached tabular summary.

Thermal losses result from uninsulated piping. Energy savings are achieved when such pipes are insulated.

Energy Saving Calculations

For the purposes of analysis, DHW systems are divided into two types:

1. Non-Circulated DHW Systems
2. Circulated DHW Systems

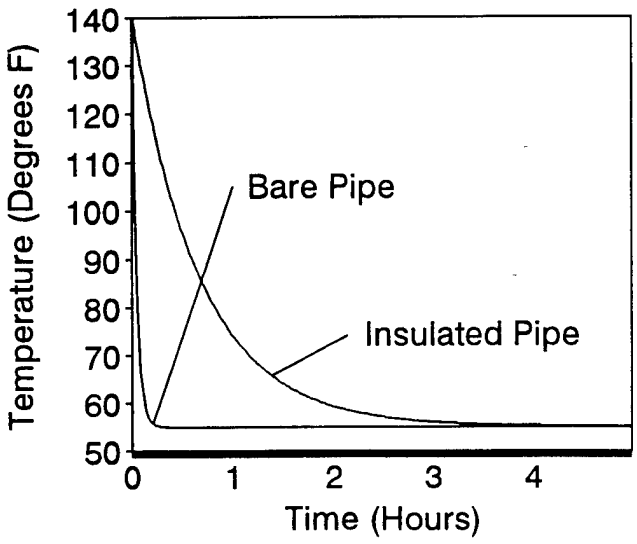
Non-Circulated DHW Systems:

Non-circulating DHW systems are typically installed in residences and office type buildings. Hot water from the water heater or tank sits motionless in piping until a faucet or other valve is opened. Standing hot water looses heat to the ambient air over time as characterized by the following equation:

$$T = To + (Ti - To)\, e\,\hat{}\,(-t/[Ct/Ut])$$

where:

T = Temperature at time increment t
To = Ambient temperature, assumed to be 55 Degrees F
Ti = Initial temperature, taken to be the DHW heater set point temperature
t = Elapsed time
Ct = Heat capacity of water (1 BTU/Degree F)
Ut = Conductance of pipe and insulation (if any) (BTU/Hr-Degree F)



ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Two questions arrise:

1. How long does it take the water in the piping to cool to an unacceptable level?

2. Does adding insulation effect this time significantly?

Review of the above plot and evaluation of the above equation for a bare pipe results in a time of about 6.6 minutes for water to cool from a temperature of 140 Degrees F to 90 Degrees F.

Review of the above plot and evaluation of the above equation for an insulated pipe results in a time of about 35 minutes for water to cool from a temperature of 140 Degrees F to 90 Degrees F.

Thus, if water demand is no more frequent than every 1/2 hour, insulation will not make a difference.

Circulated DHW Systems:

Hot water is circulated continuously through the piping system. Water temperature is maintained at or near the water heater set point. Heat transfer is steady state, unlike non-circulated systems.

Tabular calculations for circulated system heat losses follow this narrative.

Field investigation indicates that most pipes are insulated already, and that only a few repairs are required.

This ECO is evaluated assuming DEH has reset all water heater temperatures to authorized levels.

Pipe Heat Loss (Gain) Calculations

The attached tabular calculations are performed as follows:

Size In-Dia.:	Nominal pipe size, diameter in inches
Length LF:	Pipe length needing insulation, linear feet

Energy savings are determined for each pipe size and service type by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980.

Use of the nomographs results in a heat loss rate of: BTUH per LF for "Bare" pipe and for insulated piping. For the purposes of these calculations, it is assumed that 1-inch of insulation is applied.

Bare Pipe:	Heat loss for bare pipe determined from the DOE nomograph
Insulated Pipe:	Heat loss for insulated pipe (1-inch thickness) determined from the DOE nomograph

ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Boiler Efficiency:	Domestic Hot Water system boiler efficiency determined based on measurements of combustion efficiency and a field assessment of existing conditions. (Not displayed) Efficiency is applied to heat loss rates to determine fuel use.
Savings:	Listed separately for Fuel Oil and for Propane; is the difference between heat losses for bare and insulated piping.

Energy Cost Savings

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C2 REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Analysis of Circulated Domestic Hot Water Energy Savings

Fac No.	Baseline			Bare	Insulated	ECO #2 Energy Savings								
	DHW Tem	Size In Dia	Length LF	Pipe Loss Mil BTU/Yr	Pipe Loss Mil BTU/Yr	Fuel Oil Mil BTU/Y	Propane Mil BTU/Y	Fuel Oil $/Yr	Propane $/Yr	LCC Savings	Bare Cos $	Investmen $	Pay-Back	SIR
207	105	2	10	55.5	42.4	13.1	-	$65	$0	$899	$100	$174	2.67	5.17
229	105	2	10	46.5	35.5	11.0	-	$55	$0	$755	$100	$174	3.17	4.34
230	105	2	10	45.9	34.9	11.0	-	$55	$0	$755	$100	$174	3.17	4.34
S 238	105	1	10	19.3	0.0	-	7.0	$0	$55	$780	$60	$104	1.89	7.48
S 290	105	1	10	14.2	0.0	-	7.9	$0	$62	$880	$60	$104	1.68	8.44
					Totals	35.1	14.9	$174.80	$117.26	$4,069	$420	$730	2.50	5.57

CONSTRUCTION COST ESTIMATE

Project: EEAP Limited Energy Study	Project No.	Date Prepared: June 1993
Location: Fort Hunter-Liggett, California		Sheet of
Engineer-Architect: Keller & Gannon		Basis for Estimate: Code A (no design competed)
Drawing No.: ECO C2: Replace Pipe Insulation	Estimator: RJB	Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Building 207							
2" Pipe Insulation	10	LF	$6.00	$60	$4.00	$40	$100
Subtotal Bldg 207							$100
Building 229							
2" Pipe Insulation	10	LF	$6.00	$60	$4.00	$40	$100
Subtotal Bldg 229							$100
Building 230							
2" Pipe Insulation	10	LF	$6.00	$60	$4.00	$40	$100
Subtotal Bldg 230							$100
Building 238							
1" Pipe Insulation	10	LF	$4.00	$40	$2.00	$20	$60
Subtotal Bldg 238							$60
Building 290							
1" Pipe Insulation	10	LF	$4.00	$40	$2.00	$20	$60
Subtotal Bldg 290							$60
Subtotal							$420
General Conditions @ 8%							$34
Subtotal							$454
Contractor OH & Profit @ 30%							$136
Subtotal							$590
Bond @ 1%							$6
Subtotal							$596
Estimating Contingency @ 10%							$60
Total Probable Construction Cost							$655

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C-3

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO C3 Insulate Hot Water Storage Tanks
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$4,578		
B. SIOH	$252		
C. Design Cost	$275		
D. Total Cost (1A+1B+1C)	$5,105		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$5,105

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$18.23	9.2	$167.72	11.70	$1,962
B. Dist	$4.98	48.3	$240.30	13.78	$3,311
C. Propane	$7.87	46.1	$362.54	14.16	$5,134
D. Demand	$108.60	0.0 kW	$0.00	11.70	$0
E. Other					
F. Total			$770.56		$10,407

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	6.6	Years
5. Total Net Discounted Savings (2F5+3C):	$10,407	
6. Savings to Investment Ratio (SIR) 5/1G:	2.04	
7. Adjusted Internal Rate of Return (AIRR):	9.06%	

ECO C3: INSULATE HOT WATER STORAGE TANKS

Thermal losses result from uninsulated hot water storage tanks. Energy savings are achieved when the tanks are insulated.

Energy savings are determined for the domestic hot water tanks by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980. The attached table showing thermal losses for storage tanks is developed from the DOE nomograph.

Use of the charts results in heat loss rates for bare tanks and for tanks with various insulation thicknesses. For the purposes of these calculations, it is assumed that 3-inches of insulation is applied.

The attached tabular calculations are performed as follows:

Tank heat loss calculations

Tank Capacity: Gallons

Existing Temp.: degrees F

Ins. Thickness: Existing thickness assumed to be 1-inch equivalent
Replacement insulation to be 3-inch

Heat Loss Rate BTU/Hr (from charts)

Existing Condition: Rate of heat loss or gain in BTUH for existing tank condition (1-inch thick insulation) determined from DOE nomograph

Proposed Condition: Rate of heat loss or gain in BTUH for tank with new insulation (3-inch thick)determined from DOE nomograph

Energy Savings Calculations

Heat Loss: The annual heat load loss for each condition is determined by multiplying the heat loss rate per hour by 8,760 hours per year (continuous loss).

Annual Heat Loss Saved: The annual heat loss load saved is the difference of the heat loss for the exisiting and proposed conditions.

Energy Savings: Energy savings are determined by dividing the load savings by the DHW heater efficiency. For DHW system efficiencies, refer to "EEAP Limited Energy Study, Fort Hunter Liggett, California", 1993.

ECO C3: INSULATE HOT WATER STORAGE TANKS

Energy Cost Savings

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Electricity	kWH/Yr Saved x 0.003413 MBTU/kWH x $18.23/MBTU = $/Yr Saved
Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved
Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):
Allowance for Design Services:

Operation and Maintenance Cost Savings

Maintenance costs are expensed at 2.5% of the bare costs of installation p	5.5%
"Savings", entries are negative, or in parentheses.	6.0%

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C3 INSULATE HOT WATER STORAGE TANKS

Assumptions:

1. Existing Hot Water Heater tanks that do not have insulation blankets are assumed to have the equivalent of 1-inch thick insulation.

2. Installation of an insulation jacket will provide the equivalent of 3-inch thick insulation.

3. Heat losses are in addition to those included in "Efficiency" calulation under "Convection Losses".

4. Unless controlled by time clock or other means, losses are assumed to be continuous, 8,760 Hours per year.

DOMESTIC HOT WATER TANK INSULATION

Building Number	DHW Tank Gallons	Existing Temp Deg F	Existing Condition		Proposed Condition		Heat Loss Load Saved Mil BTU/Yr
			Tank Insltn Inches	Heat Loss Mil BTU/Yr	Tank Insltn Inches	Heat Loss Mil BTU/Yr	
80	80	135	1	5.1	3	1.8	3.3
81	20 & 40	135	1	5.2	3	1.9	3.3
101	100	160	1	8.3	3	3.0	5.3
101	40	140	1	3.3	3	1.2	2.1
101	83	140	1	5.6	3	2.0	3.6
120	100	110	1	3.9	3	1.4	2.5
120	100	140	1	6.5	3	2.4	4.1
124	40	160	1	4.2	3	1.5	2.7
127	100	128	1	5.5	3	2.0	3.5
144	69	Not used	1	0.0	3	0.0	0.0
197	6	128	1	1.3	3	0.5	0.8
206	2 x 850	140	1	57.8	3	21.0	36.8
210	100	140	1	6.5	3	2.4	4.1
219	80	120	1	4.0	3	1.5	2.5
238	125	122	1	5.6	3	2.0	3.6
252	52	120	1	2.9	3	1.1	1.8
287	40	140	1	3.3	3	1.2	2.1
290	100	135	1	6.1	3	2.2	3.9

DOMESTIC HOT WATER TANK INSULATION LOSSES:

Insulation Thickness (k = 0.3)	Tank Gallons	BTUH Losses at Water Temperatures							
		100 Deg F	120 Deg F	122 Deg F	128 Deg F	135 Deg F	140 Deg F	160 Deg F	180 Deg F
Bare	6	519	863	897	1,001	1,121	1,207	1,634	2,060
	20	768	1,277	1,327	1,480	1,658	1,785	2,407	3,028
	40	1,123	1,867	1,941	2,165	2,425	2,611	3,510	4,409
	50	1,301	2,163	2,249	2,507	2,809	3,024	4,062	5,100
	52	1,337	2,222	2,311	2,576	2,886	3,107	4,173	5,238
	69	1,639	2,724	2,833	3,158	3,538	3,809	5,111	6,413
	80	1,834	3,049	3,170	3,534	3,959	4,263	5,718	7,172
	83	1,888	3,138	3,262	3,637	4,075	4,387	5,884	7,380
	100	2,190	3,640	3,784	4,219	4,727	5,089	6,822	8,554
	125	2,465	4,097	4,260	4,749	5,320	5,728	7,682	9,637
	250	3,840	6,382	6,636	7,398	8,288	8,923	11,987	15,051
	500	6,292	10,456	10,872	12,122	13,579	14,620	19,640	24,660
	850	9,725	16,160	16,804	18,735	20,987	22,596	30,354	38,113
	1,700	18,062	30,014	31,209	34,794	38,978	41,966	56,374	70,783
1-inch Thick	6	83	129	134	147	164	175	223	270
	20	122	191	198	219	243	260	330	400
	40	178	280	290	320	356	381	483	585
	42	184	289	299	330	367	393	499	604
	50	206	324	335	371	412	441	560	678
	52	212	333	345	381	423	453	575	697
	69	259	408	422	467	519	556	705	854
	80	290	456	473	522	581	622	789	956
	82	296	465	482	533	592	634	805	975
	100	346	545	564	624	693	743	943	1,142
	125	390	613	635	702	780	836	1,061	1,285
	250	607	955	990	1,094	1,216	1,303	1,653	2,002
	500	994	1,565	1,622	1,793	1,992	2,135	2,708	3,280
	850	1,536	2,418	2,506	2,771	3,079	3,300	4,185	5,069
	1,700	2,852	4,490	4,654	5,146	5,719	6,129	7,772	9,414
2-inch Thick	50	109	173	179	198	220	236	299	362
	100	184	291	301	333	370	397	503	609
	250	323	510	528	584	649	696	883	1,069
	500	528	834	865	956	1,064	1,140	1,446	1,751
3-inch Thick	6	29	46	48	53	59	63	81	98
	15	40	63	65	73	81	86	110	133
	20	43	69	71	79	88	94	120	145
	40	64	101	105	116	129	138	175	212
	42	66	104	108	119	133	142	180	218
	50	74	117	121	134	149	160	203	245
	52	76	120	124	138	153	164	208	252
	69	93	148	153	169	188	202	255	308
	80	105	166	172	190	211	226	286	345
	83	108	171	177	196	217	233	294	355
	100	125	198	205	227	252	270	341	412
	125	141	222	230	255	283	304	384	464
	250	219	346	359	397	441	473	598	722
	500	359	567	588	650	723	775	980	1,184
	850	555	876	909	1,005	1,117	1,198	1,514	1,831
	1,075	681	1,075	1,115	1,233	1,370	1,470	1,857	2,247

Source: Architects and Engineers Guide to Energy Conservation in Existing Buildings, February 1980, U.S. DOE.

ECO-C3 INSULATE HOT WATER STORAGE TANKS

Fac No.	Existing Condition		ECO - C3 Energy Savings										
	Tank Insltn Inches	Heat Loss Mil BTU/Yr	Tank Insltn Inches	Fuel Oil Mil BTU/Yr	Propane Mil BTU/Y	Electric Mil BTU/Y	FO Ann. Savings	Prop. Ann Savings	Elec. Ann Savings	LCC Savings	Bare Cost	Invest-ment	SIR
P 80	1	5.1	3	-	-	3.3	$0	$0	$60	$704	$75	$130	5.40
P 81	1	5.2	3	-	-	3.3	$0	$0	$60	$704	$150	$261	2.70
P 101	1	8.3	3	-	7.6	-	$0	$60	$0	$844	$100	$174	4.85
	1	3.3	3	-	3.0	-	$0	$24	$0	$334	$75	$130	2.56
	1	5.6	3	-	5.1	-	$0	$40	$0	$572	$75	$130	4.39
T 120	1	3.9	3	-	3.3	-	$0	$26	$0	$370	$100	$174	2.13
	1	6.5	3	-	5.8	-	$0	$46	$0	$652	$100	$174	3.75
T 127	1	5.5	3	-	5.0	-	$0	$39	$0	$556	$100	$174	3.20
S 197	1	1.3	3	-	-	0.8	$0	$0	$15	$171	$75	$130	1.31
P 206	1	57.8	3	42.4	-	-	$211	$0	$0	$2,909	$1,560	$2,713	1.07
P 210	1	6.5	3	5.9	-	-	$29	$0	$0	$402	$100	$174	2.31
P 219	1	4.0	3	-	3.3	-	$0	$26	$0	$367	$75	$130	2.81
S 238	1	5.6	3	-	4.5	-	$0	$35	$0	$500	$100	$174	2.87
P 252	1	2.9	3	-	-	1.8	$0	$0	$33	$384	$75	$130	2.94
P 287	1	3.3	3	-	2.9	-	$0	$23	$0	$321	$75	$130	2.46
S 290	1	6.1	3	-	5.5	-	$0	$44	$0	$617	$100	$174	3.55
			Totals	48.3	46.1	9.2	240	363	168	$10,407	$2,935	$5,105	2.04

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet: OF

Project: EEAP Limited Energy Study | Project No.:

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Basis for Estimate: Code A (no design competed)

Drawing No.: ECO C3 Insulate Hot Water Storage Tanks | Estimator: RJB | Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
< 80 Gal. DHW Heater Insulation Kit	9	Ea	$48	$432	$27	$243	$675
fiberglas 1 1/2" thick							
> 80 Gal. DHW Heater	7	Ea	$65	$455	$35	$245	$700
850 Gal. Tank Insulated w/3" CaSil	2	Ea	$455	$910	$325	$650	$1,560
Subtotal							$2,935
General Conditions @ 8%							$235
Subtotal							$3,170
Contractor OH & Profit @ 30%							$951
Subtotal							$4,121
Bond @ 1%							$41
Subtotal							$4,162
Estimating Contingency @ 10%							$416
Total Probable Construction Cost							$4,578

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C-5 TOTAL

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: ECO C5 Reduce Domestic Hot Water Flow at Shower Heads and Faucets
Analysis Date: June 1993 | Economic Life: 15 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$1,326		
B. SIOH	$73		
C. Design Cost	$80		
D. Total Cost (1A+1B+1C)	$1,478		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$1,478

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$18.23	32.9		$599.77	11.70	$7,017
B. Dist	$4.98	0.0		$0.00	13.78	$0
C. Propane	$7.87	2.1		$16.86	14.16	$239
D. Demand	$108.60	0.0	kW	$0.00	11.70	$0
E. Other						
F. Total				$616.63		$7,256

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	2.4	Years
5. Total Net Discounted Savings (2F5+3C):	$7,256	
6. Savings to Investment Ratio (SIR) 5/1G:	4.91	
7. Adjusted Internal Rate of Return (AIRR):	15.64%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C-5 PART A

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO C-5 PART A Install Self-Metering Faucets
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$1,123		
B. SIOH	$62		
C. Design Cost	$67		
D. Total Cost (1A+1B+1C)	$1,252		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$1,252

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$18.23	20.1		$366.42	11.70	$4,287
B. Dist	$4.98	-		$0.00	13.78	$0
C. Propane	$7.87	-		$0.00	14.16	$0
D. Demand	$108.60	-	kW	$0.00	11.70	$0
E. Other						
F. Total				$366.42		$4,287

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	3.4	Years
5. Total Net Discounted Savings (2F5+3C):	$4,287	
6. Savings to Investment Ratio (SIR) 5/1G:	3.42	
7. Adjusted Internal Rate of Return (AIRR):	12.89%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C-5 PART B

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO C-5 PART B Install Flow Restrictors
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$203		
B. SIOH	$11		
C. Design Cost	$12		
D. Total Cost (1A+1B+1C)	$226		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$226

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$18.23	12.8		$233.34	11.70	$2,730
B. Dist	$4.98	-		$0.00	13.78	$0
C. Propane	$7.87	2.1		$16.86	14.16	$239
D. Demand	$108.60	-	kW	$0.00	11.70	$0
E. Other						
F. Total				$250.21		$2,969

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	0.9	Years
5. Total Net Discounted Savings (2F5+3C):	$2,969	
6. Savings to Investment Ratio (SIR) 5/1G:	13.13	
7. Adjusted Internal Rate of Return (AIRR):	23.48%	

ECO C5: REDUCE DOMESTIC HOT WATER FLOW AT SHOWER HEADS AND FAUCETS

This ECO evaluates the reduction of hot water usage by the installation of metering or sensor operated lavatory faucets and/or low flow faucets and shower heads.

Energy savings are achieved by reducing domestic hot water (DHW) consumption.

This ECO is divided into two parts:

Part A Installation of Self-Metering faucets

Part B Installation of flow restricting shower heads and lavatory aspirators

Part A

Hot water consumption can be reduced because self metering faucets prevent faucets from being left open, running continuously and wasting hot water.

Metering faucets allow water flow for only a few seconds, then the valve closes until the lever is depressed again.

Sensor operated lavatory faucets only permit water flow if a sensor perceives a person's hands inside the lavatory bowl.

Although catalog literature claims installation of said valves would reduce water consumption by 80%, it was more conservatively assumed to result in a 50% reduction in water consumption.

Thus the water savings was found by:

(# of people) x (4 hand washes per day) x (1 minute per hand wash) x 3 GPM x 50%
= (# of people) x (6 gallons per day)

Part B

Domestic hot water usage can also be reduced by the installation of flow restricting shower heads and lavatory faucets. Load reductions from existing shower heads and lavatory faucets are provided with Part B calculations.

Energy Savings Calculations

Based on hot water supply temperature and gallons saved per day the energy savings were determined for both self-metering devices and flow restrictors (refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993). Load reductions are divided by the DHW heating system efficiency to calculate energy savings.

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Electricity	kWH/Yr Saved x 0.003413 MBTU/kWH x $18.23/MBTU = $/Yr Saved
Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

ECO C5: REDUCE DOMESTIC HOT WATER FLOW AT SHOWER HEADS AND FAUCETS

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	$/Yr Saved x (15 year UPW: 11.70) = LCC $ Saved
Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C5 INSTALL FLOW RESTRICTORS

FLOW RESTRICTING SHOWER HEAD AND LAVATORY FAUCET RETROFIT

	Non Lo-Flow Devices:	Lo-Flow Devices:
Shower Heads	5.00 gpm	2.00 gpm
Faucets	3.00 gpm	0.75 gpm

Function Code 1: Offices 2.00 GPCD

Assume use from faucets 75% and by Janitor 25%.
Usage with Lo-Flow faucet aspirators: 1.10 GPCD

Function Code 2: Shops & Warehouses 5.00 GPCD

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 3.50 GPCD

Function Code 2.1: Commercial Laundries - Not Applicable to this ECO.

Function Code 3: Barracks & Quarters w/o Dining 30.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	19.50	7.80
Faucets	4.50	1.13
Clothes Washing	6.00	6.00
Total	30.00	14.93

Function Code 3.1: Detatched Latrine with Bathing 25.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	19.50	7.80
Faucets	4.50	1.13
Clothes Washing	0.00	0.00
Total	24.00	8.93

Function Code 4: Barracks & Quarters with Dining 30.00 GPCD

Same as Function Code 3 for non-cooking hot water usage:

14.93 GPCD

Function Code 5: Recreation & Gyms w/o Bathing 0.50 GPCD

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 0.35 GPCD

Function Code 5.1: Recreation & Gyms with Bathing 12.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	10.50	4.20
Faucets	1.50	0.38
Clothes Washing	0.00	0.00
Total	12.00	4.58

Function Code 6: Theaters & Similar Community Facilities 0.50

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 0.35 GPCD

Function Code 7: Dining Facilities, all uses 0.25

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 0.18 GPCD

Function Code 8: Base Exchanges & Stores 0.50 GPCD

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 0.35 GPCD

Function Code 8.1: Commissaries 0.50 GPCD

Assume use from faucets 50% of total usage.
Usage with Lo-Flow faucet aspirators: 0.35 GPCD

Function Code 9: Clubs - Officers, NCO, Enlisted Persons: 2.00

Assume use from faucets 75% and by Janitor 25%.
Usage with Lo-Flow faucet aspirators: 1.10 GPCD

Function Code 10: Family Housing 40.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	27.00	10.80
Faucets	8.00	2.00
Clothes Washing	5.00	5.00
Total	40.00	17.80

Function Code 11.1: Schools without Bathing 5.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Other Uses	0.50	0.50
Faucets	4.50	1.13
Total	5.00	1.63

Function Code 11.2: Schools with Bathing 11.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	6.50	2.60
Faucets	4.50	1.13
Total	11.00	3.73

Function Code 11.3: Child Development Centers 8.00 GPCD

Usage	GPCD	Lo-Flow GPCD
Showers	0.00	0.00
Faucets	8.00	2.00
Total	8.00	2.00

Function Code 12: Medical Facilities, Clinics 20.00 GPCD

No modifications are proposed for medical facilities.

Function Code 12.1: Medical Facilities, Hospitals 120.00 GPCD

No modifications are proposed for medical facilities.

Function Code 13: Buildings with More than One Use

Each type of use is considered separately.

ECO C5 PART A: INSTALLATION OF SELF-METERING FAUCETS

Fac No.	DHW Heating System		
	Fuel Used	System Temp.	Capacity Mil BTUH
301	Electric	132	1.875

ECO C5 Energy Savings									
Electric Mil BTU/Yr	Fuel Oil Mil BTU/Y	Propane Mil BTU/Y	Elect. Ann Savings	FO Ann. Saving	Prop. An Saving	LCC Savings	Bare Cost	Invest-ment	SIR
20.1	-	-	$366	-	-	$5,189	$720	$1,252	4.14
				-	-				
20.1	-	-	$366	-	-	$5,189	$720	$1,252	4.14

ECO-C5 PART B: INSTALLATION OF FLOW RESTRICTING SHOWER HEADS AND LAVATORY FAUCETS

Analysis of the Effect of Installation of Flow Restricting Faucets/Shower Heads on Domestic Hot Water Energy Savings

Bldg. No.	DHW Heating System			ECO C5 Energy Savings									
	Fuel Used	System Temp.	Capacity BTUH	Electric Mil BTU/Y	Fuel Oil Mil BTU/Yr	Propane Mil BTU/Y	Elect. Ann $ Savings	Fuel Oil $ Savings	Prop. Ann $ Savings	LCC Savings	Bare Cost	Invest-ment	SIR
127	Propane	110	240,000	-	-	2.1	-	-	$17	$239	$90	$157	1.53
197	Electric	125	1.25 kW	12.8	-	-	$233	-	-	$2,730	$40	$70	39.24
				12.8	-	2.1	$233	-	$17	$2,969	$130	$226	13.13

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993	Sheet:	OF:
Project: EEAP Limited Energy Study	Project No.:	Basis for Estimate: Code A (no design competed)
Location: Fort Hunter-Liggett, California		
Engineer-Architect: Keller & Gannon		
Drawing No.: ECO-C5 Install Self-Metering Faucets	Estimator: RJB	Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Self-Metering Lav. Faucets	3	EA	$40	$120	$200	$600	$720
Subtotal							$720
General Conditions @ 8%							$58
Subtotal							$778
Contractor OH & Profit @ 30%							$233
Subtotal							$1,011
Bond @ 1%							$10
Subtotal							$1,021
Estimating Contingency @ 10%							$102
Total Probable Construction Cost							$1,123

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet: OF

Project: EEAP Limited Energy Study | Project No.: | Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO-C5 Install flow restrictors | Estimator: RJB | Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
Bldg 127 Shower Flow Restrictors	3	LS	$10	$30	$20	$60	$90
Bldg 197 Lavatory Flow Restrictors	2	LS	$15	$30	$5	$10	$40
Subtotal							$130
General Conditions @ 8%							$10
Subtotal							$140
Contractor OH & Profit @ 30%							$42
Subtotal							$183
Bond @ 1%							$2
Subtotal							$184
Estimating Contingency @ 10%							$18
Total Probable Construction Cost							$203

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C8

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: ECO C8 Dishwasher Heat Recovery
Analysis Date: June 1993 | Economic Life: 15 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$5,839		
B. SIOH	$321		
C. Design Cost	$350		
D. Total Cost (1A+1B+1C)	$6,510		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$6,510

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factor October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.0		$0	11.70	$0
B. Dist	$4.98	339.0		$1,688	13.78	$23,263
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	0.0	kW	$0	11.70	$0
E. Other						
F. Total				$1,688		$23,263

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($160)		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			($1,779)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) ($1,779)

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	4.3	Years
5. Total Net Discounted Savings (2F5+3C):	$21,483	
6. Savings to Investment Ratio (SIR) 5/1G:	3.30	
7. Adjusted Internal Rate of Return (AIRR):	12.62%	

ECO C8: DISHWASHER HEAT RECOVERY

Install a commercial type package heat recovery unit at each dishwashing location in facility 206. The unit extracts waste heat from dishwasher discharge and it uses it to preheat cold water make-up.

The Waste Energy Transfer System, Molitor Industries, Inc. recycles 70% to 75% of water normally wasted.

Energy Saving Calculations

Refer to attached brochure for supporting data. DHW to dishwashers is provided at 140 deg F from building system, fuel oil fired, average thermal efficiency 70.8%.

Of the total baseline DHW heating fuel use of 906 Mil BTU/yr in building 206, 50% is assumed used in the dishwasher. Dishwashers heat DHW from the DHW supply temperature to about 180 deg F for sanitizing; discharge temperature from the dishwasher is 180 deg F.

75% heat recovery is possible:

906 Mil. BTU/yr x 0.5 x 0.708 = 321 Mil. BTU/yr thermal load for dishwashing.

75% recovery = 321 Mil. BTU/yr x 0.75 = 240 Mil. BTU/yr recovery

Recovered heat is sent to the DHW makeup. Avoided use of fuel oil is:

(240 Mil. BTU/yr / 0.708) = 339 Mil. BTU/yr fuel oil saved

$4.98 x 339 Mil. BTU/yr = $1688/year saved

Annual Energy Cost Savings:

Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Operations and Maintenance (O&M) Costs

Allow 4 hrs/yr at $40/hr for maintenance, cleaning, etc. = $160/yr

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%

ECO C8: DISHWASHER HEAT RECOVERY

Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet: OF

Project: EEAP Limited Energy Study | Project No.: | Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO-C8 Dishwasher Heat Recovery | Estimator: RJB | Checked By: BIH

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 206							
Molitor or Equal Unit	1	Ea	$352	$352	$1,217	$1,217	$1,569
Drain Piping 2-inch Galv	20	LF	$8.99	$180	$6.78	$136	$315
Water Piping 1-inch CU	130	LF	$6.14	$798	$3.52	$457	$1,256
Pipe Insulation 1-inch @ pipe	130	LF	$2.52	$328	$1.47	$191	$519
Wiring	-	Job	$100	$100	$50	$50	$150
Subtotal Building 206							$3,808
General Conditions 8%							$305
Contractor O.H. & P 30%							$1,142
Sub Total							$5,255
Bond 1%							$53
Sub Total							$5,308
Estimating Contingency 10%							$531
Total Probable Construction Cost							$5,839

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO C-9

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO C9 Install Automatic Flue Dampers on DHW Systems
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$1,712		
B. SIOH	$94		
C. Design Cost	$103		
D. Total Cost (1A+1B+1C)	$1,909		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$1,909

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273-X Used for Discount Factor October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.0		$0	11.70	$0
B. Dist	$4.98	51.0		$254	13.78	$3,500
C. Propane	$7.87	31.0		$244	14.16	$3,455
D. Demand	$108.60	0.0	kW	$0	11.70	$0
E. Other						
F. Total				$498		$6,954

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	3.8	Years
5. Total Net Discounted Savings (2F5+3C):	$6,954	
6. Savings to Investment Ratio (SIR) 5/1G:	3.64	
7. Adjusted Internal Rate of Return (AIRR):	13.36%	

ECO C9: INSTALL AUTOMATIC FLUE DAMPERS ON DHW SYSTEMS

This measure is developed to evaluate the potential energy savings created by the installation of an automatic damper which closes off the flue whenever the burner has completed a firing cycle.

During normal operations, about 2% to 3% of boiler fuel use is lost through the flue between burner firing cycles.

Energy Savings Calculations

Energy savings are achieved by raising the boiler/heater efficiency by about 1.5%. Fuel savings are determined based on baseline fuel use and existing boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

$$Qs = Qo - Qo \times Efficiency / (Efficiency + 1.5\%)$$

where:
- Qs = Fuel Savings
- Qo = Baseline fuel use (after reduction of domestic hot water temperatures to authorized levels)
- Efficiency = Baseline system efficiency

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane	MBTU/Yr Saved x $ 7.87/MBTU = $/Yr Saved
Fuel Oil	MBTU/Yr Saved x $ 4.98/MBTU = $/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane	$/Yr Saved x (15 year UPW: 14.16) = LCC $ Saved
Fuel Oil	$/Yr Saved x (15 year UPW: 13.78) = LCC $ Saved

Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.
Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.
Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C9 INSTALL AUTOMATIC FLUE DAMPERS ON DHW SYSTEMS

Fac No.	Installation Name	ECO C-9 Incl.	ECO C9 Energy Savings: Automatic Flue Dampers									
			Fuel Oil Mil BTU/Yr	Propane Mil BTU/Yr	Electric MW-Hr/Yr	FO Ann. $ Savings	Prop. Ann. $ Savings	Elec. Ann. $ Savings	LCC Savings	Constr Cost	Invest-ment	SIR
P 101	**Open Din Cons (Hacienda)**	Yes	-	2.59	-	$0	$20	$0	$289	$568	$633	0.46
P 128	**Officers Quarters Military**	Yes	-	15.78	-	$0	$124	$0	$1,759	$568	$633	2.78
P 210	**Hlth/Dntl Clinic w/ Beds**	Yes	51.02	-	-	$254	$0	$0	$3,501	$576	$642	5.45
S 238	**Sig Photo Lab**	Yes	-	0.95	-	$0	$7	$0	$106	$541	$603	1.72
	Process	Yes	-	8.34	-	$0	$66	$0	$929			
P 295	**Enl Barracks w/o Dining**	Yes	-	15.21	-	$0	$120	$0	$1,695	$568	$633	2.68
Totals			51.0	31.0	0.0	$254	$244	$0	$6,955	$1,712	$1,909	3.64

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		Sheet OF
Project EEAP Limited Energy Study				Project No.	Basis for Estimate Code A (no design competed)		
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO-C9 Install Automatic Flue Dampers			Estimator RJB		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
OIL FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	$32	$156	$156	$188
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 4-inch Flue, Oil Fired							$368
General Conditions 8%							$29
Contractor O.H. & P 30%							$29
Sub Total							$426
Bond 1%							$4
Sub Total							$431
Estimating Contingency 10%							$43
Total Probable Construction Cost							$474
6-inch Diameter Auto-Damper	1	Ea	34.90	$35	$161	$161	$196
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 6-inch Flue, Oil Fired							$376
General Conditions 8%							$30
Contractor O.H. & P 30%							$113
Sub Total							$519
Bond 1%							$5
Sub Total							$524
Estimating Contingency 10%							$52
Total Probable Construction Cost							$576
8-inch Diameter Auto-Damper	1	Ea	38.40	$38	$161	$161	$199
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 8-inch Flue, Oil Fired							$379
General Conditions 8%							$30
Contractor O.H. & P 30%							$114
Sub Total							$524
Bond 1%							$5
Sub Total							$529
Estimating Contingency 10%							$53
Total Probable Construction Cost							$582

CONSTRUCTION COST ESTIMATE					Date Prepared June 1993		Sheet OF
Project EEAP Limited Energy Study					Project No.		Basis for Estimate Code A (no design competed)
Location Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No. ECO-C9 Install Automatic Flue Dampers			Estimator RJB			Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
GAS FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	$32	$134	$134	$166
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 4-inch Flue, Gas Fired							$346
General Conditions 8%							$28
Contractor O.H. & P 30%							$104
Sub Total							$478
Bond 1%							$5
Sub Total							$483
Estimating Contingency 10%							$48
Total Probable Construction Cost							$531
6-inch Diameter Auto-Damper	1	Ea	34.90	$35	$138	$138	$173
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 6-inch Flue, Gas Fired							$353
General Conditions 8%							$28
Contractor O.H. & P 30%							$106
Sub Total							$487
Bond 1%							$5
Sub Total							$492
Estimating Contingency 10%							$49
Total Probable Construction Cost							$541
8-inch Diameter Auto-Damper	1	Ea	38.40	$38	$152	$152	$190
Relay & Wiring	-	Job	-	$120	-	$60	$180
Subtotal 8-inch Flue, Gas Fired							$370
General Conditions 8%							$30
Contractor O.H. & P 30%							$111
Sub Total							$511
Bond 1%							$5
Sub Total							$516
Estimating Contingency 10%							$52
Total Probable Construction Cost							$568

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 TOTAL

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, TOTAL PROJECT
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$37,630		
B. SIOH	$2,070		
C. Design Cost	$2,258		
D. Total Cost (1A+1B+1C)	$41,957		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($4,645)	
G. Total Investment (1D-1E-1F)			$37,312

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	159.8		$3,491	11.70	$40,839
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	22.5	kW	$2,439	11.70	$28,542
E. Other						
F. Total				$5,930		$69,381

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$1,671		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$18,578

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$18,578	
4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	4.9	Years
5. Total Net Discounted Savings (2F5+3C):	$87,960	
6. Savings to Investment Ratio (SIR) 5/1G:	2.36	
7. Adjusted Internal Rate of Return (AIRR):	10.12%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part A

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part A - 60W to 13W/5T4
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$21,175		
B. SIOH	$1,165		
C. Design Cost	$1,270		
D. Total Cost (1A+1B+1C)	$23,610		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($2,715)	
G. Total Investment (1D-1E-1F)			$20,895

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	77.2		$1,686	11.70	$19,729
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	7.8	kW	$845	11.70	$9,889
E. Other						
F. Total				$2,532		$29,619

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$894		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$9,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $9,945

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	6.1	Years
5. Total Net Discounted Savings (2F5+3C):	$39,564	
6. Savings to Investment Ratio (SIR) 5/1G:	1.89	
7. Adjusted Internal Rate of Return (AIRR):	8.52%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part B

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part B - 175W to 18W/7T4
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$234		
B. SIOH	$13		
C. Design Cost	$14		
D. Total Cost (1A+1B+1C)	$261		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($30)	
G. Total Investment (1D-1E-1F)			$231

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	0.7		$16	11.70	$181
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	0.1	kW	$11	11.70	$127
E. Other						
F. Total				$26		$308

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$11		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$125

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $125

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	6.1	Years
5. Total Net Discounted Savings (2F5+3C):	$433	
6. Savings to Investment Ratio (SIR) 5/1G:	1.88	
7. Adjusted Internal Rate of Return (AIRR):	8.46%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part C

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part C - 100W to 18W/7T4
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$2,808		
B. SIOH	$154		
C. Design Cost	$168		
D. Total Cost (1A+1B+1C)	$3,131		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($360)	
G. Total Investment (1D-1E-1F)			$2,771

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	16.1		$352	11.70	$4,121
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	1.8	kW	$195	11.70	$2,287
E. Other						
F. Total				$548		$6,408

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$212		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$2,359

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $2,359

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	3.6	Years
5. Total Net Discounted Savings (2F5+3C):	$8,767	
6. Savings to Investment Ratio (SIR) 5/1G:	3.16	
7. Adjusted Internal Rate of Return (AIRR):	12.30%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part D

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part D - 150W to 26W/8T4
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$5,029		
B. SIOH	$277		
C. Design Cost	$302		
D. Total Cost (1A+1B+1C)	$5,607		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($465)	
G. Total Investment (1D-1E-1F)			$5,142

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	24.9		$543	11.70	$6,354
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	3.5	kW	$380	11.70	$4,451
E. Other						
F. Total				$924		$10,805

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$219		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$2,438

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $2,438

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	4.5	Years
5. Total Net Discounted Savings (2F5+3C):	$13,243	
6. Savings to Investment Ratio (SIR) 5/1G:	2.58	
7. Adjusted Internal Rate of Return (AIRR):	10.77%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part E

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part E - 250W to 2-F32/T8
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$3,900		
B. SIOH	$214		
C. Design Cost	$234		
D. Total Cost (1A+1B+1C)	$4,348		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($500)	
G. Total Investment (1D-1E-1F)			$3,848

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	26.8		$586	11.70	$6,857
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	3.8	kW	$411	11.70	$4,803
E. Other						
F. Total				$997		$11,660

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$208		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$2,316

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $2,316

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	3.2	Years
5. Total Net Discounted Savings (2F5+3C):	$13,976	
6. Savings to Investment Ratio (SIR) 5/1G:	3.63	
7. Adjusted Internal Rate of Return (AIRR):	13.34%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D4 Part F

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part F - 300W to 2-F32/T8
Analysis Date: June 1993 Economic Life: 15 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$4,485		
B. SIOH	$247		
C. Design Cost	$269		
D. Total Cost (1A+1B+1C)	$5,000		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		($575)	
G. Total Investment (1D-1E-1F)			$4,425

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	14.1		$307	11.70	$3,596
B. Dist	$4.98	0.0		$0	13.78	$0
C. Propane	$7.87	0.0		$0	14.16	$0
D. Demand	$108.60	5.5	kW	$597	11.70	$6,985
E. Other						
F. Total				$904		$10,581

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$125		
(1) Discount Factor (Table A)		11.12	
(2) Discounted Savings/Cost (3A x 3A1)			$1,395

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $1,395

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	4.3	Years
5. Total Net Discounted Savings (2F5+3C):	$11,976	
6. Savings to Investment Ratio (SIR) 5/1G:	2.71	
7. Adjusted Internal Rate of Return (AIRR):	11.14%	

ECO D4: REPLACE INCANDESCENT LIGTHTING WITH FLUORESCENT

This project would replace inefficient incandescent fixtures with efficient compact fluorescent fixtures or four-foot fixtures with electronic ballasts and T8 lamps. Replacements analyzed are shown in the table on the following page.

The proposed retrofits are described as follows:

Retrofits A, B & C	Replace existing 60-100W surface-mounted incandescent lamps with 13W/5T4 to 18W/8T4 compact fluorescent lamps.
Retrofit D	Retrofit existing recessed incandescent downlight (150W lamp) with fluorescent ballast and socket adapter for 26W/8T4 quad lamp.
Retrofits E & F	Replace existing suspended incandescent fixture (250-300W lamps) with industrial pendant-mounted fluorescent fixture containing 2-F32/T8 lamps and electronic ballast.

Additional assumptions are as follows:

1. Hours of lamp operation based on field survey data.

2. Annual usage savings = (No. Fixtures) x (kW savings per fixture) x (operating Hrs./Year)

3. Annual Usage Cost Savings = kWh x $0.07454 (Year-round, daytime average rate)

4. Annual O & M Cost =
   (Operating Hrs./Year) x [(Relamp Cost Exist / Mean Life Exist) - (Relamp Cost Retrofit/Mean Life Retrofit)]

5. LCC Savings = Annual O&M Cost Savings x 11.12 +
   Annual kWh Cost Savings x 11.70 +
   Annual kW Cost Savings x 11.70

   Where Annual kW Cost Savings = kW Savings x $108.60

6. Construction Cost Estimate

   Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

   Construction cost is determined by applying the following cumulative adders:

General Conditions:	8.0%
Estimating Contingency:	10.0%
Contractor's Overhead and Profit:	30.0%
Bond:	1.0%

   Total Cost is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):	5.5%
Allowance for Design Services:	6.0%

   Investment is the Total Cost less the PG&E Rebate for the retrofit.

ECO D4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Data and Assumptions

Existing Incandescent Lamps				Replacement Fluorescent Lamps				Economic Screening Analysis						
Retrofit Designation	Total Lamp Watts	Mean Life 1 (Hours)	Relamping Cost ($)	Retrofit Lamp Type	Total Lamp Watts	Mean Life 2 (Hours)	Relamping Cost ($)	Demand Saving (kW)	Labor Cost ($)	Matrl Cost ($)	Total Cost ($)	PG&E Rebate ($)	Total Invest-ment ($)	Breakeven Operating Hrs/Year
A	60	1,000	1.50 + 1.50 Labor	13W/5T4	17	10,000	10.00 + 3.00 Labor	0.043	$35	$40	$130	$15	$115	1,070
B	75	750	1.50 + 1.50 Labor	18W/7T4	25	10,000	10.00 + 3.00 Labor	0.05	$35	$40	$130	$15	$115	825
C	100	750	2.00 + 1.50 Labor	18W/7T4	25	10,000	10.00 + 3.00 Labor	0.075	$35	$40	$130	$15	$115	190
D	150	750	2.40 + 1.50 Labor	26W/8T4	37	10,000	15.00 + 3.00 Labor	0.113	$44	$60	$181	$15	$166	220
E	250	750	2.75 + 1.50 Labor	2-F32/T8	61	20,000	8.00 + 5.20 Labor	0.189	$50	$75	$217	$25	$192	0
F	300	750	4.45 + 1.50 Labor	2-F32/T8	61	20,000	8.00 + 5.20 Labor	0.239	$50	$75	$217	$25	$192	0

1. Total Cost = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115

2. Breakeven Operating Hours per Year =

$$\frac{\text{Total Investment - (kW Savings x \$108.60 x 11.70)}}{\text{(kW Savings x \$0.07454 x 11.70) + [(Relamp \$ / Mean Life 1 - Relamp \$ / Mean Life 2) x 11.12]}}$$

3. Total Investment = Total Cost - PG&E Rebate

4. Beakeven operating hours per year represent the minimum required operating hours per year for the proposed retrofits to be economically justified.

SUMMARY OF ECO D-4: REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

ECO No.	SUMMARY OF ECO D4 ANALYSES Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
A: 60W Savings	181	22,623	7.8	$1,686	$845	$894	$39,564	$21,175	$23,610	$2,715	$20,895	1.89
B: 75W Savings	2	208	0.1	$16	$11	$11	$433	$234	$261	$30	$231	1.88
C: 100W Savings	24	4,725	1.8	$352	$195	$212	$8,767	$2,808	$3,131	$360	$2,771	3.16
D: 150W Savings	31	7,286	3.5	$543	$380	$219	$13,243	$5,029	$5,607	$465	$5,142	2.58
E: 250W Savings	20	7,862	3.8	$586	$411	$208	$13,976	$3,900	$4,348	$500	$3,848	3.63
F: 300W Savings	23	4,124	5.5	$307	$597	$125	$11,976	$4,485	$5,000	$575	$4,425	2.71
TOTALS	281	46,828	22.5	$3,491	$2,439	$1,671	$87,960	$37,630	$41,957	$4,645	$37,312	2.36

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT: SUMMARY OF TOTAL PROJECT PER BUILDING

Fac No.	SIR > 1.0 D4A Energy Savings		SIR > 1.0 D4B Energy Savings		SIR > 1.0 D4C Energy Savings		SIR > 1.0 D4D Energy Savings		SIR > 1.0 D4E Energy Savings		SIR > 1.0 D4F Energy Savings		SIR > 1.0 D4 All Energy Savings	
	kWH/Y	kW Demand	kWH/Y	kW Demand	kWH/Y	kW Demand	kWH/Y	kW Demand	kWH/Y	kW Demand	kWH/Y	kW Demand	kWH/Yr	kW Demand
P 80	-	-	-	-	98	0.2	-	-	-	-	-	-	98	0.2
P 81	-	-	-	-	-	-	-	-	-	-	783	4.8	783	4.8
T 120	1,803	0.4	-	-	349	0.1	-	-	-	-	3,341	0.7	5,493	1.2
T 121	250	0.1	-	-	218	0.1	-	-	-	-	-	-	469	0.2
T 127	2,892	0.9	-	-	3,123	1.0	-	-	-	-	-	-	6,016	1.9
P 128	6,887	2.2	-	-	-	-	-	-	-	-	-	-	6,887	2.2
T 156	80	0.0	-	-	-	-	-	-	-	-	-	-	80	0.0
S 197	1,046	0.6	-	-	-	-	-	-	-	-	-	-	1,046	0.6
P 205	429	0.1	-	-	-	-	-	-	-	-	-	-	429	0.1
P 207	413	0.1	-	-	-	-	-	-	-	-	-	-	413	0.1
P 208	413	0.1	-	-	-	-	-	-	-	-	-	-	413	0.1
P 209	1,831	1.7	-	-	-	-	-	-	-	-	-	-	1,831	1.7
P 229	413	0.1	-	-	-	-	-	-	-	-	-	-	413	0.1
P 230	413	0.1	-	-	-	-	-	-	-	-	-	-	413	0.1
S 238	-	-	-	-	-	-	7,286	3.5	-	-	-	-	7,286	3.5
P 252	89	0.0	-	-	-	-	-	-	3,538	1.7	-	-	3,628	1.7
P 256	-	-	208	0.1	-	-	-	-	393	0.2	-	-	601	0.3
P 259	89	0.0	-	-	-	-	-	-	3,931	1.9	-	-	4,021	1.9
S 283	-	-	-	-	936	0.5	-	-	-	-	-	-	936	0.5
S 291	161	0.1	-	-	-	-	-	-	-	-	-	-	161	0.1
P 295	5,409	1.2	-	-	-	-	-	-	-	-	-	-	5,409	1.2
TOTALS	22,623	7.8	208	0.1	4,725	1.8	7,286	3.5	7,862	3.8	4,124	5.5	46,828	22.5

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Fac No.	A: 60 W to 13W/5T4 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
T 120	9	1,803	0.4	$134	$42	$71.29	$2,857	$1,053	$1,174	$135	$1,039	2.75
T 121	2	250	0.1	$19	$9	$9.90	$438	$234	$261	$30	$231	1.90
T 127	21	2,892	0.9	$216	$98	$114.35	$4,942	$2,457	$2,739	$315	$2,424	2.04
P 128	50	6,887	2.2	$513	$233	$272.27	$11,766	$5,849	$6,522	$750	$5,772	2.04
T 156	1	80	0.0	$6	$5	$3.18	$160	$117	$130	$15	$115	1.39
S 197	13	1,046	0.6	$78	$61	$41.37	$2,083	$1,521	$1,696	$195	$1,501	1.39
P 205	3	429	0.1	$32	$14	$16.97	$727	$351	$391	$45	$346	2.10
P 207	3	413	0.1	$31	$14	$16.34	$706	$351	$391	$45	$346	2.04
P 208	3	413	0.1	$31	$14	$16.34	$706	$351	$391	$45	$346	2.04
P 209	39	1,831	1.7	$137	$182	$72.40	$4,533	$4,563	$5,087	$585	$4,502	1.01
P 229	3	413	0.1	$31	$14	$16.34	$706	$351	$391	$45	$346	2.04
P 230	3	413	0.1	$31	$14	$16.34	$706	$351	$391	$45	$346	2.04
P 252	1	89	0.0	$7	$5	$3.54	$172	$117	$130	$15	$115	1.49
P 259	1	89	0.0	$7	$5	$3.54	$172	$117	$130	$15	$115	1.49
S 291	2	161	0.1	$12	$9	$6.36	$320	$234	$261	$30	$231	1.39
P 295	27	5,409	1.2	$403	$126	$213.86	$8,571	$3,159	$3,522	$405	$3,117	2.75
Totals	181	22,623	7.8	$1,686	$845	$894	$39,564	$21,175	$23,610	$2,715	$20,895	1.89

Fac No.	B: 75W to 18W/7T4 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
P 256	2	208	0.1	$16	$11	$11.23	$433	$234	$261	$30	$231	1.88

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Fac No.	C: 100W to 18W/7T4 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
P 80	3	98	0.2	$7	$24	$4.41	$421	$351	$391	$45	$346	1.21
T 120	1	349	0.1	$26	$8	$15.69	$574	$117	$130	$15	$115	4.98
T 121	1	218	0.1	$16	$8	$9.80	$395	$117	$130	$15	$115	3.42
T 127	13	3,123	1.0	$233	$106	$140.19	$5,522	$1,521	$1,696	$195	$1,501	3.68
S 283	6	936	0.5	$70	$49	$42.02	$1,855	$702	$783	$90	$693	2.68
Totals	24	4,725	1.8	$352	$195	$212	$8,767	$2,808	$3,131	$360	$2,771	3.16

Fac No.	D: 150W to 26W/8T4 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
S 238	31	7,286	3.5	$543	$380	$219.23	$13,243	$5,029	$5,607	$465	$5,142	2.58

Fac No.	E: 250W to 2-F32/T8 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
P 252	9	3,538	1.7	$264	$185	$93.72	$6,289	$1,755	$1,957	$225	$1,732	3.63
P 256	1	393	0.2	$29	$21	$10.41	$699	$195	$217	$25	$192	3.63
P 259	10	3,931	1.9	$293	$205	$104.14	$6,988	$1,950	$2,174	$250	$1,924	3.63
Totals	20	7,862	4	$586	$411	$208	$13,976	$3,900	$4,348	$500	$3,848	3.63

Fac No.	F: 300W to 2-F32/T8 Savings Energy Savings					O&M	LCC Savings	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use $/Yr	Demand $/Yr	$/Yr	$	$	$	$	$	
P 81	20	783	4.8	$58	$519	$23.83	$7,021	$3,900	$4,348	$500	$3,848	1.82
T 120	3	3,341	0.7	$249	$78	$101.66	$4,955	$585	$652	$75	$577	8.58
Totals	23	4,124	5.5	$307	$597	$125	$11,976	$4,485	$5,000	$575	$4,425	2.71

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D8

Location: Fort Hunter Liggett, California | Region No. 4 | Project No.
Project Title: ECIP Facility Energy Improvements | Fiscal Year FY95
Discrete Portion Name: ECO D8 Improve Power Factor, Total Project
Analysis Date: June 1993 | Economic Life: 20 YEARS | Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$55,515		
B. SIOH	$3,053		
C. Design Cost	$3,331		
D. Total Cost (1A+1B+1C)	$61,899		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$61,899

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	47		$1,018	14.53	$14,788
B. Dist	$4.98			$0	17.63	$0
C. Propane	$7.87			$0	18.59	$0
D. Demand	$108.60	2.28	kW	$247	14.53	$3,593
E. Other						
F. Total				$1,265		$18,381

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$6,480		
(1) Discount Factor (Table A)		13.59	
(2) Discounted Savings/Cost (3A x 3A1)			$88,063

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $88,063

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	8.0	Years
5. Total Net Discounted Savings (2F5+3C):	$106,444	
6. Savings to Investment Ratio (SIR) 5/1G:	1.72	
7. Adjusted Internal Rate of Return (AIRR):	6.86%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D-8, Part A

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO D8, Part A - Power Factor Correction @ PG&E Metering Point
Analysis Date: June 1993 Economic Life: 20 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$45,781		
B. SIOH	$2,518		
C. Design Cost	$2,747		
D. Total Cost (1A+1B+1C)	$51,046		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$51,046

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84		$0.00	14.53	$0
B. Dist	$4.98		$0.00	17.63	$0
C. Propane	$7.87		$0.00	18.59	$0
D. Demand	$108.60	kW	$0.00	14.53	$0
E. Other					
F. Total			$0.00		$0

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$6,480		
(1) Discount Factor (Table A)		13.59	
(2) Discounted Savings/Cost (3A x 3A1)			$88,063

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $88,063

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	7.9	Years
5. Total Net Discounted Savings (2F5+3C):	$88,063	
6. Savings to Investment Ratio (SIR) 5/1G:	1.73	
7. Adjusted Internal Rate of Return (AIRR):	6.87%	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

ECO D8, Part B

Location: Fort Hunter Liggett, California Region No. 4 Project No.
Project Title: ECIP Facility Energy Improvements Fiscal Year FY95
Discrete Portion Name: ECO D8, Part B - Power Factor Correction @ Individual Motors
Analysis Date: June 1993 Economic Life: 20 YEARS Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$9,733		
B. SIOH	$535		
C. Design Cost	$584		
D. Total Cost (1A+1B+1C)	$10,853		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$10,853

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273-X Used for Discount Factors: October 1992

Energy Source	Cost $/MTBU/(1)	Saving MBTU/YR(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$21.84	46.6		$1,018	14.53	$14,788
B. Dist	$4.98			$0	17.63	$0
C. Propane	$7.87			$0	18.59	$0
D. Demand	$108.60	2.28	kW	$247	14.53	$3,593
E. Other						
F. Total				$1,265		$18,381

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		13.59	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4) $0

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):	8.6	Years
5. Total Net Discounted Savings (2F5+3C):	$18,381	
6. Savings to Investment Ratio (SIR) 5/1G:	1.69	
7. Adjusted Internal Rate of Return (AIRR):	6.78%	

ECO D8: IMPROVE POWER FACTOR

Application of Power Factor Correction Capacitors is considered for two general conditions:

1. Installation at the main utility metering point, and

2. Intstallation at each individual offending motor.

Location at the main service point will reduce billing penalties only and not improve load capabilities of the distribution system. Installation at individual motors will free up system capacity be reducing the amount of magnetizing current drawn from the utility supply.

1. Installation at PG&E Metering Point - Savings Calculations

Data & Assumptions:

A. PG&E rate schedule A-20 includes a 0.06% adjustment on the total billing for each 1% power factor differene from 85%. The adjustment is applied as a credit for power factors above 85% and as an additional charge for power factors below 85%.

B. Average Main Post Billings: $600,000 during summer period: $400,000 during winter period.

C. Average Power Factor: Summer period - 82/83%
Winter period - 85/86%

D. Summer Peak Demand: 3,160 kW

Calculations:

A. Peak kVAR (Existing) = kW x Tan (arcCos 0.825)
= 3,160 kW x tan(34.41 degrees)
= 2,165 kVAR

B. Peak kVAR (Corrected to 95%)
= 3,160 kW x Tan (arcCos 0.95)
= 3,160 kW x Tan(18.19 degrees)
= 1,039 kVAR

C. Peak Correction Required
= 2,165 - 1,039 kVAR = 1,126 kVAR

D. Annual Savings* = $600,000 x 12% x (0.06%)/(1%PF) = $4,320
+ $400,000 x 9% x (0.06%)/(1%PF) = $2,160
Total Savings = $6,480/year

* Assuming Correction to an average Power Factor of 95%

ECO D8: IMPROVE POWER FACTOR

2. Installation of Power Factor Correction Capacitors @ Motor Loads

Annual kWh savings due to a reduction in motor circuit (I ^ 2)R losses are estimated as follows (see notes):

HP Rating	Max kVAR	Current Reduction (%)	FLA @ 460V	Resistance Ohms/1000'	Loss I^2R (W)	New Loss I2R (W)	Savings (Watts)
5	2.5	22	7.6	1.620	17	10	21
7.5	3	20	11	1.620	35	23	36
10	4	18	14	1.620	57	38	57
15	5	18	21	1.018	81	54	78
20	6	17	27	0.640	84	58	78
25	7.5	17	34	0.640	133	92	123
30	8	16	40	0.410	118	83	102
40	15	16	52	0.410	200	141	177
50	17.5	15	65	0.259	197	142	165
60	20	15	77	0.164	175	126	147
75	25	14	96	0.129	214	158	168

HP Rating	Max kVAR	Current Reduction (%)	FLA @ 460V	Resistance Ohms/1000'	Loss I^2R (W)	New Loss I2R (W)	Savings (Watts)
2	1	24	7.8	1.620	18	10	24
3	1.5	23	11	1.620	35	21	42
5	2.5	22	17.5	1.620	89	54	105
7.5	3	20	25	1.018	115	73	126
10	4	18	32	0.640	118	79	117
15	5	18	53	0.410	207	140	201
20	6	17	68	0.259	216	149	201
25	7.5	17	85	0.259	337	232	315
30	8	16	100	0.162	292	206	258
40	15	16	130	0.129	392	277	345
50	17.5	15	163	0.081	387	280	321
60	20	15	193	0.064	429	310	357
75	25	14	240	0.043	446	330	348

Assumptions:

1. kVAR values based on raising full load power factor to approx. 95%.
2. Motors assumed to be NEMA Design B, T-Frame, 1800 RPM.
3. Resistance of motor circuit assumes conductor sized at 125% of full load amps and a length of 180'.
4. Motor circuit savings in Watts = [Exist (I ^ 2)R - New (I ^ 2)R] x 3

ECO D8: IMPROVE POWER FACTOR

SCREENING ANALYSIS - 460V MOTORS

HP Rating	Max kVAR	Savings kW	Labor Cost	Material Cost	Total Invest.[1] w/ SIOH & Design	Breakeven [2] Oper. Hrs/Yr
5	2.5	0.021	$95	$270	$588	24,490
7.5	3	0.036	$95	$280	$604	14,130
10	4	0.057	$95	$300	$636	8,940
15	5	0.078	$120	$320	$708	7,020
20	6	0.078	$120	$340	$740	7,400
25	7.5	0.123	$120	$355	$765	4,380
30	8	0.102	$120	$370	$789	5,780
40	15	0.177	$120	$485	$974	3,720
50	17.5	0.165	$145	$515	$1,062	4,580
60	20	0.147	$145	$540	$1,103	5,465
75	25	0.168	$145	$605	$1,208	5,280

[1] Investment = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115

[2] Breakeven Operating hours/year =

$$\frac{\text{Total investment - (kW savings x \$108.60/kW x 13.59)}}{\text{(kW Savings x \$0.07454 x 14.53)}}$$

SCREENING ANALYSIS - 200V MOTORS

HP Rating	Max kVAR	Savings kW	Labor Cost	Material Cost	Total Invest.[1] w/ SIOH & Design	Breakeven [2] Oper. Hrs/Yr
2	1	0.024	$85	$240	$523	18,760
3	1.5	0.042	$85	$275	$580	11,390
5	2.5	0.105	$115	$345	$740	5,145
7.5	3	0.126	$115	$360	$765	4,245
10	4	0.117	$130	$380	$820	4,675
15	5	0.201	$130	$400	$853	2,555
20	6	0.201	$130	$420	$885	2,700
25	7.5	0.315	$150	$465	$990	1,540
30	8	0.258	$150	$500	$1,046	2,380
40	15	0.345	$180	$765	$1,521	2,710
50	17.5	0.321	$200	$860	$1,706	3,545
60	20	0.357	$215	$920	$1,827	3,520
75	25	0.348	$235	$1,100	$2,149	4,340

[1] Investment = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115

[2] Breakeven Operating hours/year =

$$\frac{\text{Total investment - (kW savings x \$108.60/kW x 13.59)}}{\text{(kW Savings x \$0.07454 x 14.53)}}$$

ECO D8: IMPROVE POWER FACTOR

Life cycle cost analyses for motor installations meeting the minimum breakeven hours/yr are developed in the following spreadsheet.

CAPACITORS INSTALLED AT MOTOR LOAD

Bldg.	Supply		Return		Total	Usage	kWh
No.	HP	kW Saving	HP	kW savings	kW Savings	Hrs/Yr	Savings
205	25	0.315	10	0.117	0.432	5,840	2,523
207	25	0.315	10	0.117	0.432	5,840	2,523
208	25	0.315	10	0.117	0.432	5,840	2,523
210	10	0.117	-	-	0.117	8,760	1,025
229	25	0.315	10	0.117	0.432	5,840	2,523
230	25	0.315	10	0.117	0.432	5,840	2,523
					2.277		13,639

Note: All motors are 200V

Annual Demand Savings = 2.277 kW x $108.60/kW
= $247

Annual Mil BTU Savings = 13,640 kWh x 0.003413 Mil BTU/kWh
= 46.6 Mil BTU

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet: OF

Project: EEAP Limited Energy Study | Project No.: | Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO-D8 PF Corr-PG&E Metering Point | Estimator: RCL | Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
1200 kVAR, 12 kV pad mounted capacitor bank including incoming line section and capacitor switching	-	LS	-	$4,000	-	$23,000	$27,000
Concrete pad & site work	-	LS	-	$800	-	$200	$1,000
Feeder to PG&E metering location	30	LF	$25	$750	$20	$600	$1,350
Quotation from LGE Electrical Sales, Inc. for ABB Brown Boveri equipment dated 2/18/93							
Subtotal							$29,350
General Conditions @ 8%							$2,348
Subtotal							$31,698
Contractor OH & Profit @ 30%							$9,509
Subtotal							$41,207
Bond @ 1%							$412
Subtotal							$41,619
Estimating Contingency @ 10%							$4,162
Total Probable Construction Cost							$45,781

CONSTRUCTION COST ESTIMATE

Date Prepared: June 1993 | Sheet: OF

Project: EEAP Limited Energy Study | Project No.: | Basis for Estimate: Code A (no design competed)

Location: Fort Hunter-Liggett, California

Engineer-Architect: Keller & Gannon

Drawing No.: ECO-D8 PF Corr. @ individual motors | Estimator: RCL | Checked By: BIH

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
4 kVAR Capacitor	5	EA	$130	$650	$380	$1,900	$2,550
7.5 kVAR Capacitor	6	EA	$150	$900	$465	$2,790	$3,690
Subtotal				$1,550		$4,690	$6,240
General Conditions @ 8%							$499
Subtotal							$6,739
Contractor OH & Profit @ 30%							$2,022
Subtotal							$8,761
Bond @ 1%							$88
Subtotal							$8,849
Estimating Contingency @ 10%							$885
Total Probable Construction Cost							$9,733

installation: Fort Hunter Liggett, California

project: ECIP Facility Energy Improvements

project number
temporary: _____ program year 1995

permanent: _____ category code 80000

point of contact:

user
name _____ date _____
title _____ phone _____
autovon _____

dfae
name _____ date _____
title _____ phone _____
autovon _____

engineer district
name _____ date _____
title _____ phone _____
autovon _____

other (A-E)
name _____ date _____
title _____ phone _____
autovon _____

reviewed by:

installation facility engineer
name _____ date _____
title _____ phone _____
autovon _____

approved by:

macom engineer
name _____ date _____
title _____ phone _____
autovon _____

project development brochure, PDB-1

DA FORM 5020-R, Feb 82

facility

ECIP Facility Energy Improvements

Fort Hunter Liggett, Calif.

project coordinator for using service

functional requirements summary, PDB-1

DA FORM 5020-1-R, Feb 82

PROJECT OBJECTIVE

The objective of this project is to reduce energy consumption in cantonment area buildings by implementation of the following retrofits:

a. Install batt insulation in the ceilings of 9 buildings.

b. Install programmable controllers in 9 buildings.

c. Insulate hot water heating and cooling water piping in 12 buildings.

d. Install 24-hour programmable thermostats in 28 buildings.

e. Replace space cooling equipment in 10 buildings with more efficient systems.

f. Install automatic-draft damper controls on space heating equipment in 20 buildings.

g. Convert dual-duct air-handling system to variable air volume in 5 barracks buildings.

h. Replace boilers with high-efficiency units in 7 buildings.

i. Insulate domestic hot water piping in 6 buildings.

j. Insulate 16 domestic hot-water storage tanks in 13 buildings.

k. Install self-metering lavatory faucets in 3 buildings; and install lavatory and shower flow restrictors in 2 buildings.

l. Install dishwasher heat recovery unit in Building 206.

m. Install automatic-draft dampers on domestic hot water heaters in 3 buildings.

n. Replace incandescent lighting fixtures with fluorescent fixtures in 9 buildings.

o. Install automatic power factor correction equipment at utility metering point. Install power factor correction capacitors on 10 HP and larger motors in 6 buildings.

SPACE AND REQUIREMENTS

No additional space is required to implement this energy conservation project.

\1640310\INSERT.CUT
930721-2

SUMMARY OF FUTURE CHANGES AND IMPACTS

The buildings affected will consume less energy than they would have if this project had not be implemented.

\1640310\INSERT.CUT
930720-1

A. SPECIAL CONSIDERATIONS

	ITEM	Required or Not Required	To Be Determined *	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	R	D		
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse ccoordination, etc.)	NR			
A-4	Assignment of airspace	NR			
A-5	Economic analysis of alternatives	R	D		
A-6	Approval for new starts	NR			
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8	Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	NR			
A-9	Exceptions to established criteria	NR			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	NR			
A-11	Identification of related or support projects (so projects can be coordinated)	R	A		
A-12	Required completion date	R	A		
	Other Special Considerations (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*BY WHOM (Check and insert appropriate letter)

A — DFAE
B — Using Service
C — Construction Service
D — Designer
E — Other (Check Comments Attached and explain)

documentation checklist

4 of 9

DA FORM 5023-A-R, Feb 82

C. ARCHITECTURAL & STRUCTURAL

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	NR			
C-3	Approval for removal and relocation of existing useable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R	D		
C-19	Consideration of alternatives	R	D		
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-build drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
	Other Architectural & Structural (List and number items)				

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D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Fuel considerations and cost comparison analysis	R	D		
D-2	Energy requirements appraisal (ERA)	R	D		
D-3	Conformance with DOD Energy Reduction requirements	R	D		
D-4	Evaluation of existing and/or proposed utility systems	R	A		
	Other Mechanical and Utility Systems (List and number items)				

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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documentation checklist

DA FORM 5023-D-R, Feb 82

A. SPECIAL CONSIDERATIONS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
A-1	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area averages	NR			
A-2	Construction phasing requirements	R	A		
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in	R	D		
A-4	Equipment in place and justification	NR			
A-5	Other equipment and furniture (O&MA, OPA) and costs	NR			
A-6	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)	NR			
A-7	Type of construction (permanent, temporary, semi-permanent)	NR			
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.				
	Other special considerations (list and number items)	NR			

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technical data checklist

DA FORM 5024-A-R, Feb 82

C. ARCHITECTURAL & STRUCTURAL

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	R	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	NR			
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
	Other Architectural & Structural (List and number items)				

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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technical data checklist

DA FORM 5024-C-R, Feb 82

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	B		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	NR			
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	R	B		
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	R	B		
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	NR			
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	NR			
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	B		
D-10	Solar energy evaluation	NR			
	Other Mechanical & Utility Systems (List and number items)				

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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B — Using Service
C — Construction Service
D — Designer
E — Other (Check Comments Attached and explain)

technical data checklist

DA FORM 5024-D-R, Feb 82