

ENERGY SURVEY FOR THE UNITED STATES DISCIPLINARY BARRACKS (USDB)

AT
FORT LEAVENWORTH, KANSAS

FIELD DATA

FINAL SUBMITTAL

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ENERGY ENGINEERING ANALYSIS PROGRAM

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**KANSAS CITY DISTRICT
CORPS OF ENGINEERS**

EXECUTIVE SUMMARY

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B**



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Marie Wakefield,
Librarian Engineering

INTRODUCTION**A. General Description**

The United States Disciplinary Barracks (USDB) is located within the confines of Fort Leavenworth near Leavenworth, Kansas. Fort Leavenworth encompasses approximately 6000 acres of land in which approximately 2000 acres were developed for military use. The USDB is located to the northeast corner of the base.

B. Purpose of Report

The purpose of this report is to observe any present energy usage by the USDB and consider opportunities to conserve energy. The report details evaluation of various Energy Conservation Opportunities (ECO) to determine their feasibility.

The report also includes programming or implementation documentation for those ECO's considered feasible. Any ECO having a Savings to Investment Ratio (SIR) greater than one is considered feasible. If the ECO had a SIR greater than one and a simple payback less than 10 years it was considered for Energy Conservation Investment Program (ECIP) funding.

C. Observations

During our field trips to the USDB, we noted many observations relating equipment in disrepair. In general, little of the heating, ventilating, and air conditioning equipment appeared to have been maintained. Because of a lack of preventative maintenance throughout the USDB, a considerable amount of energy is being consumed with no appreciable contribution to the operation of the facility. The equipment controls are in need of maintenance the worst. A large portion of the control systems for the equipment were disconnected due to the lack of funding for repair. A preventative maintenance plan is currently under consideration at the USDB, but because of lack funding and proper personnel, the program could be in jeopardy.

DTIC QUALITY INSPECTED 2

Some of the feasible ECO's described in this report will replace equipment that might not have been replaced if the original equipment had had preventative maintenance.

Some of the equipment was not in service because of a pending repair, thus no energy was used. The calculations completed with an estimate of what the equipment might use if it were operating.

D. Computer Programs

A number of different computer programs were used in the development of this report. To calculate the energy usage of each of the buildings, we used a program entitled "Trace Ultra" provided by the Trane Company. This program uses an hour by hour energy calculation routine as presented in Chapter 25 of the American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE) Handbook of Fundamentals. Simplified energy calculations were completed using an electronic spreadsheet. The "Life Cycle Cost in Design" (LCCID) Economic Analysis Computer Program, developed by the Government thru the University of Illinois, was used to calculate the life cycle cost estimates.

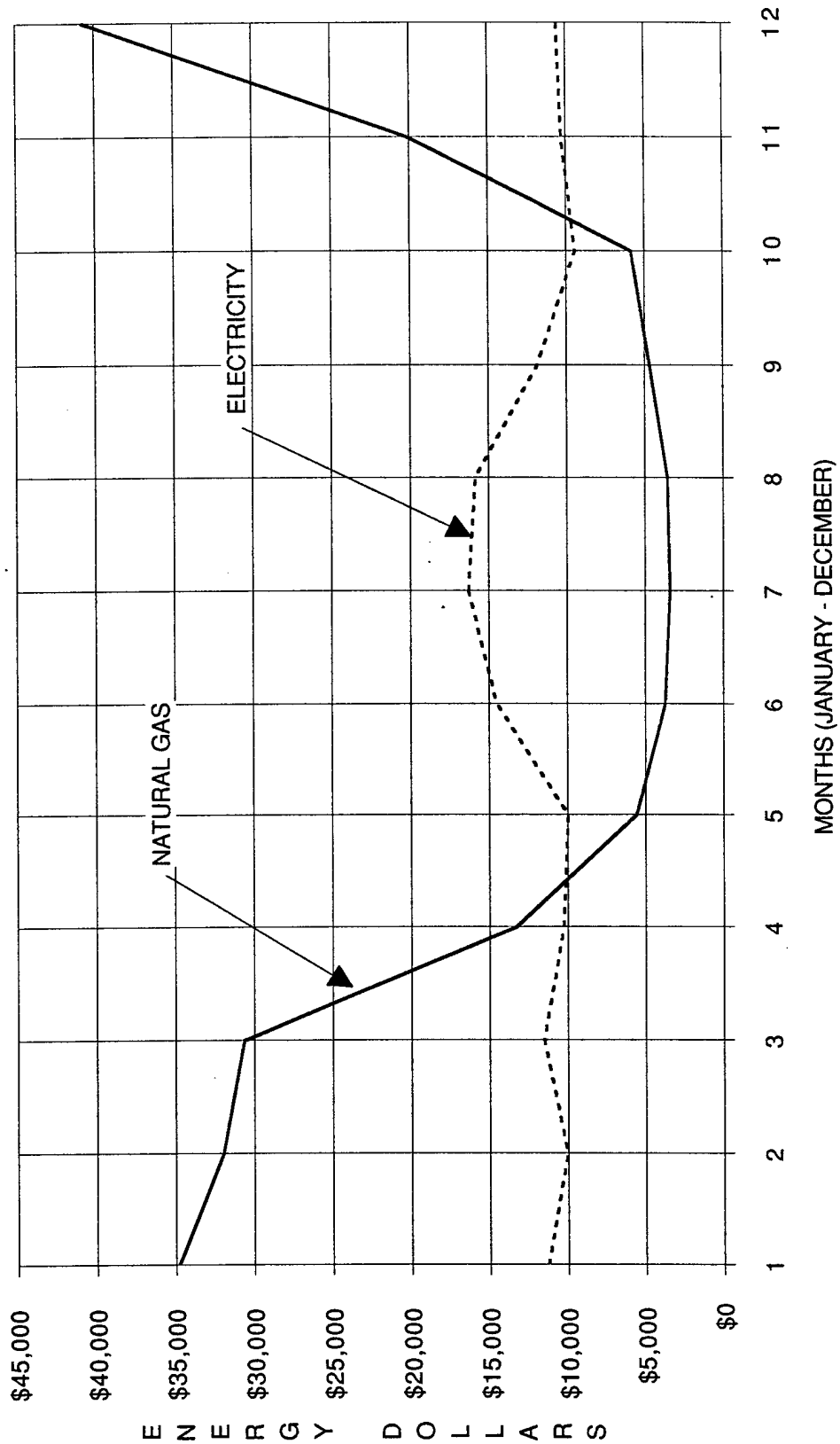
PRESENT ENERGY CONSUMPTION

General Description

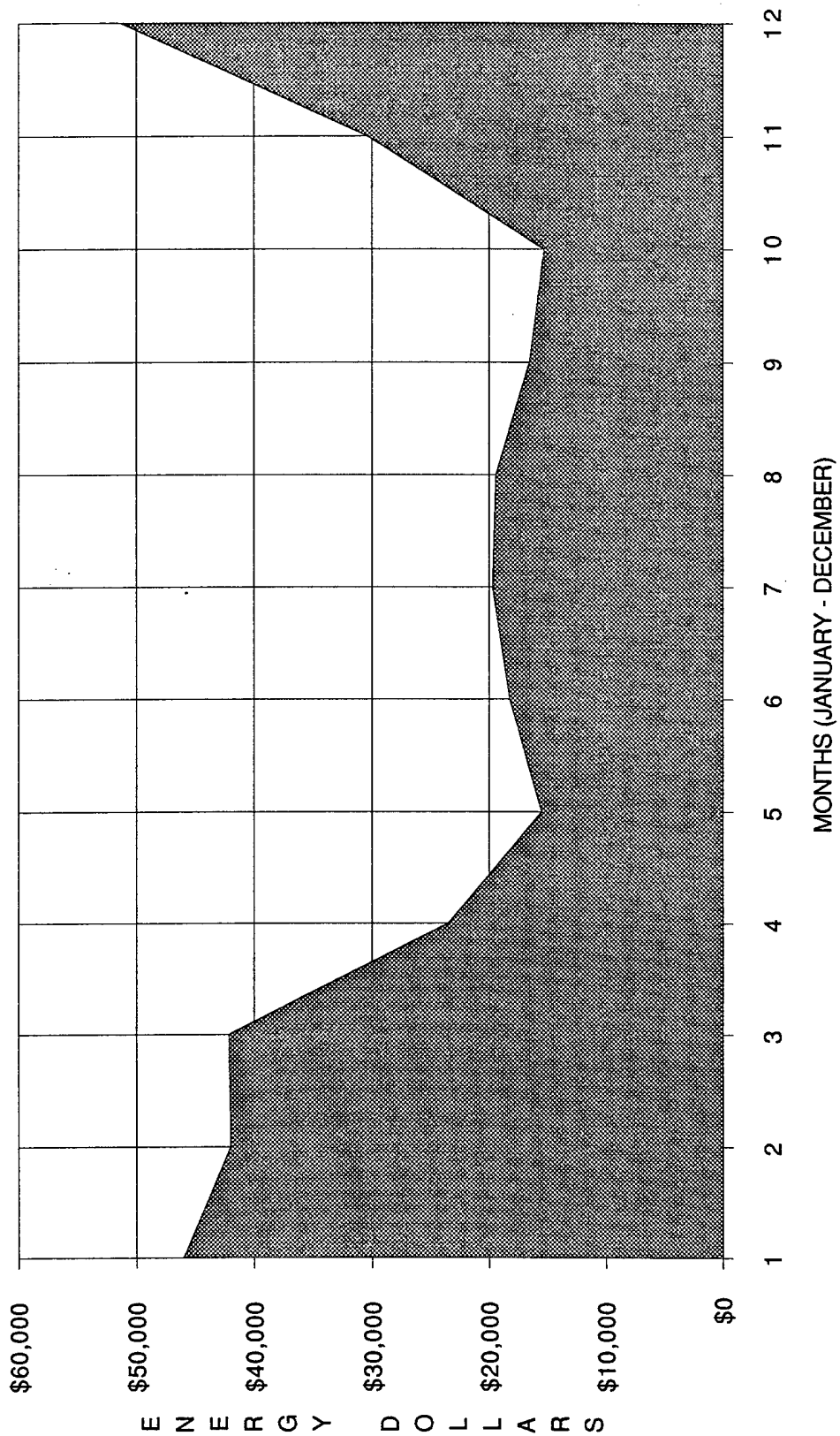
At the present time the energy usage associated with the United States Disciplinary Barracks (USDB) is in the form of three utilities. The first is electricity. The USDB uses electricity for all lighting, fan motors, and pump motors. The electricity used by the USDB is purchased from the electric utility for the area, Kansas Power and Light (KPL). The second utility used by the USDB is natural gas. Natural gas is used to fire the boilers in the boiler plant in the north section of the USDB. The boilers produce steam to be used in converters to make domestic hot water and in air handling unit coils for heating the spaces. The natural gas used to fire the boilers is purchased from the local gas utility Kansas Power and Light (KPL). Water is the third utility used in the USDB. The water is consumed in several different ways but in larger quantities by the inmate restrooms and showers. Water is purchased from a water plant owned and operated by Fort Leavenworth located on the grounds of the fort.

The following pages display the energy consumed per building studied and an overall energy consumption. Several buildings located in the USDB were not included in the scope of work to be studied. Therefore the overall energy usage would not be a total for the entire USDB. The energy usage included on the following pages is for the electrical and natural gas utilities. These energy usage amounts were calculated for each of the buildings. The USDB does not have metering available to check the amount of energy actually used.

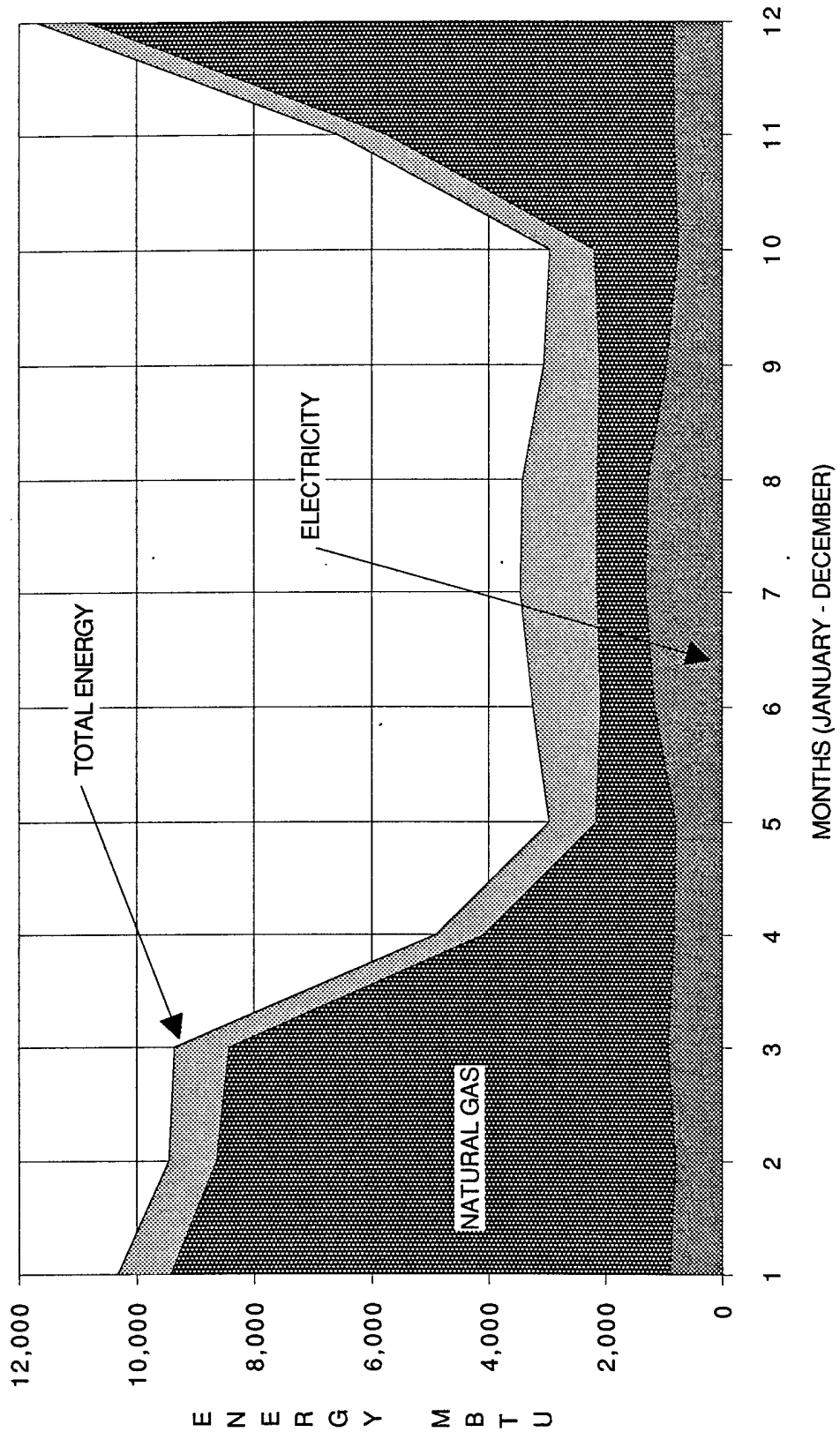
NATURAL GAS COST VS. ELECTRICITY COST



MONTHLY ENERGY COST FOR USDB FACILITY



MONTHLY ENERGY USAGE FOR USDB FACILITY



SUMMARY OF ECO'S

ARCHITECTURAL

ECO A1. Reduce Infiltration

Presently, most of the windows and doors for the buildings located in the USDB have large cracks that allow outside air to infiltrate the buildings. Reduction of the air quantities entering the buildings is not difficult and can be accomplished by weatherstripping and caulking. This work can be performed by the maintenance staff at a low cost.

Because computer modeling of this ECO showed poor economic return, we do not recommend it.

ECO A2. Window Replacement

This ECO studied the installation of double glazed windows anywhere single glazed windows exist. The replacement windows are hermetically sealed with an air gap between the two plates of glass. Infiltration into the building is usually decreased because the new windows seal the opening better.

The double glazed windows have much better insulating quality than single glazed windows. However, they are expensive to install and will not provide an adequate payback unless new windows are already required. Therefore, we are not recommending this ECO.

ECO A3. Attic Insulation

The addition of insulation to the building attics will reduce the overall heat transfer coefficient of their roofs, translating into a decreased amount of heat transferred to or from the interior spaces of the building.

Installation of 10" fiberglass batt insulation in the attics of the existing buildings is not difficult and can be accomplished by the maintenance staff.

This ECO is recommended for buildings 464, 472, and 475.

ECO A4. Dock Door Replacement

This opportunity for heating energy conservation relates to a dock door located in building 470. The existing overhead dock door is in poor condition. The energy savings associated with a new door is derived from a reduction in heat transferred from interior spaces and from

decreased infiltration. The USDB carpentry shop would be required to replace the door to make the project feasible.

ECO A5. Vestibules

Vestibules reduce energy consumption by limiting the amount of outside air infiltration into buildings through frequently used doors. The implementation of this project will change the appearance of the exterior of building #463. At the present time, no vestibules exist at the entrance or exit of this building.

Especially during the heating season, the heating equipment runs non-stop to satisfy the space conditions. Most of the time, however, the temperature conditions are not met. If the heating and cooling equipment were adequately sized, a return on the investment due to energy savings would be more likely. However, we do not recommend this ECO based on existing conditions.

ECO A6. Solar Window Shading

This energy conservation opportunity was studied for all the buildings having cooling. The reduction in solar gain through an unshaded window is beneficial during the cooling season but not during the heating season.

An increase in heating energy may be required to offset the reduced solar heat gain in the winter. Some of the buildings that are entirely air conditioned and that contain large amounts of glass will save energy dollars by the addition of solar film, while other buildings experience increased energy consumption.

The only building showing a payback on this ECO is building 450.

ECO A7. Exterior Wall Insulation

The addition of insulation to exterior building walls was studied and found to be difficult to implement in a facility of this nature. The materials necessary must have reasonable resistance to damage due to the nature of the occupants of the buildings. Because of the expense this type of construction, implementation of this ECO is not feasible.

A9. Architectural Repairs

This section is not an ECO, but a study of architectural repairs recommended for USDB buildings. Many of the items considered do not have a direct relationship to an energy savings but are listed as recommended service items for the USDB. The repairs are small in nature, and some may reduce energy consumption in the buildings, but this is difficult to calculate.

MECHANICAL

ECO M1. Schedule Air Handling Equipment

This ECO studied energy savings associated with scheduling of HVAC equipment for shutoff or setback during periods when heating or cooling are required. This can be accomplished by adding some of the equipment to the existing Energy Management System (EMS) network. This project is recommended for building 465.

ECO M2. Dry-Bulb Economizer Controls

This ECO studies the service or addition of economizer controls and dampers to air handling units utilizing outside air at the present time. The economizer functions by using outside air for cooling when the outdoor temperature is low enough to provide cooling for the building (Approximately 60°F). The air handling units studied now have or had economizer controls and dampers, but do not function properly at this time. This ECO is not recommended at this time.

ECO M3. Service Steam Piping and Traps

This ECO studied the service or replacement of faulty steam traps. Energy savings are shown by a reduction in steam use if the failed traps are repaired so that they do not pass steam into the condensate piping. Steam traps are devices that consistently fail, and are designed to be easily replaceable and repairable. These devices need to be regularly checked and serviced or replaced, if necessary, for maximum system efficiency.

Failure to maintain the steam traps properly results in wasted energy and prevents air from being vented from the piping system, which corrodes the piping, causing premature pipe failure. This ECO is recommended for the USDB.

ECO M5.

This ECO studied the addition of heat recovery systems for the exhausted air from the cell barracks in the Castle Building. The locations of the heat recovery systems are ideal because the exhaust air is directly adjacent to the intake air to be preheated. This ECO is recommended for buildings 475C, 475D, 475G, and 475F.

ECO M6. Insulate Ductwork

This ECO investigates the addition of exterior insulation to supply air ductwork. The heat transferred through the walls of the ductwork is a function of the heat transfer coefficient of the ductwork material. Adding

insulation to the ductwork improves the heat transfer resistance and therefore limits the amount of energy lost.

Uninsulated ductwork routed through unconditioned areas wastes energy. The only ductwork at the USDB facility that is in this category is located in the exterior walls of the Castle building, where installation of insulation is not feasible.

ECO M10. Central Plant Cooling

This ECO studies the replacement of all the packaged air cooling equipment with a central plant chiller producing chilled water for cooling coils located in the air handlers at the individual buildings. In almost all of the cases where a space is being cooled, a packaged direct expansion type of cooling system is utilized.

The cost per BTUH of cooling by a direct expansion type of machine is greater than the cost per BTUH of chilled water system cooling. Replacing the existing direct expansion cooling equipment with a centrifugal chiller plant with cooling towers for heat rejection can conserve energy. However, the cost of removing the existing cooling equipment and installing new chilled water equipment and installing the chilled water distribution piping in the existing tunnels makes this project not feasible.

ECO M11. Castle Air System Repair

This ECO studied the energy savings associated with properly heating and ventilating the cell barracks of the Castle Building. At the present time, the air within the cell barracks is stratified. Air stratification occurs when warm air rises to the upper level of a building and cooler air settles to the lower level. This causes overheating of the upper level in order to provide adequate heating in the lower level.

Repairing the air system in the Castle Building allows the warmer air at the upper level to be recirculated down to the lower level, thereby reducing energy consumption in the building. This ECO is recommended in buildings 475C, 475D, 475F, and 475G.

ECO M12. Reduce Steam Distribution Pressure

This energy conservation opportunity deals with reducing the steam pressure needed for the USDB facility. The laundry requires 120 psi steam, while steam used for space heating can be supplied at 80 psi pressure. Lower pressure steam costs less to generate.

We recommend that the laundry facility be served by a single 120 psi boiler when the existing boilers are replaced (within the next two years).

The space heating requirements of the facility can then be served by two boilers operating at 80 psi.

ECO M14. Service Condensate Return System

This ECO analyzes the energy savings associated with the repair and insulation of the condensate return system serving the Castle Building. The existing piping has holes drilled in the top of the piping in various locations. Repairing these holes will result in less energy loss from the condensate. This repairing and insulating of the condensate piping will result in higher temperature condensate returning to the boiler plant, thus requiring less boiler energy to produce steam. This ECO is recommended.

ECO M15. Boiler Plant Modifications

This ECO studies the boiler plant and any modifications that could save energy. The energy lost during a blowdown of a boiler can be recovered and used to preheat the boiler feedwater. Installing a boiler stack economizer is another possible method of heat recovery off of the boilers. Preheating the combustion air to the boilers will save boiler energy. Oxygen trim control will help improve the operating efficiency of the boilers.

Seven items of energy conservation for the Boiler Plant were investigated and five items were eliminated. The two remaining items, boiler stack economizer and boiler oxygen trim control, offer energy savings.

We recommend that oxygen trim controls be purchased when the existing boilers are replaced within the next two years. Incorporation of any improvements to the existing boilers would be injudicious, because the payback could not be realized before the existing boilers are replaced.

ECO M24. Convert from Steam to Hot Water

This ECO studied the conversion of the existing high pressure steam generation and distribution system to a high temperature hot water type system. The cost per BTUH for using steam is greater than the cost per BTUH for using hot water. The required increase in system efficiency to justify the construction cost is not obtainable, making this ECO not feasible.

ECO M25. Convert from Steam to Cogeneration

Due to the large capital investment and the impact of the operating costs, a very detailed analysis must be performed before funding is considered

for cogeneration. The scope of this ECO is to determine if the investment in a complete cogeneration feasibility study is justified.

Cogeneration is possible when a large heating energy and cooling energy requirement occur simultaneously and for a sufficient time period. The feasibility of cogeneration depends on the facility electrical and thermal loads and how they interrelate. This is especially true when the cost of both electricity and natural gas are moderate, as they are at the USDB.

The most efficient system, offering the best return on investment, would be a cogeneration system tied into a central cooling plant utilizing absorption chillers, which could use the waste heat for cooling purposes.

ECO M26. Reduce Hot Water Temperature

This ECO studied the energy savings associated with a reduction of the domestic hot water temperature used for restrooms and showers. An energy savings can be realized by lower heat losses from the system.

This ECO can be implemented at no cost by directing the maintenance staff to change the setpoint for all water heaters within the USDB from 180°F to 140°F. The reduction in water temperature will reduce the capacity of the domestic hot water system. This ECO is recommended, however, its impact will be reduced by implementation of ECO-M30.

ECO M29. Decentralize Hot Water System

This ECO studied the break-up of the domestic hot water system. At the present time several buildings are served from a hot water tank located in one building. By decentralizing the hot water system, the heat loss from a considerable amount of branch piping can be eliminated. Due to the cost of construction required to implement this ECO, the project is not feasible.

ECO M30. Domestic Water Pipe Insulation

This energy conservation opportunity evaluates the installation of pipe insulation for the domestic hot water piping. Energy is saved by reducing the amount of heat loss from the piping to the surrounding environment. This ECO offers attractive energy savings in the Castle building and in the pipe tunnels and is recommended for the USDB.

ECO M31. Heat Recovery for Laundry

This ECO studied the addition of heat recovery units for the laundry washwater, clothes dryers, and the steam irons to conserve energy usage. The best opportunity for implementation of this ECO would be when the laundry facility reaches a permanent location. By this means,

the heat recovery systems can be incorporated into the design more readily than for installation in an existing facility. Washwater and dryer heat recovery are recommended.

ECO M39. Water Heating Heat Pumps

This ECO studied the replacement of the existing heating and cooling equipment with a heat pump system to condition the interior spaces. In general, heat pumps have a greater efficiency than the existing types of heating and cooling equipment employed in the USDB buildings.

None of the buildings studied for heat pump installations were feasible due to the high construction costs. The heat pump system also has a higher maintenance cost than the existing heating and cooling equipment.

ELECTRICAL

ECO E1. Lighting Levels

This ECO investigates the reduction in lighting levels in areas where the existing lighting was considered to be more than necessary. Installation of motion sensors can provide a good payback in conference rooms and chapels where the lighting loads are high and the space is unoccupied 30% of the time.

ECO E2. Energy Efficient Lighting Systems

This ECO studies the replacement of existing lighting systems with more efficient lighting systems of the same light level. The replacement of lights would reduce the electrical consumption of the lighting system.

We recommend replacing the existing fluorescent lamps and ballasts with high efficiency lamps and ballasts during routine lighting maintenance by the USDB staff.

We also recommend replacement of the existing incandescent light fixtures in building #475A stairwells with high efficiency fluorescent fixtures.

ECO E3. Energy Efficient Motors

This ECO studied the replacement of existing motors that operate fans and pumps with high efficiency motors that have a higher KWh per horsepower rating. The increase in motor efficiency will decrease the amount of electrical energy used by the motors.

We recommend that the motors listed in Volume One of this report with calculated SIR values greater than 1.0 be replaced with high efficiency motors. We also recommend that all new motors installed at the USDB be high efficiency motors.

ENERGY CONSERVATION ANALYSIS

ALL ECO'S INVESTIGATED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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REDUCE INFILTRATION

A1	BUILDING #463 SOUTH GATE / VISITORS	12	\$49	\$10,617	\$11,254	217.43	0.07
A1	BUILDING #464 OUTSIDE BARBER SHOP	9	\$42	\$5,549	\$5,882	123.73	0.12
A1	BUILDING #465 INSIDE BARBER SHOP	256	\$1,061	\$61,405	\$65,089	58.08	0.28
A1	BUILDING #466 CARPENTRY SHOP	1	\$8	\$18,112	\$19,199	4544.00	0.00
A1	BUILDING #472 PRINT SHOP / COLLEGE	62	\$265	\$25,015	\$26,516	96.18	0.17
A1	BUILDING #473 CLASSIFICATION	12	\$54	\$12,250	\$12,985	215.67	0.07
A1	BUILDING #475 ROTUNDA	15	\$59	\$7,865	\$8,337	129.39	0.12
A1	BUILDING #475A INVESTIGATION	93	\$399	\$9,504	\$10,074	23.61	0.66
A1	BUILDING #475B DINING / LIBRARY	16	\$65	\$9,793	\$10,381	151.20	0.11
A1	BUILDING #475C HSG. UNIT / RECEPTION	42	\$171	\$31,812	\$33,721	186.69	0.09
A1	BUILDING #475D HSG. UNIT / 4-BASE	48	\$195	\$37,748	\$40,013	193.27	0.08
A1	BUILDING #475E DINING / LAUNDRY / GYM	53	\$146	\$42,102	\$44,628	283.56	0.07
A1	BUILDING #475F HSG. UNIT	89	\$365	\$37,990	\$40,269	105.02	0.15
A1	BUILDING #475G HSG. UNIT	41	\$169	\$32,708	\$34,670	196.54	0.08
A1	BUILDING #475H MSA / D&A BOARD / TDS	20	\$85	\$7,563	\$8,017	92.50	0.17

WINDOW REPLACEMENT

A2	BUILDING #450 MENTAL HYGIENE	104	\$455	\$34,048	\$36,091	74.60	0.21
A2	BUILDING #465 INSIDE BARBER SHOP	217	\$892	\$369,241	\$391,395	414.93	0.04
A2	BUILDING #475 ROTUNDA	78	\$317	\$104,902	\$111,196	331.03	0.05
A2	BUILDING #475C HSG. UNIT / RECEPTION	161	\$658	\$208,538	\$221,050	318.52	0.05
A2	BUILDING #475D HSG. UNIT / 4-BASE	237	\$967	\$244,911	\$259,606	254.16	0.06
A2	BUILDING #475F HSG. UNIT	186	\$761	\$244,911	\$259,606	323.81	0.05
A2	BUILDING #475G HSG. UNIT / FEM HSG	164	\$671	\$208,538	\$221,050	312.81	0.05

ATTIC INSULATION

A3	BUILDING #464 OUTSIDE BARBER SHOP	106	\$583	\$3,215	\$3,408	5.54	2.57
A3	BUILDING #472 PRINT SHOP / COLLEGE	34	\$194	\$2,438	\$2,584	11.72	1.19
A3	BUILDING #475 ROTUNDA	142	\$578	\$4,592	\$4,868	7.96	2.03
A3	BUILDING #475E DINING / LAUNDRY / GYM	40	\$169	\$30,487	\$32,316	187.69	0.09

DOCK DOOR REPLACEMENT

A4	BUILDING #470 POPE HALL / VOC SHOP	17	\$69	\$870	\$922	12.65	1.28
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* TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

ENERGY CONSERVATION ANALYSIS

ALL ECO'S INVESTIGATED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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VESTIBULES

A5	BUILDING #463 SOUTH GATE / VISITORS	12	\$49	\$88,238	\$93,532	1807.08	0.01
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SOLAR WINDOW SHADING

A6	BUILDING #450 MENTAL HYGIENE	80	\$498	\$2,001	\$2,121	7.84	1.66
A6	BUILDING #463 SOUTH GATE / VISITORS	-17	(\$53)	\$2,056	\$2,179	-73.68	-0.37
A6	BUILDING #464 OUTSIDE BARBER SHOP	-11	(\$26)	\$1,782	\$1,889	-596.00	-0.20
A6	BUILDING #472 PRINT SHOP / COLLEGE	18	\$74	\$835	\$885	37.41	0.30
A6	BUILDING #473 CLASSIFICATION	-11	\$11	\$2,565	\$2,719	85.80	-0.03
A6	BUILDING #475A INVESTIGATION	32	\$406	\$8,020	\$8,501	20.22	0.55
A6	BUILDING #475B DINING / LIBRARY	6	\$74	\$2,774	\$2,940	37.12	0.30
A6	BUILDING #475H MSA / D&A BOARD / TDS	5	\$60	\$2,610	\$2,767	42.26	0.26

EXTERIOR WALL INSULATION

A7	BUILDING #472 PRINT SHOP / COLLEGE	229	\$1,507	\$57,916	\$61,391	54.83	0.28
A7	BUILDING #475C HSG. UNIT / RECEPTION	154	\$628	\$158,675	\$168,196	253.55	0.06

ARCHITECTURAL REPAIRS

A9	BUILDING #463 SOUTH GATE / VISITORS			\$424	\$449		
A9	BUILDING #465 INSIDE BARBER SHOP			\$1,671	\$1,771		
A9	BUILDING #466 CARPENTRY SHOP			\$582	\$617		
A9	BUILDING #472 PRINT SHOP / COLLEGE			\$1,219	\$1,292		
A9	BUILDING #473 CLASSIFICATION			\$2,132	\$2,260		
A9	BUILDING #475 ROTUNDA			\$13,727	\$14,551		
A9	BUILDING #475A INVESTIGATION			\$1,221	\$1,294		
A9	BUILDING #475E DINING / LAUNDRY / GYM			\$50,302	\$53,320		

SCHEDULE AIR HANDLING EQUIPMENT

M1	BUILDING #463 SOUTH GATE / VISITORS	10	\$51	\$464	\$492	9.32	0.93
M1	BUILDING #464 OUTSIDE BARBER SHOP	45	\$396	\$8,731	\$9,255	21.85	0.42
M1	BUILDING #465 INSIDE BARBER SHOP	280	\$891	\$9,408	\$9,972	10.57	1.03

DRY-BULB ECONOMIZER CONTROLS

M2	BUILDING #463 SOUTH GATE / VISITORS	0	\$3	\$1,459	\$1,547	488.00	0.02
M2	BUILDING #464 OUTSIDE BARBER SHOP	13	\$156	\$1,333	\$1,413	8.85	0.97
M2	BUILDING #473 CLASSIFICATION	1	\$7	\$1,333	\$1,413	191.00	0.05

ENERGY CONSERVATION ANALYSIS

ALL ECO'S INVESTIGATED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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SERVICE STEAM PIPING AND TRAPS

M3	OWNER TESTING	1,510	\$6,161	\$15,738	\$16,682	2.56	4.55
M3	OUTSIDE TESTING	1,510	\$6,161	\$16,150	\$17,119	2.63	4.44

EXHAUST HEAT RECOVERY

M5	Q-DOT SYSTEM	453	\$2,130	\$12,178	\$12,909	6.66	1.76
M5	Z-DUCT SYSTEM	294	\$1,568	\$12,795	\$13,563	10.81	1.08
M5	COIL LOOP	301	\$953	\$15,352	\$16,273	12.81	0.92

INSULATE DUCTWORK

M6	THIS ECO IS NOT NOT COST EFFECTIVE						
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CENTRAL PLANT COOLING

M10	ALL BUILDINGS IN THE USDB FACILITY	220	\$2,737	\$444,542	\$471,215	162.99	0.05
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CASTLE AIR SYSTEM REPAIR

M11	BUILDING #475C HSG. UNIT / RECEPTION	273	\$1,458	\$1,678	\$1,779	1.51	7.72
M11	BUILDING #475D HSG. UNIT / 4-BASE	277	\$1,474	\$1,678	\$1,779	1.49	7.83
M11	BUILDING #475F HSG. UNIT	307	\$1,641	\$1,678	\$1,779	1.34	8.68
M11	BUILDING #475G HSG. UNIT	247	\$1,323	\$1,678	\$1,779	1.67	6.99

REDUCE STEAM DISTRIBUTION PRESSURE

M12	ALL BUILDINGS IN THE USDB FACILITY	605	\$2,470	\$9,369	\$9,931	3.81	3.06
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CONDENSATE RETURN SYSTEM SERVICE

M14	ALL BUILDINGS IN THE USDB FACILITY	1,687	\$6,883	\$35,958	\$38,115	5.24	2.23
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BOILER PLANT MODIFICATIONS

M15	ECONOMIZER HEAT RECOVERY	280	\$1,142	\$22,852	\$24,223	20.08	0.58
M15	OXYGEN TRIM CONTROLS	3,397	\$13,860	\$36,865	\$39,077	2.67	4.37

CONVERT FROM STEAM TO HOT WATER

M24	ALL BUILDINGS IN THE USDB FACILITY	14,464	\$52,024	\$634,367	\$672,429	12.24	1.00
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CONVERT FROM STEAM TO COGENERATION

M25	ALL BUILDINGS IN THE USDB FACILITY		\$58,138	\$1,200,000	\$1,272,000	21.00	
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ENERGY CONSERVATION ANALYSIS

ALL ECO'S INVESTIGATED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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REDUCE HOT WATER TEMPERATURE

M26	BUILDING #475 ROTUNDA	23	\$92	\$0	\$0	IMMEDIATELY	
M26	CASTLE BUILDINGS 475C, 475D, 475F, 475G	51	\$210	\$0	\$0	IMMEDIATELY	
M26	BUILDING #475E DINING / LAUNDRY / GYM	33	\$134	\$0	\$0	IMMEDIATELY	
M26	TUNNELS	73	\$299	\$0	\$0	IMMEDIATELY	

DECENTRALIZE HOT WATER SYSTEM

M29	BLDGS. 450, 463, 464, 466, 467, 468, 472, & 473	243	\$1,296	\$19,599	\$20,775	19.85	0.59
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DOMESTIC WATER PIPE INSULATION

M30	CASTLE BUILDING	147	\$787	\$1,365	\$1,447	2.28	5.11
M30	PIPE TUNNELS	55	\$293	\$454	\$481	2.03	5.75

HEAT RECOVERY FOR LAUNDRY

M31	WASH WATER HEAT RECOVERY	3,871	\$15,742	\$43,829	\$46,459	2.79	4.18
M31	DRYER EXHAUST HEAT RECOVERY	2,748	\$10,597	\$111,688	\$118,389	10.58	1.13

WATER HEATING HEAT PUMPS

M39	BUILDING #450 MENTALHYGIENE	9	\$117	\$73,293	\$77,691	656.70	0.01
M39	BUILDING #463 SOUTH GATE / VISITORS	1	\$106	\$53,565	\$56,779	521.87	0.02
M39	BUILDING #464 OUTSIDE BARBER SHOP	16	\$163	\$59,685	\$63,266	34.46	0.34
M39	BUILDING #465 INSIDE BARBER SHOP	307	\$1,342	\$39,012	\$41,353	29.11	0.39
M39	BUILDING #472 PRINT SHOP / COLLEGE	166	\$851	\$159,692	\$169,274	189.65	0.06
M39	BUILDING #473 CLASSIFICATION	17	\$212	\$86,261	\$91,437	410.25	0.02
M39	BUILDING #475A INVESTIGATION	20	\$249	\$97,188	\$103,019	391.68	0.02
M39	BUILDING #475B DINING / LIBRARY	12	\$154	\$61,228	\$64,902	412.37	0.02
M39	BUILDING #475H MSA / D&A BOARD / TDS	9	\$115	\$46,915	\$49,730	420.35	0.02

LIGHTING LEVELS

E1	BUILDING #450 CONFERENCE ROOM	3	\$34	\$201	\$213	5.90	1.90
E1	BUILDING #475A CONFERENCE ROOM	1	\$17	\$201	\$213	11.80	0.90
E1	BUILDING #475A CHAPEL	3	\$43	\$201	\$213	4.70	2.40
E1	BUILDING #475E CONFERENCE ROOM	1	\$13	\$201	\$213	15.70	0.70
E1	BUILDING #475B CHAPEL	3	\$40	\$201	\$213	5.00	2.20
E1	BUILDING #475H CHAPEL	2	\$21	\$201	\$213	9.50	1.20

ENERGY CONSERVATION ANALYSIS

ALL ECO'S INVESTIGATED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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ENERGY EFFICIENT LIGHTING SYSTEMS

E2	BUILDING #475A INVESTIGATION	8	\$100	\$124	\$131	1.24	9.00
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ENERGY EFFICIENT MOTORS

E3	ALL BUILDINGS IN THE USDB FACILITY	248	\$3,085	\$20,929	\$22,185	6.80	1.60
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ENERGY CONSERVATION ANALYSIS

ALL ECO'S RECOMMENDED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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ATTIC INSULATION

A3	BUILDING #464 OUTSIDE BARBER SHOP	106	\$583	\$3,215	\$3,408	5.54	2.57
A3	BUILDING #472 PRINT SHOP / COLLEGE	34	\$194	\$2,438	\$2,584	11.72**	1.19
A3	BUILDING #475 ROTUNDA	142	\$578	\$4,592	\$4,868	7.96	2.03

DOCK DOOR REPLACEMENT

A4	BUILDING #470 POPE HALL / VOC SHOP	17	\$69	\$870	\$922	12.65**	1.28
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SOLAR WINDOW SHADING

A6	BUILDING #450 MENTAL HYGIENE	80	\$498	\$2,001	\$2,121	5.00	2.96
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SCHEDULE AIR HANDLING EQUIPMENT

M1	BUILDING #465 INSIDE BARBER SHOP	280	\$891	\$9,408	\$9,972	10.57**	1.03
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SERVICE STEAM PIPING AND TRAPS

M3	OWNER TESTING	1,510	\$6,161	\$15,738	\$16,682	2.56	4.55
M3	OUTSIDE TESTING	1,510	\$6,161	\$16,150	\$17,119	2.63	4.44

EXHAUST HEAT RECOVERY

M5	Q-DOT SYSTEM	453	\$2,130	\$12,178	\$12,909	6.66	1.76
M5	Z-DUCT SYSTEM	294	\$1,568	\$12,795	\$13,563	10.81**	1.08

CASTLE AIR SYSTEM REPAIR

M11	BUILDING #475C HSG. UNIT / RECEPTION	273	\$1,458	\$1,678	\$1,779	1.51	7.72
M11	BUILDING #475D HSG. UNIT / 4-BASE	277	\$1,474	\$1,678	\$1,779	1.49	7.83
M11	BUILDING #475F HSG. UNIT	307	\$1,641	\$1,678	\$1,779	1.34	8.68
M11	BUILDING #475G HSG. UNIT	247	\$1,323	\$1,678	\$1,779	1.67	6.99

REDUCE STEAM DISTRIBUTION PRESSURE

M12	ALL BUILDINGS IN THE USDB FACILITY	605	\$2,470	\$9,369	\$9,931	3.81	3.06
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CONDENSATE RETURN SYSTEM SERVICE

M14	ALL BUILDINGS IN THE USDB FACILITY	1,687	\$6,883	\$35,958	\$38,115	5.24	2.23
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BOILER PLANT MODIFICATIONS

M15	OXYGEN TRIM CONTROLS	3,397	\$13,860	\$36,865	\$39,077	2.67	4.37
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*TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

** PB > 10 YEARS; PROJECT NOT AVAILABLE FOR FUNDING.

ENERGY CONSERVATION ANALYSIS

ALL ECO'S RECOMMENDED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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REDUCE HOT WATER TEMPERATURE

M26	BUILDING #475 ROTUNDA	23	\$92	\$0	\$0	IMMEDIATELY	
M26	CASTLE BUILDINGS 475C, 475D, 475F, 475G	51	\$210	\$0	\$0	IMMEDIATELY	
M26	BUILDING #475E DINING / LAUNDRY / GYM	33	\$134	\$0	\$0	IMMEDIATELY	
M26	TUNNELS	73	\$299	\$0	\$0	IMMEDIATELY	

DOMESTIC WATER PIPE INSULATION

M30	CASTLE BUILDING	147	\$787	\$1,365	\$1,447	2.28	5.11
M30	PIPE TUNNELS	55	\$293	\$454	\$481	2.03	5.75

HEAT RECOVERY FOR LAUNDRY

M31	WASH WATER HEAT RECOVERY	3,871	\$15,742	\$43,829	\$46,459	2.79	4.18
M31	DRYER EXHAUST HEAT RECOVERY	2,748	\$10,597	\$111,688	\$118,389	10.58**	1.13

LIGHTING LEVELS

E1	BUILDING #450 CONFERENCE ROOM	3	\$34	\$201	\$213	5.90	1.90
E1	BUILDING #475A CHAPEL	3	\$43	\$201	\$213	4.70	2.40
E1	BUILDING #475B CHAPEL	3	\$40	\$201	\$213	5.00	2.20
E1	BUILDING #475H CHAPEL	2	\$21	\$201	\$213	9.50	1.20

ENERGY EFFICIENT LIGHTING SYSTEMS

E2	BUILDING #475A INVESTIGATION	8	\$100	\$124	\$131	1.24	9.00
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ENERGY EFFICIENT MOTORS

E3	ALL BUILDINGS IN THE USDB FACILITY	248	\$3,085	\$20,929	\$22,185	6.80	1.60
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*TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

** PB > 10 YEARS; PROJECT NOT AVAILABLE FOR FUNDING.

ENERGY CONSERVATION ANALYSIS

ALL ECO'S REJECTED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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REDUCE INFILTRATION

A1	BUILDING #463 SOUTH GATE / VISITORS	12	\$49	\$10,617	\$11,254	217.43	0.07
A1	BUILDING #464 OUTSIDE BARBER SHOP	9	\$42	\$5,549	\$5,882	123.73	0.12
A1	BUILDING #465 INSIDE BARBER SHOP	256	\$1,061	\$61,405	\$65,089	58.08	0.28
A1	BUILDING #466 CARPENTRY SHOP	1	\$8	\$18,112	\$19,199	4544.00	0.00
A1	BUILDING #472 PRINT SHOP / COLLEGE	62	\$265	\$25,015	\$26,516	96.18	0.17
A1	BUILDING #473 CLASSIFICATION	12	\$54	\$12,250	\$12,985	215.67	0.07
A1	BUILDING #475 ROTUNDA	15	\$59	\$7,865	\$8,337	129.39	0.12
A1	BUILDING #475A INVESTIGATION	93	\$399	\$9,504	\$10,074	23.61	0.66
A1	BUILDING #475B DINING / LIBRARY	16	\$65	\$9,793	\$10,381	151.20	0.11
A1	BUILDING #475C HSG. UNIT / RECEPTION	42	\$171	\$31,812	\$33,721	186.69	0.09
A1	BUILDING #475D HSG. UNIT / 4-BASE	48	\$195	\$37,748	\$40,013	193.27	0.08
A1	BUILDING #475E DINING / LAUNDRY / GYM	53	\$146	\$42,102	\$44,628	283.56	0.07
A1	BUILDING #475F HSG. UNIT	89	\$365	\$37,990	\$40,269	105.02	0.15
A1	BUILDING #475G HSG. UNIT	41	\$169	\$32,708	\$34,670	196.54	0.08
A1	BUILDING #475H MSA / D&A BOARD / TDS	20	\$85	\$7,563	\$8,017	92.50	0.17

WINDOW REPLACEMENT

A2	BUILDING #450 MENTAL HYGIENE	104	\$455	\$34,048	\$36,091	74.60	0.21
A2	BUILDING #465 INSIDE BARBER SHOP	217	\$892	\$369,241	\$391,395	414.93	0.04
A2	BUILDING #475 ROTUNDA	78	\$317	\$104,902	\$111,196	331.03	0.05
A2	BUILDING #475C HSG. UNIT / RECEPTION	161	\$658	\$208,538	\$221,050	318.52	0.05
A2	BUILDING #475D HSG. UNIT / 4-BASE	237	\$967	\$244,911	\$259,606	254.16	0.06
A2	BUILDING #475F HSG. UNIT	186	\$761	\$244,911	\$259,606	323.81	0.05
A2	BUILDING #475G HSG. UNIT / FEM HSG	164	\$671	\$208,538	\$221,050	312.81	0.05

ATTIC INSULATION

A3	BUILDING #475E DINING / LAUNDRY / GYM	40	\$169	\$30,487	\$32,316	187.69	0.09
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ENERGY CONSERVATION ANALYSIS

ALL ECO'S REJECTED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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VESTIBULES

A5	BUILDING #463 SOUTH GATE / VISITORS	12	\$49	\$88,238	\$93,532	1807.08	0.01
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SOLAR WINDOW SHADING

A6	BUILDING #463 SOUTH GATE / VISITORS	-17	(\$53)	\$2,056	\$2,179	-73.68	-0.37
A6	BUILDING #464 OUTSIDE BARBER SHOP	-11	(\$26)	\$1,782	\$1,889	-596.00	-0.20
A6	BUILDING #472 PRINT SHOP / COLLEGE	18	\$74	\$835	\$885	37.41	0.30
A6	BUILDING #473 CLASSIFICATION	-11	\$11	\$2,565	\$2,719	85.80	-0.03
A6	BUILDING #475A INVESTIGATION	32	\$406	\$8,020	\$8,501	20.22	0.55
A6	BUILDING #475B DINING / LIBRARY	6	\$74	\$2,774	\$2,940	37.12	0.30
A6	BUILDING #475H MSA / D&A BOARD / TDS	5	\$60	\$2,610	\$2,767	42.26	0.26

EXTERIOR WALL INSULATION

A7	BUILDING #472 PRINT SHOP / COLLEGE	229	\$1,507	\$57,916	\$61,391	54.83	0.28
A7	BUILDING #475C HSG. UNIT / RECEPTION	154	\$628	\$158,675	\$168,196	253.55	0.06

ARCHITECTURAL REPAIRS

A9	BUILDING #463 SOUTH GATE / VISITORS			\$424	\$449		
A9	BUILDING #465 INSIDE BARBER SHOP			\$1,671	\$1,771		
A9	BUILDING #466 CARPENTRY SHOP			\$582	\$617		
A9	BUILDING #472 PRINT SHOP / COLLEGE			\$1,219	\$1,292		
A9	BUILDING #473 CLASSIFICATION			\$2,132	\$2,260		
A9	BUILDING #475 ROTUNDA			\$13,727	\$14,551		
A9	BUILDING #475A INVESTIGATION			\$1,221	\$1,294		
A9	BUILDING #475E DINING / LAUNDRY / GYM			\$50,302	\$53,320		

SCHEDULE AIR HANDLING EQUIPMENT

M1	BUILDING #463 SOUTH GATE / VISITORS	10	\$51	\$464	\$492	9.32	0.93
M1	BUILDING #464 OUTSIDE BARBER SHOP	45	\$396	\$8,731	\$9,255	21.85	0.42

DRY-BULB ECONOMIZER CONTROLS

M2	BUILDING #463 SOUTH GATE / VISITORS	0	\$3	\$1,459	\$1,547	488.00	0.02
M2	BUILDING #464 OUTSIDE BARBER SHOP	13	\$156	\$1,333	\$1,413	8.85	0.97
M2	BUILDING #473 CLASSIFICATION	1	\$7	\$1,333	\$1,413	191.00	0.05

EXHAUST HEAT RECOVERY

M5	COIL LOOP	301	\$953	\$15,352	\$16,273	12.81	0.92
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* TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

ENERGY CONSERVATION ANALYSIS

ALL ECO'S REJECTED

ECO	BUILDING NAME	ENERGY SAVINGS MBTU'S/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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INSULATE DUCTWORK

M6	THIS ECO IS NOT NOT COST EFFECTIVE						
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CENTRAL PLANT COOLING

M10	ALL BUILDINGS IN THE USDB FACILITY	220	\$2,737	\$444,542	\$471,215	162.99	0.05
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BOILER PLANT MODIFICATIONS

M15	ECONOMIZER HEAT RECOVERY	280	\$1,142	\$22,852	\$24,223	20.08	0.58
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CONVERT FROM STEAM TO HOT WATER

M24	ALL BUILDINGS IN THE USDB FACILITY	14,464	\$52,024	\$634,367	\$672,429	12.24	1.00
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CONVERT FROM STEAM TO COGENERATION

M25	ALL BUILDINGS IN THE USDB FACILITY		\$58,138	\$1,200,000	\$1,272,000	21.00	
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DECENTRALIZE HOT WATER SYSTEM

M29	BLDGS. 450, 463, 464, 466, 467, 468, 472, & 473	243	\$1,296	\$19,599	\$20,775	19.85	0.59
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WATER HEATING HEAT PUMPS

M39	BUILDING #450 MENTALHYGIENE	9	\$117	\$73,293	\$77,691	656.70	0.01
M39	BUILDING #463 SOUTH GATE / VISITORS	1	\$106	\$53,565	\$56,779	521.87	0.02
M39	BUILDING #464 OUTSIDE BARBER SHOP	16	\$163	\$59,685	\$63,266	34.46	0.34
M39	BUILDING #465 INSIDE BARBER SHOP	307	\$1,342	\$39,012	\$41,353	29.11	0.39
M39	BUILDING #472 PRINT SHOP / COLLEGE	166	\$851	\$159,692	\$169,274	189.65	0.06
M39	BUILDING #473 CLASSIFICATION	17	\$212	\$86,261	\$91,437	410.25	0.02
M39	BUILDING #475A INVESTIGATION	20	\$249	\$97,188	\$103,019	391.68	0.02
M39	BUILDING #475B DINING / LIBRARY	12	\$154	\$61,228	\$64,902	412.37	0.02
M39	BUILDING #475H MSA / D&A BOARD / TDS	9	\$115	\$46,915	\$49,730	420.35	0.02

LIGHTING LEVELS

E1	BUILDING #475A CONFERENCE ROOM	1	\$17	\$201	\$213	11.80	0.90
E1	BUILDING #475E CONFERENCE ROOM	1	\$13	\$201	\$213	15.70	0.70

* TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 1 In House Low Cost No Cost						
470 Building 470	ECO-A4	17	\$69	\$922	12.65	1.28
464 Building 464	ECO-A3	106	\$583	\$3,408	5.54	2.57
475 Building 475	ECO-M26	23	\$92	\$0		
Buildings 475C, 475D, 475F, and 475G	ECO-M26	51	\$210	\$0		
Tunnels	ECO-M26	73	\$299	\$0		
GROUP 1 TOTALS		270	\$1,253	\$4,330	6.09	1.75
GROUP 1 FUNDING CATEGORY: LOW COST/NO COST						
GROUP 2 Laundry Heat Recovery						
474 Wash Water Heat Recovery	ECO-M31	3,871	\$15,742	\$46,459	2.79	4.18
GROUP 2 TOTALS		3,871	\$15,742	\$46,459	2.79	4.18
GROUP 2 FUNDING CATEGORY: PECIP						
GROUP 3 Insulate Water Piping						
475 Castle Building	M30	147	787	\$1,447	2.28	5.11
Pipe Tunnels	M30	55	293	\$481	2.03	5.75
GROUP 3 TOTALS		202	\$1,080	\$1,928	2.21	5.27
GROUP 3 FUNDING CATEGORY: LOW COST/NO COST						
GROUP 4 Power Plant						
474 Outside Testing - Steam Traps	M3	1,510	\$6,161	\$17,119	2.63	4.44
474 Reduce Steam Pressure	M12	605	\$2,470	\$9,931	3.81	3.06
474 Condensate Return System	M14	1,687	\$6,883	\$38,115	5.24	2.23
474 Oxygen Trim Controls	M15	3,397	\$13,860	\$39,077	2.67	4.37
GROUP 4 TOTALS		7,199	\$29,374	\$104,242	3.36	3.47
GROUP 4 FUNDING CATEGORY: OSD PIF						

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
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	GROUP 5 Building 475 Repairs						
475	Attic Insulation - Rotunda	ECO-A3	142	\$578	\$4,868	7.96	2.03
475	Exhaust Heat Recovery	ECO-M5	453	\$2,130	\$12,909	6.66	1.76
475C	Air System Repair	ECO-M11	273	\$1,458	\$1,779	1.51	7.72
475D	Air System Repair	ECO-M11	277	\$1,474	\$1,779	1.49	7.83
475F	Air System Repair	ECO-M11	307	\$1,641	\$1,779	1.34	8.68
475G	Air System Repair	ECO-M11	247	\$1,323	\$1,779	1.67	6.99
475A	Lighting Levels - Chapel	ECO-E1	3	\$43	\$213	4.70	2.40
475B	Lighting Levels	ECO-E1	3	\$40	\$213	5.00	2.20
475H	Lighting Levels	ECO-E1	2	\$21	\$213	9.50	1.20
475A	Energy Efficient Lighting	ECO-E2	8	\$100	\$131	1.24	9.00
GROUP 5 TOTALS			1,715	\$8,808	\$25,663	3.40	3.41
GROUP 5 FUNDING CATEGORY: PECIP							

GROUP 6 Building 450 Repairs							
450	Solar Window Shading	ECO-A6	36	\$256	\$2,121	7.84	1.66
450	Lighting Levels	ECO-E1	3	\$34	\$213	5.90	1.90
GROUP 6 TOTALS			39	\$290	\$2,334	7.58	1.27
GROUP 6 FUNDING CATEGORY: LOW COST/NO COST							

GROUP 7 Energy Efficient Motors							
All Buildings in the USDB		ECO-E3	248	\$3,085	\$22,185	6.81	1.64
GROUP 7 TOTALS			248	\$3,085	\$22,185	6.81	1.64
GROUP 7 FUNDING CATEGORY: NONE							

ENERGY AND COST SAVINGS

TOTAL POTENTIAL ENERGY AND COST SAVINGS

		ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$/YR
GROUP 1	IN HOUSE LOW COST/NO COST	270	\$1,253
GROUP 2	LAUNDRY HEAT RECOVERY	3,871	\$15,742
GROUP 3	INSULATE DOM. WATER PIPE	202	\$1,080
GROUP 4	POWER PLANT	7,199	\$29,374
GROUP 5	BUILDING 475 REPAIRS	1,715	\$8,808
GROUP 6	BUILDING 450 REPAIRS	39	\$290
GROUP 7	ENERGY EFFICIENT MOTORS	248	\$3,085
TOTAL		13,544	\$59,632

PERCENTAGE OF ENERGY CONSERVED

POTENTIAL ENERGY SAVINGS, MBTU	13,544
EXISTING ENERGY CONSUMPTION, MBTU	55,894
PERCENT ENERGY CONSERVED	24.2%

ENERGY USE AND COST

	ENERGY MBTU/YR	ENERGY \$/YR
BEFORE ECO IMPLEMENTATION	55,894	\$323,459
AFTER ECO IMPLEMENTATION	42,350	\$263,827

GROUP 1

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 1 In House Low Cost No Cost							
470	Building 470	ECO-A4	17	\$69	\$922	12.65	1.28
464	Building 464	ECO-A3	106	\$583	\$3,408	5.54	2.57
475	Building 475	ECO-M26	23	\$92	\$0		
	Buildings 475C, 475D, 475F, and 475G	ECO-M26	51	\$210	\$0		
	Tunnels	ECO-M26	73	\$299	\$0		
GROUP 1 TOTALS			270	\$1,253	\$4,330	6.09	1.75
GROUP 1 FUNDING CATEGORY: LOW COST/NO COST							

ECO-A4

DOCK DOOR REPLACEMENT

ENERGY ANALYSIS WORKSHEET

USING

ASHRAE MODIFIED BIN METHOD

BIN TEMP	AVG. DB TEMP	BIN TEMP BELOW 68°F	BIN HOURS PER YEAR	EXIST Q1 U=1.28 A=64	NEW Q2 U=0.17 A=64	EXIST Q3 INFILT. CFM=52.98	NEW Q4 INFILT. CFM=4.55	EXIST (Q1+Q3) * (BIN HRS)	NEW Q2+Q4 * (BIN HRS)
100/104	102		3						
95/99	97		41						
90/94	92		197						
85/89	87		436						
80/84	82		638						
75/79	77		788						
70/74	72		710						
65/69	67	1	717	81.92	10.88	57.48	4.94	99952	11341
60/64	62	6	681	491.52	65.28	344.90	29.62	569602	64627
55/59	57	11	587	901.12	119.68	632.32	54.30	900127	102129
50/54	52	16	584	1310.72	174.08	919.73	78.99	1302584	147792
45/49	47	21	539	1720.32	228.48	1207.15	103.67	1577906	179030
40/44	42	26	580	2129.92	282.88	1494.57	128.36	2102202	238517
35/39	37	31	678	2539.52	337.28	1781.98	153.04	2929979	332436
30/34	32	36	589	2949.12	391.68	2069.40	177.72	2955908	335378
25/29	27	41	347	3358.72	446.08	2356.82	202.41	1983291	225025
20/24	22	46	296	3768.32	500.48	2644.23	227.09	1898115	215361
15/19	17	51	153	4177.92	554.88	2931.65	251.77	1087764	123418
10/14	12	56	77	4587.52	609.28	3219.06	276.46	601107	68202
5/9	7	61	67	4997.12	663.68	3506.48	301.14	569741	64643
0/4	2	66	47	5406.72	718.08	3793.90	325.83	432429	49064

TOTAL EXISTING YEARLY LOAD IN BTU'S

TOTAL NEW YEARLY LOAD IN BTU'S

TOTAL YEARLY LOAD DIFFERENCE IN BTU'S

19,010,707

2,156,962

16,853,745

Table A4.1

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: 470A4
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	870.
B. SIOH	\$	52.
C. DESIGN COST	\$	48.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	873.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	873.

2. ENERGY SAVINGS (+) / COST (-)
 ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	11.16	0.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	17.	\$ 69.	16.15	1114.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		17.	\$ 69.		\$ 1114.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	368.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	69.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1114.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.28	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	12.65	

ECO-A3

ATTIC INSULATION

ECO-A3 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS (\$)
	BASE ENERGY (THERMS)	ECO-A3 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-A3 LOAD (KW)	ENERGY SAVINGS (MBTU)	
463	1,577	1,379	20	83,903	82,814	4	\$127
464	2,195	1,311	88	91,802	86,441	18	\$588
472	15,515	15,241	27	234,490	232,543	7	\$194
475	13,619	12,203	142	58,399	58,386	0	\$578
475E	21,657	21,253	40	611,712	611,617	0	\$169
							\$1,657

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

DISCRETE PORTION NAME: 464A3
ECONOMIC LIFE 25 YEARS

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	3215.
B. SIOH	\$	193.
C. DESIGN COST	\$	177.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	3227.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	3227.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	18.	\$ 224.	11.16	2500.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	88.	\$ 359.	16.15	5798.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		106.	\$ 583.		\$ 8298.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	2738.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	583.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	8298.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	2.57	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	5.54	

ENG. FORM 150
1AVC-59

ECO-M26

**REDUCE HOT WATER
TEMPERATURE**

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 5
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
LOCATION				
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		COMPUTED BY RGB		
ECO MEASURE ECO-M26				
		CHECKED BY MAW		

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
 BTUH Loss per lineal foot of bare pipe

Bare Pipe

Pipe Size	180° Water	160° Water	140° Water	120° Water
3/4"	85	70	55	39
1"	105	85	66	46
1-1/4"	126	104	81	57
1-1/2"	150	121	95	67
2"	171	140	110	80
2-1/2"	205	169	133	94

Table M26-1a

Ambient Temperature 68° F
 BTUH Loss per lineal foot of insulated pipe

1/2" Fiberglass Insulation

Pipe Size	180° Water	160° Water	140° Water	120° Water
3/4"	20	15	11	8
1"	21	17	12	9
1-1/4"	26	20	16	11
1-1/2"	30	24	19	13
2"	36	30	23	15
2-1/2"	45	35	27	20

Table M26-1b

CALCULATION SHEET		DATE Mar-90	SHEET 2	OF 5
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
LOCATION				
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP			
ECO MEASURE	ECO-M26	COMPUTED BY RGB	CHECKED BY MAW	

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
 BTUH Loss per lineal foot of bare pipe

Bare Pipe

Pipe Size	Btuh loss @ 180°	Btuh loss @ 140°	Btuh Savings	Hours per Year	\$ Savings per L.F.
3/4"	85	55	30	4380	\$0.70
1"	105	66	39	4380	\$0.91
1-1/4"	126	81	45	4380	\$1.05
1-1/2"	150	95	55	4380	\$1.29
2"	171	110	61	4380	\$1.43
2-1/2"	205	133	72	4380	\$1.68

Table M26-2a

Ambient Temperature 68° F
 BTUH Loss per lineal foot of insulated pipe

1/2" Fiberglass Insulation

Pipe Size	Btuh loss @ 180°	Btuh loss @ 140°	Btuh Savings	Hours per Year	\$ Savings per L.F.
3/4"	20	15	5	4380	\$0.12
1"	22	17	5	4380	\$0.12
1-1/4"	26	20	6	4380	\$0.14
1-1/2"	30	24	6	4380	\$0.14
2"	36	30	6	4380	\$0.14
2-1/2"	45	35	10	4380	\$0.23

Table M26-2b

CALCULATION SHEET		DATE Mar-90	SHEET OF 3 5
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION	
LOCATION		☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-M26		COMPUTED BY RGB	CHECKED BY MAW

REDUCED DOMESTIC HOT WATER TEMPERATURE

$$T_m = (Q_1 \cdot T_1) + (Q_2 \cdot T_2) / (Q_1 + Q_2)$$

T_m = mixed water temperature

T₁ = temperature of fl (Cold Water Temp.)

Assumption:

T_m = 110

T₁ = 40°

T₂ = X

T _m (°)	T ₁ (°)	Q ₁ (Gal.)	T ₂ (°)	Q ₂ (Gal.)
110.00	40.00	68.18	180.00	31.82
110.00	40.00	66.67	170.00	33.33
110.00	40.00	65.00	160.00	35.00
110.00	40.00	63.16	150.00	36.84
110.00	40.00	61.11	140.00	38.89
110.00	40.00	58.82	130.00	41.18
110.00	40.00	56.25	120.00	43.75

Table M26-3

CALCULATION SHEET		DATE Mar-90	SHEET OF 5- 5
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION X ☐ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-M26		COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
 Length of pipe estimated from field inspection and plans.

Building 475E

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	Feet of Insulated	\$ Savings per FT.		\$ Savings Year
3/4"		\$0.70		\$0.12		\$0
1"		\$0.91		\$0.12		\$0
1-1/4"	100	\$1.05		\$0.14		\$105
1-1/2"	20	\$1.29	20	\$0.14		\$29
2"		\$1.29		\$0.14		\$0

Energy Savings = **\$134.00**

Tunnels between building 468, 466, 467, 463, 464, 472, 473

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	Feet of Insulated	\$ Savings per FT.		\$ Savings Year
3/4"		\$0.70		\$0.23		\$0
1"		\$0.91	180	\$0.23		\$41
1-1/4"	60	\$1.05	90	\$0.28		\$88
1-1/2"	55	\$1.29	355	\$0.28		\$170
2"		\$1.29		\$0.28		\$0

Energy Savings = **\$299.00**

CALCULATION SHEET		DATE Mar-90	SHEET OF 4 5
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION	
LOCATION		☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-M26		COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
 Length of pipe estimated from field inspection and plans.

Building 475

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	Feet of Insulated	\$ Savings per FT.		\$ Savings Year
3/4"		\$0.70		\$0.12		\$0
1"		\$0.91		\$0.12		\$0
1-1/4"	60	\$1.05		\$0.14		\$63
1-1/2"	20	\$1.29	20	\$0.14		\$29
2"		\$1.29		\$0.14		\$0

Energy Savings = \$92.00

Buildings 475C, 475D, 475F, 475G

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	Feet of Insulated	\$ Savings per FT.		\$ Savings Year
3/4"		\$0.70		\$0.23		\$0
1"		\$0.91		\$0.23		\$0
1-1/4"	200	\$1.05	0	\$0.28		\$210
1-1/2"		\$1.29		\$0.28		\$0
2"		\$1.29		\$0.28		\$0

Energy Savings = \$210.00

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 12-5-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: GROUP #1

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	4085.
B. SIOH	\$	245.
C. DESIGN COST	\$	225.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	4100.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	4100.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	18.	\$ 224.	8.69	1947.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	110.	\$ 449.	11.67	5240.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		128.	\$ 673.		\$ 7187.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	2372.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 673.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 7187.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.75
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.09

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

TRANS CODE		DOCUMENT NUMBER		BUILDING/FACILITY		DATE		OTHER FUND CITATION		SHORT JOB DESCRIPTION		BUILDING/FACILITY		BLANK	
REQ ID	SERIAL NUMBER	TYPE	NUMBER	SUFFIX	YR	MO	DA					NUMBER	SUFFIX		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78															
XFA															

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Place the dock door in building 470. Its poor condition and high heat transmission coefficient result in high heat losses by infiltration and conduction. Add 10" of batt insulation to the attic in building 464. This will result in substantial heating season energy savings. Reduce the domestic hot water temperature from 185 °F to 140 °F in buildings 475, 475C, 475D, 475F, and 475G. This cost-free measure reduces the amount of heat radiated from piping to the surroundings.

REMARKS

If the leaky, poorly insulated dock door in building 470 is not replaced, approximately 17 million more BTU's per year will be lost by conduction and infiltration. Approximately 106 million BTU's per year will continue to be lost from building 464 if the attic is not insulated. Heat will continue to be wasted from domestic hot water piping if the temperature is not reduced.

REQUESTER INFORMATION		PERSON TO CALL FOR ADDITIONAL INFORMATION	
NAME	ORGANIZATION	NAME	ORGANIZATION

FORWARD FOR APPROVAL		APPROVED FOR DESIGN		SOURCE OF FUNDS	
RECOMMENDED ACTION	ENVIRONMENTAL IMPACT	APPROVED FOR DESIGN			
☐ APPROVAL ☐ DISAPPROVAL	NO YES ☒ ENVIRONMENTAL CONSIDERATIONS ☒ EIS/EIA INITIATED ☒ EIS/EIA COMPLETED				
APPROVING AUTHORITY	WORK TO BE PERFORMED	SIGNATURE	DATE		
	☐ IN-HOUSE ☐ SELF-HELP ☐ CONTRACT ☐ TROOP				
	FUNDING				
	WC X \$4,330 WC L \$ WC UNFUNDED \$197 TOTAL \$4,527				
	FROM				
	FACILITIES ENGINEER				
	DATE				

APPROVAL ACTION		FORWARDED TO	
ACTION TAKEN	DATE	DESIGN	ESTIMATOR
A - APPROVED D - DISAPPROVED	MO DA 15 16 17 18	MO DA 19 20 21 22 23 24 25 26	MO DA
SIGNATURE OF APPROVAL AUTHORITY			

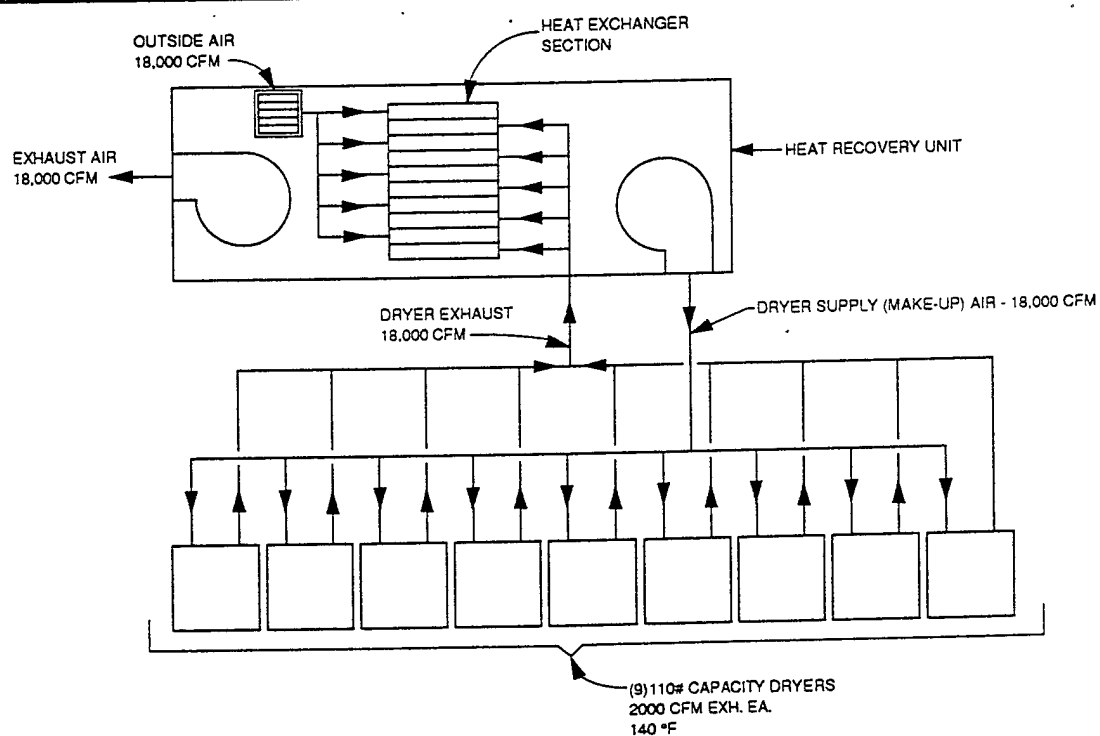
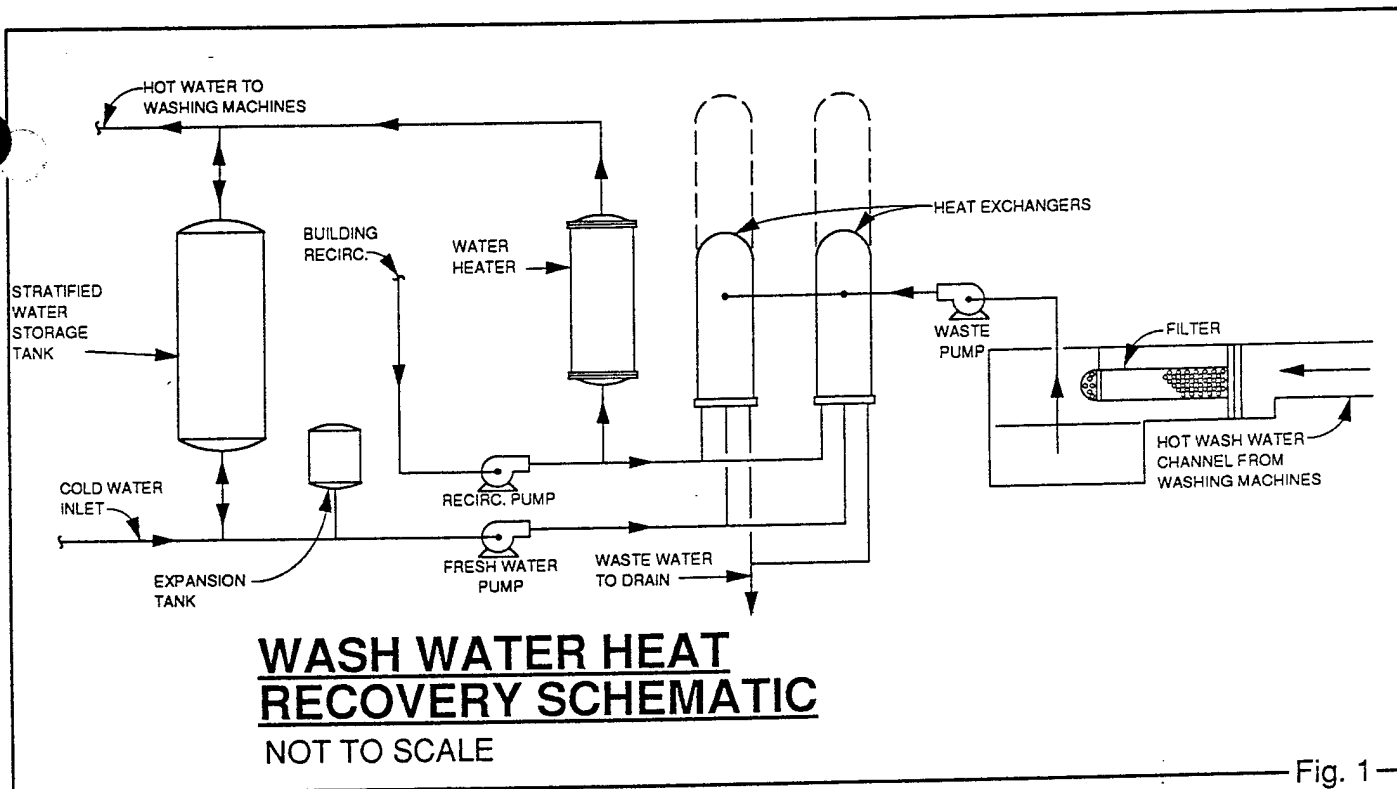
GROUP 2

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 2 Laundry Heat Recovery							
474	Wash Water Heat Recovery	ECO-M31	3,871	\$15,742	\$46,459	2.79	4.18
GROUP 2 TOTALS			3,871	\$15,742	\$46,459	2.79	4.18
GROUP 2 FUNDING CATEGORY: PECIP							

ECO-M31

**HEAT RECOVERY FOR
LAUNDRY**



CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
LOCATION	FORT LEAVENWORTH, KANSAS			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP			
ECO MEASURE	ECO-M31 WASH WATER HEAT RECOVERY	COMPUTED BY BMS	CHECKED BY MAW	

GIVEN:

HOT WATER USE TEMP., °F	160
AVERAGE COLD WATER INLET TEMPERATURE, °F	50
GALLONS WATER/LB. OF LAUNDRY	2.5
PERCENT OF WASTE WATER THAT IS HOT	70
HOURS OF OPERATION PER WEEK	40
ELECTRICITY COST, DOLLARS/MBTU	12.44
GAS COST IN DOLLARS/MBTU	4.08
BOILER SEASONAL EFFICIENCY, %	74

CALCULATED WASTE WATER TEMP., °F	127
WASTE WATER TEMP USED IN ANALYSIS, °F	124

BASED ON HEAT EXCHANGER MANUFACTURER'S
PERFORMANCE DATA FOR 30 GPM UNIT:

SHELL SIDE TEMPERATURE, °F IN/OUT	124 / 91
TUBE SIDE TEMPERATURE, °F IN/OUT	50 / 96

STEAM HEAT RECOVERED, MBTU/YR:	2,870
GAS HEAT RECOVERED, MBTU/YR:	3,878

(2) 30 GPM UNITS ARE REQUIRED.

PUMP ENERGY CALCULATION FOR THIS ECO

FRESH WATER PUMP CAPACITY, GPM:	60
FRESH WATER PUMP HEAD, FT. W:	38
FRESH WATER PUMP EFFICIENCY, %:	65
WASTE WATER PUMP CAPACITY, GPM:	84
WASTE WATER PUMP HEAD, FT. W:	10
WASTE WATER PUMP EFFICIENCY, %:	65
FRESH WATER PUMP POWER CONSUMPTION, WATTS:	662
FRESH WATER PUMP ENERGY USE, MBTU/YEAR:	4.70
WASTE WATER PUMP POWER CONSUMPTION, WATTS:	244
WASTE WATER PUMP ENERGY USE, MBTU/YEAR:	1.73
TOTAL PUMP ENERGY, MBTU/YR.:	6.43

NET ENERGY SAVINGS FOR WASH WATER H.R., MBTU/YR.: 3,872

NET ENERGY SAVINGS, \$/YR: 15,742

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-27-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: ECOM31W
 ECONOMIC LIFE 15 YEARS
 PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	43829.
B. SIOH	\$	2630.
C. DESIGN COST	\$	2411.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	43983.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	43983.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	-6.	\$ -75.	8.69	-652.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	3878.	\$ 15822.	11.67	184643.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		3872.	\$ 15747.		\$ 183991.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	60717.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	15747.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	183991.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	4.18	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.79	

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-27-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: GROUP #2
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	43829.
B. SIOH	\$	2630.
C. DESIGN COST	\$	2411.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	43983.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	43983.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	-6.	\$ -75.	8.69	-652.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	3878.	\$ 15822.	11.67	184643.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		3872.	\$ 15747.		\$ 183991.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	60717.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	15747.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	183991.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	4.18	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.79	

[illegible]

ION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

state a counterflow, helical coil heat exchanger in building 474, the present location of the USDB laundry facility. Hot, dirty wastewater from such heat could be recovered for preheat of fresh washwater is currently being wasted to drain.

If this heat recovery unit is not installed, approximately 3,878 million BTU's per year from washwater will continue to be wasted.

REQUESTER INFORMATION		PERSON TO CALL FOR ADDITIONAL INFORMATION	
ORGANIZATION	TELEPHONE NO.	NAME	ORGANIZATION
		TELEPHONE N	

FORWARD FOR APPROVAL				ESTIMATED COST	WORK TO BE PERFORMED	FROM
RECOMMENDED ACTION	ENVIRONMENTAL IMPACT		FUNDED	UNFUNDED	TOTAL	DATE
	NO	YES				
☐ APPROVAL	☒	ENVIRONMENTAL CONSIDERATIONS	WC X	\$ 46,459	☐ IN-HOUSE	FACILITIES ENGINEER
☐ DISAPPROVAL	☒	EIS/EIA	WC L	\$	☐ SELF-HELP	
		INITIATED	WC —	\$	☐ CONTRACT	
	☒	EIS/EIA COMPLETED		\$ 2,112	☐ TROOP	
				\$ 48,571		

APPROVED FOR DESIGN	SOURCE OF FUNDS
SIGNATURE DATE	☐ DIRECT ☐ AUTOMATIC REIMB. ☐ FUNDED REIMB.

APPROVAL ACTION									
DOCUMENT NUMBER				ACTION TAKEN		DATE		FORWARDED TO	
SERIAL NUMBER		TYPE				MO	DA	DESIGN	ESTIMATOR
16	7	8	9	10	11	12	13	14	
				A - APPROVED		15		16	17
				O - DISAPPROVED		18		19	20
						21		22	23
						24		25	26
						27		28	29
						30		31	32
						33		34	35
						36		37	38
						39		40	41
						42		43	44
						45		46	47
						48		49	50
						51		52	53
						54		55	56
						57		58	59
						60		61	62
						63		64	65
						66		67	68
						69		70	71
						72		73	74
						75		76	77
						78		79	80
						81		82	83
						84		85	86
						87		88	89
						90		91	92
						93		94	95
						96		97	98
						99		100	101
						102		103	104
						105		106	107
						108		109	110
						111		112	113
						114		115	116
						117		118	119
						120		121	122
						123		124	125
						126		127	128
						129		130	131
						132		133	134
						135		136	137
						138		139	140
						141		142	143
						144		145	146
						147		148	149
						150		151	152
						153		154	155
						156		157	158
						159		160	161
						162		163	164
						165		166	167
						168		169	170
						171		172	173
						174		175	176
						177		178	179
						180		181	182
						183		184	185
						186		187	188
						189		190	191
						192		193	194
						195		196	197
						198		199	200
						201		202	203
						204		205	206
						207		208	209
						210		211	212
						213		214	215
						216		217	218
						219		220	221
						222		223	224
						225		226	227
						228		229	230
						231		232	233
						234		235	236

[illegible]

GROUP 3

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
475	GROUP 3 Insulate Water Piping						
	Castle Building	M30	147	787	\$1,447	2.28	5.11
	Pipe Tunnels	M30	55	293	\$481	2.03	5.75
	GROUP 3 TOTALS		202	\$1,080	\$1,928	2.21	5.27
GROUP 3 FUNDING CATEGORY: LOW COST/NO COST							

ECO-M30

**DOMESTIC WATER PIPE
INSULATION**

CALCULATION SHEET		DATE Mar-90	SHEET 0F 1 2
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-M30	COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Table was developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F
 Domestic Hot Water Temperature 180°

Pipe Size	BTUH Loss Bare Pipe	BTUH Loss Insulated	BTUH Savings	Hours per Year	\$ Savings per L.F.
3/4"	85	19	66	4380	\$1.54
1"	105	23	82	4380	\$1.92
1-1/4"	126	26	100	4380	\$2.34
1-1/2"	150	31	119	4380	\$2.78
2"	171	37	134	4380	\$3.13
2-1/2"	250	45	205	4380	\$4.79

CALCULATION SHEET		DATE Mar-90	SHEET OF 2 2
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION	
LOCATION		☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-M30		COMPUTED BY RGB	CHECKED BY MAW

TEST DATA, BTUH LOSS PER LINEAL FOOT
 REF: Guidelines for Saving Energy in Existing Buildings
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b
 Length of pipe estimated from field inspection and plans.

Castle Buildings

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	\$ Savings Year
3/4"	80	\$1.54	\$123
1"		\$1.92	\$0
1-1/4"	260	\$2.34	\$608
1-1/2"	20	\$2.78	\$56
2"		\$3.13	\$0

Energy Savings = **\$787.00**

Pipe Tunnels

Pipe Size	Feet of Bare Pipe	\$ Savings per Ft.	\$ Savings Year
3/4"		\$1.54	\$0
1"		\$1.92	\$0
1-1/4"	60	\$2.34	\$140
1-1/2"	55	\$2.78	\$153
2"		\$3.13	\$0

Energy Savings = **\$293.00**

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7

PROJECT NO. & TITLE: 1496

FISCAL YEAR 1990

ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM30CB
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	1365.
B. SIOH	\$	82.
C. DESIGN COST	\$	75.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1370.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1370.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	147.	\$ 600.	11.67	7002.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		147.	\$ 600.		\$ 7002.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	2311.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=	_____	
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	600.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	7002.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	5.11	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.28	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM30PT
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	454.
B. SIOH	\$	27.
C. DESIGN COST	\$	25.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	455.
E. SALVAGE VALUE COST	\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	455.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	55.	\$ 224.	11.67	2614.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		55.	\$ 224.		\$ 2614.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	863.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	224.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	2614.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	5.75	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.03	

CONSTRUCTION COST ESTIMATE				DATE PREPARED			SHEET OF 1	
PROJECT USDB ENERGY STUDY				BASIS FOR ESTIMATE ☒ CODE A (NO DESIGN COMPLETED) ☐ CODE B (PRELIMINARY DESIGN) ☐ CODE C (FINAL DESIGN) ☐ OTHER (SPECIFY)				
LOCATION FORT LEAVENWORTH, KS								
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP								
DRAWING NO. Castle Buildings			ESTIMATOR R.G.B.		CHECKED BY M.A.W.			
	QUANTITY		MATERIAL		LABOR		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
1/2" FIBERGLASS PIPE INSULATION W/ ALL SERVICE JACKET								
3/4" PIPE	80	L. F.	\$0.87	\$69.60	\$1.44	\$115.20	\$184.80	
1-1/4" PIPE	260	L. F.	\$1.01	\$262.60	\$1.57	\$408.20	\$670.80	
1-1/2" PIPE	20	L. F.	\$1.10	\$22.00	\$1.57	\$31.40	\$53.40	
SUBTOTAL				\$354		\$555	\$909	
CONTINGENCY 10%			\$0.10	\$35	10%	\$55	\$90	
SUBTOTAL				\$389		\$610	\$999	
WORK COMP, TAX, SOC. SEC., INS			\$0.04	\$14	13.0%	\$79	\$93	
DIRECT COST				\$403		\$689	\$1,092	
OVERHEAD AND PROFIT			\$0.25	\$101	25%	\$172	\$273	
SUBTOTAL				\$504		\$861	\$1,365	
CONSTRUCTION COST							\$1,365	

ENG. FORM 150
1AVC-59

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 12-5-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: GROUP #3
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	1819.
B. SIOH	\$	109.
C. DESIGN COST	\$	100.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1825.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1825.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	202.	\$ 824.	11.67	9616.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		202.	\$ 824.		\$ 9616.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	3173.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	824.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	9616.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	5.27	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.21	

FACILITIES ENGINEERING WORK REQUEST - XFA XFB, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

[illegible]

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

Apply insulation to existing uninsulated domestic hot water piping in USDDB piping tunnels. This will result in less heat loss from the water to ambient spaces and less water waste.

Energy will continue to be wasted from the exposed piping to surrounding spaces. Currently, approximately 147 million BTU's per year is wasted from Castle domestic hot water piping, while approximately 55 million BTU's per year is wasted from pipe tunnel piping. In addition, more water will be consumed due to lower point-of-use temperatures.

REQUESTER INFORMATION		PERSON TO CALL FOR ADDITIONAL INFORMATION		TELEPHONE NO.	
NAME	ORGANIZATION	TELEPHONE NO.	SIGNATURE	NAME	ORGANIZATION

FORWARD FOR APPROVAL				APPROVED FOR DESIGN		SOURCE OF FUNDS
PROVING AUTHORITY	RECOMMENDED ACTION	ENVIRONMENTAL IMPACT	ESTIMATED COST	WORK TO BE PERFORMED	FROM	☐ DIRECT ☐ AUTOMATIC REIMB. ☐ FUNDED REIMB.
	☐ APPROVAL ☐ DISAPPROVAL	NO YES ☒ ENVIRONMENTAL CONSIDERATIONS ☒ EIS/EIA INITIATED ☒ EIS/EIA COMPLETED	FUNDED \$ 1,928 WC K WC L \$ WC UNFUNDED \$ 88 TOTAL \$ 2,016	☐ IN-HOUSE ☐ SELF-HELP ☐ CONTRACT ☐ TROOP	FACILITIES ENGINEER DATE	
						REMARKS

[illegible]

FORM 1 AUG 78	4283	EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED.	GROUP 3 - PAGE 9	WHITE (ORIGINAL) - PROJECT FILE COPY - FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL" BLOCK	GREEN - FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FOR APPROVAL" BLOCK
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GROUP 4

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 4 Power Plant							
474	Outside Testing - Steam Traps	M3	1,510	\$6,161	\$17,119	2.63	4.44
474	Reduce Steam Pressure	M12	605	\$2,470	\$9,931	3.81	3.06
474	Condensate Return System	M14	1,687	\$6,883	\$38,115	5.24	2.23
474	Oxygen Trim Controls	M15	3,397	\$13,860	\$39,077	2.67	4.37
GROUP 4 TOTALS			7,199	\$29,374	\$104,242	3.36	3.47
GROUP 4 FUNDING CATEGORY: OSD PIF							

ECO-M3

**SERVICE STEAM PIPING
AND TRAPS**

CALCULATION SHEET		DATE March, 1987	SHEET 1 OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	STEAM TRAP PROGRAM - OWNER TESTING	COMPUTED BY TGD	CHECKED BY MAW

COST OF STEAM AT FORT LEAVENWORTH - USDB

ENTHALPY OF WATER AT 160° F. =	128 BTU/LBM
ENTHALPY OF STEAM AT 120 PSIG =	1,192 BTU/LBM
SYSTEM EFFICIENCY =	74%
NATURAL GAS COST =	\$4.08 MCF
HEAT CONTENT OF NAT. GAS =	1,000,000 BTU/MCF
\$5.87 PER THOUSAND LBS. OF STEAM	
$[(1192-128) \times \$4.08] / (0.74 \times 1,000) =$	

COST OF INSPECTING TRAPS AFTER TEST VALVES ARE INSTALLED.

ASSUMING AN AVERAGE OF 50 TRAPS PER DAY 8 HOURS PER DAY.

8 MH	x	\$36.75 PER HOUR =	\$294 PER DAY
\$294	/	50 TRAPS PER DAY =	\$5.88 PER TRAP
COST OF INSTALLING TEST VALVES ON EACH TRAP =			\$137

SAVINGS FROM TRAP INSPECTION

USING 100 TRAPS AS A BASE WITH A 10% FAILURE RATE; 350 LB/HR F&T TRAP

COST OF INSPECTING TRAPS ONCE DURING THE HEATING SEASON	100 X \$5.88 =	\$588 PER YEAR
NUMBER OF TRAPS FAILED	100 X 10% =	10 TRAPS
COST OF REPAIRING TRAPS	10 X \$145 =	\$1,450 PER YEAR
TOTAL COST OF INSPECTING AND REPAIRING TRAPS		<u>\$2,038</u> PER YEAR
65 lbs/hr x 4380 hrs/yr x 0.5 (sys. modulation factor) =	142,350 LBS. OF STEAM PER YEAR	
142,350 x (1192-128) / 1,000,000 =	151 MBTU / YEAR / TRAP	
151 x \$5.87 =	\$886 PER TRAP / YEAR	
ENERGY LOST DUE TO FAILED TRAPS	10 X 151 =	1510 MBTU'S PER YEAR
COST OF STEAM LOST DUE TO FAILED TRAPS	10 X \$886 =	\$8,860 PER YEAR
INITIAL INVESTMENT FOR TEST VALVES	100 X \$137 =	\$13,700
CONSTRUCTION COST	\$2,038 + \$13,700 =	\$15,738

CALCULATION SHEET		DATE March, 1987	SHEET 1 OF 1																																	
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)																																		
LOCATION																																				
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP																																			
ECO MEASURE	STEAM TRAP PROGRAM - OUTSIDE TESTING	COMPUTED BY TGD	CHECKED BY MAW																																	
<u>COST OF STEAM AT FORT LEAVENWORTH - USDB</u> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">ENTHALPY OF WATER AT 160° F. =</td> <td style="width: 50%; text-align: right;">128 BTU/LBM</td> </tr> <tr> <td>ENTHALPY OF STEAM AT 120 PSIG =</td> <td style="text-align: right;">1,192 BTU/LBM</td> </tr> <tr> <td>SYSTEM EFFICIENCY =</td> <td style="text-align: right;">74%</td> </tr> <tr> <td>NATURAL GAS COST =</td> <td style="text-align: right;">\$4.08 MCF</td> </tr> <tr> <td>HEAT CONTENT OF NAT. GAS =</td> <td style="text-align: right;">1,000,000 BTU/MCF</td> </tr> <tr> <td colspan="2" style="padding-top: 10px;"> $[(1192-128) \times \\$4.08] / (0.74 \times 1,000) =$ </td> </tr> <tr> <td></td> <td style="text-align: right;">\$5.87 PER THOUSAND LBS. OF STEAM</td> </tr> </table>				ENTHALPY OF WATER AT 160° F. =	128 BTU/LBM	ENTHALPY OF STEAM AT 120 PSIG =	1,192 BTU/LBM	SYSTEM EFFICIENCY =	74%	NATURAL GAS COST =	\$4.08 MCF	HEAT CONTENT OF NAT. GAS =	1,000,000 BTU/MCF	$[(1192-128) \times \$4.08] / (0.74 \times 1,000) =$			\$5.87 PER THOUSAND LBS. OF STEAM																			
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LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-23-90

DISCRETE PORTION NAME: ECOM3 - OWNER TESTING
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	15738.
B. SIOH	\$	944.
C. DESIGN COST	\$	866.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	15793.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	15793.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	1510.	\$ 6161.	11.67	71899.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		1510.	\$ 6161.		\$ 71899.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	23727.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=	_____	
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	6161.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	71899.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	4.55	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.56	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-23-90

DISCRETE PORTION NAME: ECOM3 - OUTSIDE TESTING
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	16150.
B. SIOH	\$	969.
C. DESIGN COST	\$	888.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	16206.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	16206.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	1510.	\$ 6161.	11.67	71899.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		1510.	\$ 6161.		\$ 71899.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	23727.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=	_____	
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	6161.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	71899.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	4.44	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	2.63	

ECO-M12

**REDUCE STEAM
DISTRIBUTION PRESSURE**

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
LOCATION STEAM PLANT				
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		COMPUTED BY TGD		
ECO MEASURE ECO M12				
		CHECKED BY MAW		
STEAM PRESSURE	ENTHALPY BTU/LB. OF STEAM	SYSTEM EFFICIENCY	STEAM COST PER 1000 LBS.	ESTIMATED ANNUAL SAVINGS
120 PSIG	1,192.4	74.000%	\$5.754	NONE
115 PSIG	1,191.7	74.094%	\$5.742	\$326
110 PSIG	1,191.0	74.188%	\$5.731	\$624
105 PSIG	1,190.4	74.282%	\$5.721	\$896
100 PSIG	1,189.6	74.376%	\$5.709	\$1,222
95 PSIG	1,188.8	74.470%	\$5.698	\$1,520
90 PSIG	1,188.0	74.564%	\$5.686	\$1,846
85 PSIG	1,187.2	74.658%	\$5.675	\$2,145
80 PSIG	1,186.3	74.752%	\$5.663	\$2,470
AVERAGE STEAM USE FOR SPACE HEATING:			74,375 LBS PER DAY	
ANNUAL ENERGY SAVINGS (AT 80 PSIG):			605 MBTU'S PER YEAR	
SYSTEM EFFICIENCY CALCULATED FROM:				
IMPROVING BOILER EFFICIENCY BY S.G. DUKELOW				
SPONSORED BY KANSAS STATE UNIVERSITY AND KANSAS ENERGY OFFICE				
CHAPTER 6: EFFECT OF BOILER STEAM PRESSURE ON FLUE GAS TEMPERATURE AND BOILER EFFICIENCY				

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-19-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: ECOM12
 ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	9369.
B. SIOH	\$	562.
C. DESIGN COST	\$	515.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	9401.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	9401.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	605.	\$ 2468.	11.67	28802.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		605.	\$ 2468.		\$ 28802.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	9505.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 2468.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 28802.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 3.06
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 3.81

ECO-M14

**SERVICE CONDENSATE
RETURN SYSTEM**

CALCULATION SHEET		DATE Mar-90	SHEET OF 1 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY		
LOCATION	X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	SERVICE CONDENSATE RETURN SYSTEM ECO-M14		
COMPUTED BY		TGD	CHECKED BY MAW

INIT TEMP	AMB TEMP	INSUL THICK	WIND VEL	PIPE DIA	INSULATION CHARACTERISTICS				PIPE LEN	FLOW #/HR	SPEC HEAT	EMISS	FINAL TEMP	TOTAL HL
					T 1	CON1	T2	CON 2						
212	75	2	1	8.625	460	0.5	100	0.25	700	6200	1.05	0.9	201.1	71,040
212	75	0.001	1	8.625	460	0.5	100	0.25	700	6200	1.05	0.9	154.9	371,640

CALCULATION SHEET		DATE Mar-90	SHEET OF 1 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE SERVICE CONDENSATE RETURN SYSYTEM ECO-M14		COMPUTED BY TGD	CHECKED BY
120 PSIG STEAM PRESSURE: 1192.4 BTU/LB. ENTHALPY 155°F CONDENSATE RETURN TEMPERATURE: 123 BTU/LB. ENTHALPY 201°F CONDENSATE RETURN TEMPERATURE: 169 BTU/LB. ENTHALPY SYSTEM EFFCIENCY: 74% AVERAGE DAILY STEAM CONSUMPTION: 148,750 LBS. STEAM LOAD SERVED BY WEST TUNNEL: 50% DAYS PER YEAR: 365 $(1192.4 - 123) - (1192.4 - 169) / 0.74 = 62.16 \text{ BTU/LB.}$ $(62.16 \times 148,750 \times .5 \times 365) / 1,000,000 = 1,687 \text{ MBTU/YEAR}$			

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: ECOM14

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	35958.
B. SIOH	\$	2157.
C. DESIGN COST	\$	1978.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	36084.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	36084.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44		\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	1687.	\$ 6883.	11.67	80325.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		1687.	\$ 6883.		\$ 80325.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	26507.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 6883.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 80325.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.23
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 5.24

CONSTRUCTION COST ESTIMATE				DATE PREPARED Mar-90			SHEET 1 OF 1	
PROJECT USDB ENERGY STUDY				BASIS FOR ESTIMATE ☒ CODE A (NO DESIGN COMPLETED) ☐ CODE B (PRELIMINARY DESIGN) ☐ CODE C (FINAL DESIGN) ☐ OTHER (SPECIFY)				
LOCATION FORT LEAVENWORTH, KS								
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP								
DRAWING NO.			ESTIMATOR TGD		CHECKED BY MAW			
	QUANTITY		MATERIAL		LABOR		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
6" DIA. - 2" THICK FIBERGLASS INSULATION	400	LF	\$5.87	\$2,348	\$3.45	\$1,380	\$3,728	
ALUMINUM JACKET	400	LF	\$0.54	\$216	\$2.87	\$1,148	\$1,364	
8" DIA. SCH. 80 STEEL PIPE	100	LF	\$37.66	\$3,766	\$22.00	\$2,200	\$5,966	
8" DIA. - 2" THICK FIBERGLASS INSULATION	200	LF	\$7.25	\$1,450	\$4.31	\$862	\$2,312	
ALUMINUM JACKET	200	LF	\$0.54	\$108	\$2.87	\$574	\$682	
PIPE RACKS	6	EA	\$400	\$2,400	\$200	\$1,200	\$3,600	
REPAIR HOLES IN PIPING	3	DAYS			\$252	\$756	\$756	
8" DIA. TEE	2	EA	\$71	\$142	\$71	\$142	\$284	
8" DIA. 90° ELBOW	2	EA	\$100	\$200	\$140	\$280	\$480	
DEMOLITION	100	LF			\$3.95	\$395	\$395	
SUBTOTAL				\$10,630		\$8,937	\$19,567	
DIFFICULTY FACTOR 50%					50%	\$4,469	\$4,469	
SUBTOTAL						\$13,406	\$24,036	
CONTINGENCY 10%			10%	\$1,063	10%	\$1,341	\$2,404	
SUBTOTAL				\$11,693		\$14,747	\$26,440	
WORK COMP, TAX, SOC. SEC., INS			3.50%	\$409	13.0%	\$1,917	\$2,326	
DIRECT COST				\$12,102		\$16,664	\$28,766	
OVERHEAD AND PROFIT			25%	\$3,026	25%	\$4,166	\$7,192	
SUBTOTAL				\$15,128		\$20,830	\$35,958	
CONSTRUCTION COST							\$35,958	

ENG. FORM 150
1AVC-59

ECO-M15

**BOILER PLANT
MODIFICATIONS**

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION		
LOCATION	FORT LEAVENWORTH, KANSAS	☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP			
ECO MEASURE	ECO-M15 O2 TRIM CONTROLS	COMPUTED BY BMS	CHECKED BY MAW	

BUILDING 474 - CENTRAL HEATING PLANT

TEST DATA, BOILER #2

% OXYGEN	6.3 %
STACK TEMPERATURE	450 ° F
% EXCESS AIR	37. %
COMBUSTION EFFICIENCY	80.50%
%CO 2	8.3 %

STEAM PRODUCTION, ACCORDING TO BOILER PLANT OPERATORS:

SUMMER	75,000 LBS/DAY
WINTER	370,000 LBS/DAY
AVERAGE (CALCULATED)	148,750 LBS/DAY

BOILER TRIM CONTROL REDUCES EXCESS AIR TO 15%

FROM "GAS COMBUSTION EFFICIENCY CHART" PUBLISHED BY COOPERATIVE EXTENSION SERVICE, KANSAS STATE UNIVERSITY, MANHATTAN KS.:

15% EXCESS AIR AT 317°F = 84.50% COMBUSTION EFF.

84.50% - 80.50% = 4.00% INCREASE IN COMB. EFF.

ENTHALPY OF STEAM LEAVING BOILERS	1192.4 BTU/LB
ENTHALPY OF CONDENSATE RETURNING TO BOILERS	128 BTU/LB
ENTHALPY DIFFERENCE	1064.4 BTU/LB

148,750 LBS/DAY X 1,064 BTU/LB X 365 DAYS/YR > 0.000001 MBTU/BTU =

57,769 MBTU/YR.

THIS TRANSLATES TO GAS CONSUMPTIONS OF

57,769 / 80.50% = 71,763 MBTU/YR.

AND

57,769 / 84.50% = 68,366 MBTU/YR. WITH O2 TRIM CONTROLS.

SAVINGS

71,763 - 68,366 = 3,397 MBTU/YR.

4.08 X 3,397 = \$13,860 PER YEAR

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-28-90

DISCRETE PORTION NAME: ECOM15O2
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	36865.
B. SIOH	\$	2212.
C. DESIGN COST	\$	2028.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	36995.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	36995.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	3397.	\$ 13860.	11.67	161746.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		3397.	\$ 13860.		\$ 161746.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	53376.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 13860.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 161746.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 4.37
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 2.67

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 12-5-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: GROUP #4
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	98342.
B. SIOH	\$	5901.
C. DESIGN COST	\$	5409.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	98687.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	98687.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	7199.	\$ 29372.	11.67	342771.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		7199.	\$ 29372.		\$ 342771.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	113114.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 29372.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 342771.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 3.47
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 3.36

FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

[illegible]

ATION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Make the following boiler plant modifications:

Make the following boiler plant modifications:

- Inspect and service or replace steam traps.
- Upon replacement of existing boilers, reduce steam distribution pressure from 120 psig to 80 psig for all steam loads at the US except the laundry, served by a separate 120 psig boiler.
- Replace approximately 100 feet of 8" condensate piping. Insulate approximately 400 feet of 6" piping and 200 feet of 8" piping.
- Purchase oxygen trim controls for any new boilers.

These energy conservation measures will show economic payback.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

The boiler plant in building 474 will continue to waste approximately 7,199 million BTU's per year that could be saved by implementing these measures.

REQUESTER INFORMATION

Organization

1-11-12

ATURE

WZV

PERSON TO CALL FOR ADDITIONAL INFORMATION

ORGANIZATION

1.

FORWARD FOR APPROVAL

RECOMMENDED ACTION	ENVIRONMENTAL IMPACT	ESTIMATED COST	WORK TO BE PERFORMED	FROM
	NO YES	FUNDED \$	☐ IN-HOUSE	FACILITIES ENGINEER
☐ APPROVAL	☒ ENVIRONMENTAL	WC X \$104,242	☐ SELF-HELP	
☐ DISAPPROVAL	☐ CONSIDERATIONS	WC L \$	☐ CONTRACT	
	☒ EIS/EIA	WC \$	☐ TROOP	
	☐ INITIATED	UNFUNDED \$ 4,738		
	☒ EIS/EIA COMPLETED	TOTAL \$ 108,980		DATE
SIGNING AUTHORITY				

APPROVAL ACTION

DOCUMENT NUMBER										DATE		FORWARDED TO			
F		SERIAL NUMBER		ACTION TAKEN		MO		DA		DESIGN		ESTIMATOR			
15		7		8		9		10		11		12			
13		14		15		16		17		18		19			
20		21		22		23		24		25		26			
A - APPROVED										SIGNATURE OF APPROVAL AUTHORITY					
O - DISAPPROVED															

ENTITION OF THE USER WILL BE USED UNTIL EXHAUSTED.

GROUP 4- PAGE 18

X
 21213
 21113

- PROJECT FILE COPY
- FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK

2000

- FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FOR APPROVAL" BLOCK

GROUP 5

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 5 Building 475 Repairs							
475	Attic Insulation - Rotunda	ECO-A3	142	\$578	\$4,868	7.96	2.03
475	Exhaust Heat Recovery	ECO-M5	453	\$2,130	\$12,909	6.66	1.76
475C	Air System Repair	ECO-M11	273	\$1,458	\$1,779	1.51	7.72
475D	Air System Repair	ECO-M11	277	\$1,474	\$1,779	1.49	7.83
475F	Air System Repair	ECO-M11	307	\$1,641	\$1,779	1.34	8.68
475G	Air System Repair	ECO-M11	247	\$1,323	\$1,779	1.67	6.99
475A	Lighting Levels - Chapel	ECO-E1	3	\$43	\$213	4.70	2.40
475B	Lighting Levels	ECO-E1	3	\$40	\$213	5.00	2.20
475H	Lighting Levels	ECO-E1	2	\$21	\$213	9.50	1.20
475A	Energy Efficient Lighting	ECO-E2	8	\$100	\$131	1.24	9.00
GROUP 5 TOTALS			1,715	\$8,808	\$25,663	3.40	3.41
GROUP 5 FUNDING CATEGORY: PECIP							

ECO-A3

ATTIC INSULATION

ECO-A3 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS (\$)
	BASE ENERGY (THERMS)	ECO-A3 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-A3 LOAD (KW)	ENERGY SAVINGS (MBTU)	
463	1,577	1,379	20	83,903	82,814	4	\$127
464	2,195	1,311	88	91,802	86,441	18	\$588
472	15,515	15,241	27	234,490	232,543	7	\$194
475	13,619	12,203	142	58,399	58,386	0	\$578
475E	21,657	21,253	40	611,712	611,617	0	\$169
							\$1,657

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: 475A3
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	4592.
B. SIOH	\$	276.
C. DESIGN COST	\$	253.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	4609.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	4609.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	11.16	0.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	142.	\$ 579.	16.15	9351.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		142.	\$ 579.		\$ 9351.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	3086.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS $2F3+3A+(3B1D/(\text{YEARS ECONOMIC LIFE}))$ \$ 579.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 9351.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.03
 (IF < 1 PROJECT DOES NOT QUALIFY)
7. SIMPLE PAYBACK PERIOD (ESTIMATED) $SPB=1F/4$ 7.96

ENG. FORM 150
1AVC-59

ECO-M5

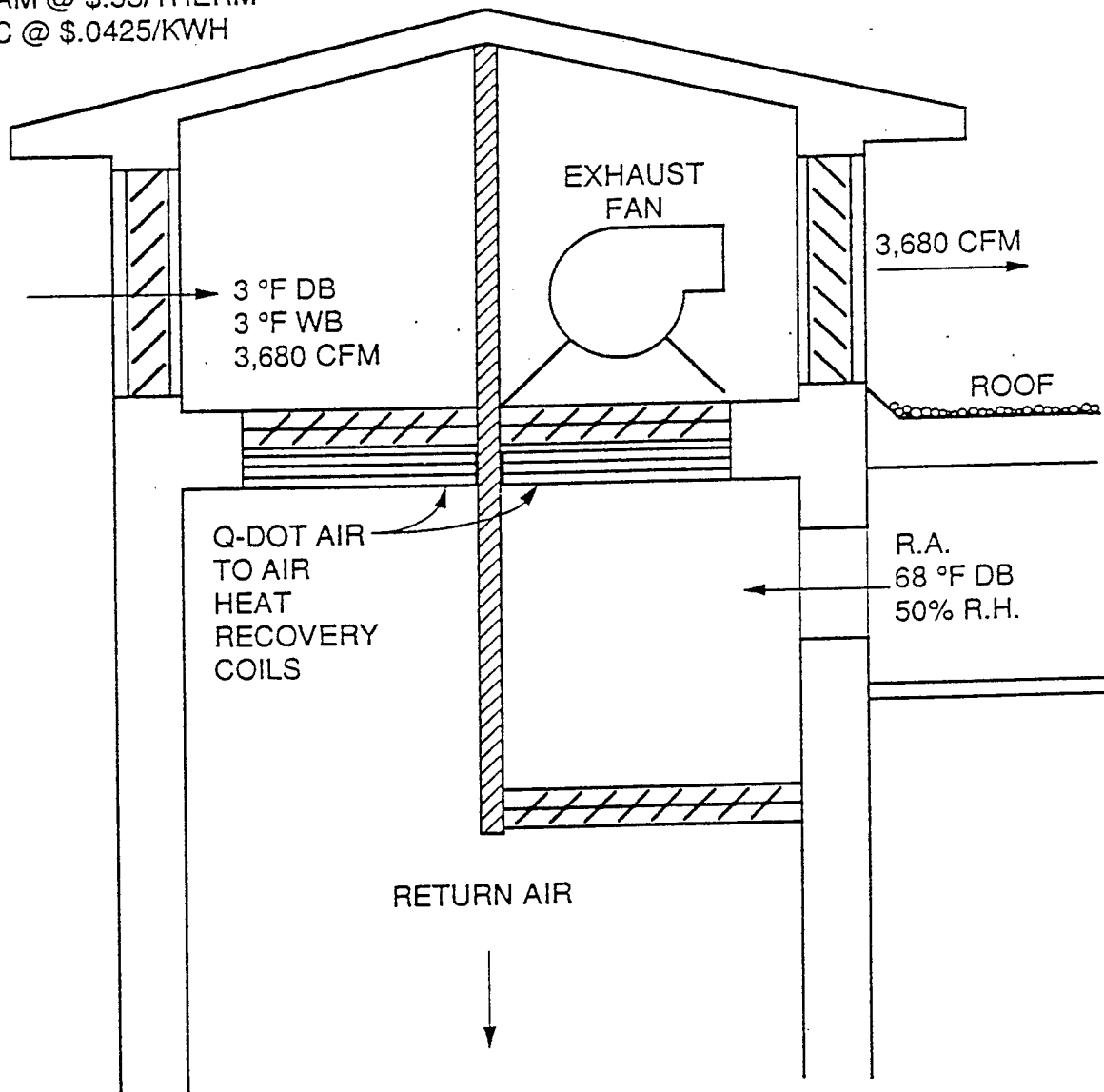
EXHAUST HEAT RECOVERY

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION		
LOCATION	FORT LEAVENWORTH, KANSAS	☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP	COMPUTED BY RGB	CHECKED BY MAW	
ECO MEASURE	ECO-M5: HEAT RECOVERY			

OPERATED: 24 HR./DAY, NOVEMBER THROUGH MARCH

STEAM @ \$.53/THERM

ELEC @ \$.0425/KWH



Q-DOT HEAT RECOVERY SYSTEM TYPICAL SECTION BUILD

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM5Q
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	12178.
B. SIOH	\$	731.
C. DESIGN COST	\$	670.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	12221.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	12221.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	-1.	\$ -12.	8.69	-104.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	453.	\$ 1848.	11.67	21566.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		452.	\$ 1836.		\$ 21462.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	7082.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	1836.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	21462.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.76	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	6.66	

ENG. FORM 150
1AVC-59

ECO-M11

**CASTLE AIR SYSTEM
REPAIR**

ECO-M11 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS (\$)
	BASE ENERGY (THERMS)	ECO-M11 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-M11 LOAD (KW)	ENERGY SAVINGS (MBTU)	
475C	13,472	10,745	273	45,478	45,427	0	\$1,115
475D	15,188	12,422	277	53,358	53,317	0	\$1,130
475F	15,926	12,856	307	53,357	53,324	0	\$1,254
475G	12,853	10,380	247	45,481	45,427	0	\$1,011
							\$4,510

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7

PROJECT NO. & TITLE: 1496

FISCAL YEAR 1990

ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM11C
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	1678.
B. SIOH	\$	101.
C. DESIGN COST	\$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1684.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	273.	\$ 1114.	11.67	13000.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		273.	\$ 1114.		\$ 13000.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	4290.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	1114.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	13000.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	7.72	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	1.51	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7

PROJECT NO. & TITLE: 1496

FISCAL YEAR 1990

ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM11D
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	1678.
B. SIOH	\$	101.
C. DESIGN COST	\$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1684.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	277.	\$ 1130.	11.67	13187.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		277.	\$ 1130.		\$ 13187.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	4352.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=	_____	
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	1130.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	13187.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	7.83	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	1.49	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM11F
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	1678.
B. SIOH	\$	101.
C. DESIGN COST	\$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1684.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1684.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	307.	\$ 1253.	11.67	14623.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		307.	\$ 1253.		\$ 14623.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	4826.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	1253.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	14623.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	8.68	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	1.34	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOM11G

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	1678.
B. SIOH	\$	101.
C. DESIGN COST	\$	92.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	1684.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	1684.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	0.	\$ 0.	8.69	0.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	247.	\$ 1008.	11.67	11763.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		247.	\$ 1008.		\$ 11763.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	3882.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	1008.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	11763.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	6.99	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	1.67	

ENG. FORM 150
1AVC-59

ECO-E1

LIGHTING LEVELS

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
LOCATION	FORT LEAVENWORTH, KS			
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP			
ECO MEASURE	ECO-E1			
		COMPUTED BY DJG	CHECKED BY MAW	

BASED ON THE FOLLOWING INFORMATION:
\$200.62 FOR TYPICAL MOTION SENSOR INSTALLATION
\$0.0425 PER KWH ELECTRICITY COST
11.16 25-YEAR DISCOUNT FACTOR

BUILDING # AND ROOM TYPE	LIGHTING WATTS	ANNUAL NORMAL HOURS	ANNUAL HOURS SAVED	ANNUAL KWH SAVED	ANNUAL SAVINGS	PAYBACK IN YEARS	SIR
450 CONFERENCE ROOM	1280	2080	624	799	\$33.96	5.9	1.9
475A CONFERENCE ROOM	640	2080	624	399	\$16.96	11.8	0.9
475A CHAPEL	1620	2080	624	1011	\$42.97	4.7	2.4
475E CONFERENCE ROOM	480	2080	624	300	\$12.75	15.7	0.7
475B CHAPEL	1500	2080	624	936	\$39.78	5.0	2.2
475H CHAPEL	800	2080	624	499	\$21.21	9.5	1.2
TOTAL (SIR >1)	5200	2080	624	3245	\$137.91	8.7	1.3

CALCULATION SHEET		DATE Oct-90	SHEET 0F 1 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION	FORT LEAVENWORTH, KS		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP		
ECO MEASURE	ECO-E1	COMPUTED BY DJG	CHECKED BY MAW

AVERAGE PAYBACK TIME FOR REPLACING EXISTING SWITCHES WITH INFRARED MOTION SENSORS FOR VARIOUS SPACES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA
ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

MOTION SENSOR INSTALLATION COST

DEMO EXISTING SWITCH BOX	\$2.66
DEMO 8' EMT WITH WIRING	\$5.76
INSTALL 20', 3/4" EMT	\$53.60
INSTALL 40', #12 CONDUCTORS	\$13.60
INSTALL MOTION SENSOR	\$125.00
TOTAL COST PER INSTALLATION	\$200.62

POSSIBLE ENERGY SAVINGS FOR TYPICAL CONFERENCE ROOM

LIGHTING LOAD	720 WATTS
ANNUAL LIGHTING TIME	2080 HOURS
ANNUAL COST @ \$0.0425 PER KWH	\$63.65
ANNUAL SAVINGS IF LIGHTS ARE OFF 30% OF TIME	\$19.10
COST OF INSTALLATION	\$200.62
PAYBACK TIME	10.5 YEARS

POSSIBLE ENERGY SAVINGS FOR TYPICAL SMALL OFFICE ROOM

LIGHTING LOAD	320 WATTS
ANNUAL LIGHTING TIME	2080 HOURS
ANNUAL COST @ \$0.0425 PER KWH	\$28.29
ANNUAL SAVINGS IF LIGHTS ARE OFF 25% OF TIME	\$7.07
COST OF INSTALLATION	\$200.62
PAYBACK TIME	28.4 YEARS

NOTE: SAVINGS ARE VERY DEPENDENT ON SEVERAL ITEMS, WHICH INCLUDE THE FOLLOWING:

- 1) CURRENT PRACTICES IN SWITCHING LIGHTS OFF. IF PEOPLE NORMALLY TURN LIGHTS OFF WHEN NOT IN USE, ENERGY SAVINGS WILL BE MINIMAL.
- 2) AMOUNT OF TIME THAT LIGHTS WILL NOT BE IN USE. THE ABOVE ESTIMATES MAY VARY AND ACTUAL SAVINGS WILL FLUCTUATE ACCORDINGLY.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 03-30-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: ECOE1
ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	802.
B. SIOH	\$	48.
C. DESIGN COST	\$	44.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	805.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	805.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	11.	\$ 137.	11.16	1529.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	0.	\$ 0.	16.15	0.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		11.	\$ 137.		\$ 1529.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	505.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	137.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1529.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.90	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	5.88	

ECO-E2

**ENERGY EFFICIENT
LIGHTING SYSTEMS**

CALCULATION SHEET		DATE Mar-90	SHEET 1 OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
LOCATION FORT LEAVENWORTH, KS			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-E2		COMPUTED BY DJG	CHECKED BY MAW

AVERAGE PAYBACK TIME FOR RELAMPING AND REBALLASTING FLUORESCENT LIGHT FIXTURES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 12 HOURS PER DAY = 4380 HOURS PER YEAR

2 LAMP FLUORESCENT LIGHT FIXTURE

COST TO REBALLAST LIGHT FIXTURE	\$58.00
COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS $9.25 \times 2 =$	\$18.50
TOTAL COST PER FIXTURE	\$76.50

ELECTRICITY SAVINGS

8W PER LAMP x 2 LAMPS PER FIXTURE	= 16W PER FIXTURE PER HOUR
	= 0.016 KWH PER FIXTURE
$\$0.0425 \text{ PER KWH} \times 0.016 \text{ KWH} \times 4380 \text{ HRS}$	= \$2.98 PER YEAR

SIMPLE PAYBACK

TOTAL COST PER FIXTURE	\$76.50
ELECTRICITY SAVINGS PER YEAR	\$2.98
SIMPLE PAYBACK IN YEARS	25.7

4 LAMP FLUORESCENT LIGHT FIXTURE

COST TO REBALLAST LIGHT FIXTURE	$\$58.00 \times 2 =$	\$116.00
COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS $9.25 \times 4 =$		\$37.00
TOTAL COST PER FIXTURE		\$153.00

ELECTRICITY SAVINGS

8W PER LAMP x 4 LAMPS PER FIXTURE	= 32W PER FIXTURE PER HOUR
	= 0.032 KWH PER FIXTURE
$\$0.0425 \text{ PER KWH} \times 0.032 \text{ KWH} \times 4380 \text{ HRS}$	= \$5.97 PER YEAR

SIMPLE PAYBACK

TOTAL COST PER FIXTURE	\$153.00
ELECTRICITY SAVINGS PER YEAR	\$5.97
SIMPLE PAYBACK IN YEARS	25.6

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT	USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION		
LOCATION	FORT LEAVENWORTH, KS	☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)		
ARCHITECT/ENGINEER	CLARK RICHARDSON & BISKUP			
ECO MEASURE	ECO-E2	COMPUTED BY DJG	CHECKED BY MAW	

CALCULATIONS FOR RETROFITTING INCANDESCENT FIXTURES TO FLUORESCENT FIXTURES
BUILDING 475A STAIRWELL

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 24 HOURS PER DAY = 8760 HOURS PER YEAR

DESCRIPTION	NUMBER (EACH)	INSTALLED COST	TOTAL COST	ENERGY USE (W)	TOTAL ENERGY USE
ADAPTER BALLAST	6	\$11.00	\$66	3	18
13W DOUBLE TWIN TUBE FLUORESCENT LAMP	6	\$5.84	\$35	13	78
LABOR	6	\$3.75	\$23	0	0
TOTAL			\$124		0.096KW

EXISTING ELECTRICITY USAGE = 6 LAMPS x 60W PER LAMP = 360 W OR .36KW/H

NEW ELECTRICITY USAGE = 0.096 KW/H

TOTAL ELECTRICITY SAVED = 0.36 KW/H - 0.096 KW/H = 0.264 KW/H

YEARLY SAVINGS = 0.264 KW/H x \$0.0425 /KWH x 8760 HOURS/YEAR = \$98.29 PER YEAR

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-23-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: ECOE2
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	124.
B. SIOH	\$	7.
C. DESIGN COST	\$	7.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	124.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	124.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	8.	\$ 100.	11.16	1116.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	0.	\$ 0.	16.15	0.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		8.	\$ 100.		\$ 1116.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	368.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	100.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1116.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	9.00	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	1.24	

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 12-5-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: GROUP #5
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	24206.
B. SIOH	\$	1452.
C. DESIGN COST	\$	1331.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	24290.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	24290.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	17.	\$ 211.	8.69	1834.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	1699.	\$ 6932.	11.67	80896.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		1716.	\$ 7143.		\$ 82730.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	27301.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	7143.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	82730.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	3.41	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	3.40	

FACILITIES ENGINEERING WORK REQUEST - XFA, XF8, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

[illegible]

FORWARD FOR APPROVAL									
RECOMMENDED ACTION		ENVIRONMENTAL IMPACT		ESTIMATED COST		WORK TO BE PERFORMED		FROM	
NO YES		NO YES		FUNDING		IN-HOUSE		FACILITIES ENGINEER	
☐ APPROVAL ☐ DISAPPROVAL		☒ ENVIRONMENTAL ☐ CONSIDERATIONS ☒ EIS/EIA ☐ INITIATED ☒ EIS/EIA COMPLETED		FUNDED \$ 25,663 WC K WC L WC UNFUNDED \$ 1,166 TOTAL \$ 26,829		☐ IN-HOUSE ☐ SELF-HELP ☐ CONTRACT ☐ TROOP		DATE	
PROVING AUTHORITY									

APPROVAL ACTION																							
DOCUMENT NUMBER		ACTION TAKEN		DATE		FORWARDED TO		REMARKS															
EQ	IO	SERIAL NUMBER		MO	DA	DESIGN	ESTIMATOR																
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
A - APPROVED																							
O - DISAPPROVED																							
SIGNATURE OF APPROVAL AUTHORITY																							

GROUP 6

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP		ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 6							
Building 450 Repairs							
450	Solar Window Shading	ECO-A6	36	\$256	\$2,121	7.84	1.66
450	Lighting Levels	ECO-E1	3	\$34	\$213	5.90	1.90
GROUP 6 TOTALS			39	\$290	\$2,334	7.58	1.27
GROUP 6 FUNDING CATEGORY: LOW COST/NO COST							

ECO-A6

SOLAR WINDOW SHADING

ECO-A6 ECONOMIC ANALYSIS

BUILDING NUMBER	STEAM CONSUMPTION			ELECTRIC CONSUMPTION			TOTAL SAVINGS (\$)
	BASE ENERGY (THERMS)	ECO-A6 LOAD (THERMS)	ENERGY SAVINGS (MBTU)	BASE LOAD (KW)	ECO-A6 LOAD (KW)	ENERGY SAVINGS (MBTU)	
450	3,629	2,920	71	135,466	132,697	9	\$407
463	1,577	1,796	-22	83,903	82,425	5	(\$27)
464	2,195	2,352	-16	91,802	90,467	5	(\$7)
472	15,515	15,515	0	234,490	229,344	18	\$218
473	2,407	2,609	-20	148,420	145,653	9	\$35
475A	12,773	12,773	0	146,357	136,920	32	\$401
475B	8,477	8,477	0	95,207	93,496	6	\$73
475H	8,137	8,137	0	87,858	86,474	5	\$59
							\$751

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: 450A6
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	2001.
B. SIOH	\$	120.
C. DESIGN COST	\$	110.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	2008.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	2008.

2. ENERGY SAVINGS (+) / COST (-)
 ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	13.	\$ 162.	11.16	1808.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	23.	\$ 94.	16.15	1518.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		36.	\$ 256.		\$ 3326.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	1098.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	256.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	3326.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.66	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	7.84	

ENG. FORM 150
1AVC-59

ECO-E1

LIGHTING LEVELS

CALCULATION SHEET		DATE Mar-90	SHEET 1	OF 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION ☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)			
LOCATION FORT LEAVENWORTH, KS				
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP				
ECO MEASURE ECO-E1	COMPUTED BY DJG	CHECKED BY MAW		

BASED ON THE FOLLOWING INFORMATION:
 \$200.62 FOR TYPICAL MOTION SENSOR INSTALLATION
 \$0.0425 PER KWH ELECTRICITY COST
 11.16 25-YEAR DISCOUNT FACTOR

BUILDING # AND ROOM TYPE	LIGHTING WATTS	ANNUAL NORMAL HOURS	ANNUAL HOURS SAVED	ANNUAL KWH SAVED	ANNUAL SAVINGS	PAYBACK IN YEARS	SIR
450 CONFERENCE ROOM	1280	2080	624	799	\$33.96	5.9	1.9
475A CONFERENCE ROOM	640	2080	624	399	\$16.96	11.8	0.9
475A CHAPEL	1620	2080	624	1011	\$42.97	4.7	2.4
475E CONFERENCE ROOM	480	2080	624	300	\$12.75	15.7	0.7
475B CHAPEL	1500	2080	624	936	\$39.78	5.0	2.2
475H CHAPEL	800	2080	624	499	\$21.21	9.5	1.2
TOTAL (SIR >1)	5200	2080	624	3245	\$137.91	8.7	1.3

CALCULATION SHEET		DATE Oct-90	SHEET 0F 1 1
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY	BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)		
LOCATION FORT LEAVENWORTH, KS			
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP			
ECO MEASURE ECO-E1	COMPUTED BY DJG	CHECKED BY MAW	

AVERAGE PAYBACK TIME FOR REPLACING EXISTING SWITCHES
WITH INFRARED MOTION SENSORS FOR VARIOUS SPACES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA
ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

MOTION SENSOR INSTALLATION COST

DEMO EXISTING SWITCH BOX	\$2.66
DEMO 8' EMT WITH WIRING	\$5.76
INSTALL 20', 3/4" EMT	\$53.60
INSTALL 40', #12 CONDUCTORS	\$13.60
INSTALL MOTION SENSOR	\$125.00
TOTAL COST PER INSTALLATION	\$200.62

POSSIBLE ENERGY SAVINGS FOR TYPICAL CONFERENCE ROOM

LIGHTING LOAD	720 WATTS
ANNUAL LIGHTING TIME	2080 HOURS
ANNUAL COST @ \$0.0425 PER KWH	\$63.65
ANNUAL SAVINGS IF LIGHTS ARE OFF 30% OF TIME	\$19.10
COST OF INSTALLATION	\$200.62
PAYBACK TIME	10.5 YEARS

POSSIBLE ENERGY SAVINGS FOR TYPICAL SMALL OFFICE ROOM

LIGHTING LOAD	320 WATTS
ANNUAL LIGHTING TIME	2080 HOURS
ANNUAL COST @ \$0.0425 PER KWH	\$28.29
ANNUAL SAVINGS IF LIGHTS ARE OFF 25% OF TIME	\$7.07
COST OF INSTALLATION	\$200.62
PAYBACK TIME	28.4 YEARS

NOTE: SAVINGS ARE VERY DEPENDENT ON SEVERAL ITEMS, WHICH INCLUDE THE FOLLOWING:
1) CURRENT PRACTICES IN SWITCHING LIGHTS OFF. IF PEOPLE NORMALLY TURN LIGHTS OFF WHEN NOT IN USE, ENERGY SAVINGS WILL BE MINIMAL.
2) AMOUNT OF TIME THAT LIGHTS WILL NOT BE IN USE. THE ABOVE ESTIMATES MAY VARY AND ACTUAL SAVINGS WILL FLUCTUATE ACCORDINGLY.

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: ECOE1
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	802.
B. SIOH	\$	48.
C. DESIGN COST	\$	44.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	805.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	805.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	11.	\$ 137.	11.16	1529.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	0.	\$ 0.	16.15	0.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		11.	\$ 137.		\$ 1529.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	505.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	137.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1529.
6. DISCOUNTED SAVINGS RATIO (IF < 1 PROJECT DOES NOT QUALIFY)	(SIR)=(5 / 1F)=	1.90
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4		5.88

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
PROJECT NO. & TITLE: 1496
FISCAL YEAR 1990
ANALYSIS DATE: 12-5-90

STUDY: USDBAE
LCCID 1.035
CENSUS: 2

DISCRETE PORTION NAME: GROUP #6
ECONOMIC LIFE 15 YEARS
PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	2214.
B. SIOH	\$	133.
C. DESIGN COST	\$	122.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	2222.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	2222.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	16.	\$ 199.	8.69	1729.
B. DIST	\$.00	0.	\$ 0.	12.42	0.
C. RESID	\$.00	0.	\$ 0.	12.21	0.
D. NAT G	\$ 4.08	23.	\$ 94.	11.67	1097.
E. COAL	\$.00	0.	\$ 0.	10.36	0.
F. TOTAL		39.	\$ 293.		\$ 2826.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)		\$	933.
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	293.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	2826.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.27	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	7.58	

FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC, XFD, XFE, XFF, XFG, XFH, XFJ, XFL, XFQ, XFR, XFS, XFT, XFU, XFX, XFY, XFZ, XGA, XGB, XGC, XGD, XGE, XGF, XGG, XGH, XGI, XGJ, XGL, XGM, XGN, XGO, XGP, XGQ, XGR, XGS, XGT, XGU, XGV, XGW, XGX, XGY, XGZ, XHA, XHB, XHC, XHD, XHE, XHF, XHG, XHH, XHI, XHJ, XHL, XHM, XHN, XHO, XHP, XHQ, XHR, XHS, XHT, XHU, XHV, XHW, XHX, XHY, XHZ, XIA, XIAB, XIC, XID, XIE, XIF, XIG, XIH, XII, XIL, XIM, XIN, XIO, XIOP, XIQ, XIR, XIS, XIT, XIU, XIUV, XIW, XIX, XIY, XIZ, XJA, XJB, XJC, XJD, XJE, XJF, XJG, XJH, XJI, XJJ, XJL, XJM, XJN, XJO, XJP, XJQ, XJR, XJS, XJT, XJU, XJV, XJW, XJX, XJY, XJZ, XKA, XKB, XKC, XKD, XKE, XKF, XKG, XKH, XKI, XKJ, XKL, XKM, XKN, XKO, XKP, XKQ, XKR, XKS, XKT, XKU, XKV, XKW, XKX, XKY, XKZ, XLA, XLB, XLC, XLD, XLE, XLF, XLG, XLH, XLI, XLJ, XLL, XLM, XLN, XLO, XLP, XLQ, XLR, XLS, XLT, XLU, XLV, XLW, XLX, XLY, XLZ, XMA, XMB, XMC, XMD, XME, XMF, XMG, XMH, XMI, XMJ, XML, XMN, XMO, XMP, XMQ, XMR, XMS, XMT, XMU, XMV, XMW, XMX, XMY, XMZ, XNA, XNB, XNC, XND, XNE, XNF, XNG, XNH, XNI, XNJ, XNL, XNM, XNN, XNO, XNP, XNQ, XNR, XNS, XNT, XNU, XNV, XNW, XNX, XNY, XNZ, XOA, XOB, XOC, XOD, XOE, XOF, XOG, XOH, XOI, XOJ, XOL, XOM, XON, XOO, XOP, XOQ, XOR, XOS, XOT, XOY, XOZ, XPA, XPB, XPC, XPD, XPE, XPF, XPG, XPH, XPI, XPJ, XPL, XPM, XPN, XPO, XPP, XPQ, XPR, XPS, XPT, XPU, XPV, XPW, XPX, XPY, XPZ, XQA, XQB, XQC, XQD, XQE, XQF, XQG, XQH, XQI, XQJ, XQL, XQM, XQN, XQO, XQP, XQQ, XQR, XQS, XQT, XQU, XQV, XQW, XQX, XQY, XQZ, XRA, XRB, XRC, XRD, XRE, XRF, XRG, XRH, XRI, XRJ, XRL, XRM, XRN, XRO, XRP, XRQ, XRR, XRS, XRT, XRU, XRV, XRW, XRX, XRY, XRZ, XSA, XSB, XSC, XSD, XSE, XSF, XSG, XSH, XSI, XSJ, XSL, XSM, XSN, XSO, XSP, XSQ, XSR, XSS, XST, XSU, XSV, XSW, XSX, XSY, XSZ, XTA, XTAB, XTC, XTD, XTE, XTF, XTG, XTH, XTI, XTJ, XTL, XTM, XTN, XTO, XTP, XTQ, XTR, XTS, XTT,XTT,XTT,XTU,XTV,XTW,XTX,XTY,XTZ,XUA,XUB,XUC,XUD,XUE,XUF,XUG,XUH,XUI,XUJ,XUL,XUM,XUN,XUO,XUP,XUQ,XUR,XUS,XUT,XUU,XUV,XUW,XUX,XUY,XUZ,XVA,XVB,XVC,XVD,XVE,XVF,XVG,XVH,XVI,XVJ,XVL,XVM,XVN,XVO,XVP,XVQ,XVR,XVS,XVT,XVU,XVV,XVW,XVX,XVY,XVZ,XWA,XWB,XWC,XWD,XWE,XWF,XWG,XWH,XWI,XWJ,XWL,XWM,XWN,XWO,XWP,XWQ,XWR,XWS,XWT,XWU,XWV,XWW,XWX,XWY,XWZ,XXA,XXB,XXC,XXD,XXE,XXF,XXG,XXH,XXI,XXJ,XXL,XXM,XXN,XXO,XXP,XXQ,XXR,XXS,XXT,XXU,XXV,XXW,XXX,XXY,XXZ,XYA,XYB,XYC,XYD,XYE,XYF,XYG,XYH,XYI,XYJ,XYL,XYM,XYN,XYO,XYP,XYQ,XYR,XYS,XYT,XYU,XYV,XYW,XYX,XYZ,XZA,XZB,XZC,XZD,XZE,XZF,XZG,XZH,XZI,XZJ,XZL,XZM,XZN,XZO,XZP,XZQ,XZR,XZS,XZT,XZU,XZV,XZW,XZX,XZY,XZZ

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

TRANS CODE	CHANGE	DOCUMENT NUMBER			BUILDING/FACILITY			DATE			OTHER FUND CITATION			SHORT JOB DESCRIPTION			BUILDING/FACILITY			BLANK																																																										
		REQ ID	SERIAL NUMBER	TYPE	NUMBER	SUFFIX	YR	MO	DA	30	31	32	33	34	35	36	37	38	39		40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79																		
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2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	2	3	4	5	6	7																																																																								

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

Add solar shading film to the south, east and west windows in building 450. This will reduce the solar heat gain, resulting in cooling energy savings. Install motion sensors in building 450. This will save energy by turning lights off during unoccupied times.

If the windows remain untinted, spaces in building 450 will continue to experience large solar loads in the cooling season. Failure to install motion sensors could result in continued waste of lighting energy because of lights being left on during unoccupied times.

REQUESTER INFORMATION		PERSON TO CALL FOR ADDITIONAL INFORMATION			TELEPHONE N	
NAME	ORGANIZATION	TELEPHONE NO.	SIGNATURE	NAME		ORGANIZATION

FORWARD FOR APPROVAL				WORK TO BE PERFORMED	FROM
RECOMMENDED ACTION ☐ APPROVAL ☐ DISAPPROVAL	NO	YES	ENVIRONMENTAL IMPACT	ESTIMATED COST	
	☒	☐	ENVIRONMENTAL CONSIDERATIONS	FUNDED \$	
	☒	☐	EIS/EIA INITIATED	WC \$ 2,334	☐ IN-HOUSE ☐ SELF-HELP
	☒	☐	EIS/EIA COMPLETED	WC \$	☐ CONTRACT ☐ TROOP
				UNFUNDED \$ 106	
				TOTAL \$ 3,440	DATE
PROVING AUTHORITY _____					

APPROVAL ACTION																			
ACTION TAKEN		DOCUMENT NUMBER		DATE		FORWARDED TO													
		REQ ID	SERIAL NUMBER	MO	DA	DESIGN	ESTIMATOR	MO	DA										
3	4	5	6	7	8	9	10	11	12	13	14	19	20	21	22	23	24	25	26
A - APPROVED														SIGNATURE OF APPROVAL AUTHORITY					
D - DISAPPROVED																			

FORM 1 AUG 78 4283 EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED. GROUP 6 - PAGE 9

WHITE (ORIGINAL)	PROJECT FILE COPY	GREEN
PINK	FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK	FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FC APPROVAL" BLOCK

GROUP 7

**ENERGY CONSERVATION ANALYSIS
ESOS**

PROJECT GROUP	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 7 Energy Efficient Motors						
All Buildings in the USDB	ECO-E3	248	\$3,085	\$22,185	6.81	1.64
GROUP 7 TOTALS		248	\$3,085	\$22,185	6.81	1.64
GROUP 7 FUNDING CATEGORY: NONE						

ECO-E3

ENERGY EFFICIENT MOTORS

**AVERAGE EFFICIENCIES AND ENERGY SAVINGS FOR
VARIOUS MOTOR SIZES
STANDARD VS HIGH EFFICIENCY
PAYBACKS FOR REPLACING AN EXISTING MOTOR**

HORSE-POWER	STANDARD MOTOR EFFICIENCY	HI EFF MOTOR EFFICIENCY	STANDARD MOTOR WATT LOSS	HI EFF MOTOR WATT LOSS	WATT LOSS DIFFERENCE	INSTALLED HI EFF MTR COST
1	76.5	84.0	229	142	87	\$420
1.5	78.5	85.5	306	190	117	\$442
2	80.8	86.5	355	233	122	\$466
3	79.9	88.5	563	291	272	\$582
5	83.1	89.5	759	438	321	\$644
7.5	83.8	90.2	1082	608	474	\$820
10	85.0	90.2	1316	811	506	\$966
15	86.5	91.7	1746	1013	734	\$1,255
20	87.5	93.0	2131	1123	1008	\$1,527
25	88.0	93.0	2543	1404	1139	\$1,780
30	88.1	93.0	3023	1685	1338	\$2,030
40	89.4	93.6	3538	2040	1498	\$2,623
50	90.4	94.1	3961	2339	1622	\$3,232

HORSE-POWER	8760 HOURS				5000 HOURS			
	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR
1	763	\$32	13.0	0.9	435	\$19	22.7	0.5
1.5	1,022	\$43	10.2	1.1	584	\$25	17.8	0.6
2	1,066	\$45	10.3	1.1	608	\$26	18.0	0.6
3	2,384	\$101	5.7	1.9	1,361	\$58	10.1	1.1
5	2,812	\$119	5.4	2.0	1,605	\$68	9.4	1.2
7.5	4,150	\$176	4.6	2.4	2,369	\$101	8.1	1.4
10	4,432	\$188	5.1	2.2	2,530	\$108	9.0	1.2
15	6,426	\$273	4.6	2.4	3,668	\$156	8.1	1.4
20	8,834	\$375	4.1	2.7	5,042	\$214	7.1	1.5
25	9,981	\$424	4.2	2.6	5,697	\$242	7.4	1.5
30	11,725	\$498	4.1	2.7	6,692	\$284	7.1	1.5
40	13,120	\$558	4.7	2.3	7,489	\$318	8.2	1.3
50	14,212	\$604	5.4	2.1	8,112	\$345	9.4	1.2

HORSE-POWER	4380 HOURS				2920 HOURS			
	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR	ENERGY SAVINGS	COST SAVINGS	SIMPLE PAYBACK	SIR
1	381	\$16	25.9	0.4	254	\$11	38.9	0.3
1.5	511	\$22	20.3	0.5	341	\$14	30.5	0.4
2	533	\$23	20.6	0.5	355	\$15	30.9	0.4
3	1,192	\$51	11.5	1.0	795	\$34	17.2	0.6
5	1,406	\$60	10.8	1.0	937	\$40	16.2	0.7
7.5	2,075	\$88	9.3	1.2	1,383	\$59	13.9	0.8
10	2,216	\$94	10.3	1.1	1,477	\$63	15.4	0.7
15	3,213	\$137	9.2	1.2	2,142	\$91	13.8	0.8
20	4,417	\$188	8.1	1.4	2,945	\$125	12.2	0.9
25	4,991	\$212	8.4	1.3	3,327	\$141	12.6	0.9
30	5,862	\$249	8.1	1.4	3,908	\$166	12.2	0.9
40	6,560	\$279	9.4	1.2	4,373	\$186	14.1	0.8
50	7,106	\$302	10.7	1.0	4,737	\$201	16.1	0.7

25 YEAR DISCOUNT FACTOR = 11.16

ELECTRICITY COST = 4.25¢/KWH

CALCULATION SHEET				DATE Mar-90		SHEET OF 1 2	
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY				BASIS FOR CALCULATION X HAND COMPUTER CONTRACTOR BID OTHER (SPECIFY)			
LOCATION FORT LEAVENWORTH, KS							
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP							
ECO MEASURE ECO-E3				COMPUTED BY DJG		CHECKED BY MAW	
BUILDING # AND MOTOR DESCRIPTION	HP	OPER. HOURS/ YEAR	SAVINGS PER YEAR MBTU'S	SAVINGS PER YEAR DOLLARS	INSTALLED COST	SIR	PAYBACK YEARS
BUILDING 463 FAN	1.5	4380	1.7	\$21.15	\$442	0.5	20.9
BUILDING 463 CONDENSING UNIT	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 464 FAN	1.5	4380	1.7	\$21.15	\$442	0.5	20.9
BUILDING 464 FAN	1.5	4380	1.7	\$21.15	\$442	0.5	20.9
BUILDING 465 COMPRESSOR	5	5000	5.5	\$68.42	\$644	1.2	9.4
BUILDING 465 COMPRESSOR	5	5000	5.5	\$68.42	\$644	1.2	9.4
BUILDING 465 COLD WATER PUMP	1.5	4380	1.7	\$21.15	\$442	0.5	20.9
BUILDING 465 HOT WATER PUMP	7.5	4380	7.1	\$88.32	\$820	1.2	9.3
BUILDING 465 AIR HANDLING UNIT	2	4380	1.8	\$22.39	\$466	0.5	20.8
BUILDING 465 AIR HANDLING UNIT	1	4380	1.3	\$16.17	\$420	0.4	26.0
BUILDING 465 AIR HANDLING UNIT	1	4380	1.3	\$16.17	\$420	0.4	26.0
BUILDING 472 HOT WATER PUMP	3	4380	4.1	\$51.00	\$582	1.0	11.4
BUILDING 472 FAN	1.5	4380	1.7	\$21.15	\$442	0.5	20.9
BUILDING 473 HOT WATER PUMP	3	4380	4.1	\$51.00	\$582	1.0	11.4
BUILDING 473 HOT WATER PUMP	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 474 BOILER FEED PUMP	40	8760	44.8	\$557.31	\$2,623	2.4	4.7
BUILDING 474 FAN	10	8760	15.1	\$187.84	\$966	2.2	5.1
BUILDING 474 FAN	10	8760	15.1	\$187.84	\$966	2.2	5.1
BUILDING 474 FAN	10	8760	15.1	\$187.84	\$966	2.2	5.1
BUILDING 474 CONDENSATE PUMP	10	8760	15.1	\$187.84	\$966	2.2	5.1
BUILDING 474 CONDENSATE PUMP	10	8760	15.1	\$187.84	\$966	2.2	5.1
BUILDING 474 AIR COMPRESSOR	3	8760	8.1	\$100.76	\$582	1.9	5.8
BUILDING 474 AIR COMPRESSOR	25	8760	34.1	\$424.20	\$1,780	2.7	4.2
25-YEAR DISCOUNT FACTOR= 11.16							

CALCULATION SHEET		DATE Mar-90	SHEET OF 2 - 2
PROJECT USDB ENERGY SAVINGS OPPORTUNITY SURVEY		BASIS FOR CALCULATION	
LOCATION FORT LEAVENWORTH, KS		☒ HAND ☐ COMPUTER ☐ CONTRACTOR BID ☐ OTHER (SPECIFY)	
ARCHITECT/ENGINEER CLARK RICHARDSON & BISKUP		COMPUTED BY DJG	CHECKED BY MAW
ECO MEASURE ECO-E3			

BUILDING # AND MOTOR DESCRIPTION	HP	OPER. HOURS/ YEAR	SAVINGS PER YEAR MBTU'S	SAVINGS PER YEAR DOLLARS	INSTALLED COST	SIR	PAYBACK YEARS
BUILDING 475 ROTUNDA CONDENSING UNIT	3	4380	4.1	\$51.00	\$582	1.0	11.4
BUILDING 475 ROTUNDA CONDENSING UNIT	7.5	4380	7.1	\$88.32	\$820	1.2	9.3
BUILDING 475C FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475C FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475D FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475D FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475F FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475F FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475G FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
BUILDING 475G FAN	5	4380	4.8	\$59.71	\$644	1.0	10.8
TOTAL (SIR > 1)			248	\$3,085.00	\$20,929	1.6	6.8

25-YEAR DISCOUNT FACTOR= 11.16

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7
 PROJECT NO. & TITLE: 1496
 FISCAL YEAR 1990
 ANALYSIS DATE: 03-19-90

STUDY: USDBAE
 LCCID 1.035
 CENSUS: 2

DISCRETE PORTION NAME: GROUP #7
 ECONOMIC LIFE 15 YEARS
 PREPARED BY: CRB

1. INVESTMENT		
A. CONSTRUCTION COST	\$	20929.
B. SIOH	\$	1256.
C. DESIGN COST	\$	1151.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	21002.
E. SALVAGE VALUE COST	\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	21002.

2. ENERGY SAVINGS (+) / COST (-)
 ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 12.44	248.	\$ 3085.	11.16	34429.
B. DIST	\$.00	0.	\$ 0.	17.19	0.
C. RESID	\$.00	0.	\$ 0.	17.12	0.
D. NAT G	\$ 4.08	0.	\$ 0.	16.15	0.
E. COAL	\$.00	0.	\$ 0.	13.92	0.
F. TOTAL		248.	\$ 3085.		\$ 34429.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11		
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4)		\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST			
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$ 11362.		
A IF 3D1 IS = OR > 3C GO TO ITEM 4			
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=			
C IF 3D1B IS = > 1 GO TO ITEM 4			
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY			

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	3085.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	34429.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.64	
(IF < 1 PROJECT DOES NOT QUALIFY)		
7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4	6.81	

11-1

731

[illegible]

ATION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Replace existing standard efficiency motors with high efficiency motors, where economically feasible. Use energy efficient motors when replacing motors during regular maintenance. This will result in higher complex power factors at the USDB and less electrical energy consumption.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

Energy will continue to be wasted by operation of standard efficiency motors.

[illegible]

FORWARD FOR APPROVAL				APPROVED FOR DESIGN		SOURCE OF FUNDS
RECOMMENDED ACTION	ENVIRONMENTAL IMPACT NO YES	ESTIMATED COST	WORK TO BE PERFORMED	FROM	SIGNATURE	DATE
☐ APPROVAL ☐ DISAPPROVAL	☒ ENVIRONMENTAL CONSIDERATIONS ☐ EIS/EIA ☐ INITIATED ☒ EIS/EIA COMPLETED	FUNDED \$ 22,185 WC X WC L WC — UNFUNDED \$ 1,008 TOTAL \$ 23,193	☐ IN-HOUSE ☐ SELF-HELP ☐ CONTRACT ☐ TROOP	FACILITIES ENGINEER		
NG AUTHORITY						

APPROVAL ACTION									
DOCUMENT NUMBER				ACTION TAKEN		DATE		FORWARDED TO	
SERIAL		NUMBER		TYPE		MO		OA	
5	6	7	8	9	10	11	12	13	14
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						17		18	
						19		20	
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						99		100	

73 4283 EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED.

GROUP 7 - PAGE 6

WHITE (ORIGINAL) - PROJECT FILE COPY
PINK - FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK

GREEN
-- FORWARD TO KEYPUNCH AFTER
COMPLETION OF "FORWARD FOR
APPROVAL" BLOCK