PROGRAMMING DOCUMENTS	
ENERGY ENGINEERING ANALYSIS PROGRAM	
LIMITED ENERGY STUDY	
FORT HUNTER LIGGETT, CALIFORNIA 1993	
VOLUME IV	
Distribution Indiana PREPARED FOR 19971016	195
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA	
PREPARED BY	
- KELLER & GANNON ENGINEERS • ARCHITECTS 1453 MISSION STREET, SAN FRANCISCO, CA 94013	
CONTRACT NO. DACA 05-C-92-0155 DUIC QUALITY INSPECTED	28

REPLYTO ATTENTIO

DEPARTMENT OF THE ARMY

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

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Marie Wakeffeld, Librarian Engineering

EEAP, Limited Energy Study Fort Hunter Liggett, California

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Project Development Brochure	(PDB-I)	119
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\1640310\ENERGY.REV 930722-3

1. COMPONENT Army	FY 1995 MILITARY CON	STRUCTION PI	ROJECT	T DATA	2. DATE June	: 1993
3. INSTALLATION AND	LOCATION	4. PROJECT TT	ГLE			
	r Liggett, California			Energy Imp	rovemen	ts
				1		
5. PROGRAM ELEMEN		7. PROJECT NU	MBER	8. PROJ	ECT COS	T (\$000)
	80000				900.6	
	9. COST	ESTIMATES				
	Item		U/M	Quantity	Unit Cost	Cos (\$00
Primary Facility						717.7
Insulate ceilings			LS	-	-	(18.9
Install duty cycli			LS	-	-	(26.2
	system pipe insulation		LS	_	-	(2.1
	nable thermostats		LS	-	-	(60.7
Replace ineffici				-	-	(363.8
	c-draft dampers on space heat	ing boilers	LS LS	-	-	(11.9
Retrofit to varia			LS	-		(111.2
Replace inefficie	ic hot water piping		LS	_	_	(25.5
Insulate hot wat						(4.1
	faucets and flow restrictors		LS	_	-	(1.2
	om dishwasher hot water		LS	_	_	(5.3
	c draft dampers on DHW hea	ters	LS		-	(1.6
	escent lighting with fluorescent		LS	_	-	(34.2
Improve power			LS	_	-	(50.4
Supporting Facilities					-	0
Estimated Contract (Cost					717.7
Contingency (10%)						71.8
Subtotal						789.5
	-1 Original (5.50%)					43.4
Supervision, Inspect a	and Overnead (5.5%)					1
Unescalated CWE	_					832.9
Escalation to FY 199	5					67.7
Total Request						900.6
	ROPOSED CONSTRUCTION					
	g energy conservation and cos				101	
	ation in ceilings of 9 bldgs (E				.COJ A4).	
	ng controls (programmable co					
	er heating and cooling water p					
	with more efficient systems in					
	c-draft dampers on space heat				B 10).	
						15).
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 ().		
k. Install self-metering lavatory faucets in 3 buildings; and install lavatory and show					r flow	
restrictors in 2 b	ouildings (ECO C5).	-				
	er heat recovery unit in Buildi					
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 						

DD FORM 1391

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11.	REQUIREMENT:	N.A.
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PROJECT: Implement energy conservation retrofits in 44 buildings. (Current mission)

<u>**REQUIREMENT</u></u>: 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.</u>**

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.

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

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

<u>ADDITIONAL</u>: 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	2
Estimated Construction Completion: November 1995	Index: 2075	5

LOCATION: Fort Hunter Liggett, California PROJECT TITLE: ECIP Facility Energy Improvements

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
٠	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

LOCATION: Fort Hunter Liggett, California PROJECT TITLE: ECIP Facility Energy Improvements

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.

LOCATION: Fort Hunter Liggett, California PROJECT TITLE: ECIP Facility Energy Improvements

**

DETAILED CALCULATIONS

\1640310\ENERGY.REV 930722-3

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

TOTAL PROJECT

	Fort Hunter Liggett, California IP Facility Energy Improvements Name: Total Project	Region No. 4			Project No. Fiscal Year FY95
Analysis Date:		Economic Life:	20	YEARS	Preparer: KELLER & GANNON
		and	15	YEARS	
1. Investment Co	osts		_		
A. Construction	Costs	\$789,542	_		
B. SIOH		\$43,425	_		
C. Design Cost		\$47,373	_		
D. Total Cost (1/	A+1B+1C)	\$880,339	-		
E. Salvage Value	e of Existing Equipment			\$0	
F. Public Utility (Company Rebate			(\$38,033)	
G. Total Investm	ent (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
B. Dist	15 Yr 20 Yr	\$18.23 \$4.98	905.7	\$16,510 \$0	11.70 17.63	\$193,168 \$0
C. Propane	15 Yr 20 Yr	\$4.98 \$7.87	3,276.8	\$16,318 \$1,666	13.78 18.59	- \$224,864 \$30,979
D. Demand	15 Yr 20 Yr	\$7.87 \$108.60	4,030.0	\$31,716 kW \$247	14.16 14.53	\$449,092 \$3,593
E. Other	15 Yr	\$108.60	230.1	kW \$24,990	11.70	\$292,383
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 (-)

ltem	Savings(+)	Year of	Discount	Discounted Sa	V-
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)	(4)
a.	\$107.993	3	0.89	\$96,114	
ь.	\$221,264	5	0.82	\$181,437	
С.	\$30,885	10	0.67	\$20,693	
d. Total	\$360,142			\$298,243	
C Total Non Energy	y Discounted Savir	ngs (3A2+3Bd4)		\$366,821	
4. Simple Payback	1G/(2F3+3A+(3B	d1/Economic Life	e)):	5.9	Years
5. Total Net Discou	•	-		\$1,893,675	
6. Savings to Invest	tment Ratio (SIR) 5	5/1G:		2.25	
7. Adjusted Internal	l Rate of Return (A	IRR):		9.78%	

. .

ECO	Energy Sa			Year)		Annual Er	ergy 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
СЗ	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	15 9.8	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

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SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

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 Co	st Savings			Non-Energy S	avings	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
СЗ	\$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

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

ECO	Investment Co:	sts			Economic	Evalua	tion
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	-

SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

Descriptions of ECO's

- A4 Insulate Ceilings and/or Roofs
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- 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

FACILITY AND RETROFIT SUMMARY

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Fac		Category	Area				ENERGY CONSERVATION OBPORT INITY MILITIES		NICED	VITIC								
No.	Installation Name	Code	(SF)	A 4	B-1	84	B-6/7		B-10	B-15	B-21					0 C	Z	a C
S 79	Post Office, Main	73073	1,000	•	 .			-#			; ·	; .	3	3	3	S	S	5
P 80	Exchange, Main Retail	74053	9,093	,	•	•	•	1	•	•		• •			• •	•	•	•
P 81	Theater with Dressing Rm's	74076	6,719	1	1	•		•	•	,	,	1) (•
P 101		74046	22,211	•	•	•	•	•	•	,	•			•				•
P 116		74052	1,788	,	•	1		, ,	, .	,	•	•	•	•			• •	•
T 120	Fire Station	74034	9,600	•	,	,	•	•	•	•					1			•
T 121	Bowling Center	74011	5,580	•	,	•	•		, .) '	, ,				•
T 127	Officers Quarters Military	72410	2,250	•	1		, ,	•	•	,								•
P 128	Officers Quarters Military	72410	20,196	•	•	•	•	•	•	,	•	•	•			•		•
	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	1	,	,	•	•		,		, ,		•	•	•		•
T 161	Admin General Purpose	61050	2,250	•	ı		•	•	•	,				•	•	•	•	•
T 162	Elec Maint. Shop	21710	2,250	•	ı		•	,	•				•	•	•	,	•	•
T 163	Officers Quarters Military	72410	2,250	•	,		•				,				,	1	•	•
T 164	Admin General Purpose	61050	2,250	•	•	•				,				• •	•	•	•	•
	Admin General Purpose	61050	2,250	•	,	•		•	•							,	•	•
	Officers Quarters Military	72410	2,250	•	,		•	•		•				, ,	•	•	•	•
167	Officers Quarters Military	72410	2,250	•	•	1	•	,		,	1						,	•
168	General Purp Warehouse	44220	6,560	•	,	,	•	,	•	,					, ,	•	•	•
172	Cold Storage Warehouse	43210	800		•		•		,	•		,						•
	Technical Library	61065	3,599	•		•	•		•				· · ·			•	•	•
	Child Development Cntr	74047	3,599	,	•	,	•		•	,					• •	• •	•	•
S 182 0	Commissary	74021	3,000	,	,	,	•	•	,	•	,							•
_	Sup Svc Admin Bldg	61023	1,920	•	,		•	•			4	,			•			
	Post Chapel	73017	2,720	ı	-	•	•			,	•		-		•			
S 197 A	Admin Bldg R&D	61060	7,728	,	,		•		•	,	•		•					•
	General Inst Bidg	171120	1,090	,	'				•	,) •	, . , .				,
	Admin General Purpose	61050	40,981	•	•	•	•	•	•	•		•			1		•	•
	Enlisted Pers Dining Fac	72210	16,768	,	•	•	•		•	, ,								
			35,820	•	•	•	•	-	•			•)	•		•
-	Dining		40,981	•	•											•		
-		74062	3,320	•			•	, .	, .	, ,)
		55040	10,973	•	•		•		•							•		•
	Imming Pool	75030	•				•) ,		, ,	•	•	
212	Gymnasium	74034	8,907				•			•				1				•
P 219 P	Physical Fitness Center	74028	3,212		-	-							-				•	•
ĺ	:		•	•	-	-	-	-	-	-	-	-	-		-	— ,	 ,	•

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ECO recommended for this building

FACILITY AND RETROFIT SUMMARY

Lan L		Category	Area				ENERGY CONSERVATION OPPORTUNITY NUMBER	V CO	USER	VATIO	N O PF	ORTI	VIIV	NUM	BER			
			Úų,		0		<u>67</u>	ď	01-10	В.15	R-01	ပိ	e C	С С	0-8 0	6-0	40	8-0
ŝ	Installation Name	Code	(Sr)	¥	Ē	-#	-#			2		5	3	3	5	3	5	
P 229	P 229 Enl Barracks w/o Dining	72111	40,915	•	•	•	•	•	•	•	•	•	•	•	,	•		
P 230	Ent Barracks w/o Dinfng	72111	40,981	•	•	•	•	•	•	•	•	•	,	•	•	•	•	
S 235	S 235 Admin General Purpose	61050	3,000	•	•	•	1	,	1	•	•	•	•	•	•	•	•	•
S 236	Admin General Purpose	61050	3,000	'	•	,	•	•	•	•	•	•	•	,	,	•	•	•
S 237	S 237 Admin General Purpose	61050	3,000	,	•	<u>،</u>	•	•	•	•	4	•	•	•	•	•	• •	•
S 238	Sig Photo Lab	14130	14,548	1	•	•	,	•	•	,	•	•	•	•	•	•	•	1
P 240	Admin General Purpose	61050	3,000	•	•	•	•		•	•	٠	•	•	1			•	•
S 241	GM Facility	31220	10,000	•	,	•	•	,	•	•	•	•	,	•	•	•	•	1
S 243	S 243 Admin General Purpose	61050	3,000	•	•	•	•	,	•	•	•	•	•	ı	۱	•	•	ı
S 244	S 244 Admin General Purpose	61050	3,000	•	•	•	١,	•	•	•	•	,	•	•	•	•	•	1
S 246	Admin General Purpose	61050	3,000	•	,	,	•	,	1	,	•	•	•	•	•	•	•	•
S 247	S 247 Admin General Purpose	61050	3,000	ı	•	•	•	•	•	•	•	•	,	•	•	•	•	•
P 252	P 252 Vehicle Maint Shop DS	21420	12,299	,	•	•	,	•	•	,	•	•	•	1	ŗ	•		ı
P 256	Vehicle Maint Shop ORG	21410	5,294	•	•	•	•	,	•	•	,		•	,	•	•	•	•
P 259	Vehicle Maint Shop ORG	21410	13,667	•	4	ı	•	•	•	•	۰	•		ı	,	,	•	1
S 283		44220	4,000	•	•	,	•	•	•	•	•	,	•	•	•	•	•	
S 286	Admin General Purpose	61050	3,000	•	•	•	•	•	•		•	•	•	•	•	•	•	•
P 287	P 287 Recreation Building	74069	5,584	•	•	•	,	•	•	•	•	•	•	÷	•	•	•	•
S 288	S 288 General Purpose Warehous	44220	3,000	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
S 290	Electron Equip Facility	31740	14,856	,	,	•	•	•	•	•	•	•	•	•	•		•	,
S 291	Cont Humid Warehouse	44230	7,400	,	•	•	•	•	•	•	•	•	•	1	1	•	•	·
P 295		72111	46,593	•	•	•	•	•	•	•	•	•	•	•	•	•	•	-1
P 301	ADP Building	61031	10,800	•	,	•	•	•	ł	•	•	•	•	•	,	•	•	•
P 642	P 642 Detached Latrine/Shower	72324	<u> 9</u> 95	•	•	•	•	•	•	•	•	;	•	ı	•	1	,	•
S 220	S 220 Control Tower - Range SPT	17123	891		•	•		•		•	•	•	•	•	•	·	•	·

ECO Number / Description

- Insulate Ceilings and/or Roofs А 44 1-4
 - Install Duty Cycling Controls
- **Replace Heating System Pipe Insulation** н 4
- Install Time Clocks & Programmable Thermostats B-6/7

- Replace Inefficient Chillers 8-8
- Install Automatic File Dampers on Heating System Boilers B-10

 - Convert Multizone HVAC Systems to Variable Air Volume B-15

ECO recommended for this building

Improve Power Factor

Reduce Domestic Hot Water Flow at Shower Heads and Faucets

Install Automatic Flue Dampers on DHW Systems

Dishwasher Heat Recovery

Replace Pipe Insulation on Domestic Hot Water Systems

Replace Inefficient Boilers

Insulate Hot Water Storage Tanks

Replace Incandescent Lighting with Fluorescent

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

	ECIP Facility En Iame: ECO A4	ggett, California ergy Improvements Insulate Ceilings an	Region No. 4 d/or Roofs Economic Life:	20 YEARS	Project No. Fiscal Year FY95 Preparer: KELLER & GANNON
1. Investment Cos A. Construction C B. SIOH C. Design Cost D. Total Cost (1A- E. Salvage Value F. Public Utility Co G. Total Investme	osts +1B+1C) of Existing Equi ompany Rebate		\$20,777 \$1,143 \$1,247 \$23,166	- - - \$0 \$0	\$23,166
2. Energy Savings	s (+)/Cost(-):	or Discount Factors:	October 1992	-	
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec. B. Dist C. Propane D. Demand E. Other F. Total	\$21.84 \$4.98 \$7.87 \$108.60	35.4 0.0 211.7 0.0 kW	\$774 \$0 \$1,666 \$0 \$2,441	14.53 17.63 18.59 14.53	\$11,248 \$0 \$30,979 \$0 \$42,226
3. Non Energy Sa	vings (+) or Co	st (-):			
A. Annual Recurri (1) Discount Facto (2) Discounted Sa	ng (+/-) or (Table A)		\$0	13.59	
B. Non Recurring	Savings (+) or	Cost (-)			
ltem	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted ings(+)Cost	
a. b. c. d. Total			- 		- - -
C Total Non Ener	gy Discounted S	Savings (3A2+3Bd4)	\$0	
4. Simple Paybac 5. Total Net Disco 6. Savings to Inve 7. Adjusted Intern	unted Savings stment Ratio (S	IR) 5/1G:	fe)):	9.5 \$42,226 1.82 7.17	5

ECO A4

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.

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BASELINE, BEFORE ECO A4 IMPLEMENTED

Trane Air Conditioning Economics By: Trane Customer Direct Service Network

- PACKAGED TERMINAL AIR COND. PTAC Peak System 1

te-4

Peaked at Time *	=>	Mo/Hr:	7/1 7					/18 *		Mo/Hr: 13/		
Outside Air ==>	OAL	DB/WB/HR:	96/ 70/ 70.0			* 0A *	D8: 9	ין ≖ *		OADB: 27		
			Ret. Air	Net	Percnt	* Sp	ace	Percnt *	Space Peak	Coil Pe	ak i	Percnt
	Space	Ret. Air Sensible		Total		* Sensi		Of Tot *	Space Sens	Tot Se	ns (Of Tot
	Sens.+Lat.			(Stuh)			uh)	(%) *	(Btuh)	(Btu	h)	(%)
Envelope Loads	(Btuh)	(Btuh) O		0		*	0	0.00 *	0		0	0.00
Skylite Solr	0	0		Ő		*	0	0 .00 *	0		0	0.00
Skylite Cond	0	14 ,919		14,919		*	0	0 .00 *	0	-7,8	98	22.93
Roof Cond	0	0		15,120		* 16,	940	35.17 *	0	-	0	0.00
Glass Solar	15,120	0		2,421	3.53	-	002	4.16 *	-6,291	-6,2	91	18.27
Glass Cond	2,421	6,143		30,130	43.92	* 24,	108	50 .05 *	-16,474	-20,2	52	58 .8 0
Wall Cond	23,987	0,143		0	0.00	*	0	0 .00 *	0	ļ.	0	0.00
Partition	0			0	0.00	*	0	0 .00 *	0	j.	0	0.00
Exposed Floor	0			0		*	0	0.00 *	0	J	0	0.00
Infiltration	0	21 043	,	62,590	91.24	* 43.	050	89.37 *	- 22,765	-34,4	40	100.00
Sub Total==>	41,528	21 ,062		02,370		*		*	•	•		
Internal Loads				1,707	2.49	* 1.	707	3.54 *	٥	ł	0	0.00
Lights	1,707	0		4,300	6.27		800	3.74 *	G		0	0.00
People	4,300	-		4,500	0.00	•	0	0.00 *	0		0	0.00
Misc	0	0	_	_			506	7.28 *	0		0	0.00
Sub Total==>	6,007	0		6,007		-	614	3.35 *	-1,109		0	0.00
Ceiling Load	1,961	-1,961		0		- 'ı •	0	0.00 *	.,		0	0.00
Outside Air	0	0	0	0	0.00	*	v	0.00 *	•		Ō	0.00
Sup. Fan Heat		-		0		- -		0.00 *			ō	0.00
R et. Fan Heat		0		0	0.00	-		0.00 *			ō	0.00
Duct Heat Pkup		0	1	0	0.00	•	0	0.00 *	c	1	ō	0.00
OV/UNDR Sizing	0			0	0.00	- +	U	0.00 *			õ	0.00
Exhaust Heat		C		0	0.00	•		0.00 *			0	0.00
Terminal Bypass		0) 0	0	0.00	*		*			•	
Grand Total==>	49 ,496	19 ,100	0	68, 596	100 .00	* 48,	, 170	10 0.00 *	-23,873	-34,4	40	100 .0
		COC	LING COIL SE							AREAS		
Tota	l Capacity	Sens Cap.	Coil Airfl		ng DB/WB/H			B/WB/HR	Gross Total		8 (sf)) (%)
(Tons) (Mbh)	(Mbh)	(cfm)	Deg F De	g f Grain			Grains		1,000		
lain Clg 5.	7 6 8.6	66.1	3,219		4.5 66.		57.5		Part	0		
ux Cig 0.	o 0.0	0 .0	0		0.0 0.		0.0		ExFlr	0		•
opt Vent 0.	0.0	0 .0	0	0.0	0 .0 0.	.0 0.0	0.0	0 .0		1,000		0
lotais 5.	7 68 .6								Wall	1,400	14	40 1
HEAT	ING COTI SEL	ECTION		AI	RFLOWS (c	fm)		ENGINEERING	CHECKS	TEMPERA	TURES	(F)
Capac			Lvg	Туре	Cooling	Heating	CL	g % OA	0.0	Туре	Clg	Htg
(Mb		fmn) Degi		Vent	0	0	CL	g Cfm/Sqft	3.22	SADB	61.2	74.
		219 60.3		Infil	0	0	Cl	g Cfm/Ton	56 3.16	Plenum	81 .2	
	0.0	0 0.0		Supply	3,219	3,219	Cl	g \$qft/ĭon	174.94	Return	81.1	60.
		,219 60.3		Hincfm	0	0	Cl	g Btuh/Saft	68 .60	Ret/OA	81.1	60.
	0.0	0 0.0		Return	3,219	3,219	No	. People	10	Ru narnd	75.0	68.
	0.0	0 0.0		Exhaust	0	0	Ht	g % DA	0.0	Fn MtrTD	0.0	٥.
Humidif	***									-		•
	0.0	0 0.1	0.0	Rm Exh	0	0	Ht	g Cfm/SqFt	3.22	Fn BidTD	0.0	0.

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AFTER ECO A4 IMPLEMENTED

Trane Air Conditioning Economics By: Trane Customer Direct Service Network

-37.2

Total

- PACKAGED TERMINAL AIR COND. PTAC 1 Peak System

Mo/Hr: 7/18 * Mo/Hr: 13/ 1 ٠ Mo/Hr: 7/18 Peaked at Time ==> OADB: 91 OADE: 27 OADB/WB/HR: 91/ 68/ 70.0 Outside Air ==> Percnt * Space Peak Coil Peak Percnt Ret. Air Ret. Air Net Percnt * Space Space Of Tot * Space Sens Tot Sens Of Tot Sensible Total Of Tot * Sensible Latent Sens.+Lat. (Stuh) (%) * (Btuh) (Btuh) (%) (%) * (Btuh) (Btuh) (Btuh) (Btuh) Envelope Loads * 0.00 0 0.00 Ô 0 0.00 * 0 0 Skylite Solr 0 0.00 * 0.00 0 ۵ 0 0.00 * ۵ 0 ۵ Skylite Cond 0.00 * 5.16 0 0 -1,468 3.92 * 2.272 2,272 0 Roof Cond 18,550 39.05 * 0 0 0.00 16,940 29.25 0 16,940 Glass Solar 3.21 * 1,523 -6,291 -6,291 22.11 2,002 3.46 0 Glass Cond 2,002 30**,702** 48**.89** -20,688 72.72 53.01 23,224 * -16,474 6,594 24,108 Wall Cond 0.00 * 0 0 0.00 0.00 0 ۰. 0 Partition 0 0.00 * 0 0 0.00 0.00 . Ω 0 Exposed Floor 0 0.00 * 0 0 0.00 0 0.00 * 0 Infiltration 100.00 51,915 89.63 . 43,297 91.14 * -22,765 -28,447 8,865 43,050 Sub Total==> Internal Loads 3.59 * ۵ 0.00 2.95 * 1,707 0 1,707 1.707 0 Liahts 3.79 * 1,800 ۵ ٥ 0.00 7.42 * 4,300 4,300 People 0.00 * 0 0.00 0.00 * 0 0 ٥ 0 0 Misc 0 10.37 * 7.38 * 0 0 0.00 3.506 0 0 6,007 6,007 Sub Total==> 1.48 * 0 0.00 0.00 * 704 -515 0 812 -812 Ceiling Load 0.00 * 0 0.00 * 0 0 0.00 O 0 ۵ û Outside Air n 0.00 0.00 * 0 0.00 * Sup. Fan Heat ۵ 0.00 0.00 * 0.00 * 0 A Ret. Fan Heat 0.00 * ۵ 0.00 0.00 * 0 0 Duct Heat Pkup 0.00 * 0 0.00 0.00 * n 0 0 OV/UNDR Sizing 0 0.00 * ٥ 0.00 0 0.00 * 0 0 Exhaust Heat 0.00 * 0 0.00 0.00 * 0 0 ٥ Terminal Bypass -28,447 100.00 57,922 100.00 * 47,507 100.00 * -23,280 8,054 0 Grand Total=> 49,868 ----- AREAS------------COOLING COIL SELECTION-----Glass (sf) (%) Leaving DB/WB/HR Gross Total Total Capacity Sens Cap. Coil Airfl Entering DB/WB/HR Deg F Deg F Grains Floor 1,000 Deg F Deg F Grains (cfm) (Mbh) (Mbh) (Tons) 66.9 61.2 57.3 66.0 Part 0 63.3 55.4 3,170 77.5 57.9 4.8 Main Clg 0.0 0.0 0.0 0.0 ExFlr 0 0 0 0.0 0.0 0 0.0 0.0 Aux Clg Roof 1,000 0 0 0.0 0.0 0.0 0.0 0.0 0.0 0 0.0 0.0 0.0 Opt Vent Wall 1,400 140 10 57.9 4.8 Totals -- TEMPERATURES (E)--------AIRFLOWS (cfm)--------ENGINEERING CHECKS-------HEATING COIL SELECTION-----Cla Hta Heating Clg 🗶 OA 0.0 Type Cooling Type Capacity Coil Airfl Ent Lva 3.17 SADB 61.2 74.8 0 0 Clg Cfm/Sqft (cfm) Deg F Deg F Vent (Mbh) Cla Cfm/Ton 656.65 Plenum 77.6 63.7 0 0 3,170 74.8 Infil 63.9 -37.2 Main Htg 77.5 Cla Saft/Ton 207.18 Return 64.2 3.170 3.170 0 0.0 0.0 Supply 0.0 Aux Htg Ret/OA 77.5 64.2 Clg Btuh/Saft 57.92 0 3,170 64.2 61.2 Mincfm 0 -0.0 Preheat Runernd 75.0 68.0 3,170 3.170 No. People 10 0.0 0.0 Return 0.0 0 Reheat 0 Htg X OA 0.0 Fn MtrTD 0.0 0.0 0 0 0.0 0.0 Exhaust 0.0 Humidif Fn BldTD 0.0 3.17 0.0 ٥ 0 Htg Cfm/SqFt 0.0 0 0.0 0.0 Rm Exh Opt Vent Fn Frict 0.0 Htg Btuh/SqFt -37.22 0.0 0 0 Auxil

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ECO A4 INSULATE CEILINGS / ROOFS

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

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ECO A4 COST SAVINGS

1.8	\$42,226	\$23,166	\$20,777					TOTALS
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	167
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	166
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	165
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	164
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	1 8
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	162
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	161
2.6	\$7,603	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	127
	Savings \$	\$	B x 1.10	OHP x 1.01	GC x 1.30	CC x 1.08	Cost (CC) \$	Number
SIR	LCC Energy	Investment	Contingency	Bond	ОН&Р	Gen Cond	Building Construction Cost	Building

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

OH & PContractors 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:

14.53 Electricity =

18.59

Propane =

Fuel Oil =

17.63

SIRLCC Savings/Investment

18

CONSTRUCTION COST ES	STIMAT	E		Date Prepared	3	Sheet Of	
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study							
Location					Code A	(no design compe	ited)
Fort Hunter-Liggett, California Engineer-Architect					4		
Keller & Gannon							
Drawing No.		Estimat	or		Checked	Ву	
ECO A-4 Insulate Ceilings/Roofs							
Line Item	Que No.	antity Unit	Per	Labor	Per	Material	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
Building 127		ļ					
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,66
Subtotal Building 127							\$1,66
Building 161							
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,66
Subtotal Building 161							\$1,66
Building 162 through 167			I i i i		Ī		
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,66
Subtotal Building 162 through 167					1	1	\$1,66
					1		
Building 252			1	<u> </u>		† – – †	
R-19 Batt Insulation	12300	SF	\$0.24	\$2,952	\$0.50	\$6,150	\$9,10
Subtotal Building 252					1	1	\$9,10
				1			
]				
			1				
		İ	1		1	1 1	
						<u>† </u>	
					1		
					1	<u> </u>	
			1			<u>† </u>	
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			+	1		<u>† </u>	
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Life Cycle Cost Analysis Summary ECO B-1 Energy Conservation Investment Program (ECIP)

Project No. Region No. 4 Location: Fort Hunter Liggett, California Fiscal Year FY95 Project Title ECIP Facility Energy Improvements Discrete Portion Name: ECO B1 Install Duty Cycling Controls Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs A. Construction Costs \$28,795 B. SIOH \$1,584 C. Design Cost \$1,728 \$32,106 D. Total Cost (1A+1B+1C) E. Salvage Value of Existing Equipment F. Public Utility Company Rebate \$200 \$31,906 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discount Discounted Annual \$ Saving Energy Cost Savings(5) Source \$/MTBU/(1) MBTU/YR(2) Savings(3) Factor(4) \$0 \$0 11.70 A. Elec. \$21.84 \$0 13.78 \$0 B. Dist \$4.98 \$0 \$0 \$7.87 14.16 C. Propan D. Other 11.70 E. Demand @ \$108/kW-Yr 43.5 \$55,334 kW \$4,729 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 (-) Discount **Discounted Sav-**Savings(+) Year of ltem Factor(3) Cost(-)(1) Occur. (2) ings(+)Cost(-)(4) а. 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

7.07%

7. Adjusted Internal Rate of Return (AIRR):

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

	Controlled Ear KW KW KW Str. Str. Str. Str. Str. Str. Str. Str.	Building	Item to be	, z	ЧH	Mtr	ΚW	Total	New	Demand	Demand	Demand	O&M Saved O&M Saved	O&M Saved	Invest	Simple	SIR
y of Building Amalysis Factors y of Building Amalysis Factors 1 Else Resters(1) 1 2 100% 56.0 51.050 51.283 (557) (5745) 54,060 4.15 5 Return Fam Motor 1 1 2 100% 56.0 9.0 7.3 15 519.0 (557) (5745) 54,060 4.15 6 Return Fam Motor 1 1 83.0 55.3 55.39 55.39 55.91 55.10 (557) 54,060 11.19 7 cols 3 3 2.3 3.3 3.3 3.3 3.	Total Total State State <th< td=""><td></td><td>Controlled</td><td>Ea.</td><td></td><td>Eff</td><td></td><td>kW</td><td>kW</td><td>kW Saved</td><td></td><td>\$LCC</td><td>\$/Yr</td><td>LCC \$</td><td>\$</td><td>Payback</td><td></td></th<>		Controlled	Ea.		Eff		kW	kW	kW Saved		\$LCC	\$/Yr	LCC \$	\$	Payback	
I Elec Ree Heaters (1) 1 - 100% 56.0 58.0 51.050 51.258 55.400 415 14 5 Return Fam Motor 1 1 25 87.8 31.1 25 87.90 71.1 25 87.90 71.1 27 87.90 71.1 27 87.90 87.10 87.450 87.00 41.5 Return Fam Motor 1 1 23 0.0 0.1 52 85.90 (557) 57.450 84.000 82.2 Return Fam Motor 2 10 85% 27 54 4.5 0.0 87.91 87.11 87.000 87.15 Return Fam Motor 1 1 83 83.11 84.540 87.910 <td< td=""><td>1 Electerers (1) 1 - 100% 58.0 58.0 51.000 51.2.283 (557) (5745) 54,000 415 Reutor FamMotor 1 2 0 0 0 0 0 51.95 51.95 51.95 54.000 415 74.5 54.000 415 Reutor FamMotor 1 1 0.05 0.1 51.6 51.90 (557) 54.000 415 6 Supply FamMotor 2 10 95% 58.00 550.00 557.1 54.000 415 6 Supply FamMotor 1 1 83% 0.0 0.1 51.0 55.00 557.1 54.000 415 6 Supply FamMotor 1 1 83% 0.1 51.0 55.000 557.1 54.000 415 7 11 83% 0.3 0.1 51.6 55.000 557.1 54.000 57.45 54.000 57.45 7</td><td>mmary</td><td>of Building Analysis Factor</td><td>rs</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	1 Electerers (1) 1 - 100% 58.0 58.0 51.000 51.2.283 (557) (5745) 54,000 415 Reutor FamMotor 1 2 0 0 0 0 0 51.95 51.95 51.95 54.000 415 74.5 54.000 415 Reutor FamMotor 1 1 0.05 0.1 51.6 51.90 (557) 54.000 415 6 Supply FamMotor 2 10 95% 58.00 550.00 557.1 54.000 415 6 Supply FamMotor 1 1 83% 0.0 0.1 51.0 55.00 557.1 54.000 415 6 Supply FamMotor 1 1 83% 0.1 51.0 55.000 557.1 54.000 415 7 11 83% 0.3 0.1 51.6 55.000 557.1 54.000 57.45 54.000 57.45 7	mmary	of Building Analysis Factor	rs													
S Supply Fan Motor 1 25 67% 21.4 21.4 21.4 21.4 21.4 21.4 21.4 21.6 23.6 23.6 31.6	Return Fam Motor 1 25 67% 214 214 214 214 214 215 5160 5550 5571 54,000 822 7 Supply Fan Motor 1 1 23% 03	101		۰	•	100%	58.0	58.0	48.3	9.67	\$1,050	\$12,283	(\$67)	(\$745)	\$4,080	4.15	2.83
Return Fan Motor 1 10 655 8.8 7.3 1.5 \$150 \$1,05 \$1,00 8.22 Net Water Pump 1 1 83% 0.9 0.7 0.1 \$515 \$1,90 \$657 \$5,165 \$4,000 8.22 R bupty Fam Motor 2 10 85% 0.9 0.7 0.1 \$515 \$5,136 \$577 \$4,000 8.22 R bupty Fam Motor 2 3 83% 2.7 \$4,45 \$598 \$5,590 \$567 \$5745 \$4,000 8.22 7 bupty Fam Motor 1 1 83% 0.9 0.7 0.1 \$516 \$576 \$4,000 8.22 7 bupty Fam Motor 1 1 83% 0.9 0.7 0.1 \$516 \$5745 \$4,000 8.22 7 but Water Pump 1 1 1 83% \$516 \$559 \$5569 \$5745 \$4,000 8.22 8 bupty Fam Motor 1 1	Return Fam Motor 1 10 65% 8.8 7.3 1.5 \$15 \$190 \$657 \$745 \$4,000 8.22 1001 101 1 1 1 1 8.3 9.0 0.7 0.1 \$15 \$559 \$559 \$4,000 8.22 5 Upply Fam Motor 2 1 8.3 9.0 0.9 0.9 0.1 \$119 \$471 \$4,000 8.22 5 Upply Fam Motor 1 1 2 8.3 8.3 \$4,400 \$567 \$4,160 8.2 7 Etail 2 1 2 1 2 4 5 5 \$559 \$4,540 \$4,190 \$4,240 \$4,900 8.22 7 Etail 2 3 3 3 \$539 \$4,840 \$4,900 8.22 \$4,900 8.22 \$4,900 8.22 \$4,900 8.22 \$4,900 8.22 \$4,900 8.22 \$4,900 \$2,23 \$2,900 \$5,71 <	205		-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
Hote Water Pump 1 1 83% 0.0 0.1 510 510 510 510 512 510 511 <th< td=""><td>Hote Water Pump 1 1 83% 0.9 0.7 0.1 516 5190 (567) (5745) 84,060 6.22 Supply Fan Motor 2 10 65% 8.8 17.6 1.4.6 2.9 55.36 55.37 57.45</td><td></td><td>Return Fan Motor</td><td>-</td><td>10</td><td>85%</td><td>8.8</td><td>8.8</td><td>7.3</td><td>1.5</td><td>\$159</td><td>\$1,859</td><td></td><td></td><td></td><td></td><td></td></th<>	Hote Water Pump 1 1 83% 0.9 0.7 0.1 516 5190 (567) (5745) 84,060 6.22 Supply Fan Motor 2 10 65% 8.8 17.6 1.4.6 2.9 55.36 55.37 57.45		Return Fan Motor	-	10	85%	8.8	8.8	7.3	1.5	\$159	\$1,859					
Total Total 31.1 5.2 \$5569 (\$57) (\$745) \$4,060 \$22 6 Suppy Fam Motor 2 1 0 35% 8.8 17.6 14.6 2.9 \$3171 \$4,060 \$2.2 6 Suppy Fam Motor 2 3 8.3 71 \$4,00 \$677 \$745 \$4,060 \$1.2 7 Hout Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$17.9 \$4,060 \$1.9 7 Suppy Fam Motor 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$1.19 <	Total Total 31.1 5.2 \$558 \$6,589 (\$57) \$745 \$4,080 \$22 Return Fam Motor 2 10 65% 17.6 14.6 2.9 \$3142 \$4,080 \$22 \$4,080 \$22 \$4,080 \$22 \$4,080 \$4,20 \$5,00 \$5,71 \$4,080 \$4,20 \$4,90		Hot Water Pump	-	-	83%	0.0	0.9	0.7	0.1	\$16	\$190					
6 Supply Fam Motor 2 10 85% 8.8 17.6 14.6 2.9 83317 83,717 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 33,7 1 3 3 3 3 3 3 3 3 3 3 3 3 1	S Buppi Fam Motor 2 10 65% 8.8 17.5 14.5 2.9 \$33:1 \$3.717 14.2 \$4.060 11.19 Herum Fam Motor 1 1 1 23.8 27 5.4 4.5 0.9 \$360 \$1.142 \$4.060 11.19 Total 1 1 1 25 87% 21.4 17.9 3.6 \$380 \$4.560 (\$57) \$4.060 11.19 7 Supply Fam Motor 1 1 10 85% 21.4 17.9 3.6 \$380 \$4.500 (\$57) \$4.060 11.19 7 Bupty Fam Motor 1 1 1 88 7.3 15.5 \$5.66 \$6.57) \$4.740 \$4.060 11.19 7 Butty Parm 1 1 10 85% 21.4 17.5 \$5.165 \$5.756 \$6.569 \$6.579 \$6.745 \$4.060 11.19 7 Data 1 1 1 1 1 1		Total					31.1		5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
Return Fan Motor 2 3 83% 2.7 5.4 4.5 0.0 \$358 \$1,142 \$100 11.19 1 bot Water Pump 1 1 1 83% 0.9 0.7 0.1 \$15 \$1,90 \$1,119 7 Supply Fan Motor 1 25 87% 21.4 21.4 17.9 3.6 \$388 \$4,640 \$4,060 11.19 7 Supply Fan Motor 1 1 25 87% 21.4 21.4 17.9 3.6 \$388 \$4,640 \$4,060 8.22 7 Supply Fan Motor 1 1 8 0.9 0.0 0.7 0.1 \$515 \$1,950 \$567 \$4,060 8.22 1 colal 1 1 8 8 7.3 1.5 \$1,953 \$4,540 \$4,060 8.22 \$24.540 1 colal 1 1 8 7.3 1.5 \$1,953 \$4,540 \$4,540 \$4,540 \$4,540 \$4,540 \$4,540<	Return Fan Motor 2 3 83% 2.7 5.4 4.5 0.9 539 51,142 Hot Water Pump 1 1 1 83% 2.7 5.4 4.5 0.9 0.7 0.1 \$16 \$5190 \$5677 \$5745 \$4,000 11.19 7 Supply Fan Motor 1 1 25 87% 21.4 7.14 3.6 \$588 \$4,540 \$5745 \$4,000 11.19 7 Supply Fan Motor 1 1 25 87% 21.4 21.4 17.9 3.6 \$588 \$4,540 \$5745 \$4,000 8.22 7 Supply Fan Motor 1 1 25 87% 21.4 21.4 17.9 3.6 \$590 \$567 \$54,000 8.22 \$4,540 10:01 11 10 85% 8.4,540 \$5190 \$567 \$5745 \$4,000 \$224 \$24 \$24 \$24 \$24 \$24 \$24 \$24	206		2	10	85%	8.8	17.6	14.6	2.9	\$318	\$3,717					
	Hot Water Pump 1 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$11.19 7 Uptai Protein 1 2.5 87% 21.4 7.3 5.5 5.500 (557) (577) 54,080 11.19 7 Uptai Hetum Fam Motor 1 2.5 87% 21.4 7.3 1.5 \$3190 \$3190 (577) (5745) \$4,080 8.22 8 Uptai Fam Motor 1 2.5 87% 21.4 7.3 1.5 \$3190 \$4501 (577) \$4,745) \$4,080 8.22 8 Uptai Fam Motor 1 2.5 87% 21.4 7.3 1.5 \$159 \$1,859 \$4,940 \$7,450 \$4,080 8.22 \$4,080 8.22 \$4,080 \$22 \$4,080 \$22 \$4,080 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 \$24 <t< td=""><td></td><td>Return Fan Motor</td><td>2</td><td>ო</td><td>83%</td><td>2.7</td><td>5.4</td><td>4.5</td><td>0.9</td><td>\$98</td><td>\$1,142</td><td></td><td>•</td><td></td><td></td><td></td></t<>		Return Fan Motor	2	ო	83%	2.7	5.4	4.5	0.9	\$98	\$1,142		•			
	Total Zola 4.0 \$4:32 \$5,050 (\$57) (\$745) \$4,060 11.19 7 Supply Fan Motor 1 25 817 21.4 7.3 316 \$318 \$4,540 (\$745) \$4,080 11.19 1 Hot Water Pump 1 10 85% 8.8 8.1 55 \$1563 \$1657 \$1745) \$4,080 8.22 8 Upty Fan Motor 1 1 83% 0.3 0.1 0.7 0.1 \$5 \$1563 \$667) \$7345) \$4,080 8.22 8 Upty Fan Motor 1 1 10 85% 8.8 8.1 \$5<		Hot Water Pump	-	-	83%	0.9	0.9	0.7	0.1	\$16	\$190					
7 Supply Fan Motor 1 22 87% 21.4 21.4 17.9 3.6 \$388 \$4,540 7 7 900 7 900 7 900 7 910 87.9 1.5 \$190 7 910 87.9 91.95 <th< td=""><td>7 Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 7 7 Return Fan Motor 1 1 10 85% 8.8 7.3 1.5 \$159 \$1890 \$657) \$4,000 8.22 Total 1 1 83% 0.9 0.9 0.7 0.1 \$150 \$1900 \$657) \$5745) \$4,000 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,600 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,600 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,540 \$214 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 <t< td=""><td></td><td>Total</td><td></td><td></td><td></td><td></td><td>23.8</td><td></td><td>4.0</td><td>\$432</td><td>\$5,050</td><td>(\$67)</td><td>(\$745)</td><td>\$4,080</td><td>11.19</td><td>1.06</td></t<></td></th<>	7 Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 7 7 Return Fan Motor 1 1 10 85% 8.8 7.3 1.5 \$159 \$1890 \$657) \$4,000 8.22 Total 1 1 83% 0.9 0.9 0.7 0.1 \$150 \$1900 \$657) \$5745) \$4,000 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,600 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,600 8.22 Return Fan Motor 1 1 1 8.8 7.3 1.5 \$150 \$1,850 \$4,540 \$214 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 <t< td=""><td></td><td>Total</td><td></td><td></td><td></td><td></td><td>23.8</td><td></td><td>4.0</td><td>\$432</td><td>\$5,050</td><td>(\$67)</td><td>(\$745)</td><td>\$4,080</td><td>11.19</td><td>1.06</td></t<>		Total					23.8		4.0	\$432	\$5,050	(\$67)	(\$745)	\$4,080	11.19	1.06
Return Fan Motor 1 10 65% 8.8 7.3 1.5 \$159 \$1,859 \$1,859 \$1,859 \$22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$223 S Uption 1 25 87% 21.4 21.4 17.9 3.6 \$388 \$4,540 \$4,080 \$22 B Supply Fan Motor 1 25 87 21.4 21.4 17.9 3.6 \$388 \$4,540 \$4,080 \$22 B Supply Fan Motor 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$573 \$4,080 \$22 B Supply Fan Motor 1 1 83% \$4,540 \$190 \$5745 \$4,080 \$22 S Supply Fan Motor 1 2 87% 21.4 21.4 17.9 3.6 \$588 \$4,540 \$745 \$4,080 \$22 \$21 \$21 \$21 \$21 \$21<	Return Fan Motor 1 10 B5% 8.8 7.3 1.5 \$159 \$1,859 (\$7145) \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$165 \$190 (\$67) \$5745) \$4,080 8.22 Rupply Fan Motor 1 1 25 81% 21.4 17.9 36 \$88 \$4,540 (\$7145) \$4,080 8.22 Return Fan Motor 1 1 25 81% 31.1 31.1 25.2 \$558 \$6,589 (\$67) \$745) \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$165 \$190 (\$67) \$745) \$4,080 8.22 Supply Fan Motor 1 1 23% 21.4 21.4 17.9 3.65.89 \$65.89 \$65.79 \$4,080 8.22 Return Fan Motor 1 1 1 21.4 17.9 3.1.5	207	_	-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$190 \$10 \$22 Total 1 25 67% 21.4 7.3 1.5 \$5583 \$6,589 (\$67) \$745 \$4,060 8.22 Beturn Fam Motor 1 10 85% 21.4 7.3 1.5 \$5583 \$6,589 (\$67) \$745 \$4,060 8.22 Heturn Fam Motor 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$573 \$5,589 \$6,589 \$6,569 \$5,740 \$2 Feturn Fam Motor 1 2 817 21.4 17.9 3.6 \$388 \$4,540 \$574 \$2,4,060 8.22 Supply Fam Motor 1 2 81 21.4 17.9 3.6 \$388 \$4,540 \$5745 \$4,060 8.22 Feturn Fam Motor 1 1 1 1 1<1	Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$273 \$360 \$573 \$5745 \$4,060 8.22 B Supply Fan Motor 1 10 85% 0.9 0.9 0.7 0.1 \$15 \$553 \$56,599 (\$577) \$7453 \$4,060 8.22 B Return Fan Motor 1 10 85% 0.9 0.9 0.7 0.1 \$15 \$159 \$1,657 \$5745 \$4,060 8.22 D Hot Water Pump 1 1 10 85% 0.9 0.9 0.7 0.1 \$16 \$190 \$5745 \$4,060 8.22 Supply Fan Motor 1 2 87% 21.4 21.4 17.9 3.6 \$388 \$4,540 \$5745 \$4,060 8.22 Return Fan Motor 1 1 183% 0.9 0.9 0.1 3.15 \$5158 \$4,540 \$5745 \$4,060 8.22 \$5745 \$4,060		Return Fan Motor	-	10	85%	8.8	8.8	7.3	1.5	\$159	\$1,859					
Total Total 1 2 5	Total Total 1 2 5.2 5.563 56,569 (\$67) (\$745) \$4,080 8.22 B Supply Fan Motor 1 25 8.3 1.5 \$159 \$1,650 (\$67) (\$745) \$4,080 8.22 Return Fan Motor 1 1 8.3% 8.8 7.3 1.5 \$159 \$1,650 (\$67) (\$745) \$4,080 8.22 Noter 1 1 8.3% 8.8 \$4,540 (\$67) (\$745) \$4,080 8.22 Supply Fan Motor 1 1 8.3% 0.3 0.3 0.3 0.3 8.55 \$563 \$6,569 (\$67) \$4,080 8.22 Hot Water Pump 1 1 8.8 8.8 7.3 1.5 \$150 \$4,540 \$7,450 \$4,080 8.22 \$2 \$563 \$6,563 \$6,573 \$4,080 8.22 \$2 \$563 \$6,563 \$6,573 \$4,080 \$2 \$2 \$2 \$2		Hot Water Pump	-	-	83%	0.9	0.9	0.7	0.1	\$16	\$190					
B Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$3388 \$4,540 7 7 7 Hotu Water Pump 1 1 85% 8.8 7.3 1.5 \$159 \$1,890 \$570 \$1,450 \$4,900 8.22 Hot Water Pump 1 1 83% 0.9 0.0 0.1 \$16 \$190 \$573 \$6,599 \$575 \$4,080 \$8,4,900 8.22 Supply Fan Motor 1 1 83% 21.4 7.3 1.5 \$159 \$1,657 \$5745 \$4,080 8.22 Supply Fan Motor 1 1 8.8 7.3 1.5 \$159 \$1,657 \$5745 \$4,080 8.22 Hot Water Pump 1 1 8.8 7.3 1.5 \$156 \$190 \$577 \$4,080 \$273 \$2499 \$4,080 \$273 \$2400 \$273 \$2400 \$273 \$2400 \$273 \$2400 \$273	B Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$338 \$4,540 7		Total			-		31.1		5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
Return Fan Motor 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 .	Return Fan Motor 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,857 \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$575 \$563 \$5,599 \$575 \$4,080 8.22 9 Supply Fan Motor 1 2 88 7.3 1.5 \$159 \$1,657 \$4,080 8.22 Peturn Fan Motor 1 1 88% 21.4 21.4 17.9 3.6 \$398 \$4,540 \$575 \$4,080 8.22 Notor 1 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$273 \$150 \$14,455 \$4,080 8.22 \$14,080 \$273 \$150 \$1573 \$14,080 \$273 \$150 \$1573 \$1573 \$1573 \$15677 \$1745 \$1745 \$1745 \$1745 \$1745	208		-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$4,080 \$8.2 \$1,080 \$8.2 <td>Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$3.745 \$4,080 8.22 Pouply Fan Motor 1 2 81.1 31.1 25.9 5.2 \$5.63 \$6,589 \$4,080 8.22 9 Supply Fan Motor 1 25 87% 21.4 7.3 1.5 \$159 \$1,859 \$4,540 8.22 9 Supply Fan Motor 1 1 0.9 0.9 0.7 0.1 \$16 \$190 \$2745 \$4,080 8.22 1 Hot Water Pump 1 1 83% 2.3 \$5589 \$4,540 \$5745 \$4,080 8.22 1 Supply Fan Motor 1 1 1 83% 21.4 21.4 17.9 3.6 \$5639 \$5750 \$5745 \$4,080 8.22 \$56589 \$56589 \$56589 \$5679 \$5745 \$4,080 \$22 1 Cotal 1 1 1 1 1 1 1 5</td> <td></td> <td>Return Fan Motor</td> <td>--</td> <td>9</td> <td>85%</td> <td>8.8</td> <td>8.8</td> <td>7.3</td> <td>1.5</td> <td>\$159</td> <td>\$1,859 .</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$3.745 \$4,080 8.22 Pouply Fan Motor 1 2 81.1 31.1 25.9 5.2 \$5.63 \$6,589 \$4,080 8.22 9 Supply Fan Motor 1 25 87% 21.4 7.3 1.5 \$159 \$1,859 \$4,540 8.22 9 Supply Fan Motor 1 1 0.9 0.9 0.7 0.1 \$16 \$190 \$2745 \$4,080 8.22 1 Hot Water Pump 1 1 83% 2.3 \$5589 \$4,540 \$5745 \$4,080 8.22 1 Supply Fan Motor 1 1 1 83% 21.4 21.4 17.9 3.6 \$5639 \$5750 \$5745 \$4,080 8.22 \$56589 \$56589 \$56589 \$5679 \$5745 \$4,080 \$22 1 Cotal 1 1 1 1 1 1 1 5		Return Fan Motor	- -	9	85%	8.8	8.8	7.3	1.5	\$159	\$1,859 .					
Total Total 1 21.1 31.1 21.1 <th2< td=""><td>Total 31.1 31.1 25.9 5.2 \$563 \$6,569 (\$714) \$4,080 8.22 9 Supply Fan Motor 1 25 87,4 17.9 3.6 \$388 \$4,540 (\$715) \$4,080 8.22 Peturn Fan Motor 1 1 25 87,3 1.5 \$159 \$1,859 \$1,859 \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$1,859 \$1,859 \$1,859 \$1,859 \$4,080 8.22 10 85% 8.8 8.8 7.3 1.5 \$56589 \$4,540 \$5745 \$4,080 8.22 1 1 12 25 87 31.6 \$1,859 \$1,850 \$4,540 \$5745 \$4,080 8.22 1 10 85% 8.1 \$10 \$1,12 \$1 \$1,90 \$214 \$21 \$1,12 \$1,12 \$1,12 \$1,12 \$1,12</td><td></td><td>Hot Water Pump</td><td>-</td><td>-</td><td>83%</td><td>0.9</td><td>0.0</td><td>0.7</td><td>0.1</td><td>\$16</td><td>\$190</td><td></td><td></td><td></td><td></td><td></td></th2<>	Total 31.1 31.1 25.9 5.2 \$563 \$6,569 (\$714) \$4,080 8.22 9 Supply Fan Motor 1 25 87,4 17.9 3.6 \$388 \$4,540 (\$715) \$4,080 8.22 Peturn Fan Motor 1 1 25 87,3 1.5 \$159 \$1,859 \$1,859 \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$1,859 \$1,859 \$1,859 \$1,859 \$4,080 8.22 10 85% 8.8 8.8 7.3 1.5 \$56589 \$4,540 \$5745 \$4,080 8.22 1 1 12 25 87 31.6 \$1,859 \$1,850 \$4,540 \$5745 \$4,080 8.22 1 10 85% 8.1 \$10 \$1,12 \$1 \$1,90 \$214 \$21 \$1,12 \$1,12 \$1,12 \$1,12 \$1,12		Hot Water Pump	-	-	83%	0.9	0.0	0.7	0.1	\$16	\$190					
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Return Fan Motor 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 \$1,859 \$1,900 \$22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$4,900 \$22 Not Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$573 \$6,589 (\$57) \$4,080 \$22 Supply Fan Motor 1 1 25 8.8 7.3 1.5 \$56,589 (\$57) \$545 \$4,080 \$22 Return Fan Motor 1 1 10 85% 8.8 7.3 1.5 \$5159 \$1,859 \$54,540 \$24,090 \$22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$116 \$190 \$25 \$56,589 \$56,589 \$54,640 \$24,900 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21 \$21	Return Fan Motor 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 (\$745) \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$5.2 \$553 \$6,589 (\$57) \$745) \$4,080 8.22 D Supply Fan Motor 1 25 8.8 7.3 1.5 \$563 \$6,589 (\$57) \$745) \$4,080 8.22 D Supply Fan Motor 1 10 85% 8.8 8.3 7.3 1.5 \$159 \$1,859 (\$57) \$1,450 8.22 Return Fan Motor 1 1 10 85% 8.8 7.3 1.5 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,859 \$1,856 \$1,859 \$1,856 \$1,856 \$1,856 \$1,856 \$1,856	229	· · · · ·	-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$745 \$4,080 \$22 Total Total 31.1 31.1 31.1 25.9 5.2 \$563 \$6,589 (\$67) \$745 \$4,080 8.22 Supply Fan Motor 1 25 87% 21.4 21.4 17.9 3.6 \$388 \$4,540 (\$67) \$745 \$4,080 8.22 Return Fan Motor 1 1 85% 8.8 7.3 1.5 \$159 \$1,859 \$4,540 \$745 \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$545 \$4,080 8.22 Hot Water Pump 1 2 81.1 31.1 25.9 5.2 \$563 \$6,745 \$4,080 8.22 Total 1 7.3 2.8 \$310 \$5,633 \$6,75 \$4,080 \$2.28	Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$100 \$22 Total Total 31.1 31.1 25.9 5.2 \$563 \$6,589 (\$67) \$745) \$4,080 8.22 D Supply Fan Motor 1 1 25 8.8 7.3 1.5 \$159 \$1,859 (\$67) \$745) \$4,080 8.22 D Supply Fan Motor 1 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 (\$67) \$745) \$4,080 8.22 Hot Water Pump 1 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 (\$745) \$4,080 8.22 \$100 \$2.25 \$1,23 \$1,23 \$1,13 \$1,1 \$1,1 \$1,1 \$1,1 \$1,2 \$31,1 \$1,1 \$1,2 \$31,2 \$1,428 \$4,080 \$3,653 \$6,573 \$6,573 \$6,573 \$6,573 \$1,2 \$1,2		Return Fan Motor	-	10	85%	8.8	8.8	7.3	1.5	\$159	\$1,859					
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0 Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 1 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 1 1 1 85% 8.8 7.3 1.5 \$159 \$1,859 \$1,859 \$4,080 8.22 \$2 Hot Water Pump 1 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$4,080 \$8.22 \$190 \$20 \$2,563 \$6,589 \$5,589 \$4,080 \$8.22 \$2,142 \$2,123 \$2,142 \$2,142 \$2,123 \$2,142 \$2,123 \$2,142 \$2,123 \$2,	0 Supply Fan Motor 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 1 1 1 25 87% 21.4 17.9 3.6 \$388 \$4,540 1 1 1 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 \$4,540 1 1 10 85% 8.8 8.8 7.3 1.5 \$159 \$1,859 \$4,090 8.22 Hot Water Pump 1 1 83% 0.9 0.9 0.7 0.1 \$16 \$190 \$563 \$6,569 \$5,603 \$6,563 \$6,563 \$6,563 \$6,563 \$6,563 \$6,563 \$6,563 \$6,567 \$5,4,050 \$5,4,050 \$7,45 \$4,060 \$22 Fan Coil Unit SA Fan 1 7.5 83 17.1 14.3 2.86 \$310 \$3,632 \$5,420 \$5,453 \$4,060 \$22 Fan Coil Unit SA Fan 1 7.5 83 5.65 \$5,14		Total				31.1	31.1	25.9	5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
Return Fan Motor 1 10 85% 8.8 7.3 1.5 \$159 \$1,859 1 1 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$4,080 8.22 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$4,080 8.22 Total 1 2 8.1 31.1 21.1 25.9 5.2 \$563 \$6,589 \$5,745 \$4,080 8.22 Fan Coil Unit RA Fan 1 7.5 83.1 2.86 \$310 \$3,632 \$5,059 \$5,745 \$4,080 8.22 Fan Coil Unit RA Fan 1 7.5 83.7 5.6 1.12 \$1,428 \$5,059 \$5,745 \$3,349 9.17 Fan Coil Unit RA Fan 1 7.5 5.6 1.12 \$1,22 \$1,428 \$3,349 9.17 Fan Coil Unit RA Fan 1 7.5 \$5,059 \$5,059 \$5,736	Return Fan Motor 1 10 85% 8.8 8.8 7.3 1.5 \$159 \$1,859 1 1 Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$4,080 8.22 For total 1 1 20 87% 17.1 17.1 25.9 5.2 \$563 \$6,589 \$5745 \$4,080 8.22 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$1,428 \$1,428 \$1,425 \$1,425 \$1,425 \$1,425 \$1,745 \$2,349 9.17 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$1,428 \$1,426 \$5,745 \$3,3349 9.17 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$5,503 \$5,7450 \$3,7396 7.17 I matched a has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on duri	230		-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$145 \$4,080 8.22 Total Total 31.1 31.1 31.1 25.9 5.2 \$563 \$6,589 (\$573) \$4,080 8.22 Fan Coil Unit SA Fan 1 20 87% 17.1 17.1 14.3 2.86 \$310 \$3,632 (\$745) \$4,080 8.22 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$1,22 \$1,428 (\$745) \$3,349 9.17 Fan Coil Unit RA Fan 1 7.5 83.9 58,059 (\$67) (\$745) \$3,349 9.17 I construction Total 1 7.5 8.310 \$55,059 (\$57) \$31,906 7.61	Hot Water Pump 1 1 83% 0.9 0.7 0.1 \$16 \$190 \$145) \$4,080 8.22 Total Total 31.1 31.1 31.1 25.9 5.2 \$563 \$6,589 (\$5745) \$4,080 8.22 Fan Coil Unit RA Fan 1 2.5 8.2 \$553 \$6,589 (\$577) \$5745) \$4,080 8.22 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 <t< td=""><td></td><td>Return Fan Motor</td><td>-</td><td>9</td><td>85%</td><td>8.8</td><td>8.8</td><td>7.3</td><td>1.5</td><td>\$159</td><td>\$1,859</td><td></td><td></td><td></td><td></td><td></td></t<>		Return Fan Motor	-	9	85%	8.8	8.8	7.3	1.5	\$159	\$1,859					
Total 31.1 31.1 31.1 25.9 5.2 \$563 \$6,589 (\$745) \$4,080 8.22 3 Fan Coil Unit SA Fan 1 20 87% 17.1 14.3 2.86 \$310 \$3,632 (\$573) (\$745) \$4,080 8.22 3 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 5.6 9.17 5.6 9.17 5.6 9.12 5.659 (\$57) (\$745) \$3,349 9.17 Fan Coil Unit RA Fan 1 7.5 83.0 19.91 3.98 \$432 \$5,059 (\$57) \$3,349 9.17 I Total 1 2.3 19.91 3.98 \$4729 \$5,059 (\$57) \$3,349 9.17	Total 31.1 31.1 21.1 25.9 5.2 \$563 \$6,589 (\$745) \$4,080 8.22 7 Ean Coil Unit SA Fan 1 20 87% 17.1 17.1 14.3 2.86 \$310 \$3,632 (\$573) (\$5745) \$4,080 8.22 7 Fan Coil Unit SA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 \$5,503 \$5,5735 \$5,745) \$3,339 9.17 7 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 \$5,745) \$3,349 9.17 1 Total 2 23.89 23.9 19.91 3.98 \$432 \$5,059 \$5,3349 9.17 1 Activic Tesistance space heaters. Assume that 60% are left on during the day, and 1.61 7.61 1.75		Hot Water Pump	-	-	83%	0.9	0.0	0.7	0.1	\$16	\$190					
3 Fan Coil Unit SA Fan 1 20 87% 17.1 17.1 14.3 2.86 \$310 \$3,632 7 7 5.63 7 7 5.6 1.12 11.2 512 51,428 7 5.63 1.12 51.64 5.7 5.6 1.12 51.2 51.428 7 5.63 1.12 51.428 7 5.63 1.12 7.5 83% 5.745 5.3349 9.17 7 5.61 1.12 7.5 81,428 7 5.63 1.5 83,349 7.51 7 5.61 1.12 7.5 83,349 7.51 1.5 83,349 7.51 1.5 83,349 7.51 1.5 83,349 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	3 Fan Coil Unit SA Fan 1 20 87% 17.1 17.1 14.3 2.86 \$310 \$3,632 9 9 9 17 Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 (\$67) (\$745) \$3,339 9.17 Total 23.89 23.9 19.91 3.98 \$432 \$5,059 (\$67) (\$745) \$3,349 9.17 1 Accienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and 7.61		Total				31.1	31.1	25.9	5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
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 I 43.55 \$4,729 \$55,334 (\$55,960) \$31,906 7.61	Fan Coil Unit RA Fan 1 7.5 83% 6.74 6.7 5.6 1.12 \$122 \$1,428 6.745 \$3,349 9.17 Total Total 23.89 23.9 19.91 3.98 \$432 \$5,059 (\$67) (\$745) \$3,349 9.17 I Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and	238	Fan Coil Unit SA Fan	-	20	87%	17.1	17.1	14.3	2.86	\$310	\$3,632					
Total 23.89 23.9 19.91 3.98 \$432 \$5,059 (\$67) (\$745) \$3,349 9.17 I 43.55 \$4,729 \$55,334 (\$5,960) \$31,906 7.61	Total 23.89 23.9 19.91 3.98 \$432 \$5,059 (\$67) (\$745) \$3,349 9.17 1 Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and 7.61		Fan Coil Unit RA Fan	-	7.5	83%	6.74	6.7	5.6	1.12	\$122	\$1,428					
I 43.55 \$4,729 \$55,334 (\$536) \$31,906 7.61	1 4.729 \$55,334 (\$536) (\$5,960) \$31,906 7.61 1. Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and		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

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 EST	ΓΙΜΔΤ	F		Date Prepared	2	Sheet Of	
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Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study				1	Code A	(no design compe	ted)
Fort Hunter-Liggett, California						· · · · · · · · · · · · · · · · · · ·	,
Engineer-Architect					-		
Keller & Gannon							
Drawing No.		Estimate			Checked	,	
		antity	RJB	Labor		BIH	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Programmable Controller	1	EA	\$350	\$350	\$750	\$750	\$1,10
General Conditions @ 8%							\$8
Subtotal			1				\$1,18
Contractor OH & Profit @ 30%							\$35
Subtotal	1		1			<u> </u>	\$1,54
Bond @ 1%	1	<u> </u>	1				\$1
Subtotal	1		1	1			\$1,56
Estimating Contingency @ 10%	1	†	1				\$15
Total Probable Construction Cost	1	1	1				\$1,71
Digital Output Control w/Wiring	1	EA	\$100	\$100	\$320	\$320	\$42
General Conditions @ 8%							\$3
Subtotal							\$45
Contractor OH & Profit @ 30%					1		\$13
Subtotal							\$59
Bond @ 1%							
Subtotal							\$59
Estimating Contingency @ 10%							\$6
Total Probable Construction Cost	1						\$65
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Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Project No. Region No. 4 Location: Fort Hunter Liggett, California Fiscal Year FY95 Project Title: ECIP Facility Energy Improvements Discrete Portion Name: ECO B-4 Replace Heating System Pipe Insulation Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: March 1993 1. Investment Costs \$2,358 A. Construction Costs \$130 B. SIOH \$142 C. Design Cost \$2,630 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$2,630 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annual \$ Discount Discounted Cost Saving Energy MBTU/YR(2) Savings(3) Factor(4) Savings(5) Source \$/MTBU/(1) 0.1 \$1.15 11.70 \$13 A. Elec. \$21.84 \$301.68 13.78 60.6 \$4,157 B. Dist \$4.98 32.2 \$253.04 14.16 \$3,583 C. Propane \$7.87 11.70 0.0 kW \$0.00 \$0 \$108.60 D. Demand E. Other \$555.87 \$7,754 F. Total 3. Non Energy Savings (+) or Cost (-): (\$38) A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 (2) Discounted Savings/Cost (3A x 3A1) (\$420) B. Non Recurring Savings (+) or Cost (-) Savings(+) Year of Discount **Discounted Sav-**Item Occur. (2) Factor(3) ings(+)Cost(-)(4) Cost(-)(1)а. 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

11.36%

7. Adjusted Internal Rate of Return (AIRR):

ECO B4

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 BT	J/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/\	r: 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 Ca	culations
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 Savin	gs: Annual energy savings is the annual load loss/gain divided by the system

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Bldg	Pipe Heat Loss Calcs	oss Calc	S	BTU/Hr-LF	ĹF	Heating	Boiler		Savings		Annual E	Annual Energy Cost Savings	Savings	
	Size	Len	Type	Bare	Insl'd	Degree	Eff.	Elec	Propane	Öİ	Elec	Propane	ii	Annual
	In Dia	LF	HW/CH	pipe	Pipe	Hr / Yr	%	KWH/Y	MBTU/YR	MBTU/YR	\$/YR	\$/YR	\$/YR	\$ Saved
80	1.5	50	MH	150	25	59,325	68.5%	NA	11.8	NA	AN	\$93	NA	\$93
190	1.25	15	MH	125	20	82,596	73.7%	AN	AN	3.8	AN	NA	\$19	\$19
206	4	10	MH	300	75	115,562	70.8%	٧N	AN	8.0	-	•	•	
206	3	15	MH	250	60	115,562	70.8%	٧N	٧N	10.1	-	-	•	
206	1.5	10	МН	150	25	115,562	70.8%	NA	AN	4.4	-	1	-	
206 TOTAL	3	-	-	-	•	•	3	NA	NA	22.5	AN	AN	\$112	\$112
207	2.5	20	MH	200	35	85,120	71.4%	NA	NA	8.6	AN	AN	\$43	\$43
208	2.5	20	MH	200	35	85,120	71.4%	AN	AN	8.6	AN	AN	\$43	\$43
209	1.25	10	MH	125	20	71,537	61.2%	NA	2.7	NA	AN	\$21	AN	\$21
219	1.5	10	MH	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	ŧ	•		
219 TOTAL	•	-	•	•	-		-	NA	. 5.4	NA	NA	\$42	NA	\$42
229	2.5	20	MH	200	35	85,120	71.4%	NA	NA	8.6	NA	NA	\$43	\$43
230	2.5	20	ΗW	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	4	-	-	-	•	•	•	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	-	•	•	•	•	ı	•	15.4	32.2	60.6	\$1.14	\$253	\$302	\$556

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		-UU Energy Cost Savings	Savings		Construction Cost Estimate	on Cost E	stimate	O&M Savings	sbuix	Economic Analysis	Analysis	
	Elec	Propane	Öİ	Total	Bare	Constr	Investment	Annual	СС ГС	Total LCC	Simple	SIR
	LCC \$	LCC \$	LCC \$	LCC \$	Cost \$	Cost \$	Total \$	\$/Yr	Total \$	Saved \$	Payback	
80	NA	\$1,311	AN	\$1,311	\$225	\$351	\$391	(\$6)	(\$63)	\$1,249	4.50	3.19
190	AN	AN	\$263	\$263	\$68	\$106	\$118	(\$2)	(\$19)	\$244	6.79	2.07
206	AN	AN	AN	AN	•	1	•	•	•	•	•	•
206	AN	AN	AN	NA	•	1	•	•	•	ı	•	,
206	AN	AN	AN	AN	•	٠		•	1			•
206 TOTAL	AN	AN	\$1,546	\$1,546	\$269	\$420	\$468	(\$7)	(\$75)	\$1,471	4.44	3.15
207	AN	AN	\$587	\$587	\$140	\$218	\$243	(\$4)	(\$39)	\$548	6.23	2.25
208	AN	AN	\$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	AN	NA	NA	NA	•	•		•	•	1	•	•
219	AN	AN	AN	AN	•	•	•	1	1	ı	•	•
219 TOTAL	AN	\$600	AN	\$600	06\$	\$140	\$157	(\$2)	(\$25)	\$575	3.90	3.67
229	AA	AN	\$587	\$587	\$140	\$218	\$243	(\$4)	(\$39)	\$548	6.23	2.25
230	NA	NA	\$587	\$587	\$140	\$218	\$243	(\$4)	(68\$)	\$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	•			-	•	ł	•	•
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				
Fort Hunter-Liggett, California				1	Code A	(no design compe	ted)	
Engineer-Architect					1			
Keller & Gannon		I I - Alina a A			Charlest	0		
Drawing No.		Estimat	RJB		Checked By BIH			
ECO B4: Replace Pipe Insulation	Quantity			Labor		Material		
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost	
Building 80								
1-1/2" Pipe Insulation	50	LF	\$2.50	\$125	\$2.00	\$100	\$225	
Subtotal Bldg 80							\$225	
Building 190			<u> </u>					
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		LF	\$3.50	\$53	\$5.00	\$75	\$128	
4" Pipe Insulation			\$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 Bidg 209							\$45	
Building 219			-				<u> </u>	
3/4" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$45	
1-1/2" Pipe Insulation		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 Location Fort Hunter-Liggett, California				Project No.	Basis for Estimate		
				Code A (no design competed)			ted)
Engineer-Architect					1		
Keller & Gannon							
Drawing No.		Estimat			Checked	-	
ECO B4: Replace Pipe Insulation		ARJB Antity Labor			BIH Material		
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 230							
2-1/2" Pipe Insulation	20	LF	\$3.00	\$60	\$4.00	\$80	\$14
Subtotal Bldg 230							\$14
Building 238							
1-1/2" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$4
Subtotal Bldg 238							\$4
Building 241							
2-1/2" Pipe Insulation	10	LF	\$3.00	\$30	\$4.00	\$40	\$7
2" Pipe Insulation	10	LF	\$3.00	\$30	\$4.00	\$40	\$7
Subtotal Bldg 241							\$14
Building 291			-				
2" Pipe Insulation	10	LF	\$3.00	\$30	\$4.00	\$40	\$7
Subtotal Bldg 291							\$7
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Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

ECO B6 & 7

Region No. 4 Project No. Fort Hunter Liggett, California Location: Project Title: ECIP Facility Energy Improvements Fiscal Year FY95 Discrete Portion Name: ECO B6 & B7 Install Time Clocks & Programmable Thermostats Economic Life: 15 YEARS Analysis Date: June 1993 Preparer: KELLER & GANNON 1. Investment Costs \$66,786 A. Construction Costs \$3,673 B. SIOH \$4,007 C. Design Cost \$74,467 D. Total Cost (1A+1B+1C) E. Salvage Value of Existing Equipment \$0 (\$13,510) F. Public Utility Company Rebate \$60,957 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discount Annual \$ Discounted Energy Cost Saving \$/MTBU/(1) MBTU/YR(2) Savings(3) Factor(4) Savings(5) Source 686.9 \$15,001 11.70 \$175,515 A. Elec. \$21.84 \$4.98 2,460.0 \$12,251 13.78 \$168,816 B. Dist \$25,367 \$7.87 3,223.3 14.16 \$359,202 C. Propane \$108.60 kW \$0 11.70 \$0 D. Demand E. Other \$52,619 \$703,533 F. Total 3. Non Energy Savings (+) or Cost (-): (\$1,689) A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 (2) Discounted Savings/Cost (3A x 3A1) (\$18,781) B. Non Recurring Savings (+) or Cost (-) Discount **Discounted Sav-**Item Savings(+) Year of Occur. (2) Factor(3) ings(+)Cost(-)(4) Cost(-)(1) 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 22.20% 7. Adjusted Internal Rate of Return (AIRR):

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		Existing Schedule	F	Heating Season		Cooling	Degree Ho	Degree Hours per Year, 7 Days/WI	7 Days/Wk			FULL LOAD HOURS/YEAR	JURS/YEAR
Ś	Installation Name	Time	6	Setpoint	ack	Setpoint	Heating	Heating	Htg Setbk	Total	Total	Heating	Cooling
		HVAC ON HV		Deg F	Deg F	Deg F	NO	Set-Back	7 Day/Wk	Heating	Cooling	FLHr/Yr	FLHr/Yr
P 80	Exchange, Main Retail	800	1700	68	55	72	18,715	40,610	44,615	59,325	18,106	425	604
P 101	Open Din Cons (Haclenda)	1000	1600	20	55	72	14,616	42,688	44,615	57,304	15,420	318	514
	Club (Bar)	1600	2200	22	55	72	21,855	40,134	44,615	61,989	9,650	475	322
	Hacienda, East Rooms	1700	800	2	55	٩N	98,616	7,025	44,615	105,641	AN	2,144	0
	Hacienda, West Rooms												
T 121	Bowling Center	008	2200	68	55	72	42,842	33,140	44,615	67,020	21,833	911	520
P 128	Officers Quarters Military	009	2200	89	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
S 146	FE Facility	200	1600	55	40	78	10,781	3,537	5,161	11,702	9,003	281	268
T 161	Admin General Purpose	200	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 162	Elec Maint. Shop	200	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 163	Officers Quarters Military	200	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 164	Admin General Purpose	200	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 165	Admin General Purpose	200	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 166	Officers Quarters Military	200	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 167	Officers Quarters Military	200	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 177	Technical Library	200	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	006	1700	68	55	72	18,715	40,610	44,615	55,122	18,106	568	431
S 186	Sup Svc Admin Bidg	700	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 205	Admin General Purpose	009	2200	89	55	72	60,015	25,104	44,615	73,547	21,833	1,137	520
P 205A	Company HQ Building												
P 207 P 207A	Eni Barracks w/o Dining Comnany HO Building	600	2200	8	. 55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 208		600	2200	68	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 208A													
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 P 229A	Enl Barracks w/o Dining Company HQ Building	600	2200	89	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 230		600	2200	88	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 230A													
S 283	FE Maintenance Shop	200	1700	55	40	72	10,781	4,287	5,161	12,238	15,420	288	367
S 290	Electron Equip Facility	002	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
S 291	Cont Humid Warehouse	200	1600	68	55	72	33,064	33,833	44,615	60,531	15,420	756	367
P 295	Eni Barracks w/o Dining	80 09	2200	89	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 301	ADP Building Office	200	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	756	367
	Computer Room	0	2400	89	89	74	115,562	0	0	115,562	17,007	2,626	607

ECO B6/7 TIME CLOCKS AND PROGRAMMABLE THERMOSTATS

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		SIR	72.489	2.712	2.122	10.426	4.845	8.054	8.054	8.054	8.054	8.054	8.054	8.054	25.203	199.929	27.965	17.516	12.163	12.163	12.163	000 80	21.000	815.CR	12.163	12.163	13.170	54.151	42.067	8.007	112.407	-
Analysis	Simple	Payback	0.18	4.34	6.42	1.31	2.71	1.57	1.57	1.57	1.57	1.57	1.57	1.57	0.50	0.06	0.47	0.74	1.14	1.14	1.14	4	2 L	0.10	1.14	1.14	1.08	0.25	0.32	1.67	0.12	
Life Cycle Cost Analysis	LCC,N=15	Savings	\$18,659	\$22,296	\$820	\$92,690	\$2,183	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$4 ,871	\$7,302	\$5,405	\$6,771	\$32,910	\$32,910	\$32,910		141010	CH0'05*	\$32,910	\$32,910	\$2,545	\$41,864	\$16,261	\$185,695	\$43,451	
1	Total	Invest	\$257	\$8,221	\$387	\$8,891	\$451	\$387	\$387	\$387	\$387	\$387	\$387	\$387	\$183	\$37	\$193	\$387	\$2,706	\$2,706	\$2,706		1000	195%	\$2,706	\$2,706	\$183	\$773	\$387	\$23,193	\$387	
	PG&E	Rebate	\$40	\$1,280	06 \$	\$2,070	\$85	\$90	\$90	06\$	06\$	\$30	8	88	\$45	8	\$45	\$90	069\$	069\$	\$630	4	3	2	\$630	\$630	\$45	\$180	8	\$5,400	98 98	•
	Total	Cost	\$297	\$9,501	\$477	\$10,961	\$536	\$477	\$477	\$477	\$477	\$477	\$477	\$477	\$238	\$37	\$238	\$477	\$3,336	\$3,336	\$3,336	ļ		S.	\$3,336	\$3,336	\$238	\$953	2477	\$28,593	\$471	
n Cost	Constr	Cost	\$267	\$8,521	\$427	068,93	\$480	\$427	\$427	\$427	\$427	\$427	\$427	\$427	\$214	89 3	\$214	\$427	\$2'992	\$2,992	\$2,992	1014	1244	1756	\$2,992	\$2,992	\$214	\$855	\$427	\$25,644	\$427	•
Construction Cost	Bare	Cost	\$171	\$5,463	\$274	\$6,302	\$308	\$274	\$274	\$274	\$274	\$274	\$274	\$274	\$137	\$21	\$137	\$274	\$1,918	\$1,918	\$1,918	1 204	4/14	\$17	\$1,918	\$1,918	\$137	\$548	\$274	\$16,440	\$274	
Saving	CC	\$ Total	(\$7)	(\$2,159)	(\$7)	(\$3,103)	(\$67)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$67)	(\$67)	(\$67)	(\$7)	(\$944)	(\$944)	(\$944)		(14)	()e)	(\$944)	(\$944)	(\$67)	(\$270)	(\$7)	(\$8'095)	(\$7)	
Non-Energy Saving	Non-Egy	s/Yr	(\$1)	(\$194)	(\$1)	(\$279)	(\$6)	(13)	(\$1)	(\$1)	(\$1)	(\$1)	(\$1)	(\$1)	(\$\$)	(\$6)	(\$6)	(13)	(\$85)	(\$85)	(\$85)		(1.0)	(16)	(\$85)	(\$85)	(98)	(\$24)	(13)	(\$728)	(\$1)	
	Total	\$/Year	\$1,442	\$2,090	1 55	\$7,057	\$172	\$246	\$246	\$246	\$246	\$246	\$246	\$246	\$394	\$593	\$419	\$520	\$2,458	\$2,458	\$2,458		0000	810/20	\$2,458	\$2,458	\$185	960'8\$	\$1,215	\$14,645	\$3,188	
Savings	Fuel Oil	S/Year	8	C\$	8	8	%	8	8	8	8	8	8	Q\$	8	8	S s	\$	\$2,450	\$2,450	\$2,450		88	8	\$2,450	\$2,450	8	8	8	8	8	
ECO B6/B7 Energy Cost Savings	Propane	\$/Year	\$728	G \$	\$47	\$5,375	968	\$97	\$97	\$97	\$97	\$97	265	\$97	\$132	\$176	\$231	\$282	0\$	0\$	3 5		+Ce	020'20	8	G\$	\$181	\$2,403	\$832	\$9,125	\$2,502	
ECO B6/B7	Electric	\$/Year	\$715	\$2,090	\$14	\$1,683	\$76	\$150	\$150	\$150	\$150	\$150	\$150	\$150	\$ 263	\$417	\$188	\$238	8 5	8 \$	8\$	0100			8	88	2	\$693	\$383	\$5,520	\$687	
	Fuet Oil	Mil BTU/Yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	492.0	492.0	492.0			0.0	492.0	492.0	0.0	0.0	0.0	0.0	0.0	-
ergy Savings	Propane	Mil BTU/Yr	92.5	0.0	6.0	682.9	12.2	12.3	12.3	12.3	12.3	12.3	12.3	12.3	16.7	22.4	29.4	35.8	0.0	0.0	0.0		n 0 100	321.0	0.0	0.0	23.0	305.4	105.7	1,159.5	317.9	
ECO B6/B7 Energy Savings	Electric	kWH/Yr	9,589	28,041	186	22,574	1,022	2,006	2,006	2,006	2,006	2,006	2,006	2,006	3,526	5,588	2,522	3,197	105	105	105			1,230	105	105	57	9,292	5,142	74,049	9,212	
	Ň		P 80	o 101	T 121	P 128	S 146	T 161	T 162	T 163	T 164	T 165	T 166	T 167	P 177	P 178	5 1 8 2	S 186	P 205 P 205A	P 207 P 207A	P 208	P 208A	507 5	212	P 229 P 229A	P 230A	\$ 283	s 290	291	P 295	P 301	•

35

CONSTRUCTION COST ES	STIMAT	Έ		Date Prepared June 1993	3	SHEET	OF
Project EEAP Limited Energy Study				Project No.	Basis for	Estimate	
Location				1	Code A	(no design comp	eted)
Fort Hunter-Liggett, California					4		
Engineer-Architect Keller & Gannon							
Drawing No.		Estimato	r		Checked	Ву	
ECO-B6/7 (T-Clock / Programmable		RJB			BIH		
Line Item	Qui No.	antity Unit	La Per	abor	N Per	Material	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
Building 80							
Time Clock & Wiring	1	EA	\$51	\$51	\$120	\$120	\$17
Subtotal (Bldg 80)							\$17
Building 101 Dining & Lounge Areas	and Dwe	elling U	nits				
Time Clock & Wiring - Din/Lng	2	EA	\$51	\$102	\$120	\$239	\$34
Time Clock & Wiring - Dwellings	30	EA	\$51	\$1,534	\$120	\$3,587	\$5,12
Subtotal (Bldg 101 Dining & Lounge	Areas ar	nd Dwe	lling Unit	s)			\$5,46
Building 121							
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 121)							\$27
Building 128							
24 Hour Auto T-Stat	46	EA	\$32	\$1,472	\$105	\$4,830	\$6,30
Subtotal (Bldg 128)							\$6,30
Building 146	i						· · ·
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$13
Time Clock & Wiring	1	EA	\$51	\$51	\$120	\$120	\$17
Subtotal (Bldg 146)						<i></i>	\$30
Buildings 161, 162, 163, 164, 165, 16	6 & 167	each		1	I		
24 Hour Auto T-Stat		EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldgs 161, 162, 163, 164, 1				<u> </u>	4100	ΨΖΙΟ	\$27
Building 177			Jaony				ΨΖΙ
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$13
Subtotal (Bidg 177)			<u><u><u></u></u></u>		\$100	φ100	\$13
Building 178							φις
Reset Existing Timer	1	EA	\$16	\$16	\$5	\$5	¢^
Subtotal (Bldg 178)			ψιυ	φ10 	- 	φ <u>υ</u>	\$2 \$2
Building 182							Φ 2
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	<u> </u>
Subtotal (Bldg 182)			432	<i>φ</i> 32	\$105	\$105	\$13
Building 186		├					\$13
24 Hour Auto T-Stat	2	EA	¢00	#64	\$10F		^ ~~
	2		\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 186)							\$27
Outstand while Otherski light if the little							
Subtotal, this Sheet, including all buil	dings		<u></u>				\$15,00

CONSTRUCTION COST ES	STIMAT	Е		Date Prepared June 1993	3	SHEET	OF
Project EEAP Limited Energy Study		· · · · · · · · · · · · · · · · · · ·		Project No.	Basis for I	Estimate	
Location	<u> </u>				Code A	(no design comp	eted)
Fort Hunter-Liggett, California					4		
Keller & Gannon							
Drawing No.		Estimato	r		Checked	Ву	
ECO-B6/7 (T-Clock / Programmable		RJB			BIH		
Line Item	Qui No. Units	antity Unit Meas.	La Per` Unit	bor Total	Per Unit	laterial Total	Total Cost
Buildings 205, 207, 208, 229 & 230, e	each						<u>.</u>
24 Hour Auto T-Stat	14	EA	\$32	\$448	\$105	\$1,470	\$1,91
Subtotal (Bldgs 205, 207, 208, 229 &	230, ead	;h)					\$1,91
Building 209							
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 209)					1		\$27
Building 212					1		
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 212)					1		\$27
Building 283					1		
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$13
Subtotal (Bldg 283)					1		\$13
Building 290					1		
24 Hour Auto T-Stat	4	EA	\$32	\$128	\$105	\$420	\$54
Subtotal (Bldg 290)						· · · · ·	\$54
Building 291			-		1		
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 291)							\$27
Building 295				<u></u>			,
24 Hour Auto T-Stat	120	EA	\$32	\$3,840	\$105	\$12,600	\$16,44
Subtotal (Bldg 295)				·	1		\$16,44
Building 301					1		
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$27
Subtotal (Bldg 301)							\$27
Subtotal, this sheet		I I			<u> </u>		\$27,81
Subtotal (ECO B-6/7), all sheets							\$42,81
General Conditions 8%	1	Ι			Γ		\$3,42
Subtotal		<u>† †</u>			1		\$46,24
Contractor O.H. & P. 30%							\$13,87
Subtotal							\$60,11
Bond 1%					<u> </u>		\$60
Subtotal		<u> </u>		· · · · · · · · · · · · · · · · · · ·			\$60,71
Estimating Contingency 10%					1		\$6,07
Total Probable Construction Cost		<u> </u>		······································			\$66,78

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

	Fort Hunter Ligg	rgy improvements	Region No. 4			Project No. Fiscal Year FY95
	tion Name: ECO B :e: June 1993	-8 Replace Inefficien	Economic Life:	15	YEARS	Preparer: KELLER & GANNON
•						
1. Investmer A. Construct			\$400,158	_		
B. SIOH			\$22,009			
C. Design C	ost		\$24,009	_		
-	it (1A+1B+1C)		\$446,176			
E. Salvage \	alue of Existing Ed	luipment			\$0	_
	lity Company Reba				\$19,688	-
G. Total Inve	estment (1D-1E-1F)					\$426,488
2 Energy St	avings (+)/Cost(-):					
Date of NIST	FIR 85-3273-X Used	for Discount Factors	: October 1992			
Energy	Cost	Saving	Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	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 Ener	gy Savings (+) or (Cost (-):		_		
A. Annual R	ecurring (+/-)		\$0	_		
	Factor (Table A)				11.12	
(2) Discount	ed Savings/Cost (3	BA x 3A1)	. •			\$0
B. Non Recu	urring Savings (+)	or Cost (-)				
ltem	Savings(+)	Year of	Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4)	
a.	\$107,993	3	0.89		\$96,114	
b.	\$221,264	5	0.82 -		\$181,437	
с.	\$30,885	10	0.67		\$20,693	
d. Total	\$360,142				\$298,243	
C Total Non	Energy Discounter	d Savings (3A2+3Bd	4)		\$298,243	
•		A+(3Bd1/Economic l	_ife)):		8.6	Years
	Discounted Saving				\$597,123	
6 Sovings t	o Investment Ratio	(SIR) 5/1G:			1.40	
	Internal Rate of Re				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	Existing	Existing	New	New		Demand
		Nominal	Cing Usage	Unit EER	Unit EER	Cing Usage	Savings	Savings
		Tonnage	(KWH/YR)			(KWH/YR)	(KWH/YR)	(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						Single Yea	r Savings	: (1)	
No.	Annual	Life Cycle			Total		Year	LCC	Savings
	Cost	Cost	Capitol	PG&E	Invest	Savings	Saving	Savings	Investment
	Savings (\$)	Savings (\$)	Costs (\$)	Rebate	\$	\$	Occurs	\$	Ratio (SIR)
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.

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CONSTRUCTION COST	ESTI	MATE		Date Prepared		Sheet of	
Project				Project No.	Basis for Estim	late	
EEAP Limited Energy Study					Code A (no c	lesign competed)
Fort Hunter-Liggett, Californ	ia			*		g	,
Engineer-Architect					-		
Keller & Gannon							
Drawing No.		Estimate			Checked By		
ECO B-8 REPLACE COOLING EC		antity		bor	Mater	BIH	
Line Item	No.	Unit	Per		Per	I	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
BUILDING 101		·····		-	·····		
Demolish existing unit	1	EA	\$750	\$750	-	\$0	\$75
Install 20 ton Air Cooled Unit	1	EA	\$2,400	\$2,400	\$11,500	\$11,500	\$13,90
Subtotal							\$14,65
General Conditions @ 8%							\$1,17
Subtotal							\$15,82
Contractor OH & Profit @ 30%							\$4,74
Subtotal							\$20,56
Bond @ 1%							\$20
Subtotal							\$20,77
Estimating Contingency @ 10%							\$2,07
TOTAL PROBABLE CONSTRUCT	ION CO	OST			•		\$22,85
	T				1		
	1						
BUILDING 128		I			I	1	
Demolish existing unit	1	EA	\$810	\$810	-	\$0	\$81
Install 25 ton Air Cooled Unit	1	EA	\$2,625	\$2,625	\$12,300	\$12,300	\$14,92
Subtotal							\$15,73
General Conditions @ 8%							\$1,25
Subtotal							\$16,99
Contractor OH & Profit @ 30%							\$5,09
Subtotal							\$22,09
Bond @ 1%							\$22
Subtotal							\$22,31
Estimating Contingency @ 10%	1						\$2,23
TOTAL PROBABLE CONSTRUCT		' דפר		r	L	1	\$24,54



				Date Prepared		Sheet of	
CONSTRUCTION COST	ESTI	ΜΑΤΕ		June 199	3		
Project				Project No.	Basis for Estim	ate	
EEAP Limited Energy Study					Code A (no. d	lesign commeted	`
Fort Hunter-Liggett, Californi			lesign competed)			
Engineer-Architect				1			
Keller & Gannon							
Drawing No.		Estimat			Checked By		
ECO B-8 REPLACE COOLING EQ		JIP. JCC Quantity Lab		T.2		BIH	e
Line Item	No.	Unit	Per		Materi Per	ai	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
BUILDING 205, 207, 208, 229 & 23	1			1		1	
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		1					\$40,237
Estimating Contingency @ 10%							\$4,024
TOTAL PROBABLE CONSTRUCTI	ON C	ÖST	•			·	\$44,261
	I						
		1					
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	1						\$22,008
Bond @ 1%	1						\$220
Subtotal							\$22,228
Estimating Contingency @ 10%	1						\$2,223
TOTAL PROBABLE CONSTRUCTI		DST					\$24,451
				·			₩= 1, 10 1

CONSTRUCTION COST	Date Prepared Sheet of June 1993						
Project EEAP Limited Energy Study				Project No.	Basis for Estim	ate	
Location			Code A (no c	lesign competed)		
Fort Hunter-Liggett, California							
Engineer-Architect Keller & Gannon							
Drawing No.		Estimat			Checked By		
ECO B-8 REPLACE COOLING EQ		<u> </u>	JCC	4		BIH	
Line Item	No.	antity Unit	Per	lbor	Materi Per	a:	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
BUILDING 295	-	r					
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 CONSTRUCT	ON CO	DST		• · · · ·		·	\$72,689
	1						
				· · · · · · · · · · · · · · · · · · ·			
	1						
BUILDING 301	1						<u> </u>
	1	EA	¢1 000	¢1 000		¢0	¢1.000
Demolish existing unit Install 80 ton Air Cooled Unit	1	EA	\$1,000	\$1,000	-	\$0	\$1,000
Subtotal		LA	\$2,100	\$2,100	\$18,900	\$18,900	\$21,000 \$22,000
General Conditions @ 8%							\$22,000 \$1,760
Subtotal					· · · · · · · · · · · · · · · · · · ·		
Contractor OH & Profit @ 30%							\$23,760
Subtotal							\$7,128
							\$30,888
Bond @ 1%							\$309
Subtotal							\$31,197
Estimating Contingency @ 10% TOTAL PROBABLE CONSTRUCTI							\$3,120
TOTAL PHOBABLE CONSTRUCT		121					\$34,317

Life Cycle Cost Analysis Summary ECO B10 Energy Conservation Investment Program (ECIP)

Location: Project Title:		ergy Improvements	Region No. 4		Project No. Fiscal Year FY95
	ion Name: ECO B [.] e: June 1993	10 Install Automatic	Flue Dampers on He Economic Life:	ating System Boilers 15 YEARS	Preparer: KELLER & GANNON
1. Investmen A. Constructi B. SIOH C. Design Co D. Total Cost E. Salvage V F. Public Utili	t Costs on Costs	te	\$13,059 \$718 \$784 \$14,561	\$0 \$0 \$0	
	vings (+)/Cost(-):		a: Ostabar 1002	_	
Date of NIST Energy Source	Cost \$/MTBU/(1)	for Discount Factor Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec. B. Dist C. Propane D. Demand E. Other	\$21.84 \$4.98 \$7.87 \$108.60	0.0 282.8 174.3 0.0	\$0 \$1,408 \$1,372 kW \$0	11.70 13.78 14.16 11.70	\$0 \$19,408 \$19,423 \$0
F. Total		457.1	\$2,780		\$38,830
A. Annual Re (1) Discount (2) Discounte	y Savings (+) or (curring (+/-) Factor (Table A) ed Savings/Cost (3 rring Savings (+) o	A x 3A1)	\$0		\$0
ltem	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Sav- ings(+)Cost(-)(4)	
a. b. c. d. Total			-		
C Total Non	Energy Discounted	d Savings (3A2+3Bd	4)	\$0	
5. Total Net I 6. Savings to	yback 1G/(2F3+3/ Discounted Saving Investment Ratio Internal Rate of Ret	(SIR) 5/1G:	Life)):	5.2 \$38,830 2.67 11.03%	Years

•

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. of	No. of ECO B10 E	Energy Savings:		Automatic Flue Dampers	Dampers						
No.	Installation Name	Flues	L	Propane	Fuel Oil	Electric	Propane	Fuel Oil	LCC \$	Constr	Investment	Payback	SIR
		& Dia	kWH∕Yr	MII BTU/Y MII BTU/Y	Mil BTUM	\$∕Yr	\$/Yr	\$/Yr	Saved	Cost		Years	
P 101	Open Din Cons (Hacienda)	2 x 8"		23.5	•		\$184.99		\$2,619	\$1,136	\$1,267	6.85	2.07
	Club (Bar)												
T 120	Fire Station - Office	N N	•	15.7	1	,	\$123.44	,	\$1,748	\$1,082	\$1,206	9.77	1.45
	Fire Station - Dorm	ů											
	Fire Station - Garage												
P 128	Officers Quarters Military	œً	•	13.1	•	•	\$102.99	•	\$1,458	\$568	\$633	6.15	2.30
S 197	Admin Bldg R&D - Office	6	•	5.7	•	•	\$44.87	•	\$635	\$541	\$603	13.44	1.05
	Admin Bldg R&D - Electronics												
P 205	Admin General Purpose	8	•	•	28.2	•	•	\$140.25	\$1,933	\$582	\$649	4.63	2.98
P 205A	P 205A Company HQ Building												
P 206	Enlisted Pers Dining Fac	2 x 8"	•	-	81.8		,	\$407.38	\$5,614	\$1,164	\$1,298	3.19	4.33
	Kitchen Area - Scullery												
P 207	Enl Barracks w/o Dining	"8	•	-	28.3	•	•	\$140.90	\$1,942	\$582	\$649	4.61	2.99
P 207A	Company HQ Building												
P 208	Enl Barracks w/o Dining	8	•	-	28.0	•	•	\$139.49	\$1,922	\$582	\$649	4.65	2.96
P 208A	Company HQ Building												
P 210	Hith/Dntl Clinic w/ Beds	8"	1	•	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	\$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		8	•	•	28.1	•	'	\$139.87	276'1\$	\$582	\$649	4.64	2.97
P 229A													-
P 230	Enl Barracks w/o Dining	م	•	•	28.4	1	•	\$141.35	\$1,948	\$582	679\$	4.59	3.00
P 230A	Company HQ Building												
S 238	Sig Photo Lab	4	•	10.8	•	. 1	\$85.17	1	\$1,206	\$531	\$592	6.95	2.04
	Process												
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	1	•	\$100.11	\$1,379	\$582	\$649	6.48	2.13
S 290	Electron Equip Facility	8	١	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

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CONSTRUCTION COST ES	STIMAT	E		Date Prepared June 1993	3	Sheet C	F
Project EEAP Limited Energy Study				Project No.	Basis for	l Estimate	
Location				1	Code A	(no design compe	ted)
Fort Hunter-Liggett, California					1		
Engineer-Architect Keller & Gannon							
Drawing No.		Estimato	r		Checked	Ву	
ECO-B10 Install Automatic Flue Dam	pers		RJB			BIH	
Line Item	Qui No.	antity Unit	Per	abor	Material Per I		Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
GAS FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$134	\$134	\$16
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 4-inch Flue, Gas Fired							\$34
General Conditions 8%							\$2
Contractor O.H. & P 30%							\$10
Sub Total							\$47
Bond 1%							\$
Sub Total							\$48
Estimating Contingency 10%							\$4
Total Probable Construction Cost							\$53
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$138	\$138	\$17
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 6-inch Flue, Gas Fired							\$35
General Conditions 8%				-			\$2
Contractor O.H. & P 30%							\$10
Sub Total							\$48
Bond 1%					1		\$
Sub Total	1				1		\$49
Estimating Contingency 10%							\$4
Total Probable Construction Cost							\$54
					1		
8-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$152	\$152	\$19
Relay & Wiring	- 1	Job	-	\$120	-	\$60	\$18
Subtotal 8-inch Flue, Gas Fired					1		\$37
General Conditions 8%	-				1		\$3
Contractor O.H. & P 30%	-		T				\$11
Sub Total							\$51
Bond 1%					<u> </u>		\$
Sub Total							\$51
Estimating Contingency 10%							\$5
Total Probable Construction Cost					<u> </u>		\$56

CONSTRUCTION COST ES	STIMAT	Е		Date Prepared June 1993	3	Sheet C)F
Project EEAP Limited Energy Study				Project No.	Basis for	l Estimate	
Location		·		I	Code A	(no design compe	ted)
Fort Hunter-Liggett, California							,
Engineer-Architect							
Keller & Gannon		Estimato	r		Checked	By	
ECO-B10 Install Automatic Flue Dam	ners		RJB			BIH	
		antity	Le	bor		Material	
Line item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
OIL FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$156	\$156	\$18
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 4-inch Flue, Oil Fired							\$36
General Conditions 8%							\$2
Contractor O.H. & P 30%							\$2
Sub Total	1						\$42
Bond 1%							\$
Sub Total							\$43
Estimating Contingency 10%					1		\$4
Total Probable Construction Cost						1	\$47
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$161	\$161	\$19
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 6-inch Flue, Oil Fired							\$37
General Conditions 8%							\$3
Contractor O.H. & P 30%							\$11
Sub Total							\$51
Bond 1%							\$
Sub Total							\$52
Estimating Contingency 10%							\$5
Total Probable Construction Cost		i i					\$57
					1		•
B-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$161	\$161	\$19
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 8-inch Flue, Oil Fired			· · · · · · · · · · · · · · · · · · ·				\$37
General Conditions 8%					1		\$3
Contractor O.H. & P 30%		t				†	\$11
Sub Total					1		\$52
Bond 1%							
Sub Total					1	<u> </u> -	\$52
Estimating Contingency 10%							\$5
Total Probable Construction Cost			·		 	<u> </u>	\$58

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

ECO B15

Region No. 4 Project No. Fort Hunter Liggett, California Location: Fiscal Year FY95 ECIP Facility Energy Improvements Project Title: ECO B15 Convert Multizone HVAC Systems to Variable Air Volume **Discrete Portion Name:** Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$122,292 A. Construction Costs \$6,726 B. SIOH 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 \$136,355 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annual \$ Discount Discounted Saving Energy Cost MBTU/YR(2) Factor(4) Savings(3) Savings(5) Source \$/MTBU/(1) 863.6 \$15.743 \$184,188 11.70 A. Elec. \$18.23 \$0 13.78 \$0 \$4.98 0 B. Dist \$0 14.16 \$0 C. Propane \$7.87 0 D. Other NA 0 \$0 NA NA \$0 11.70 \$0 E. Demand Savings 864 \$15,743 \$184,188 F. Total 3. Non Energy Savings (+) or Cost (-): (\$1,000) A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 (2) Discounted Savings/Cost (3A x 3A1) (\$11,120)B. Non Recurring Savings (+) or Cost (-) Year of Discount Discounted Sav-Item Savings(+) Occur. (2) Factor(3) ings(+)Cost(-)(4) Cost(-)(1) \$0 15 0.56 \$0 a. \$0 15 0.56 \$0 b. 0.56 \$0 \$0 15 c. \$0 0.00 \$0 0 d. Total 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 5.67%

7. Adjusted Internal Rate of Return (AIRR):

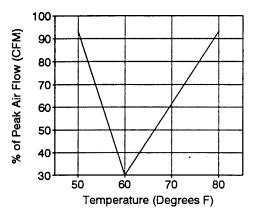
ECO B15: CONVERT MULTIZONE HVAC SYSTEMS TO VARIABLE AIR VOLUME

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	Percent of	Percent of	VAV Fan Load
Range	Total CFM	Year at 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 Energ	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

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

ac.	Fac. Fan Amps		Full Load	Full Load VAV System	Savings	Energy C	Savings Energy Cost Saved O&M Cost Saved	O&M Cos	t Saved	Constr.	Investment Pay-	Pay-	SIR
ò.	SA Fan	RA Fan	kW hr / Yr	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	396,76	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	29	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	10.32	1.14
		Totals	744,171	491,153	253,018	\$15,743	253,018 \$15,743 \$184,188 (\$1,000) (\$11,120) \$122,292	(\$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 ESTI	МАТ	F		Date Prepared June 1993	1	Sheet Of	
					Basis for		
Project				Project No.	Dasis for	Estimate	
EEAP Limited Energy Study					Code A	(no design comp	eted)
Fort Hunter-Liggett, California							
Engineer-Architect					1		
Keller & Gannon					Checked	B	
Drawing No. ECO-B9 Convert Multizone to VAV		Estimato	JCS		Checked	BIH	
ECO-B9 Convert Multizone to VAV	Qui	antity		Labor		Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Buildings 205, 207, 208, 229 & 230 (Typ	ical fc	or Each	ר)			·····	
Double-Duct VAV Box with T-stat	8	EA	\$300	\$2,400	\$650	\$5,200	\$7,6
and duct static pressure sensor							
20 HP Variable Frequency Drive	1	LS	-	\$1,200	-	\$3,000	\$4,2
installed w/ actuator							
Remove Constant Volume Mixing Boxe	8	LF	\$250	\$2,000	-	\$0	\$2,0
					1		·····
Testing and Balancing	1	LS	-	-	-	-	\$1,8
ŭ		1					
					ļ		
Subtotal							\$15,6
General Conditions @ 8%					1		\$1,2
Subtotal							\$16,9
Contractor OH & Profit @ 30%							\$5,0
Subtotal						1	\$22,0
Bond @ 1%			`		1		\$2
Subtotal		1		<u> </u>	†		\$22,2
Estimating Contingency @ 10%					1		\$2,2
Total Probable Construction Cost		1	<u> </u>	<u> </u>	1		\$24,4

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

ECO B21

Project No. Region No. 4 Fort Hunter Liggett, California Location: Fiscal Year FY95 Project Title: ECIP Facility Energy Improvements Discrete Portion Name: ECO B21 Replace Inefficient Boilers Preparer: KELLER & GANNON Economic Life: 15 YEARS Analysis Date: June 1993 1. Investment Costs \$28,061 A. Construction Costs \$1,543 B. SIOH \$1,684 C. Design Cost \$31,288 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$31,288 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annuai \$ Discount Discounted Cost Saving Energy Factor(4) Savings(5) Savings(3) Source \$/MTBU/(1) MBTU/YR(2) \$0 0.0 \$0 11.70 A. Elec. \$21.84 \$0 \$0 13.78 \$4.98 0.0 B. Dist \$7.87 506.1 \$3,983 14.16 \$56,397 C. Propane 0.0 kW \$0 11.70 \$0 D. Demand \$108.60 E. Other \$56.397 506 \$3,983 F. Total 3. Non Energy Savings (+) or Cost (-): \$0 A. Annual Recurring (+/-) 11.12 (1) Discount Factor (Table A) \$0 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) Discounted Sav-Discount Year of Item Savings(+) Factor(3) ings(+)Cost(-)(4) Cost(-)(1) Occur. (2) a. b. c. d. Total \$0 C Total Non Energy Discounted Savings (3A2+3Bd4) 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 x (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		Boiler System Data	tern Data		Existing	Boiler (Existing Boiler System Losses	08SØS			
, No	nstallation Name	Fuel	System	Capacity	Firing	Auxil-	Radiant	Firing Auxil- Radiant Convec- Shut Genri	Shut	Genrl	Net
		Used	Type	BTUH	Ξ	tiary		tion	tion Down Cond	Cond	£
P 101	Open Din Cons Hacienda	Propane	Propane AHU-HWB/C	300,000 82.9%	82.9%	•	6.0%	4.0% 2.0% 3.0% 67.9%	2.0%	3.0%	67.9%
	Clu Bar										
	Hacienda, Dwellings	Electric ER-PH	ER-PH	30 × 3kW	•	•		•	,	•	•
S 290	Electron E uip Facility	Propane	Propane AHU-PROP/C	1,020,000 80.8%	80.8%	•	8.0%	4.0% 2.0% 3.0%	2.0%	3.0%	63.8%
P 642	Detached Latrine/Shower	Propane	Propane HWH/TK-Circ	180,000 75.2%	75.2%	•	7.0%	4.0% 2.0% 3.0%	2.0%	3.0%	59.2%

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Fac		New Boiler	iler Syst	- System Losses	SS				Econom	Economic Analysis						
° Ž	Installation Name	Firing	Auxil-	Radiant	Auxil- Radiant Convec- Shut Genri Net	Shuf	Genri	Net	ΕĦ	Energy Energy Annual	Energy	Annual	CCC	Constr	Invest-	
		Ŧ	liary		tion	tion Down Cond	Cond	Ŧ	Added	Usage Savings Cost	Savings	Cost	Saved	Cost	ment	
										MBtu/Yr	MBtu/Yr	MBtu/Yr MBtu/Yr Saved \$	⇔	\$	\$	SIR
101	en Din Cons acienda	94.0%	•	4.0%	2.0% 2.0%	2.0%	1.0%	85.0%	17.1%	1.0% 85.0% 17.1% 1,064.0		214 \$1,685	\$23,854	\$6'941	\$7,739	3.1
	Clu Bar															
	acienda, Dwellings	-		•	•	-	•									
S 290	Electron E ui Facility	94.0%	•	4.0%	2.0%	2.0%	1.0%	85.0%	1.0% 85.0% 21.2%	741.5	185	185 \$1,455	\$20,609	\$20,609 \$15,793 \$17,609	\$17,609	1.2
642	Detached Latrine/Shower	0.94		0.04	0.02	2.0%		85.0%	1.0% 85.0% 25.9%	116.7	107	\$843	\$11,934	\$5,327	\$5,940	2.0
							Totals				506 506	\$3,983	\$56,397	\$28,061	\$31,288	

CONSTRUCTION COST EST	IMAT	Е		Date Prepared June 19	June 1993		
Project EEAP Limited Energy Study				Project No.			
				1	Code A (no	design competed	i)
Fort Hunter-Liggett, California			•				
Engineer-Architect							
Keller & Gannon		Estimate			Checked By		
Drawing No. ECO B21 REPLACE INEFFICIENT BOIL	FRS	Launau	,				
ECO BZI REFLACE INELLIGIENT BOL		antity	L	abor	Mate	erial	
Line Item	No. Units	Unit Meas.	P e r Unit	Total	Per Unit	Total	Total Cost
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					1		\$4,450
General Conditions @ 8%							\$356
Subtotal							\$4,80
Contractor OH & Profit @ 30%							\$1,44
Subtotal		1					\$6,24
Bond @ 1%							\$6
Subtotal							\$6,310
Estimating Contingency @ 10%							\$63
Total Probable Construction Cost							\$6,94 ⁻
	Ι						
BUILDING 290							
Demolish existing boiler	1	EA	\$1,200	\$1,200		\$0	\$1,20
Provide & Install 1,020,000 BTUH Boile	1	EA	\$1,675	\$1,675	\$7,250	\$7,250	\$8,92
Subtotal							\$10,12
General Conditions @ 8%							\$81
Subtotal							\$10,93
Contractor OH & Profit @ 30%							\$3,28
Subtotal							\$14,21
Bond @ 1%							\$14
Subtotal							\$14,35
Estimating Contingency @ 10%							\$1,43
Total Probable Construction Cost							\$15,79

CONSTRUCTION COST EST	IMAT	E		Date Prepared June 19	93	Sheet Of	
Project				Project No.	Basis for Esti	mate	
EEAP Limited Energy Study							
Location					Code A (no	design competed)
Fort Hunter-Liggett, California							
Engineer-Architect							
Keller & Gannon							
Drawing No.		Estimator	ſ		Checked By		
ECO B21 REPLACE INEFFICIENT BOIL	ERS						
Line Item	Qui No.	antity Unit	La	abor	Mate Per	erial	Total
	Units	Meas.	Unit -	Total	Unit	Total	Cost
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

Project No. Fort Hunter Liggett, California Region No. 4 Location: Fiscal Year FY95 **ECIP Facility Energy Improvements** Project Title: Discrete Portion Name: ECO C2 Replace Pipe Insulation on Domestic Hot Water Systems Preparer: KELLER & GANNON Economic Life: 15 YEARS Analysis Date: June 1993 1. Investment Costs \$655 A. Construction Costs \$36 B. SIOH \$39 C. Design Cost \$730 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$730 G. Total Investment (1D-1E-1F) Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discounted Saving Annual \$ Discount Cost Energy \$/MTBU/(1) MBTU/YR(2) Savings(3) Factor(4) Savings(5) Source 0.0 \$0.00 11.70 \$0 A. Elec. \$21.84 \$4.98 35.1 \$174.80 13.78 \$2,409 B. Dist \$1,660 14.9 \$117.26 14.16 \$7.87 C. Propane 11.70 \$0 \$108.60 0.0 kW \$0.00 D. Demand E. Other \$292.06 \$4,069 F. Total 3. Non Energy Savings (+) or Cost (-): \$0 A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 \$0 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) **Discounted Sav-**Savings(+) Year of Discount Item Occur. (2) Factor(3) ings(+)Cost(-)(4) Cost(-)(1) a. b. c. d. Total \$0 C Total Non Energy Discounted Savings (3A2+3Bd4) 4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)): 2.5 Years 5. Total Net Discounted Savings (2F5+3C): \$4,069 5.57 6. Savings to Investment Ratio (SIR) 5/1G: 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

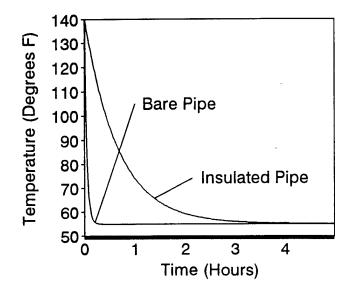
Non-Circulated DHW Systems:

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:

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

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 MB	TU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved
Fuel Oil MB	TU/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	Base	Baseline		Bare	Insulated	ECO #	ECO #2 Energy Savings	avings						
No.	MHQ	Size	Length	Pipe Loss	Pipe Loss	Fuel Oil	Fuel Oil Propane Fuel Oil Propane	Fuel Oil	Propane	ГСС	Bare Cos	Bare Cos Investmen	h Pay-	SIR
	Tem	In Dia	Щ	Mil BTU/Yr		Mil BTU/Y	Mil BTU/Y	\$∕∕r	\$/Yr	Savings	↔	↔	Back	
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	1	\$55	\$0	\$755	\$100	\$174	3.17	4.34
S 238	105		10	19.3	0.0	1	7.0	\$0	\$55	\$780	\$60	\$104	1.89	7.48
S 290	105	-	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	\$117.26	\$4,069	\$420	\$730	2.50	5.57

r				Date Prepared		Sheet of	
CONSTRUCTION COST EST	IMAT	E		June 1993			
Project				Project No.	Basis for Estimate		
EEAP Limited Energy Study				I		(no design compe	ated)
Fort Hunter-Liggett, California			_			fue condu compe	
Engineer-Architect				<u> </u>	1		
Keller & Gannon							
Drawing No.		Ëstimat			Checked	-	
ECO C2: Replace Pipe Insulation	<u> </u>	antity	RJB	Labor	<u> </u> ,	BIH	
Line item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 207	4				T		
2" Pipe Insulation	10	LF	\$6.00	\$60	\$4.00	\$40	\$100
Subtotal Bidg 207				-			\$100
					<u> </u>		
Building 229					1	,	
2" Pipe Insulation	10	LF	\$6.00	\$60	\$4.00	\$40	\$100
Subtotal Bldg 229	-		1		i		\$100
Building 230				· -		·	
2" Pipe Insulation	10	LF	\$6.00	\$60	\$4.00	\$40	\$100
Subtotal Bldg 230				T		······	\$100
Building 238				·····			
1" Pipe Insulation	10	LF	\$4.00	\$40	\$2.00	\$20	\$60
Subtotal Bldg 238		_		······································	-		\$60
			<u> </u>				
Building 290		,					
1" Pipe Insulation	10	LF	\$4.00	\$40	\$2.00	\$20	\$60
Subtotal Bldg 290	-			.			\$60
					1		
Subtotal	<u> </u>			ļ	1		\$420
General Conditions @ 8%							\$34
Subtotal							\$454
Contractor OH & Profit @ 30%							\$136
Subtotal							\$590
Bond @ 1%							\$6
Subtotal							\$596
Estimating Contingency @ 10%					1		\$60
Total Probable Construction Cost							\$655

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

ECO C-3

Project No. Region No. 4 Fort Hunter Liggett, California Location: Fiscal Year Project Title: ECIP Facility Energy Improvements FY95 Discrete Portion Name: ECO C3 Insulate Hot Water Storage Tanks Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$4,578 A. Construction Costs \$252 B. SIOH \$275 C. Design Cost \$5,105 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$5,105 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annual \$ Discount Discounted Energy Cost Saving Factor(4) Savings(5) Savings(3) Source \$/MTBU/(1) MBTU/YR(2) \$1,962 \$167.72 11.70 \$18.23 9.2 A. Elec. \$240.30 13.78 \$3,311 \$4.98 48.3 B. Dist 14.16 \$5,134 \$7.87 46.1 \$362.54 C. Propane \$0.00 11.70 \$0 \$108.60 0.0 kW D. Demand E. Other \$10,407 F. Total \$770.56 3. Non Energy Savings (+) or Cost (-): \$0 A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 \$0 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) Discount **Discounted Sav-**Year of Savings(+) Item ings(+)Cost(-)(4) Factor(3) Occur. (2) Cost(-)(1)a. b. c. d. Total C Total Non Energy Discounted Savings (3A2+3Bd4) \$0 6.6 Years 4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)): 5. Total Net Discounted Savings (2F5+3C): \$10,407 2.04 6. Savings to Investment Ratio (SIR) 5/1G: 9.06% 7. Adjusted Internal Rate of Return (AIRR):

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:		al heat load loss for each condition is determined by multiplying the 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.

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- 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.

Building	DHW		Existing Cond		Proposed Co		Heat Loss
Number	Tank	Existing	Tank Insitn	Heat Loss	Tank Insltn	Heat Loss	Load Saved
	Gallons	Temp Deg F		Mil BTU/Yr	Inches	Mil BTU/Yr	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

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DOMESTIC HOT WATER TANK INSULATION LOSSES:

Insulation Thickness	Tank	BTUH Losses at	Water Temper	atures					
(k = 0.3)	Gallons	100 Deg F	120 Deg F	122 Deg F	128 Deg F	135 Deg F	140 Deg F	160 Deg F	180 Deg F
	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
Bare	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
	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	49 9	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
1-inch Thick	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
	50	109	173	179	198	220	236	299	362
2-inch Thick	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
	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
3-inch Thick	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
		de to Energy Con		1,113	1,200	1,010		1,007	6,671

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

RAGE TANKS
VATER STO
ATE HOT V
CO-C3 INSUL

Fac	Existing (Existing Condition	ECO - C3 Energy	Energy Savings									
Š	Tank Insttn	Tank Insttn Heat Loss	Tank Instrn	Fuel Oil	Propane	Electric	FO Ann.	Prop. Ann Elec. Ann	Elec. Ann		Bare	Invest-	SIR
	Inches	Mil BTU/Yr	Inches	Mil BTU/Yr	Mil BTU/Y	Mil BTU/Y	Savings	Savings	Savings	Savings	Cost	ment	
P 80	-	5.1	e	-	1	3.3	\$0	0\$	09\$	\$704	\$75	\$130	5.40
P 81	-	5.2	e	1	١	3.3	\$0	0\$	09\$	\$704	\$150	\$261	2.70
P 101	-	8.3	e	•	7.6	•	\$0	\$60	0\$	\$844	\$100	\$174	4.85
-	-	3.3	e		3.0	ı	\$0	\$24	0\$	\$334	\$75	\$130	2.56
-	-	5.6	e	1	5.1		\$0	\$40	\$0	\$572	\$75	\$130	4.39
T 120	-	3.9	e		3.3	•	\$0	\$26	0\$	\$370	\$100	\$174	2.13
	-	6.5	e	1	5.8	1	\$0	\$46	0\$	\$652	\$100	\$174	3.75
T 127	-	5.5	ю	1	5.0	·	\$0	62\$	0\$	\$556	\$100	\$174	3.20
S 197	-	1.3	ო	•	'	0.8	\$0	\$0	\$15	\$171	\$75	\$130	1.31
P 206	-	57.8	e	42.4	,	•	\$211	\$0	0\$	\$2,909	\$1,560	\$2,713	1.07
P 210	-	6.5	m	5.9	•		\$29	\$0	0\$	\$402	\$100	\$174	2.31
P 219	-	4.0	ю	•	3.3	1	0\$	\$26	\$0	\$367	\$75	\$130	2.81
S 238	-	5.6	3		4.5	1	\$0	\$35	\$0	\$500	\$100	\$174	2.87
P 252	-	. 2:9	ю	t	1	1.8	0\$.	\$0	\$33	\$384	\$75	\$130.	2.94
P 287	-	3.3	e	t	2.9	•	0\$	\$23	\$0	\$321	\$75	\$130	2.46
S 290	-	6.1	ຕ	-	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 EST	TIMAT	E		Date Prepare June 19		Sheet C	DF
Project EEAP Limited Energy Study				Project No.	Basis for Estimate Code A (no design competed)		
Location	<u></u>			I	Code A (no design com	peted)
Fort Hunter-Liggett, California					-		
Engineer-Architect							
Keller & Gannon Drawing No.		Estimato	or		Checked B	v	
ECO C3 Insulate Hot Water Storage Ta	inks	RJB			він		
ECO CS Insulate not water otorage ra		antity		Labor		aterial	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
< 80 Gal. DHW Heater Insulation Kit	9	Ea	\$48	\$432	\$27	\$243	\$67
	+				<u> </u>		+-1
fiberglas 1 1/2" thick	7	Ea	\$65	\$455	\$35	\$245	\$70
	2	Ea	\$455	\$910	\$325	\$650	\$1,56
850 Gal. Tank Insulated w/3" CaSil		La	<u>9400</u>	0160	φ020		ψ1,00
Subtotal	1						\$2,93
General Conditions @ 8%		ļ					\$23
Subtotal							\$3,17
Contractor OH & Profit @ 30%							\$95
Subtotal							\$4,12
Bond @ 1%							\$4
Subtotal							\$4,16
Estimating Contingency @ 10%			•				\$41
Total Probable Construction Cost							\$4,57
		1					
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ECO C-5 TOTAL

Region No. 4 Project No. Fort Hunter Liggett, California Location: Fiscal Year FY95 Project Title: ECIP Facility Energy Improvements Discrete Portion Name: ECO C5 Reduce Domestic Hot Water Flow at Shower Heads and Faucets Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$1,326 A. Construction Costs \$73 B. SIOH \$80 C. Design Cost \$1,478 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$1,478 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discounted Discount Saving Annual \$ Cost Energy Savings(5) MBTU/YR(2) Savings(3) Factor(4) \$/MTBU/(1) Source 11.70 \$7,017 32.9 \$599.77 \$18.23 A. Elec. 13.78 \$0 0.0 \$0.00 \$4.98 B. Dist \$239 2.1 \$16.86 14.16 \$7.87 C. Propane \$0 0.0 kW \$0.00 11.70 D. Demand \$108.60 E. Other \$7,256 \$616.63 F. Total 3. Non Energy Savings (+) or Cost (-): \$0 A. Annual Recurring (+/-) 11.12 (1) Discount Factor (Table A) \$0 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) Discounted Sav-Discount Year of Item Savings(+) Factor(3) ings(+)Cost(-)(4) Cost(-)(1) Occur. (2) а. b. c. d. Total

C Total Non Energy Discounted Savings (3A2+3Bd4)\$04. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):2.4Years5. Total Net Discounted Savings (2F5+3C):\$7,2566. Savings to Investment Ratio (SIR) 5/1G:4.917. Adjusted Internal Rate of Return (AIRR):15.64%

ECO C-5 PART A

			•			
Location: Project Title:	Fort Hunter Ligge ECIP Facility Energ		Region No. 4			Project No. Fiscal Year FY95
Analysis Date		PARTA Install Self	Economic Life:	15	YEARS	Preparer: KELLER & GANNON
1. Investment	t Costs					
A. Constructi		<u> </u>	\$1,123			
B. SIOH			\$62	_		
C. Design Co			\$67	-		
	(1A+1B+1C)	unmont.	\$1,252		\$0	
E. Salvage Value of Existing Equipment					\$0	<u></u>
F. Public Utility Company Rebate G. Total Investment (1D-1E-1F)						\$1,252
	,					
2 Energy Sa	vings (+)/Cost(-):					
Date of NIST	IR 85-3273-X Used 1	for Discount Factors:	October 1992			
	Cost	Saving	Annual \$		Discount	Discounted
Energy Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
oource	¢/((1)		•			
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 *0
D. Demand	\$108.60		W \$0.00		11.70	\$0
E. Other F. Total			\$366.42			\$4,287
F. TOtal			\$000.1Z			+ ·;==·
3. Non Energ	y Savings (+) or C	ost (-):				
A. Annual Re	curring (+/-)		\$0			
(1) Discount Factor (Table A)					11.12	
(2) Discounted Savings/Cost (3A x 3A1)						\$0
B Non Recu	rring Savings (+) o	r Cost (-)				
B. Hommood						
ltem	Savings(+)	Year of	Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4))
a.						_
b.			-			_
с.						=
d. Total			• •			
C Total Non	Energy Discounted	Savings (3A2+3Bd4)			\$0	
4. Simple Pa	yback 1G/(2F3+3A	+(3Bd1/Economic Lif	e)):		3.4	Years
5. Total Net I	Discounted Savings	; (2F5+3C):			\$4,287	
	Investment Ratio (3.42	
7. Adjusted I	nternal Rate of Retu	ırn (AIRR):			12.89%	5

ECO C-5 PART B

Project No. Region No. 4 Fort Hunter Liggett, California Location: Project Title: ECIP Facility Energy Improvements Fiscal Year FY95 Discrete Portion Name: ECO C-5 PART B Install Flow Restrictors Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$203 A. Construction Costs \$11 B. SIOH \$12 C. Design Cost \$226 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$226 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annual \$ Discount Discounted Cost Saving Energy Factor(4) Savings(5) Savings(3) \$/MTBU/(1) MBTU/YR(2) Source \$2,730 \$233.34 11.70 12.8 A. Elec. \$18.23 13.78 \$0 \$0.00 \$4.98 B. Dist -14.16 \$239 \$7.87 2.1 \$16.86 C. Propane \$0.00 11.70 \$0 kW \$108.60 D. Demand -E. Other \$250.21 \$2,969 F. Total 3. Non Energy Savings (+) or Cost (-): \$0 A. Annual Recurring (+/-) 11.12 (1) Discount Factor (Table A) \$0 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) Discount **Discounted Sav-**Year of ltem Savings(+) Factor(3) ings(+)Cost(-)(4) Occur. (2) Cost(-)(1) a. b. c. d. Total \$0 C Total Non Energy Discounted Savings (3A2+3Bd4)

4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)):0.9Years5. Total Net Discounted Savings (2F5+3C):\$2,9696. Savings to Investment Ratio (SIR) 5/1G:13.137. 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

Total

FLOW RESTRICTING SHOWER HEAD AND LAVATORY FAUCET RETROFIT

Shower Heads Faucets	5.00	w Devices: gpm gpm		Lo-Flow D 2.00 0.75	evices: gpm gpm				
Function Code 1:	Offices			2.00	GPCD				
Assume Usage w	or 25%.	1.10	GPCD						
Function Code 2: S	Function Code 2: Shops & Warehouses								
Assume Usage w	9.	3.50	GPCD						
Function Code 2.1:	Commercial	Laundries - I	Not Applic	able to this	ECO.				
Function Code 3: B	arracks & Qu	arters w/o D	ining		30.00	GPCD			
Usage		GPCD	Lo-Flow GPCD						
Showers		19.50	7.80	-					
Faucets	•	4.50	1.13						
Clothes	Nashina	6.00	6.00						
Total	Trasming	30.00	14.93	-					
Function Code 3.1:	Detatched La	atrine with B	athing		25.00	GPCD			
			Lo-Flow						
Usage		GPCD	GPCD	-					
Showers	6	19.50	7.80						
Faucets		4.50	1.13						
Clothes	Washing	0.00	0.00	-					
Total		24.00	8.93						
Function Code 4: B	arracks & Qu	arters with D	Dining		30.00	GPCD			
Same as	Function Co	de 3 for non	-cooking h	not water us	sage:				
			14.93	GPCD					
Function Code 5: R	ecreation & G	∂yms w/o Ba	athing		0.50	GPCD			
Assume use from faucets 50% of total usage. Usage with Lo-Flow faucet aspirators: 0.35									
Function Code 5.1:	Recreation &	Gyms with	Bathing		12.00	GPCD			
		•							
11		6000	Lo-Flow GPCD						
Usage		GPCD		-					
Showers	•	10.50 1.50	4.20 0.38						
Faucets	Washing	0.00	0.38						
Clothes	wasiniy	0.00	0.00	-					

12.00

4.58

ECO C5 INSTALL FLOW RESTRICTORS

Function C	ode 6: Theaters & Sir	milar Commu	nity Facilities		0.50
	0.35	GPCD			
Function C		0.25			
	Usage with Lo-Flow fa	aucet aspirat	ors:	0.18	GPCD
Function C	ode 8: Base Exchang	jes & Stores		0.50	GPCD
	0.35	GPCD			
Function C	0.50	GPCD			
	0.35	GPCD			
Function C	ode 9: Clubs - Office		2.00		
	Assume use from fau Usage with Lo-Flow fa				GPCD
Function C	ode 10: Family Hous	ing		40.00	GPCD
		GPCD	Lo-Flow GPCD		
	Usage Showers	27.00	10.80		
	Faucets	8.00	2.00		
	Clothes Washing	5.00	5.00		
	Total	40.00	17.80		
Function C	ode 11.1: Schools wi	ithout Bathing	3	5.00	GPCD
			Lo-Flow		
	Usage	GPCD	GPCD		
	Other Uses	0.50	0.50		
	Faucets	4.50	1.13		
	Total	5.00	1.63		
Function C	Code 11.2: Schools w	ith Bathing		11.00	GPCD
			Lo-Flow		
	Usage	GPCD	GPCD		
	Showers	6.50	2.60		
	Faucets	4.50	1.13		
	Total	11.00	3.73		

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ECO C5 INSTALL FLOW RESTRICTORS

Function Code 11.3: Child Development Centers8.00								
Usage Showers	GPCD	Lo-Flow GPCD 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 se	parately.						

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ECO C5 PART A: INSTALLATION OF SELF-METERING FAUCETS

	SIR		4.14		4.14	
	Ś					
	Invest-	ment	\$1,252		\$1,252	
	Bare	Cost	\$720		\$720	
		Savings	\$5,189		\$5,189	
	Prop. An	Saving	1	-	•	
	FO Ann.	Saving	•	-	•	
	Elect. Ann	Savings	\$366		\$366	
s	Propane Elect. Ann FO Ann. Prop. An	BTU/Yr Mil BTU/Y Mil BTU/Y Savings	•		1	
O C5 Energy Savings	Fuel Oil				1	
ECO C5 EN	Electric	Mil BTU/Yr	20.1		20.1	
	Capacity	MII BTUH	1.875			
eating System	System	Temp.	132		11	
DHW Heat	Fuel	Used	Electric			
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 ECO-C5 PART B: INSTALLATION OF FLOW RESTRICTING SHOWER HEADS AND LAVATORY FAUCETS

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Bldg.	DHW Heal	leating System	m	JECO CS Er	D C5 Energy Savings								
Š	Fuel	System	Capacity	Electric	Fuel Oil	Propane	Elect. Ann	Fuel Oil	Propane Elect. Ann Fuel Oil Prop. Ann	CC	Bare	Invest-	SIR
	Used	Temp.	BTUH	Mil BTU/Y	Mil BTU/Yr Mil BTU/Y \$ Savings \$ Savings \$ Savings		\$ Savings	\$ Savings		Savings	Cost	ment	
127	Propane	110	240,000	'	,	2.1	-	•	\$17	\$239	06\$	\$157	1.53
197	Electric	125	1.25 kW	12.8	,		\$233	•	-	\$2,730	\$40	\$70	39.24
				12.8		2.1	\$233	1	\$17	\$2,969	\$130	\$226	\$226 13.13

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CONSTRUCTION COST	ESTI	MATE		Date Prepared Sheet OF June 1993			
Project EEAP Limited Energy Study				Project No.	Basis for Estimate		
Fort Hunter-Liggett, California					Code A (n	o design comp	eted)
Engineer-Architect							
Keller & Gannon Drawing No.		Estimat	or		Checked By	,	
ECO-C5 Install Self-Metering Fauc	ets	RJB			BIH		
Line Item	No.	Unit	Per	Labor	Per	terial	Total
Solf Motoring Lav Equests	Units 3	Meas. EA	Unit \$40	Total \$120	Unit \$200	Total \$600	Cost \$720
Self-Metering Lav. Faucets			Ψ+U	ψ120	Ψ200	\$000	ψ120
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
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CONSTRUCTION COST ESTIMATE					Date Prepared Sheet OF June 1993			
	:5111	VIATI		Project No.	93			
Project					Basis for Es	stimate		
EEAP Limited Energy Study						- design comm	a ta cil	
Location						no design comp	eted)	
Fort Hunter-Liggett, California		-						
Keller & Gannon								
Drawing No.		Estima	tor	Checked By				
ECO-C5 Install flow restrictors RJB			1	BIH	A			
Quantity Line Item No. Unit Per			Per	Labor	Per	terial	Totai	
			Unit	Total	Unit	Total	Cost	
Bldg 127 Shower Flow Restrictors	3	LS	\$10	\$30	\$20	\$60	\$90	
Bldg 197 Lavatory Flow Restrictors	2	LS \$15 \$30		\$30	\$5	\$10	\$40	
					-			
Subtotal	ļ			<u> </u>			\$130	
General Conditions @ 8%	ļ						\$10	
Subtotal							\$140	
Contractor OH & Profit @ 30%	ļ					\$42		
Subtotal					\$18			
Bond @ 1%					\$			
Subtotal					\$184			
Estimating Contingency @ 10%				\$18				
Total Probable Construction Cost							\$203	
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Life Cycle Cost Analysis Summary

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ECO C8

Energy Conservation Investment Program (ECIP)

Location: Project Title:	Fort Hunter Ligg ECIP Facility Energy	gy Improvements	Region No. 4			Project No. Fiscal Year FY95
	tion Name: ECO C8 e: June 1993	3 Dishwasher Heat Rec	Economic Life:	15	YEARS	Preparer: KELLER & GANNON
1. Investmer			47.000	_		
A. Construct	ion Costs		\$5,839	-		
B. SIOH			\$321			
C. Design C			\$350	=		
	t (1A+1B+1C)	•	\$6,510		# 0	
	alue of Existing Eq				\$0 \$0	_
	lity Company Reba	te				
G. Total Inve	estment (1D-1E-1F)					\$0,510
2. Energy Sa	avings (+)/Cost(-):			_		
Date of NIST	TIR 85-3273-X Used	for Discount Factor Oc	tober 1992			
	Cost	Saving	Annual \$		Discount	Discounted
Energy	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
Source	\$/MIBU/(I)		0441195(0)		1 40.01(1)	Sat
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 Ener	gy Savings (+) or C	Cost (-):		_		
			(\$1.00)			
	ecurring (+/-)		(\$160)	-	11.12	
	Factor (Table A)	A v 9A1)			11.12	(\$1,779)
(2) Discount	ed Savings/Cost (3	AX SAI)				(41,113)
B. Non Recu	urring Savings (+) o	or Cost (-)				
ltem	Savings(+)	Year of	Discount		Discounted Sav-	
Renn	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4)	i
a.		-				-
b.			-			
с.				-		
d. Totai						
C Total Non	Energy Discounted	l Savings (3A2+3Bd4)			(\$1,779)	
4 Simple Pa	avback 1G/(2F3+3/	+(3Bd1/Economic Life)):		4.3	Years
	Discounted Saving		•	•	\$21,483	
	o Investment Ratio	•			3.30	
	Internal Rate of Ret				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.

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

				Date Prepared		Sheet	OF
CONSTRUCTION COST ES	TIMAT	Έ		June 1993	3		
Project				Project No.	Basis for Esti	mate	
EEAP Limited Energy Study				<u>.</u>			
Location					Code A (no	design competed)
Fort Hunter-Liggett, California							
Keller & Gannon							
Drawing No.		Estimato	r		Checked By		
ECO-C8 Dishwasher Heat Recovery		RJB			BIH		
	Qui No.	antity Unit	Per	abor	Mate Per	ərial	Total
Line Item	Units	Meas.	Unit	Total	Unit	Total	Cost
Building 206							
Molitor or Equal Unit	1	Ea	\$352	\$352	\$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
					ļ		
Subtotal Building 206							\$3,808
General Conditions 8%							\$305
Contractor O.H. & P 30%				L			\$1,142
Sub Total							\$5,255
Bond 1%							\$53
Sub Total	_						\$5,308
Estimating Contingency 10%							\$531
Total Probable Construction Cost			······				\$5,839
	_						
					L	ļļ	
	_				<u> </u>	ļļ	
							,

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 Economic Life: 15 YEARS Analysis Date: June 1993 Preparer: KELLER & GANNON 1. Investment Costs A. Construction Costs \$1,712 **B. SIOH** \$94 \$103 C. Design Cost 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 Cost Saving Annual \$ Discount Discounted Source \$/MTBU/(1) MBTU/YR(2) Savings(3) Factor(4) 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 \$108.60 D. Demand 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 (-) Year of ltem Savings(+) Discount **Discounted Sav-**Cost(-)(1)Occur. (2) Factor(3) ings(+)Cost(-)(4) а. 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

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No.		С С С	ECO ECO C9 Energy	ergy Savings:		Automatic Flue Dampers	pers					
	Installation Name	ရ ပ	Fuel Oil	Propane	Electric	FO Ann.	Prop. Ann.	Prop. Ann. Elec. Ann.		Constr	Invest-	SIR
		Incl.	Mil BTU/Yr	Mil BTU/Yr	MW-Hr/Yr	\$ Savings	\$ Savings	\$ Savings	Savings	Cost	ment	
P 101 0	Open Din Cons (Haclenda)	Yes	•	2.59	•	0\$	\$20	\$0	\$289	\$568	\$633	0.46
P 128 0	Officers Quarters Military	Yes	•	15.78	'	\$0\$	\$124	\$0	\$1,759	\$568	\$633	2.78
P 210 H	Hith/Dntl Clinic w/ Beds	Yes	51.02	•	'	\$254	\$0	\$0	\$3,501	\$576	\$642	5.45
S 238 SI	Sig Photo Lab	Yes	•	0.95	•	\$0	\$7	\$0	\$106	\$541	\$603	1.72
ā	Process	Yes	I	8.34	'	\$0	\$66	\$0	\$929			
P 295 Ei	Enl Barracks w/o Dining	Yes	1	15.21	1	\$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

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CONSTRUCTION COST ES	TIMAT	E		Date Prepared June 1993	3	Sheet C)F
EEAP Limited Energy Study				Project No.	Basis for	I Estimate	
Fort Hunter-Liggett, California				• • • • • •	Code A	(no design compe	ted)
Engineer-Architect					1		
Keller & Gannon		-					
Drawing No.		Estimato	-	-	Checked	•	
ECO-C9 Install Automatic Flue Dampe		antity	RJB	abor	K	BIH Interial	
Line item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
OIL FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$156	\$156	\$18
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 4-inch Flue, Oil Fired							\$36
General Conditions 8%							\$2
Contractor O.H. & P 30%	1						\$2
Sub Total							\$42
Bond 1%							\$
Sub Total							\$43
Estimating Contingency 10%							\$4
Total Probable Construction Cost					1		\$47
					1		¥
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$161	\$161	\$19
Relay & Wiring	-	Job	-	\$120	-	\$60	\$18
Subtotal 6-inch Flue, Oil Fired							\$37
General Conditions 8%							\$3
Contractor O.H. & P 30%							\$11
Sub Total							\$51
Bond 1%							\$
Sub Total	-						\$52
Estimating Contingency 10%							\$5
Total Probable Construction Cost		<u>├</u>					\$57
		-					
B-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$161	\$161	\$19
Relay & Wiring	-	Job	-	\$120		\$60	\$18
Subtotal 8-inch Flue, Oil Fired						+00	\$37
General Conditions 8%				100			\$3
Contractor O.H. & P 30%							\$11
Sub Total							\$52
Bond 1%							\$ \$
Sub Total	+						ۍ \$52
Estimating Contingency 10%				<u></u>			ع دو \$5
	1	1 1			1		ാറ

CONSTRUCTION COST ES	TIMAT	Е		Date Prepared	3	Sheet C)F
Project				Project No.	Basis for	l Estimate	
EEAP Limited Energy Study			·····.		Code A	(no design compe	ted)
Fort Hunter-Liggett, California						(,
Keller & Gannon							
Drawing No.		Estimato	r.		Checked	Ву	
ECO-C9 Install Automatic Flue Dampo	ers		RJB			BIH	
	Qui	antity		abor		Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
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%					1		\$28
Contractor O.H. & P 30%						1 1	\$104
Sub Total							\$478
Bond 1%							\$5
Sub Total		11					\$483
Estimating Contingency 10%						1	\$48
Total Probable Construction Cost							\$53
		11				<u> </u>	
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				1			\$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%							\$11
Sub Total							\$51
Bond 1%							\$
Sub Total	-						\$516
Estimating Contingency 10%							\$52
Total Probable Construction Cost							\$568

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ECO D4 TOTAL

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

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Location:Fort Hunter Liggett, CaliforniaRegion No. 4Project No.Project Title:ECIP Facility Energy ImprovementsFiscal YearFY95Discrete Portion Name:Replace Incandescent Lighting with Fluorescent, TOTAL PROJECTAnalysis Date:June 1993Economic Life: 15 YEARSPreparer: 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	Cost	Saving MBTU/YR(2)		Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
Source	\$/MTBU/(1)			Savings(S)	Factor(4)	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 Recu	urring (+/-)			\$1,671		
(1) Discount Fa	••••				11.12	
	Savings/Cost (3A x 3A1)				\$18,578
		a . ()				
B. Non Recurri	ng Savings (+)	or Cost (-)				
ltem	Savings(+)	Year of		Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)		Factor(3)	ings(+)Cost(-)(4)	
a.			-			
b.			-	~		
C.			-			
d. Total						
C Total Non Er	nergy Discounte	ed Savings (3A2-	+3B	d4)	\$18,578	
4. Simple Pavb	ack 1G/(2F3+3	A+(3Bd1/Econ	omic	: Life)):	4,9	Years
	scounted Saving	•		<i>,,</i>	\$87,960	
	vestment Ratio				2.36	
•	ernal Rate of Re	• •			10.12%	
		· · ·				

ECO D4 Part A

Project No. Fort Hunter Liggett, California Region No. 4 Location: Fiscal Year ECIP Facility Energy Improvements FY95 Project Title: Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part A - 60W to 13W/5T4 Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs A. Construction Costs \$21,175 \$1,165 **B. SIOH** \$1,270 C. Design Cost \$23,610 D. Total Cost (1A+1B+1C) \$0 E. Salvage Value of Existing Equipment (\$2,715) F. Public Utility Company Rebate \$20,895 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Annual \$ Discount Discounted Cost Saving Energy Factor(4) MBTU/YR(2) Savings(3) Savings(5) Source \$/MTBU/(1) \$19,729 \$1,686 11.70 A. Elec. \$21.84 77.2 13.78 \$0 0.0 \$0 B. Dist \$4.98 14.16 \$0 0.0 \$0 C. Propane \$7.87 11.70 \$9,889 D. Demand \$108.60 7.8 kW \$845 E. Other \$29,619 \$2,532 F. Total 3. Non Energy Savings (+) or Cost (-): \$894 A. Annual Recurring (+/-) (1) Discount Factor (Table A) 11.12 \$9,945 (2) Discounted Savings/Cost (3A x 3A1) B. Non Recurring Savings (+) or Cost (-) **Discounted Sav-**Savings(+) Year of Discount Item ings(+)Cost(-)(4) Cost(-)(1) Occur. (2) Factor(3) а b. c. d. Total C Total Non Energy Discounted Savings (3A2+3Bd4) \$9,945 6.1 Years 4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)): \$39,564

1.89

8.52%

5. Total Net Discounted Savings (2F5+3C): \$ 6. Savings to Investment Ratio (SIR) 5/1G:

7. Adjusted Internal Rate of Return (AIRR):

98

Location: Project Title:	ECIP Facility Er	ggett, California hergy Improvements e Incandescent Ligl	Region No. 4 6 hting with Flu		t. Part B - 175\	Project N Fiscal Ye N to 18W	ar FY95	
Analysis Date:		e meandescent Ligi	Economic Li	ife: 15	YEARS			& GANNON
1. Investment C								
A. Construction	Costs		\$234					
B. SIOH			\$13					
C. Design Cost			\$14	;				
D. Total Cost (1	A+1B+1C)		\$261					
E. Salvage Valu	e of Existing Eq	uipment			\$0			
F. Public Utility	Company Reba	te			(\$30)			
G. Total Investm	nent (1D-1E-1F)						\$231	
2. Energy Savin	gs (+)/Cost(-):							
Date of NISTIR	85-3273-X Used	for Discount Facto	rs: October 1	992				
Energy	Cost	Saving	Annual \$	•	Discount	Dis	scounted	
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Sa	vings(5)	
Ocurce	¢/	,	J				5 ()	
A. Elec.	\$21.84	0.7	\$	616	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	\$	511	11.70		\$127	
E. Other	<u> </u>		•				• • = •	
F. Total				26			\$308	•
F. Total			•				• - • -	
3. Non Energy	Savings (+) or (Cost (-):						
			\$11					
A. Annual Recu			ΨΠ		11.12			
(1) Discount Fa		A 0 A 1)			11,12		\$125	
(2) Discounted	Savings/Cost (3	A X 3A1)					φ120	
B. Non Recurrir	ng Savings (+) o	or Cost (-)						
ltem	Savings(+)	Year of	Discount		Discounted Sa	av-		
item	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-			
						/ · /		
a.								
b.			•	•				
c.				- '				
d. Total					<u>-</u>	:		
C Total Non En	ergy Discounted	d Savings (3A2+3B	d4)		\$125			
			l ifo)):		6.1	Va	ars	
		A+(3Bd1/Economic	; Lilej).		5.1 \$433	16	:013	
	counted Saving							
 b Savings to In 	vestment Ratio	(SIR) 5/10:			1.88			

8.46%

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Location: Project Title: Discrete Portion Analysis Date:	ECIP Facility Er Name: Replac	ggett, California nergy Improvements e Incandescent Ligi	Region No. 4 s hting with Fluoresc Economic Life: 1	Fisc ent, Part C - 100W to	ect No. ai Year FY95 18W/7T4 barer: KELLER & GANNON
1. Investment C	oete				
			\$2,808		
A. Construction	Cosis				
B. SIOH			\$154		
C. Design Cost			\$168		
D. Total Cost (1	A+1B+1C)		\$3,131		
E. Salvage Valu	e of Existing Ec	quipment		\$0	_
F. Public Utility				(\$360)	
G. Total Investm	nent (1D-1E-1F)				\$2,771
	,				
2. Energy Savin	as (+)/Cost(-);				
Date of NISTIR	85-3273-X Used	for Discount Facto	rs: October 1992		
	Cost	Saving	Annual \$	Discount	Discounted
Energy		MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
Source	\$/MTBU/(1)		Savings(S)		Catings(c)
	604 04	101	¢050	11 70	¢4 101
A. Elec.	\$21.84	16.1	\$352	11.70	\$4,121
B. Dist	\$4.98	0.0	\$0	13.78	\$O
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 Recu	rring (+/-)		\$212		
(1) Discount Fa	ctor (Table A)			11.12	
(2) Discounted		3A x 3A1)			\$2,359
B. Non Recurrir	na Savinas (+) (or Cost (-)			
B. Norrisouri	,g = g = (.) .	()			
ltem	Savings(+)	Year of	Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.		w			
b.		· · · · · · · · · · · · · · · · · · ·			
С.					
d. Total					
C Total Non En	ergy Discounte	d Savings (3A2+3B	d4)	\$2,359	
4 Simple Paulo	ack 1G//2F3+3	A+(3Bd1/Economic	t ife)):	3.6	Years
	•	•		\$8,767	. 3010
	counted Saving			•	
-	vestment Ratio			3.16	
 Adjusted inte 	rnal Rate of Re	turn (AIKK):		12.30%	

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Location: Project Title:	ECIP Facility Er	ggett, California hergy Improvements se Incandescent Ligl	Region No. 4	F	Project No. Fiscal Year FY95 / to 26W/8T4
Analysis Date:			Economic Life: 1		Preparer: KELLER & GANNON
1, Investment C	osts				
A. Construction			\$5,029		
B. SIOH			\$277		
C. Design Cost			\$302		
D. Total Cost (1			\$5,607		
E. Salvage Valu		uinment	+-,	\$0	
F. Public Utility				(\$465)	
G. Total Investn					\$5,142
G. TOTAL INVESTI			. •		
2. Energy Savin	as (+)/Cost(-):				
Date of NISTIR	85-3273-X Used	for Discount Factor	rs: October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
A. Elec.	\$21.84	24.9	\$543	11.70	\$6,354
B. Dist	\$4.98	0.0	\$0	13.78	\$O
C. Propane	\$7.87	0.0	\$0	14.16	\$ 0
D. Demand	\$108.60	3.5 kW	\$380	11.70	\$4,451
E. Other				<u> </u>	
F. Total			\$924		\$10,805
3. Non Energy	Savings (+) or (Cost (-):			
A. Annual Recu	rrina (+/-)		\$219		
(1) Discount Fa				11.12	
(2) Discounted		3A x 3A1)			\$2,438
B. Non Recurrir	ng Savings (+) o	or Cost (-)			
ltem	Savings(+)	Year of	Discount	Discounted Sat	V-
nem	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)	
-					
a. 5					
b.			-		
C. d. Total				<u></u>	
d. Total					
C Total Non En	ergy Discounted	d Savings (3A2+3B	d4)	\$2,438	
4. Simple Pavba	ack 1G/(2F3+3/	A+(3Bd1/Economic	Life)):	4.5	Years
5. Total Net Dis				\$13,243	
6. Savings to In				2.58	

10.77%

ECO D4 Part E

Project No. Region No. 4 Fort Hunter Liggett, California Location: Fiscal Year FY95 ECIP Facility Energy Improvements Project Title: Discrete Portion Name: Replace Incandescent Lighting with Fluorescent, Part E - 250W to 2-F32/T8 Economic Life: 15 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$3,900 A. Construction Costs B. SIOH \$214 \$234 C. Design Cost \$4,348 D. Total Cost (1A+1B+1C) E. Salvage Value of Existing Equipment \$0 (\$500) F. Public Utility Company Rebate \$3,848 G. Total investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discounted Discount Saving Annual \$ Cost Energy Savings(5) \$/MTBU/(1) MBTU/YR(2) Savings(3) Factor(4) Source \$6,857 \$586 11.70 \$21.84 26.8 A. Elec. 13.78 \$0 \$4.98 0.0 \$0 B. Dist \$0 14.16 \$0 0.0 \$7.87 C. Propane 11.70 \$4,803 kW 3.8 \$411 D. Demand \$108.60 E. Other \$11,660 \$997 F. Total 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 (-) Discount Discounted Sav-Savings(+) Year of ltem ings(+)Cost(-)(4) Cost(-)(1)Occur. (2) Factor(3) a. b. c. d. Total \$2,316 C Total Non Energy Discounted Savings (3A2+3Bd4) 4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)): 3.2 Years \$13,976 5. Total Net Discounted Savings (2F5+3C): 3.63 6. Savings to Investment Ratio (SIR) 5/1G:

7. Adjusted Internal Rate of Return (AIRR):

13.34%

102

Location: Project Title:	ECIP Facility E	ggett, California nergy Improvement	Region No. 4 s ghting with Fluoresc	F	roject No. iscal Year FY95 to 2-F32/T8
Analysis Date:			Economic Life: 1	5 YEARS F	reparer: KELLER & GANNON
1. Investment C A. Construction	Costs		\$4,485		
B. SIOH			\$247		
C. Design Cost			\$269		
D. Total Cost (1			\$5,000		
•	ue of Existing Ed	quipment		\$0	
-	Company Reba			(\$575)	
•	nent (1D-1E-1F)				
Q. Total investi		/			• • • • • • •
2 Energy Savir	ngs (+)/Cost(-):				
Date of NISTIR	85-3273-X Used	d for Discount Facto	ors: October 1992		
Energy	Cost	Saving	Annuai \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	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	5.5kW	/ \$597	11.70	\$6,985
E. Other					
F. Total			\$904		\$10,581
3. Non Energy	Savings (+) or	Cost (-):			
A. Annual Recu	urring (+/-)		\$125 -	,	
(1) Discount Fa	actor (Table A)			11.12	
(2) Discounted	Savings/Cost (3A x 3A1)			\$1,395
B. Non Recurri	ng Savings (+)	or Cost (-)			
ltem	Savings(+)	Year of	Discount	Discounted Sav	/-
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)
3					
a. b.					
			-		
c. d. Total					
u. Iutai					
C Total Non Er	nergy Discounte	d Savings (3A2+3E	3d4)	\$1,395	
4. Simple Payb	ack 1G/(2F3+3	A+(3Bd1/Economi	c Life)):	4.3	Years
5. Total Net Dis	scounted Saving	gs (2F5+3C):		\$11,976	
6. Savings to Ir	nvestment Ratio	(SIR) 5/1G:		2.71	
7. Adjusted Inte	ernal Rate of Re	turn (AIRR):		11.14%	

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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	Replace existing 60-100W surface-mounted incandescent lamps with 13W/5T4 to 18W/8T4 compact fluorescent lamps.
A, B & C	
Retrofit D	Retrofit existing recessed incandescent downlight (150W lamp) with fluorescent ballast and socket adapter for 26W/8T4 quad lamp.
	nuorescent ballast and socket adapter for 2007/014 quad lamp.
Retrofits	Replace existing suspended incandescent fixture (250-300W lamps) with
E & F	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	descent	Lamps		Replacement Fluorescent Lamps	ent Fluc	rescent L	amps	Economic Screening Analysis	Screel	ning An₅	ılysis			
Retrofit	Total	Mean	Relamping	Retrofit	Total	Mean	Relamping	Demand 1	Labor	Matri	Total	PG&E	Total	Breakeven
Designation	Lamp	Life 1	Cost	Lamp	Lamp	Life 2	Cost	Saving	Cost	Cost	Cost	Rebate	Invest-	Operating
	Watts	(Hours)	(\$)	Type	Watts	(Hours)	(\$)	(kW)	(\$)	(\$)	(\$)	(\$)	ment (\$)	ment (\$) Hrs/Year
A	8	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
œ	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
ပ	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
٩	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
ш	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
L	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

 Breakeven Operating = Hours per Year

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

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Total Investment = Total Cost - PG&E Rebate

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

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ECO	SUMM.	ARY OF E	SUMMARY OF ECO D4 ANALYSES	SES								
No.	ш	Energy Savings	vings			O&M	LCC Savings Construction	onstruction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kWH/Yr kW Demand Use	Use \$/Yr	\$/Yr Demand \$/Yr	\$/Yr	↔	\$	\$	φ	ŝ	
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	N	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

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	SIR > 1.0 D4A	۲	SIR > 1.0 D4B		SIR > 1.0 D4C	D4C	SIR > 1.0 D4D	đ	SIR > 1.0 D4E	D4E	SIR > 1	SIR > 1.0 D4F	SIR	SIR > 1.0 D4 AII	
No.	Energy Savings kWH/Y kW Den	ngs Demand	Energy Savings Energy Savings kWH/Y kW Demand	gs Demand	Energy Savings kWH/Y kW Den	Energy Savings Energy kWH/Y kW Demand kWH/Y		nand	Energy kWH/Y	avings W Demand	Energy i kWH/Y	Savings Energy Savings Energy S kW Demand kWH/Y kW Demand kWH/Yr	Ener nd kWH	Energy Savings kWH/Yr kW Demand	nand
P 80	•	י ו	-	•	86	0.2		•		•	•			86	0.2
P 81	ı	'	ı	•		•	ł	ı	•	•	783	4	4.8 7	783	4.8
T 120	1,803	0.4	,	•	349	0.1	٠	•	•	•	3,341	Ö	0.7 5,4	5,493	1 2
T 121	250	0.1	•	•	218	0.1	•	'		•	·		ч 1	469	0.2
T 127	2,892	0.9	ı	•	3,123	1.0	ı	•	ı	•	•		- 6,(6,016	1.9
P 128	6,887	2.2	·	•	•	I	•	•	ı	•	•		- 6,	6,887	2:2
T 156	80	0.0		•	ı	•	•	•	•	•	•		,	80	0.0
S 197	1,046	0.0	ŀ	١	ļ	·	•	•	•	•	•		- 1'(1,046	0.6
P 205	429	0.1	,	•	•		ı	•	•	•	·		•	429	0.1
P 207	413	0.1	,	•	•	•	ı	•	•	•	•		•	413	0.1
P 208	413	0.1	ı	•	•	ı	ı	•	•	•	•		•	413	0.1
P 209	1,831	1.7	,	•	•	ı	•	•	•	•	•		- 1,1	1,831	1.7
P 229	413	0.1	•	•	•	'	•	•	،	•	•			413	0.1
P 230	413	0.1	,	•	•	•	•	•	•	•	•		•	413	0.1
S 238	•	1 -		•	•	•	7,286	3.5	ı	•	•		- 7,	7,286	3.5
P 252	89	0.0		'	•			٠	3,538	1.7	•		- 3	3,628	1.7
P 256	٠	•	208	0.1	•	•	,	•	393	0.2	•		-	601	0.3
P 259	89	0.0	ı	•	•	,	٠	•	3,931	1.9	•		- 4,1	4,021	1.9
S 283	•	۰		,	936	0.5	,	•	ı	•	•			936	0.5
S 291	161	0.1		ı	•	•		•	•	•	•		•	161	0.1
P 295	5,409	1 2	•	•	•	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	328	22.5

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

		Energy Savings	vings			O&M	LCC Savings	LCC Savings Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kW Demand	Use \$/ Y r	\$/Yr Demand \$/Yr	. \$/Yr	\$	₩	\$	\$	\$	
T 120	6	1,803	0.4	\$134	\$42	\$71.29	\$2,857	\$1,053	\$1,174	\$135	\$1,039	2.75
T 121	0	250	0.1	\$19	\$9	\$9.90	\$438	\$234	\$261	\$30	\$231	1.90
T 127	21	2,892	0.9	\$216	\$98				\$2,739	\$315	\$2,424	2.04
P 128	50	6,887	2.2	\$513	\$233	•/	44	\$5,849	\$6,522	\$750	\$5,772	2.04
T 156	-	80	0.0	\$6 \$	\$ 5				\$130	\$15	\$115	1.39
S 197	13	1,046	0.6	\$78	\$61				\$1,696	\$195	\$1,501	1.39
P 205	ო	429	0.1	\$32	\$14				\$391	\$45	\$346	2.10
P 207	ო	413	0.1	\$31	\$14				\$391	\$45	\$346	2.04
P 208	ო	413	0.1	\$31	\$14				\$391	\$45	\$346	2.04
P 209	3 0	1,831	1.7	\$137	\$182				\$5,087	\$585	\$4,502	1.01
P 229	ო	413	0.1	\$31	\$14				\$391	\$45	\$346	2.04
P 230	ო	413	0.1	\$31	\$14				\$391	\$45	\$346	2.04
P 252	-	68	0.0	\$7	\$5				\$130	\$15	\$115	1.49
P 259	-	68	0.0	\$7	\$5	\$3.54			\$130	\$15	\$115	1.49
S 291	2	161	.0.1	\$12	6\$			-	\$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

	SIR		1.88
	Investment	θ	\$231 1.88
	Rebate	\$	\$30
	Total Cost	\$	\$261
	Construction	\$	\$234
8	O&M LCC Savings Construction	\$	\$433
	0&M	r \$/Ƴr	\$11 \$11.23
		\$/Yr Demand \$/Yr	\$11
		Use \$/Yr	\$16
B: 75W to 18W/7T4 Savings	sbu	Fxtrs kWH/Yr kW Demand Use	0.1
V to 18W/71	Energy Savings	kWH/Yr	208
B: 75V	ш	Fxtrs	2
Fac	No.		P 256

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Fac	C: 10	C: 100W to 18W/7T4 Savings	4 Savings					C				
No.		Energy Savings	sb			O&M	O&M LCC Savings Construction	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr kW Demand	W Demand	Use \$/Yr	\$/Yr Demand \$/Yr	\$/ ≺ r	↔	\$	\$	\$	\$	
P 80	e	86	0.2	\$7	\$24	\$4.41	\$421	\$351	\$391	\$45	\$346	1.21
T 120	-	349	0.1	\$26	\$8	\$15.69	\$574	\$117	\$130	\$15	\$115	4.98
T 121	-	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	9	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	D: 15	150W to 26W/8T4 Savings	14 Savings									
No	Fxtrs	Energy Savings kWH/Yr kW Demand	gs W Demand	Use \$/Yr	Use \$/Yr Demand \$/Yr	0&M \$∕Yr	O&M LCC Savings Construction \$/Yr \$	Construction \$	Total Cost \$	Rebate \$	Investment \$	SIR
S 238	31	7,286	3.5	\$543	\$380	\$219.23	\$13,243	\$5,029	\$5,607	\$465	\$5,142	2.58
		-							-			
Fac	E: 25	250W to 2-F32/T8 Savings	18 Savings									
No.		Energy Savings	gs			O&M	O&M LCC Savings Construction	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr k/	kW Demand	Use \$/Yr	Demand \$/Yr	\$/Yr	\$	⇔	₽	ø	↔	
P 252	6	3,538	1.7	\$264	\$185	\$93.72	\$6,289	\$1,755	\$1,957	\$225	\$1,732	3. 83
P 256	-	393	0.2	\$29	\$21	\$10.41	\$699	\$195	\$217	\$25	\$192	3. 8
P 259	10	3,931	1.9	\$293	\$205	\$104.14	\$6,988	\$1,950	\$2,174	\$250	\$1,924	3.63
Totals	50	7,862	4	\$586	\$411	\$208	\$13,976	\$3,900	\$4,348	\$500	\$3,848	3.63
Fac	F: 30	300W to 2-F32/T8 Savings	8 Savings									
No.		Energy Savings) ds			O&M	LCC Savings Construction	Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr k	kW Demand	Use \$/Yr	Demand \$/Yr	\$/Yr	, လ	↔	₩	↔	↔	
P 81	50	783	4.8	\$58	\$	\$23.83	\$7,021	\$3,900	\$4,348	\$500	\$3,848	1.82
T 120	ъ	3,341	0.7	\$249		\$101.66	\$4,955	\$585	\$652	\$75	\$577	8.58
Totals	R	4,124	5.5	\$307	\$597	\$125	\$11,976	\$4,485	\$5,000	\$575	\$4,425	2.7

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP) ECO D8

Project No. Region No. 4 Fort Hunter Liggett, California Location: Project Title: ECIP Facility Energy Improvements Fiscal Year FY95 Discrete Portion Name: ECO D8 Improve Power Factor, Total Project Economic Life: 20 YEARS Preparer: KELLER & GANNON Analysis Date: June 1993 1. Investment Costs \$55,515 A. Construction Costs B. SIOH \$3,053 \$3,331 C. Design Cost D. Total Cost (1A+1B+1C) \$61,899 \$0 E. Salvage Value of Existing Equipment \$0 F. Public Utility Company Rebate \$61,899 G. Total Investment (1D-1E-1F) 2. Energy Savings (+)/Cost(-): Date of NISTIR 85-3273-X Used for Discount Factors: October 1992 Discount Discounted Annual \$ Cost Saving Energy MBTU/YR(2) Savings(3) Factor(4) Savings(5) \$/MTBU/(1) Source \$1,018 \$14,788 14.53 47 A. Elec. \$21.84 17.63 \$0 \$4.98 \$0 B. Dist \$0 18.59 \$0 \$7.87 C. Propane 14.53 \$3,593 2.28 kW \$247 \$108.60 D. Demand E. Other \$18,381 \$1,265 F. Total 3. Non Energy Savings (+) or Cost (-): \$6,480 A. Annual Recurring (+/-) (1) Discount Factor (Table A) 13.59 (2) Discounted Savings/Cost (3A x 3A1) \$88,063 B. Non Recurring Savings (+) or Cost (-) Year of Discount **Discounted Sav-**Savings(+) Item Factor(3) ings(+)Cost(-)(4) Occur. (2) Cost(-)(1) a. b. c. d. Total C Total Non Energy Discounted Savings (3A2+3Bd4) \$88,063 8.0 Years 4. Simple Payback 1G/(2F3+3A+(3Bd1/Economic Life)): 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 Ligg Project Title: ECIP Facility Ene	rgy Improvements	Region No. 4		Project No. Fiscal Year FY95
Discrete Portion Name: ECO D	8, Part A - Power Fac			
Analysis Date: June 1993		Economic Life: 2	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 Ed	quipment		\$0	
F. Public Utility Company Reba	ate		\$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 Cost	Saving	Annual \$	Discount	Discounted
Source \$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	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 (-):			
<u>T</u> , <u>T</u> , <u>N</u> _, <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> _, <u>N</u> , <u>N</u> , <u>N</u> _, <u>N</u> , <u>N</u> , <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> , <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> _, <u>N</u> , <u>N</u> , <u>N</u> _, <u>N</u> , <u>N</u> _, <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> , <u>N</u> ,				
A. Annual Recurring (+/-)		\$6,480	13.59	
(1) Discount Factor (Table A)			13.59	\$88,063
(2) Discounted Savings/Cost (3A X 3AT)			\$68,005
B. Non Recurring Savings (+)	or Cost (-)			
Item Savings(+)	Year of	Discount	Discounted Sav-	
Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
	()			
a.				
b.		-		_
C.	-			
d. Total				-
C Total Non Energy Discounte	d Savings (3A2+3Bd	4)	\$88,063	
4. Simple Payback 1G/(2F3+3	A+(3Bd1/Economic	Life)):	7.9	Yea rs
5. Total Net Discounted Saving			\$88,063	
6. Savings to Investment Ratio			1.73	
7. Adjusted Internal Rate of Re			6.87%	

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

ECO D8, Part B

Location: Project Title	Fort Hunter Ligg	gett, California trgy Improvements	Region No. 4		Project No. Fiscal Year FY95
Discrete Por	tion Name [,] FCO D	8. Part B - Power Fa	ctor Correction @ Individ	dual Motors	
	te: June 1993			20 YEARS	Preparer: KELLER & GANNON
1. Investme	nt Costs				
A. Construc	tion Costs		\$9,733		
B. SIOH			\$535		
C. Design C	ost		\$584		
D. Total Cos	st (1A+1B+1C)		\$10,853		
E. Salvage \	Value of Existing E	quipment		\$0	
F. Public Uti	ility Company Reba	ate		\$0	
G. Total Inv	estment (1D-1E-1F))			\$10,853
2. Energy S	avings (+)/Cost(-):				
		d for Discount Factor	s: October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
Source	φ/ιντεο/(τ)		outilige(o)		
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 Ener	gy Savings (+) or	Cost (-):			
	ecurring (+/-)		\$0		
	Factor (Table A)			13.59	
(2) Discount	ted Savings/Cost (3A x 3A1)			\$0
B. Non Rec	urring Savings (+)	or Cost (-)			
		Year of	Discount	Discounted Sav-	
ltem	Savings(+)				
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.			_		
b.					
с.					
d. Total	29989 dillion a surget in derivation				
C Total Nor	Energy Discounte	ed Savings (3A2+3Bo	14)	\$0	
4. Simple P	avback 1G/(2F3+3	A+(3Bd1/Economic	Life)):	8.6	Yea rs
•	Discounted Saving		• •	\$18,381	
	o Investment Ratio			1.69	
	Internal Rate of Re			6.78%	
1. Aujusieu	mema nate of he			0.7076	

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:

	Α.	factor differene from 85%.	ncludes a 0.06% adjustment on the The adjustment is applied as a crec harge for power factors below 85%.	lit for power factors above
	В.	Average Main Post Billings: period.	\$600,000 during summer period:	\$400,000 during winter
	C.	Average Power Factor:	Summer period - 82/83% Winter period - 85/86%	
	D.	Summer Peak Demand:	3,160 kW	
Calcu	ulatio	ins:		
	Α.		= kW x Tan (arcCos 0.825) = 3,160 kW x tan(34.41 degrees) = 2,165 kVAR	
	в. 1	Peak kVAR (Corrected to 955	%)	
		=	= 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	l
	D.	-	00,000 x 12% x (0.06%)/(1%PF) 00,000 x 9% x (0.06%)/(1%PF) Total Savings	= \$4,320 = \$2,160 = \$6,480/year
			Total Cavilys	- 40,400/yeai
		* Assuming Correction to a	n average Power Factor of 95%	

2. Installation of Power Factor Correction Capacitors @ Motor Loads

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

HP	Max	Current	FLA@	Resistance	Loss	New	Savings
Rating	kVAR	Reduction	460V	Ohms/1000'	i ² R (W)	Loss	
		(%)				12R (W)	(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	Max	Current	FLA@	Resistance	Loss	New	Savings
Rating	kVAR	Reduction	460V	Ohms/1000'	l ² R (W)	Loss	
		(%)				12R (W)	(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

HP	Max	Savings	Labor	Material	Total Invest.[1]	Breakeven [2]
Rating	kVAR	kW	Cost	Cost	w/ SIOH & Design	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

SCREENING ANALYSIS - 460V MOTORS

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

[2] Breakeven Operating hours/year =

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

HP	Max	Savings	Labor	Material	Total Invest.[1]	Breakeven [2]
Rating	kVAR	kW	Cost	Cost	w/ SIOH & Design	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

SCREENING ANALYSIS - 200V MOTORS

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

[2] Breakeven Operating hours/year =

Total investment - (kW savings x \$108.60/kW x 13.59) (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.

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
<u> </u>		<u> </u>		1	2.277		13,639

CAPACITORS INSTALLED AT MOTOR LOAD

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 Prepare			OF	
Project EEAP Limited Energy Study Location Fort Hunter-Liggett, California				Project No. Basis for Estimate Code A (no design competed)			
	Estimato	or		Checked	Ву		
int	RCL			ВІН			
			Labor		Aaterial	.	
NO. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost	
<u> </u>	IS		\$4 000		\$23.000	\$27,000	
+		-				\$1,000 \$1,000	
	L	\$25				\$1,000	
- 30		φ23	\$750	φ20	\$000	\$1,550	
-							
-						\$29,350	
						\$2,348	
						\$31,698	
						\$9,509	
						\$41,207	
						\$412	
+						\$41,619	
+						\$4,162	
1						\$45,781	
+						\$10,701	
+	ļ						
	int No.	Estimato RCL Quantity No. Unit Units Meas. - LS - LS	Estimator Int RCL Quantity No. Unit Per Units Meas. Unit 	STIMATE June 19 Project No. Project No. Int RCL Quantity Labor No. Unit Per Units Meas. Unit Total IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	STIMATE June 1993 Project No. Basis for Code A Code A Estimator Checked Int RCL BIH Quantity Labor N No. Unit Per Units Meas. Unit Total Unit I I I I I I I I I I I I I I I I I I I	STIMATE June 1993 Project No. Basis for Estimate Code A (no design composition of the structure) Code A (no design composition of the structure) Int RCL BIH Quantity Labor Material No. Unit Per Units Meas. Unit Total Inits Init Total Init Inits Init State State Inits Init State Init Inits Init State Init Inits Init State Init Inits Init State Init Inits Init Init Init	

CONSTRUCTION COST ESTIMATE				Date Prepare						
			Project No.	Basis for Estimate						
Project EEAP Limited Energy Study						Lotimato				
Location					Code A	(no design com	npeted)			
Fort Hunter-Liggett, California										
Engineer-Architect										
Keller & Gannon Drawing No.		Estimate			Checked	By				
ECO-D8 PF Corr. @ individual motors RCL					Checked By BIH					
ECO-D8 FT Coll: @ Individual mot		uantity	<u> </u>	Labor		Material				
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost			
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	<u> </u>			\$1,550	1	\$4,690	\$6,240			
General Conditions @ 8%		ļ					\$499			
Subtotal							\$6,73			
Contractor OH & Profit @ 30%							\$2,022			
Subtotal							\$8,76			
Bond @ 1%							\$88			
Subtotal							\$8,849			
Estimating Contingency @ 10%							\$88			
Total Probable Construction Cost							\$9,73			
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facility

ECIP Facility Energy Improvements Fort Hunter Liggett, Calif.

project coordinator for using service

functional requirements summary, PDB-1

1`of 9

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.
- I. 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.

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functional requirements summary, PDB-1

DA FORM 5020-2-R, Feb 82

2 of

SUMMARY OF FUTURE CHANGES AND IMPACTS

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

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functional requirements summary, PDB-1

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DA FORM 5020-2-R, Feb 82

	. SPECIAL CONSIDERATIONS	Required or Not Required	+ pec	~	=
		Req	je je	nen ched	mer
	ITEM	Jequ Vor I	To Be + Determined	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	R		04	
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR	<u>D</u>		·
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities				
	construction and operating permits, clearinghouse coordination, etc.)	NR			
A-4	Assignment of airspace	NR			••••••
<u>A-5</u>	Economic analysis of alternatives	R	D		
<u>A-6</u>	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				·
A-9	Exceptions to established criteria	<u>NR</u>			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	<u>NR</u>			[
A-11	Identification of related or support projects (so projects can be coordinated)	NR_			
A-12	Required completion date	R	A		
	Other Special Considerations (List and number items)	<u> </u>			
REQU	IRED OR NOT REQUIRED Not relevant or no information to com-	and inte	/ /1 200		
[mu	nicate. Enter "R" if item is relevant and is required for this project. ter "NR" if item is irrelevant and is not required for this project. A - DFAE				
то ве	DETERMINED - Information needed but not currently available. B - Using Service				
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and	IENT ATTACHED — Significant information summarized or explained D — Designer				
DOCU	MENT ATTACHED - Significant information is in an existing docu- explain)	k Comm	ents Att	ached an	d
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	documentation check	s	st	4 01	E 9
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	2. ARCHITECTURAL & STRUCTURAL	Required or Not Required	• peri	t p	en t
	ITEM	Requir Not Re	To Be • Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements				
C·Z	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 NR			<u> </u>
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			ļ
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR	-		L
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13		NR			
C-14	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-15	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-16	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-18 C-17	Tenant facilities coordination with installation where sited	NR			<u> </u>
	Facilities for or exposed to explosions, toxic chemicals, or ammunition-review by DDESB (See also item 8-4)	NR			
<u>C-18</u>	Analysis of deficiencies	R	D		<u> </u>
C-19	Consideration of alternatives	R	D		<u> </u>
<u>C-20</u>	Determination whether occupants will Include physically handicapped or disabled persons		- <u> </u> <u>U</u>		
C-21	As-build drawings for alterations or additions	NR	C		├───
<u>C-22</u>	Availability of Standard Design or site adaptable designs	NR			
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Ent	IRED OR NOT REQUIRED — Not relevant or no information to com- nicate. Enter "R" if item is relevant and is required for this project. (ar "NR" if item is irrelevant and is not required for this project. (A - DFAE)	and inse	rt approp	riate lett	ter)
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D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS Required or Not Required To Be * Determined Document Attached Comment Attached ITEM D-1 Fuel considerations and cost comparison analysis R D D-2 Energy requirements appraisal (ERA) D-3 R D 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 relevent and is required for this project. *BY WHOM (Check and insert appropriate letter) Enter "NR" if item is irrelevant and is not required for this project. A - DFAE TO BE DETERMINED - Information needed but not currently evailable. 8 - Using Service Enter code for information source. COMMENT ATTACHED - Significant information summarized or explained C - Construction Service D - Designer and attached. DOCUMENT ATTACHED - Significant information is in an existing docu-E - Other (Check Comments Attached and ment which is attached. explain) documentation checklist 6 of 9 DA FORM 5023-D-R, Feb 82

A. SPECIAL CONSIDERATIONS Required or Not Required To Be * Determined Document Attached Comment Attached **ITEM** Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable A-1 NR A-2 Construction phasing requirements Functional support equipment (mechanical, electrical, structural, and security) to be built in R A A-3 R D A-4 Equipment in place and justification NR A-5 Other equipment and furniture (O&MA, OPA) and costs NR Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.) A-6 NR A-7 Type of construction (permanent, temporary, semi-permanent) NR Government furnished equipment (quantities, procurement time, availability A-8 and special handling and storage requirements). Funds used for procurement. NR 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. *BY WHOM (Check and insert appropriate letter) Enter "NR" if item is irrelevant and is not required for this project. A - DFAE TO BE DETERMINED - Information needed but not currently available. B - Using Service Enter code for information source. COMMENT ATTACHED - Significant information summarized or explained C - Construction Service D - Designer DOCUMENT ATTACHED - Significant information is in an existing docu-- Other (Check Comments Attached and E ment which is attached. explain) technical data checklist 7 of 9 DA FORM 5024-A-R, Feb 82

	ARCHITECTURAL & STRUCTURAL	Required or Not Required	To Be * Determined	nent Jed	nent
	ITEM	Requ Not F	To Be Deter	Comment Attached	Document
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)				
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radia- tion, chemical/biological)	<u>NR</u>			
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 valids inspire course)	_NR_			
	Other Architectural & Structural (List and number items)	_NR_			
	• •				
Enti Enti Enti COMMI and DOCUM	RED OR NOT REQUIRED – Not relevant or no information to com- nicate. Enter "R" if item is relevant and is required for this project. *BY WHOM (Check is a required for this project. DETERMINED – Information needed but not currently available. er code for information source. A - DFAE ENT ATTACHED – Significant information is in an existing docu- ty which is attached. Description	Service			

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS Required or Not Required To Be * Determined Document Attached Comment Attached ITEM 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 В 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 В D-6 Ventilating, air condition/refrigeration-availability, general system type and characteristics (pro-Dosed and/or existing) R В 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 Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.) D-9 R В D-10 Solar energy evaluation NR Other Mechanical & Utility Systems (List and number items) REQUIRED OR NOT REQUIRED - Not relevant or no information to com-*BY WHOM (Check and insert appropriate letter) municate. 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. A - DFAE TO BE DETERMINED - Information needed but not currently available. B - Using Service Enter code for information source. C - Construction Service COMMENT ATTACHED - Significant information summarized or explained D - Designer and attached. E - Other (Check Comments Attached and DOCUMENT ATTACHED - Significant information is in an existing document which is attached. explain) technical data checklist 9 of 9 DA FORM 5024-D-R, Feb 82