

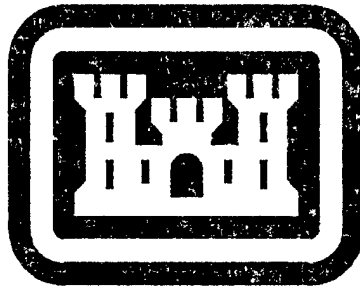
# ***(EEAP) LIGHTING SURVEY STUDY***

***AT THE***

## ***RED RIVER ARMY DEPOT***

***TEXARKANA, TEXAS***

### ***FINAL REPORT***



**US Army Corps  
of Engineers**

Fort Worth Division

***CONDUCTED BY***

***HUITT-ZOLLARS, INC.***

***CONSULTING ENGINEERS***

***FORT WORTH, TEXAS***

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(EEAP) Lighting Survey Study  
at the  
Red River Army Depot  
Texarkana, Texas

FINAL REPORT  
May 15, 1995

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## I. EXECUTIVE SUMMARY

### A. Introduction

This energy conservation study was performed by Huitt-Zollars Inc, for the U.S. Army Engineer District (USAED), Fort Worth, under contract number DACAC63-94-D-0015. The study was conducted at Red River Army Depot (RRAD) in Texarkana, Texas, between October 17, 1994 and April 14, 1995. The site survey and data collection were performed by C.A. Pieper, P.E. and Tom Lockett, Lighting Designer.

The purpose of the study was to perform a limited site survey of specific buildings at the facility, identify specific Energy Conservation Opportunities (ECOs) that exist, and then evaluate these ECOs for technical and economic feasibility. These ECOs were limited to building interior lighting and it's effects on the heating, ventilating and air conditioning (HVAC) systems.

This survey was conducted with the assistance of many individuals at the facility. Special thanks is extended to all who assisted, including the following individuals:

Ross Ramsauer, Energy Coordinator  
Doyle Grider, Electrical Maintenance Supervisor  
Wayne Rahea, Planner & Estimator

Any questions concerning this report should be directed to the Project Manager, C.A. Pieper, P.E., at Huitt-Zollars Inc., 512 Main Street, Suite 1500, Fort Worth, Texas 76102. Phone 817-335-3000.

### B. Buildings Studied

The buildings included in this study and their total building areas are listed below:

Building 323, Vehicle Rehab	- 59,392 sqft
Building 468, School / Clinic	- 59,614 sqft
Building 15, Post Headquarters	- 31,267 sqft
Building 441, Small Arms Repair / Whs.	- 37,267 sqft
Building 133, Misc. Trade Work	- 13,654 sqft
Building 245, Maintenance Shops	- 15,827 sqft
Building 315, Vehicle Rehab	- 43,776 sqft
Building 321, Body Shop	- 123,648 sqft
Building 345, Vehicle Rebuild / Gun Shop	- 370,688 sqft
Building 421, Facility Maintenance	- 51,456 sqft

### C. Present Energy Consumption

*Base Year Energy Consumption:* The total metered electrical and gas consumptions for 12 consecutive months, prior to this study, were obtained from the facility and are referred to as the 'base year'. These data are shown on page 8 and are summarized as follows:

Electrical	59.344 MWH
Natural Gas	156,471 MCF

*Lighting Energy Consumption:* The present annual lighting energy consumption (HVAC not included) for the building areas studied was calculated on page B-2 as follows:

Lighting Energy	1,932,080 KWH
	3.2% of base year total

### D. Energy Conservation Opportunity (ECO) Analysis

*ECOs Rejected:* After reviewing the data collected at the facility and considering all of the practical limitations involved, certain potential ECOs were rejected prior to performing calculations. These ECOs are summarized below with their reasons for rejection.

1. *Install Additional Switches in Large Areas, Turn Lights Off:* Most of the building areas were found to be evenly occupied during working hours, and the addition of extra switches for groups of lights in a large area would not allow lights to be turned off. Those areas that had irregular or intermittent occupancy were considered for adding occupancy sensors to turn off lights. See ECO 3 in Appendix E.
2. *Install Fluorescent Reflectors in Existing Fixtures:* This ECO requires installing the polished silver reflectors into 4 lamp fluorescent fixtures and then removing 2 lamps and a ballast. While this cuts the fixtures energy consumption in half, it also drops the lumen output from the fixture by at least 1/3, based on IES tests. Therefore, an area must be overlighted by at least 33% in order to maintain acceptable light levels. Very few areas were found that could meet this criteria.
3. *Replace Exit Signs With Low Wattage Signs:* There are many different types of exist signs at RRAD, and many are not illuminated. Because there appears to be no stringent requirement for illuminated exit signs at the facility, any uniform replacement of the existing signs with low wattage illuminated signs would likely increase the lighting energy consumption. However, all new exit sign installations should be standardized to use only low wattage LED or fluorescent types, rather than the incandescent type.
4. *Install Compact Fluorescent Lamps in Incandescent Fixtures:* These new compact fluorescent lamps can be easily replaced at a later time with inefficient incandescent lamps, therefore eliminating the benefit of any lamp retrofit project. Since the longevity of this energy conservation retrofit cannot be guaranteed, this potential ECO has been rejected.

*ECOs Recommended:* Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility and are recommended for implementation. Complete documentation of all calculations as well as information required for implementation is included in Appendix D. These recommended ECOs are summarized below in order of descending Savings to Investment Ratio (SIR).

ECO 2: Replace Existing Fluorescent Lighting With Electronic Fluorescent Lighting

Electrical Energy Savings	539,071	KWH/yr
Electrical Demand Savings	2,694	KW-mo/yr
Natural Gas Energy Penalty	915.0	MMBTU/yr
Net Energy Savings	924.8	MMBTU/yr
Annual Cost Savings	30,980	\$/yr
Total Investment	206,512	\$
Simple Payback	6.6	yrs
SIR	2.21	

ECO 1: Replace Existing Incandescent And Mercury Vapor Lighting.

Electrical Energy Savings	214,901	KWH/yr
Electrical Demand Savings	1,126	KW-mo/yr
Natural Gas Energy Penalty	369.0	MMBTU/yr
Net Energy Savings	364.4	MMBTU/yr
Annual Cost Savings	18,494	\$/yr
Total Investment	165,411	\$
Simple Payback	8.9	yrs
SIR	1.65	

*ECOs Not Recommended:* Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility but are not recommended for implementation. Complete documentation of all calculations are included in Appendix E. These non-recommended ECOs are summarized below in order of order of descending SIR.

ECO 3: Provide Motion Sensor Controls For Lights

Electrical Energy Savings	1,659	KWH/yr
Electrical Demand Savings	0	KW-mo/yr
Natural Gas Energy Penalty	0	MMBTU/yr
Net Energy Savings	5.6	MMBTU/yr
Annual Cost Savings	42	\$/yr
Total Investment	1,716	\$
Simple Payback	41.1	yrs
SIR	0.37	

Because of the long payback period and the low SIR, this ECO is not recommended for implementation.

*ECIP Projects Developed.* The facility decided not to submit any projects for ECIP funding. All projects will be submitted for funding as Non-ECIP projects.

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*Non-ECIP Projects Developed.* Project 1 below will be submitted by the facility for funding as a non-ECIP project. However, there is some opposition to the implementation of Project 2 within the facility staff. It has been included in this summary in case the opposition is eliminated and the staff decide to implement it in an effort to conserve energy:

Project 1: Replace Existing Incandescent And Mercury Vapor Lighting.

Electrical Energy Savings	214,901	KWH/yr
Electrical Demand Savings	1,126	KW-mo/yr
Natural Gas Energy Penalty	369.0	MMBTU/yr
Net Energy Savings	364.4	MMBTU/yr
Annual Cost Savings	18,494	\$/yr
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Net Energy Savings	924.8	MMBTU/yr
Annual Cost Savings	30,980	\$/yr
Total Investment	206,512	\$
Simple Payback	6.6	yrs
SIR	2.21	

*Recommended Maintenance & Operations Practices:* The following maintenance and operations (M&O) practices are recommended to help conserve lighting energy at the RRAD.

1. The Energy Coordinator should work together with the RRAD Director of Public Works to develop a Standard Specification for all future lighting repair and renovation projects. All facility lighting designers, as well as the lighting maintenance contractors, should be required to follow this specification. The energy coordinator should review all new lighting designs to check for compliance with the specifications. This will help to eliminate the inadvertent use of inefficient lighting systems at the facility.
2. Facility lighting designers should obtain and use published design lighting levels for all lighting renovation projects or new installations. This will help to eliminate overlighting.
3. The installation of new incandescent lighting should be prohibited. More efficient sources should be used in all cases.
4. The energy coordinator should direct considerable energy conservation efforts towards the production processes using electrical energy, as this is the largest area of potential savings. See page 8, *Utility Data*, for more details.
5. The energy coordinator should attend training seminars for building energy managers, such as those listed in Appendix G, whenever possible.

E. Energy And Cost Savings

*Total Potential Energy and Cost Savings.* The calculated energy and cost savings from the implementation of both projects is as follows:

Electrical Energy Savings	753,972	KWH/yr
Electrical Demand Savings	3,820	KW-mo/yr
Natural Gas Energy Penalty	1,284	MMBTU/yr
Total Energy Savings	1,289	MMBTU/yr
Total Cost Savings	49,474	\$/yr
Total Investment	371,923	\$
Simple Payback	7.5	yrs

*Energy Use and Costs Before and After.* Based on the base year electrical and gas energy consumptions and costs shown on page 8, and the calculated total potential savings above, the RRAD energy and usage and costs before and after implementation of the two Non-ECIP projects is as follows:

	<u>Before</u>	<u>After</u>
Electrical	59.344 MWH	58.590 MWH
Natural Gas	156,471 MCF	157,755 MCF
Total Cost	2,943,671 \$	2,894,197 \$

*Percentage Saved.* Based on the base year electrical and gas energy consumptions and costs, the percentage of savings from the two projects is as follows:

$$\text{Electrical Energy Saved} = \left[ \frac{0.753 \text{ MWH}}{59.344 \text{ MWH}} \right] = 1.3\%$$

$$\text{Gas Energy Penalty} = \left[ \frac{1,284 \text{ MCF}}{156,471 \text{ MCF}} \right] = 0.8\%$$

$$\text{Energy Cost Savings} = \left[ \frac{49,474 \text{ \$}}{2,943,671 \text{ \$}} \right] = 1.7\%$$

## II. NARRATIVE REPORT

### A. Entry Interview

*Work Plan:* An entry interview meeting was conducted at the Red River Army Depot (RRAD) facility on October 17, 1994. Present at the meeting were representatives of Huitt Zollars Inc., C.A. Pieper, *Project Manager*, and Tom Luckett, *Lighting Designer*, as well the representative from RRAD, Ross Ramsauer, *Energy Coordinator*. At that time, a description of the work plan for this study was presented. The work plan was a summary of the individual tasks to be performed to complete the lighting survey and the approximate date that each task was to begin. Each step of the work plan was described in detail to the RRAD staff. The work plan is shown in Figure 1.

Figure 1. Work Plan

10/17/94	Entry Interview Meeting
10/17/94	Lighting & Building Data Collection
11/21/94	Perform ECO Calculations
12/14/94	Interim Findings Submittal
2/17/95	Pre-Final Report Submittal
4/5/95	Final Report Submittal

*Data List:* After discussing the work plan, the RRAD staff was presented a list of data items to be collected by the study team, shown in Figure 2. The study team and RRAD staff discussed the methods by which all of the data on the list were to be obtained. The data concerning the existing lighting systems and light levels were to be collected from the buildings or areas studied and recorded onto preprinted data forms. All other data were to be obtained from the facility personnel responsible for each item. The RRAD representative provided useful information on past energy conservation efforts, as well as any ongoing or future

Figure 2. Data Acquisition List

1. Existing lighting systems in buildings.
2. Existing light levels in buildings.
3. Building HVAC system efficiencies and operational hours.
4. Building size, age and remaining useful life.
5. Existing lighting operational periods and area usage.
6. Facility electricity, gas, other utility rates.
7. Facility electricity, gas, other utility consumptions.
8. Utility company rebate programs.
9. Past lighting energy conservation projects.
10. Proposed or planned lighting energy conservation projects.
11. Typical lighting maintenance procedures, costs and materials.
12. Typical lighting retrofit procedures.

planned energy conservation measures. Also, he provided direction as to where to obtain other information on the list. Any security passes that the surveyors needed to gain access to the facility were discussed and plans were made to obtain them.

*ECO List:* Following the discussion on the data list, the RRAD personnel were presented a list of specific Energy Conservation Opportunities (ECOs) that the surveyors were looking for. It included three general ways to conserve on lighting energy. The first method reduces lighting energy consumption by simply removing lamps or fixtures from areas which are currently overlighted or which could be modified to reduce the need for the existing quantity of lights. Light levels were to be measured by the surveyors and compared with design standards to determine whether or not an area was overlighted. The second method saves energy by turning lights off with additional switches, motion sensors or daylight sensors. Areas which were partially

or intermittently unoccupied, or which had sufficient daylight from windows or skylights were to be located by the surveyors. The third method saves energy by reducing the wattage of the existing light source. The surveyors were to look for inefficient light sources within the buildings. These three general energy conservation strategies were discussed in detail with the RRAD staff, who provided feedback on potential applications at their facilities. The ECO list is shown in Figure 3.

## B. Data Collection

*Building Data:* This lighting study at the RRAD was originally targeted at forty nine (49) buildings, with many different functions, ranging from administrative offices, to storage and production facilities. All of the buildings are located at the Red River Army Depot in Texarkana, Texas. However, during the field survey, a total of thirteen (13) buildings were dropped, due to security access reasons. These buildings were the 600, 900 and 1100 series buildings, listed in the Scope of Work, in Appendix F (see page F-9).

All of the thirty-six (36) remaining buildings were field surveyed, and there were no duplicate type buildings found. Therefore, the ten (10) buildings with the greatest potential for lighting energy savings were selected for the detailed study. The total building area covered in the initial survey was 1,733,553 sqft. General data on each of the 10 buildings selected for detailed study are provided on the Building Data Sheets in Appendix C. The total area of the 10 buildings selected was 806,589 sqft. The buildings selected for detailed study were listed on page 1.

*Lighting Data:* In order to collect the existing lighting data, a walk through of the buildings was performed. This walk through covered all of the buildings included in the study. During the walk through, the auditors went room by room, recording the quantity and type of existing lighting systems, measured average light levels, and potential ECOs available. These data were recorded onto the Energy Conservation Opportunity (ECO) data forms included in Appendix C. Building maps are also included in Appendix C, which show room numbers corresponding to those listed on the data forms. This will allow the facility staff, as well as the study team, to readily identify the existing lighting conditions anywhere in the buildings studied.

The interior lighting is currently operated during the entire work day, which runs from 6:45 am until 5:15 pm. The total annual lighting energy consumption for the buildings studied was calculated at 1,932,080 KWH, see Appendix B. Many areas have very old incandescent, fluorescent or mercury vapor lighting, which should be replaced with newer, more efficient fixtures whenever possible.

Figure 3. Energy Conservation Opportunity (ECO) List

1. Reduce / Enhance Lighting: Remove Lamps and or Fixtures.
  - a) Overlighted areas
  - b) Increase daylighting
  - c) Lower fixtures
  - d) Paint walls and ceiling light color.
2. Improve Lighting Controls: Turn Lights Off.
  - a) Occupancy sensors
  - b) Additional switches in large areas
3. Improve Lighting Efficiency: Reduce Lighting Wattage
  - a) Replace incandescent source with more efficient source
  - b) Install more efficient fluorescent lamps / ballasts / reflectors
  - c) Replace existing HID with more efficient HID source

*Maintenance Data:* Lighting maintenance at RRAD is currently performed by both outside contractors, and in-house personnel, due to the size of the facility, the number of light fixtures, and the reduced size of the maintenance staff. The facility energy coordinator is not involved in most of the building maintenance and renovation projects, and therefore has no direct control over the type of lighting used. No lighting energy conservation projects were planned at the time of this report. During the building walk through, the following additional observations were made.

1. Incandescent lighting remained in use in areas where newer High Pressure Sodium lighting had been installed to replace it. The incandescent fixtures should have been removed.
2. Light fixtures remained in use over top of areas where partitions and ceilings had been added to create office space in large open buildings. These fixtures should have been removed.
3. Many rooms or areas were found unoccupied with all of the lights burning. Occupancy sensors should be installed wherever possible to turn these lights off.
4. Workmen were observed installing incandescent fixtures in a building for task lighting. Fluorescent fixtures should have been used.
5. In a building under renovation, new fluorescent fixtures were being installed in a corridor, which were poorly suited to the task involved. A more suitable fixture should have been selected by the designer.
6. Many newly renovated areas were overlighted. Lighting level design standards should be obtained and followed in future lighting projects.
7. No relamping standard is followed by the maintenance contractors. Energy efficient lamps, ballasts, fixtures, etc, should be required to be installed wherever possible.

*Utility Data:* A 12 month utility billing history was obtained from the energy coordinator, which covered the period from August, 1993 through July, 1994. These data are to be referenced as a 'base year', and included all of the metered electric and natural gas consumption for the facility. The data are shown in Figure 4. The total cost of electricity for the base year was \$2.4 million and the total cost for natural gas was \$0.4 million.

Figure 4. RRAD Base Year Energy and Cost Data

Billing Period	Electrical			Natural Gas	
	Consumption	Demand	Cost	Consumption	Cost
	MWH	KW	\$	MCF	\$
AUG	5.832	14,111	242,366	4,661	13,228
SEP	5.688	14,263	241,257	4,720	12,134
OCT	4.291	12,337	190,072	5,387	16,463
NOV	4.349	11,612	188,280	18,571	56,913
DEC	5.198	12,001	215,204	27,469	81,336
JAN	4.421	12,286	182,213	29,838	87,286
FEB	4.666	12,026	183,857	22,787	66,289
MAR	4.450	11,833	180,680	16,730	49,803
APR	4.594	12,234	186,613	10,486	34,557
MAY	4.666	12,623	200,637	5,610	17,180
JUN	5.458	14,567	229,179	3,551	11,214
JUL	5.731	13,789	237,776	6,661	19,134
Total	59.344	153,682	2,478,134	156,471	465,537

Charts of the base year energy usages were plotted and are shown in Figures 5 and 6. These charts provide a visual representation of the energy usage patterns for the year.

Looking at Figure 5, it can be seen that the electrical usage almost never falls below 4.5 MWH per month. This is considered a 'baseline' of electrical energy use. It can be assumed that all energy usage above this baseline is used for heating and cooling systems, based on the peaks and the months in which they occur. Therefore, the baseline would include all of the lighting as well as the manufacturing process energy usage. Considering that the calculated lighting energy consumption for the buildings studied amounts to only 0.161 MWH per month, it is reasoned that the process electrical energy usage makes the greatest contribution to the baseline of 4.5 MWH per month.

Since this process energy usage appears to be so much greater than that for lighting, the potential for process energy savings is considered very great. Therefore, it is recommended that the energy coordinator direct considerable conservation efforts to process energy usage.

Looking at Figure 6, the monthly baseline of usage is about 5,000 MCF, which is domestic and process hot water, as well as food service energy. It is clear that heating is the main use of gas at the facility, based on the obvious peak between October and May. Still, some energy savings might be obtained by directing some conservation efforts at the baseline usage of gas at the facility.

The electric utility rate schedule from the Southwestern Electric Power Company (SWEPCO), and the natural gas rate schedule from ENRON are included in Appendix A. There is currently no rebate available from the SWEPCO for lighting energy conservation projects. The current avoided costs for electricity and gas are \$0.0254 per KWH, \$5.01 per KW of peak demand, and \$1.89 per MMBTU of gas. These avoided costs are the marginal savings per unit of energy and demand savings at the facility. See Appendix A for a complete analysis of the utility rates.

Figure 5. RRAD Electrical Usage 1993-94

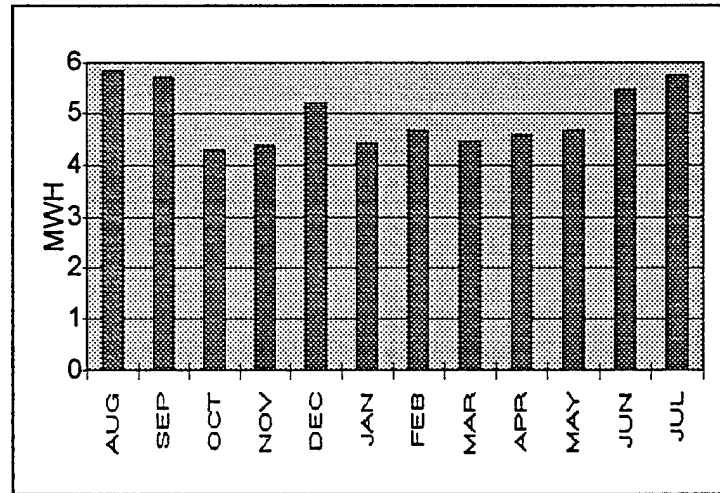
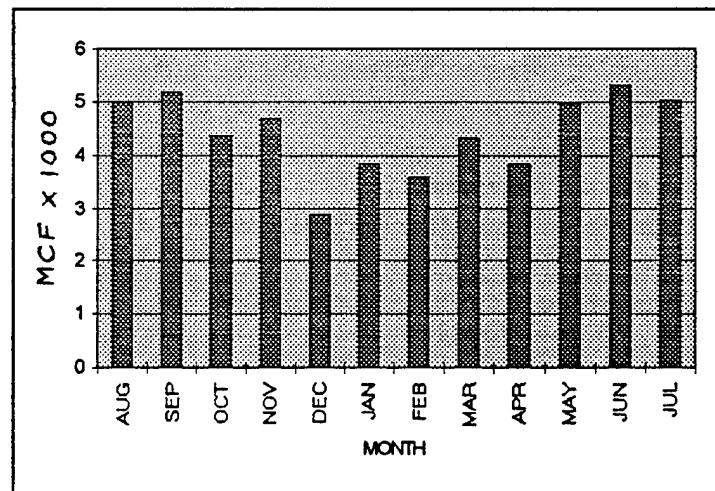


Figure 6. RRAD Natural Gas Usage 1993-94



C. Plan To Implement Projects:

The analysis of all potential lighting ECOs at the facility has been completed and the grouping of individual ECOs into projects has been determined. These were detailed previously in the Executive Summary. Below is an abbreviated plan for implementation of the recommended projects.

*Project 1:* The forms DD-1391, cost estimate and associated life cycle cost analysis summary sheet for this project are provided on pages 12 to 15. These are to be submitted for project funding, along with the calculations in Appendix D if required. The recommended plan to implement this project after funding is obtained is as follows:

- A. This project shall require a new lighting layout design, demolition and removal of existing fixtures, and installation of new fixtures and associated wiring. The new design should call for the removal of approximately 825 existing incandescent and mercury vapor light fixtures, and installation of approximately 676 new fluorescent and high pressure sodium light fixtures. The existing fixtures are identified on a room by room basis on the ECO data sheets on pages C-3 through C-69 for the designer. The new fixtures should be selected by the designer on a room by room basis, using the replacement light sources shown in the following table.

EXISTING FIXTURE LIGHT SOURCE	RECOMMENDED NEW FIXTURE LIGHT SOURCE
60W Incandescent	18W Fluorescent
100W Incandescent	26W Fluorescent
150W Incandescent	32W Fluorescent
200W Incandescent	(2) 32W Fluorescent
300W Incandescent	(3) 32W Fluorescent
160W Mercury	32W Fluorescent
175W Mercury	100W HPS
250W Mercury	150W HPS
400W Mercury	200W HPS
1000W Mercury	400W HPS

- B. The fluorescent fixtures should be specified with electronic ballasts and T8 lamps. Locate the new light fixtures over desks or other work tables as required to provide the design light levels at the work station in each room. All switching and circuitry is to remain the same wherever possible.

*Project 2:* The forms DD-1391, cost estimate and associated life cycle cost analysis summary sheet for this project are provided on pages 16 to 19. These are to be submitted for project funding, along with the calculations in Appendix D if required. The recommended plan to implement this project after funding is obtained is as follows:

- A. This project shall require a new lighting layout design to obtain IES recommended design lighting levels by removing approximately 441 existing fixtures in overlit rooms. These rooms are identified in the savings calculation spreadsheets on pages D-40 through D-64. The design should call for the removal of the extra fixtures in the rooms identified as having an existing lighting level greater than the new light level, and repair of the ceilings as required for aesthetics.
  
- B. The design should call for the removal of magnetic ballasts and T12 lamps from 2,873 existing fluorescent light fixtures and the installation of electronic ballasts and T8 lamps in the fixtures. The 'new fixture' quantities are identified on a room by room basis in the savings calculation spreadsheets on pages D-40 through D-64. In some cases it may be less expensive to simply replace the fixtures with new ones, depending upon the age and condition of the existing fixtures. This should be determined by the designer on a room by room basis. All switching and circuitry is to remain the same.

1. COMPONENT ARMY		FY 1996 MILITARY CONSTRUCTION PROJECT DATA			2. DATE 14, APR, 1995			
3. INSTALLATION AND LOCATION RED RIVER ARMY DEPOT, TEXARKANA, TEXAS				4. PROJECT TITLE REPLACE INC. & MERCURY LIGHTING				
5. PROGRAM ELEMENT		6. CATAGORY CODE	7. PROJECT NUMBER		8. PROJECT COST (\$000) 165.0			
9. COST ESTIMATES								
ITEM					U/M	QUANTITY	UNIT COST	COST (\$000)
Replacement of existing inefficient incandescent and mercury vapor lighting with more efficient lighting.					EA	1	165.0	165.0
ESTIMATED CONTRACT COST								148.351
CONTINGENCY (0%)								0.0
SIOH								8.159
DESIGN								<u>8.901</u>
TOTAL REQUEST								165.411
TOTAL REQUEST (ROUNDED)								165.000
10. DESCRIPTION OF PROPOSED CONSTRUCTION								
<p>Remove 825 existing incandescent and mercury vapor light fixtures, and replace them with 676 new fluorescent and high pressure sodium light fixtures. The fluorescent fixtures should be specified with electronic ballasts and T8 lamps. Locate the new light fixtures over desks or other work tables as required to provide the design light levels at the work station in each room. This project shall require a new lighting layout design, demolition and removal of existing fixtures, and installation of new fixtures and associated wiring. All switching and circuitry is to remain the same wherever possible.</p>								

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3. INSTALLATION AND LOCATION RED RIVER ARMY DEPOT, TEXAS																								
4. PROJECT TITLE REPLACE INC . & MERCURY LIGHTING		5. PROJECT NUMBER																						
11. REQUIREMENT  The project is required to reduce lighting energy consumption at the Red River Army Depot facilities. The project provides new interior lighting, which will be more efficient than the existing lighting, in order to save lighting energy and cost. All buildings included in this project will be active throughout the payback period. Installation of this lighting will result in the following: <table data-bbox="308 630 1266 913" style="margin-left: 40px;"> <tr> <td>Electrical Savings</td> <td style="text-align: right;">214,901</td> <td style="text-align: right;">KWH/yr</td> </tr> <tr> <td>Electrical Demand Savings</td> <td style="text-align: right;">1,126</td> <td style="text-align: right;">KW</td> </tr> <tr> <td>Natural Gas Penalty</td> <td style="text-align: right;">369.0</td> <td style="text-align: right;">MMBTU/yr</td> </tr> <tr> <td>Total Energy Savings</td> <td style="text-align: right;">364.4</td> <td style="text-align: right;">MMBTU/yr</td> </tr> <tr> <td>Cost Savings</td> <td style="text-align: right;">18,494</td> <td style="text-align: right;">\$/yr</td> </tr> <tr> <td>Payback Period</td> <td style="text-align: right;">8.9</td> <td style="text-align: right;">yrs</td> </tr> <tr> <td>SIR</td> <td style="text-align: right;">1.65</td> <td></td> </tr> </table> CURRENT SITUATION: The facility currently has numerous incandescent and mercury vapor lighting systems in it's buildings. These existing light sources are inefficient and should be replaced with more efficient light sources, such as fluorescent and high pressure sodium. IMPACT IF NOT PROVIDED If this project is not provided, a reduction of 364.4 MMBTU per year of energy and \$18,494 of utility and maintenance costs will continue to be wasted. There will be no contribution to energy reduction goals established at the facility. Also, mercury vapor lamps are now considered hazardous waste and require special and expensive disposal. Implementation of this project will save disposal costs in addition to the energy and maintenance savings shown.				Electrical Savings	214,901	KWH/yr	Electrical Demand Savings	1,126	KW	Natural Gas Penalty	369.0	MMBTU/yr	Total Energy Savings	364.4	MMBTU/yr	Cost Savings	18,494	\$/yr	Payback Period	8.9	yrs	SIR	1.65	
Electrical Savings	214,901	KWH/yr																						
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SIR	1.65																							



LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: RRAD

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID FY95 (92)

INSTALLATION & LOCATION: RRAD      REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03-0185-01 LIGHTING SURVEY STUDY

FISCAL YEAR 1995      DISCRETE PORTION NAME: PROJECT1

ANALYSIS DATE: 04-14-95      ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	\$	148351.	
B. SIOH	\$	8159.	
C. DESIGN COST	\$	8901.	
D. TOTAL COST (1A+1B+1C)	\$	165411.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$	0.	
F. PUBLIC UTILITY COMPANY REBATE	\$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$ 165411.

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

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS				OCT 1994	
FUEL	UNIT COST	SAVINGS	ANNUAL \$	DISCOUNT	DISCOUNTED
	\$/MBTU(1)	MBTU/YR(2)	SAVINGS(3)	FACTOR(4)	SAVINGS(5)
A. ELECT	\$ 7.44	733.	\$ 5456.	15.08	\$ 82284.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 1.89	-369.	\$ -697.	18.58	\$ -12958.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 5641.	14.88	\$ 83938.
N. TOTAL		364.	\$ 10400.		\$ 153264.

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

A. ANNUAL RECURRING (+/-)		\$ 8094.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$ 120439.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+)	YR	DISCNT	DISCOUNTED
	COST(-)	OC	FACTR	SAVINGS(+)/
	(1)	(2)	(3)	COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 120439.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$  \$ 18494.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.94 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 273703.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.65  
(IF < 1 PROJECT DOES NOT QUALIFY)

1. COMPONENT ARMY		FY 1996 MILITARY CONSTRUCTION PROJECT DATA			2. DATE 14, APR, 1995	
3. INSTALLATION AND LOCATION RED RIVER ARMY DEPOT, TEXARKANA, TEXAS			4. PROJECT TITLE UPGRADE FLUORESCENT LIGHTING			
5. PROGRAM ELEMENT		6. CATAGORY CODE	7. PROJECT NUMBER		8. PROJECT COST (\$000) 207.0	
9. COST ESTIMATES						
ITEM			U/M	QUANTITY	UNIT COST	COST (\$000)
Replacement of existing inefficient fluorecent ballasts and lamps with more efficient electronic ballasts and lamps.			EA	1	207.0	207.0
ESTIMATED CONTRACT COST						185.212
CONTINGENCY (0%)						0.000
SIOH						10.187
DESIGN						11.113
TOTAL REQUEST						206.512
TOTAL REQUEST (ROUNDED)						207.000
10. DESCRIPTION OF PROPOSED CONSTRUCTION						
Remove 441 fluorecent light fixtures from overlit areas. Remove existing magnetic ballasts and T12 lamps in all remaining fluorecent light fixtures and replace them with new electronic ballasts and T8 lamps. The total number of fixtures affected by this ballast and lamp retrofit is 2,873.						

1. COMPONENT ARMY	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 14, APR, 1995																					
3. INSTALLATION AND LOCATION RED RIVER ARMY DEPOT, TEXARKANA, TEXAS																							
4. PROJECT TITLE UPGRADE FLUORESCENT LIGHTING	5. PROJECT NUMBER																						
<p>11. REQUIREMENT</p> <p>The project is required to reduce lighting energy consumption at the Red River Army Depot facilities. The project provides new electronic fluorescent lighting, which will be more efficient than the existing fluorescent lighting, in order to save lighting energy and cost. All buildings included in this project will be active throughout the payback period. Installation of this lighting will result in the following:</p> <table border="0" data-bbox="300 630 1250 913"> <tr> <td>Electrical Savings</td> <td>539,071</td> <td>KWH/yr</td> </tr> <tr> <td>Electrical Demand Savings</td> <td>2,694</td> <td>KW</td> </tr> <tr> <td>Natural Gas Penalty</td> <td>915.0</td> <td>MMBTU/yr</td> </tr> <tr> <td>Total Energy Savings</td> <td>924.8</td> <td>MMBTU/yr</td> </tr> <tr> <td>Cost Savings</td> <td>30,980</td> <td>\$/yr</td> </tr> <tr> <td>Payback Period</td> <td>6.6</td> <td>yrs</td> </tr> <tr> <td>SIR</td> <td>2.21</td> <td></td> </tr> </table> <p>CURRENT SITUATION:</p> <p>The facility currently has much fluorescent lighting in it's buildings. These existing light fixtures typically have the T12 lamps and standard magnetic ballasts. Also, many areas were found to be overlighted, when compared to the Illumination Engineers Society (IES) design light levels.</p> <p>The existing lamps and ballasts should be replaced with new electronic ballasts and T8 lamps. These newer lamps and ballasts are more efficient and use less energy. Also, in areas which are currently overlighted, the quantity of fixtures should be reduced. The new lighting layout design should consider the design light levels recommended by the IES, and place the fixtures over desks, work tables or work stations. This will maintain recommended levels at the work stations while not overlighting the surrounding work areas.</p> <p>IMPACT IF NOT PROVIDED</p> <p>If this project is not provided, a reduction of 924.8 MMBTU per year of energy and \$30,980 of utility and maintenance costs will continue to be wasted. There will be no contribution to energy reduction goals established at the facility.</p>			Electrical Savings	539,071	KWH/yr	Electrical Demand Savings	2,694	KW	Natural Gas Penalty	915.0	MMBTU/yr	Total Energy Savings	924.8	MMBTU/yr	Cost Savings	30,980	\$/yr	Payback Period	6.6	yrs	SIR	2.21	
Electrical Savings	539,071	KWH/yr																					
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Natural Gas Penalty	915.0	MMBTU/yr																					
Total Energy Savings	924.8	MMBTU/yr																					
Cost Savings	30,980	\$/yr																					
Payback Period	6.6	yrs																					
SIR	2.21																						

# ENGINEER'S ESTIMATE OF PROBABLE COST

**LOCATION:** Red River Army Depot, Texas  
**PROJECT NO:** 03-0185.01      **DATE:** 4/14/95  
**BY:** PIEPER, C.A.      **CHECKED BY:** X

**PROJECT DESCRIPTION:** Project-2, Replace Existing Fluorescent Lighting With Electronic Fluorescent Lighting

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Miscellaneous ceiling patching from fixture removal	441	ea.	0.20	30.00	2,646	5.00	2,205	4,851
Demolition of existing fluorescent light fixtures	441	ea.	0.16	30.00	2,117			2,117
Installation of new F32TB electronic ballasts and sockets	4,248	ea	0.20	30.00	25,488	16.70	70,942	96,430
Installation of new F32TB lamps	8,495	ea	0.10	30.00	25,485	2.65	22,512	47,997
Installation of new F96TB electronic ballasts and sockets	156	ea	0.20	30.00	936	29.38	4,583	5,519
Installation of new F96TB lamps	312	ea.	0.10	30.00	936	10.27	3,204	4,140
<p><b>Note:</b> The material prices were taken from the Energy Efficient Lighting catalog from the Defense General Supply Center, 1-800-DLA-BULB. The labor prices were estimated based on experience with contractors.</p>								

<b>SUBTOTAL</b>	57,608	103,446	161,054
<b>O &amp; P @ 20%</b>	11,522	20,689	24,158
<b>SUBTOTAL</b>	69,130	124,135	185,212
<b>DESIGN @ 6%</b>			11,113
<b>SUBTOTAL</b>			196,325
<b>SIQH @ 5.5%</b>			10,187
<b>TOTAL</b>			<b>\$206,512</b>

**HUITT-ZOLLARS, INC.**  
**ENGINEERS / ARCHITECTS**  
 512 MAIN STREET, SUITE 1500  
 FORT WORTH, TEXAS 76102-3922  
 (817) 335-3000 \* FAX (817) 335-1025

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: RRAD

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID FY95 (92)

INSTALLATION & LOCATION: RRAD      REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03-0185-01 LIGHTING SURVEY STUDY

FISCAL YEAR 1995      DISCRETE PORTION NAME: PROJECT2

ANALYSIS DATE: 04-14-95      ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	\$	185212.		
B. SIOH	\$	10187.		
C. DESIGN COST	\$	11113.		
D. TOTAL COST (1A+1B+1C)	\$	206512.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			\$	206512.

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

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 7.44	1840.	\$ 13688.	15.08	\$ 206417.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 1.89	-915.	\$ -1729.	18.58	\$ -32131.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 13497.	14.88	\$ 200835.
N. TOTAL		925.	\$ 25456.		\$ 375121.

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

A. ANNUAL RECURRING (+/-)		\$	5524.
(1) DISCOUNT FACTOR (TABLE A)			14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	82197.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 82197.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$  \$ 30980.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.67 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 457318.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.21  
(IF < 1 PROJECT DOES NOT QUALIFY)

APPENDIX A  
ENERGY COST ANALYSIS

APPENDIX A  
ENERGY COST ANALYSIS

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APPENDIX A  
ENERGY COST ANALYSIS

A. Electrical Energy Cost Analysis

*Electric Rate Schedule:* The RRAD is supplied electrical power by the Southwestern Electric Power Company (SWEPCO), based in Shreveport, LA. The SWEPCO representative for the RRAD account is currently George Leake, in Texarkana, Texas, 903-793-7641. The facility is billed under the Large Lighting And Power Service (LLP) rate schedule, which is provided, beginning on page A-3. The current monthly billing components of this rate schedule are as follows:

Demand Charge:       \$50,000       for first 10,000 KW or less of billing demand  
                              \$5.01           per KW of billing demand over 10,000 KW

where:               Billing Demand is the average 15 minute peak KW load during each month, but never less than 80% of the highest billing demand, established by RRAD during the previous 11 months.

Energy Charge:       \$0.007           per KWH of energy

Fuel Charge:         \$0.01716       per KWH of energy used from Dec. through Feb.  
                              \$0.01905       per KWH of energy used from Mar. through May.  
                              \$0.02021       per KWH of energy used from Jun. through Aug.  
                              \$0.01716       per KWH of energy used from Sep. through Nov.

note:                The fuel charge figures shown above have been adjusted, as is done by SWEPCO, to account for line losses in the 'substation' type service that is provided by SWEPCO. This simply means that the fixed fuel factors in Schedule FC of the LLP Rate Schedule have been multiplied by a factor of 0.9695 to account for these losses. See pages A-5 and A-6 for details.

Cost of Service (Tax): \$0.000025       per KWH of energy used

note:                This is a tax collected by the utility company, for the State of Texas. See pages A-7 through A-9 for details.

Facility Charge:     \$2.40           per month

*Avoided Costs:* In order to convert electric demand and energy savings into dollar savings, the avoided costs of demand and energy are determined. These are the marginal cost savings to be realized by the facility, per unit of demand or energy saved. Using the above billing components, the *Avoided Cost of Demand* ( $C_D$ ) and the *Avoided Cost of Energy* ( $C_E$ ) are determined as follows:

$$C_D = \frac{\$5.01}{KW}$$

$$C_E = (E + AF + T) \times \frac{KWH}{3413 \text{ BTU}} \times \frac{1,000,000 \text{ BTU}}{MMBTU} \frac{\$}{MMBTU}$$

where,

E = energy charge = \$0.007/KWH

AF = average fuel cost factor<sup>1</sup> = \$0.01839/KWH

T = cost of service tax = \$0.000025/KWH

$$C_E = (0.007 + 0.01839 + 0.000024) \times \frac{1,000,000}{3413} = \frac{\$7.44}{MMBTU}$$

**Southwestern Electric Power Company**  
**General Offices - Shreveport, Louisiana**  
**Texas**

Authorized By: PUCT Order-Docket No.5301

February 15, 1984

LARGE LIGHTING AND POWER SERVICE (LLP)

AVAILABILITY

This rate schedule is available to all customers on an annual basis for service for lighting, heating and power or combination of lighting, heating and power where facilities of adequate capacity and suitable phase and voltage are available. Service will be supplied at one point of delivery through one meter.

MONTHLY RATE

Kilowatt Charge:

\$50,100.00 for the first 10,000 Kilowatts of Billing Demand or less in the month.

\$5.01 each for all kilowatts in excess of 10,000 Kilowatts of Billing Demand in the month.

Kilowatt-hour Charge:

0.70¢ per kilowatt-hour

Fuel Cost Component Of Base Rates: In addition to all other charges, the amount of the bill will be increased by an amount per KWH calculated in accordance with Schedule FC.

Tax Adjustment: Total billing will be decreased or increased by the proportionate part of any new tax or change in rate of tax as provided in the Tax Adjustment Rider.

Determination of Kilowatts of Billing Demand:

The Kilowatts of Billing Demand for each month will be the average kilowatt load used by the Customer during the 15 minute period of maximum use during the month, but not less than 80% of the highest Kilowatts of Billing Demand established during the 11 preceding months. The Kilowatts of Billing Demand will be subject to the Power Factor Adjustment Clause.

Capacity Charge for Highly Fluctuating Loads:

Should the Customer operate equipment with highly fluctuating, intermittent, or abnormal characteristics that make it necessary for the Company to install special facilities to serve the Customer or to prevent disturbances to the service to other Customers, an additional charge of \$1.00 per month per kilovolt-ampere (KVA) or fraction thereof of transformer

# Southwestern Electric Power Company

Continuation of Schedule

LARGE LIGHTING AND POWER SERVICE (LLP)

(Continued)

capacity installed by the Company to serve the Customer will be added to the Customer's bill.

Power Factor Adjustment:

The Company reserves the right to determine the power factor of the Customer's installation served hereunder. Should the power factor at the time of establishment of any 15-minute period of maximum use during the month be determined to be below 90%, the Customer's Kilowatts of Billing Demand will be adjusted by multiplying the Kilowatts of Billing Demand by 90% and dividing the result by the actual power factor at the time of maximum use.

Transmission Discount:

Upon the request of the Customer, there will be a discount of 29 cents per Kilowatt of Billing Demand billed on all monthly bills if electric service is provided at the Company's available transmission voltage of 69 KV or higher and the Customer furnishes and maintains all necessary transformation equipment beyond this point.

PAYMENT FOR SERVICE

Bills for electric service are due 15 days after the date of issuance and become delinquent if not paid by the due date. Bills paid after the due date will be assessed a penalty of 2% of the total monthly bill. If the bill is unpaid after the due date, service is subject to being disconnected in accordance with the rules of the Public Utility Commission of Texas.

TERMS AND CONDITIONS

Service will be furnished under the Company's Standard Terms and Conditions.

Rate Code: 060 PDI 0 Sub. Fuel  
070 PDI 0 Pri. Fuel  
070 PDI 1 Tran.-138KV Fuel

Revenue Class: 05  
Schedule: LLP

# SOUTHWESTERN ELECTRIC POWER COMPANY GENERAL OFFICES - SHREVEPORT, LOUISIANA TEXAS

Approved By: Docket No. 12916

July 6, 1994

## FIXED FUEL FACTOR (FUEL COST COMPONENT OF BASE RATES) (SCHEDULE FC)

Applicable to all standard rates and all kilowatt-hours sold thereunder. For electric service billed under applicable rate schedules for which there is no metering, the monthly usage shall be estimated by the Company and the fuel factors shall be applied. The following fuel factors adjusted by the appropriate loss multiplier will be included in each rate schedule to recover fuel costs:

<u>Applicable Period</u>	<u>Fixed Fuel Factor</u>
December, January, February	\$ .01770 per kilowatt-hour
March, April, May	\$ .01965 per kilowatt-hour
June, July, August	\$ .02085 per kilowatt-hour
September, October, November	\$ .01770 per kilowatt-hour

The cost of fuel included within the Fixed Fuel Factor is comprised of the following items:

1. Cost of fuel consumed in Company's generating plants, plus
2. Cost of purchased economy energy and power and energy purchased from small power production and cogeneration facilities, plus
3. Cost of other purchased energy (excluding capacity charges), plus
4. Cost of small power production and cogeneration, wheeling and other costs associated with generated or purchased power as approved by the Public Utility Commission of Texas, less
5. Cost of energy (excluding capacity charges) sold outside the retail jurisdictional system.

The cost of fuel consumed in the Company's generating plants shall include only these items includible in FERC Accounts 501 and 547 less those costs determined in Docket No. 5301 to be nonrecoverable and/or nonreconcilable through the Fixed Fuel Factor.

SOUTHWESTERN ELECTRIC POWER COMPANY  
GENERAL OFFICES - SHREVEPORT, LOUISIANA  
TEXAS

Continuation of Schedule

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FIXED FUEL FACTOR  
(FUEL COST COMPONENT OF BASE RATES)  
(SCHEDULE FC) (Continued)

The Fixed Fuel Factor for the applicable period will be adjusted by the appropriate loss multiplier to account for differences in line losses corresponding to the voltage level of service. The line loss multipliers are as follows:

Transmission	
138 KV	.95378
69 KV	.96443
Substation *	.96950
Primary	.98064
Secondary	1.01611

\* Applicable to Primary Service supplied from the substation bus for customers served on the LLP rate schedule.

The Company will maintain up-to-date monthly and cumulative records of fuel costs, fuel revenues and the difference between them. When permitted in accordance with Public Utility Commission of Texas Substantive Rule 23.23(b)(2), Rate Design, the Company will reconcile any cumulative over- or under-recovery of fuel cost and will either credit or surcharge, whichever is appropriate, the over- or under-recovered fuel costs with interest at the rate established by the Commission for overbilling and underbilling.

The Fixed Fuel Factor is subject to change by the Commission in accordance with Substantive Rule 23.23 (b)(2), Rate Design.

**Southwestern Electric Power Company**  
**General Offices - Shreveport, Louisiana**  
**Texas**

Authorized By: PUCT Order-Docket No.5301

February 15, 1984

TAX ADJUSTMENT RIDER

The monthly bill will be decreased or increased by the proportionate part of any new tax, or change in rate of tax or franchise fee, or governmental imposition or charge (except state, county, city and special district ad valorem taxes and any taxes on net income) levied or assessed against the Company's electric business that varies from the present 2% rate as the result of any new or amended laws or ordinances after August 1, 1976, except as the power and energy sold under this schedule may be exempt from the effects of any such tax or taxes or fees.

# SOUTHWESTERN ELECTRIC POWER COMPANY GENERAL OFFICES - SHREVEPORT, LOUISIANA TEXAS

Authorized By: PUCT Order-Docket No 12545

January 7, 1994

## INTERIM HOUSE BILL 11 TAX ADJUSTMENT FACTORS

Interim House Bill 11 Tax Adjustment Factors shall be effective with the first billing cycle of January 1994 and will remain in effect until revised in January of each year or until the Company has a general rate case which accounts for the effect of House Bill 11 in accordance with PUCT Substantive Rule 23.21.

Electric service supplied under the following rate schedules shall be subject to the applicable Interim House Bill 11 Tax Adjustment Factor which applies to kilowatt-hours billed during each monthly billing cycle, with the exception of those rates applicable to customers served at transmission level voltage. For customers served at transmission level voltage, the applicable percentage shall be applied to the customer's base revenue.

RATE SCHEDULE	RATE CODE	House Bill 11 Tax Adjustment Factors	
		\$ per kwh (1)	% x base revenue (2)
Residential Service (RS)	0610, 0613, 0614, 0615	0.000101	
Rider to Residential Service for Controlled Service to Water Heater (RWH)	0640	0.000392	
General Service (GS)	0660, 0662	0.000141	
Lighting and Power Service (LP) - Secondary	0100, 0102	0.000066	
Lighting and Power Service (LP) - Primary	1100, 1102	0.000061	
Lighting and Power Service (LP) - Transmission Level Voltage			0.297655
Large Lighting and Power Service (LLP)	2060, 0070, 1070	0.000025	
Large Lighting and Power Service (LLP) - Transmission Level Voltage			0.152219
Metal Melting Service - Distribution Voltages (MMS)	0350	0.000101	
Metal Melting Service - 69 KV or Higher (MMS-69KV) - Transmission Level Voltage	0840		0.486582
Contract with Lone Star Steel Company (LSS) - Transmission Level Voltage	0380		0.392930
Oil Field Large Industrial Power Schedule (OLI)	0800	0.000052	
Municipal Pumping Service (MPS)	0710	0.000120	
Municipal Service Schedule (MS)	0740, 0742	0.000095	
Municipal Lighting Service	0730, 0760	0.000083	

11.04

**SOUTHWESTERN ELECTRIC POWER COMPANY  
GENERAL OFFICES - SHREVEPORT, LOUISIANA  
TEXAS**

Authorized By: PUCT Order-Docket No 12545

January 7, 1994

**INTERIM HOUSE BILL 11 TAX ADJUSTMENT FACTORS (Continued)**

<u>RATE SCHEDULE</u>	<u>RATE CODE</u>	<u>House Bill 11 Tax Adjustment Factors</u>	
		<u>\$ per kwh (1)</u>	<u>X x base revenue (2)</u>
Private & Area Lighting Service (PL & AL)	0790, 0890	0.000092	
As-Available Standby Power Service - Secondary	0080	0.000066	
As-Available Standby Power Service - Primary	1080	0.000061	
C-1 Rider	0661, 0101, 0741	0.000093	

(1) To be applied to metered or unmetered kilowatt-hours

(2) Base Revenues excluding any fuel or add-on revenue taxes

The interim House Bill 11 Tax Adjustment will be labeled on the customer's bill in accordance with PUCT Substantive Rule 23.21.

SOUTHWESTERN ELECTRIC POWER COMPANY  
STANDARD TERMS AND CONDITIONS  
TEXAS

1. APPLICABLE TO ALL CLASSES OF ELECTRIC SERVICE

In order that all Customers may receive uniform, efficient, and adequate service, electric service will be supplied to and accepted by all Customers receiving service from the Company in accordance with these Terms and Conditions.

2. ORDER FOR SERVICE

Contract and Agreement For Electric Service Form CA-101 and other applicable Contract For Electric Service forms are provided by the Company to show agreement under which the Customer receives and the Company delivers electric service. Appropriate arrangements will be completed with Customer, or authorized agent, before service is supplied by the Company. A separate contract will be in effect for each class of service at each separate location. All service by the Company is governed by the Company's Service Refusal Policy, Sheet No. 101.

3. OPTIONAL RATES

The Company's published rate schedules state the conditions under which each is available for electric service. When two or more rates are applicable to a certain class of service, the choice of such rates lies with the Customer.

The Company, at any time upon request, will determine for any Customer the rate best adapted to existing or anticipated service requirements as defined by the Customer, but the Company does not assume responsibility for the selection of such rate or for the continuance of the lowest annual cost under the rate selected.

The Company lacking knowledge of changes that may occur at any time in the Customer's operating conditions does not assume responsibility that Customer will be served under the most favorable rate; nor will the Company make refunds covering the difference between the charges under the rate in effect and those under any other rate applicable to the same service.

Rates are normally established on a twelve-month basis and a Customer having selected a rate adapted to his service may not change to another rate within a twelve-month period unless there is a substantial change in the character or conditions of his service. A new Customer will be given reasonable opportunity to determine his service requirements before definitely selecting the most favorable rate therefor.

4. DEPOSIT

The Customer, if requested by the Company to do so, will make and maintain a reasonable deposit to secure payment of bills. Rules and regulations governing the requirement for and refundability of deposits are contained in the Company's Deposit Policy, Sheet No. 102.

5. MONTHLY BILLS

Bills for service will be rendered monthly, unless otherwise specified. The term "month" for billing purposes will mean the period between any two consecutive readings of the meters by the Company, such readings to be taken as nearly as practicable every thirty days.

Failure to receive a bill in no way exempts Customers from payment for electric service.

When there is good reason for doing so, estimated bills may be submitted provided that an actual meter reading is taken every six (6) months. In months when the meter reader is unable to gain access to the premises to read the meter on regular meter-reading trips, or in months when meters are not read, Company will provide the Customer with a postcard and request the Customer to read the meter and return the card to Company. If such postcard is not received by Company in time for billing, Company may estimate meter reading and render bill accordingly.

When a bill rendered to a Commercial or Industrial Customer is paid after the due date, a one-time penalty in an amount set forth in the applicable rate schedule will be added to the amount owed the Company.

6. DISCONTINUANCE OF SERVICE

A Customer's utility service may be disconnected and the Company's property removed from the Customer's premises if the bill has not been paid by the due date and proper notice has been given in accordance with the Company's Collection and Disconnect Policy, Sheet No. 103. No such suspension of electric service will interfere with the enforcement by the Company of any other legal right or remedy nor relieve the Customer from liability to pay the minimum charge during any suspension. No delay by the Company in enforcing any of its rights will be deemed a waiver of such rights nor will waiver by the Company of any default by the Customer be deemed a waiver of any other subsequent default.

7. EXCLUSIVE SERVICE ON INSTALLATION CONNECTED TO COMPANY'S SYSTEM

Except as may be specifically permitted under tariffs governing the interconnection or provision of service to small power producers or cogenerators, standard electric rate schedules are based on exclusive use of Company's service.

Except in cases where the Customer has a contract with the Company for breakdown or standby service, no other electric light or power service will be used by the Customer on the same installation in conjunction with the Company's service, either by means of a throw-over switch or any other connection.

The Company will not be required to supply or continue to supply service to any Customer where a portion of Customer's service requirement is obtained from other sources, except when such service is covered by a contract under Standby Service Schedule (S).

The Customer will not sell the electricity purchased from the Company to any other customer, company, or person, and Customer will not deliver electricity purchased from the Company to any connection wherein said electricity is to be used off of the Customer's premises on which the meter is located.

8. CUSTOMER'S INSTALLATION

Customer is responsible for installing and maintaining such protective devices as are recommended or required by the then current edition of the National Electrical Code or as may be necessary to protect Customer's equipment or process during abnormal service conditions or the failure of all or a part of the electric service provided by the Company. All wiring and other electrical equipment furnished by the Customer will be installed, operated, and maintained by the Customer at all times in conformity with good electrical practice and with the requirements of the constituted authorities and these Terms and Conditions. Where no public authorities have jurisdiction, Company, for Customer's protection, may require Customer to furnish Company a certificate from wiring electrician that Customer's installation conforms to the National Electrical Code and/or the National Electrical Safety Code. The Company does not assume responsibility for design, operation, or condition of the Customer's installation.

Service will be delivered to Customer for each premise at one point of delivery to be designated by Company and to conform to Company's service standards. Mutual protection of Customer and Company, only authorized employees of Company are permitted to make and energize the connection between Company's wire and Customer's service entrance conductors. The Customer will indemnify and save the Company harmless from all loss on account of injury or damage to persons or property on the Customer's premises, and at and from the point of delivery of power if such point is located off the Customer's premises, growing out of any accident or mishap.

9. OWNER'S CONSENT TO OCCUPY

The Company shall have the right to install and maintain equipment in, over and under the Customer's property and shall have access to the Customer's premises for any other purpose necessary for supplying electric service to the Customer. In case the Customer is not the owner of the premises or of the intervening property between the premises and the Company's lines, the Customer will obtain from the property owner or owners the easements or right-of-way necessary to install and maintain in, over or under said premises all such wires and electrical equipment as are necessary or convenient for supplying electric service to the Customer.

10. MOTOR INSTALLATIONS

For mutual protection of service to all Customers, all motor installations will be as follows:

(a) All motors rated in horsepower up to and including 7½ HP and individual air conditioning units with ratings of 65,000 BTUH (ARI rating) or less will be single phase, unless otherwise agreed to by the Company or served in conjunction with other larger three phase loads.

(b) All three phase motors will be equipped with approved starting equipment having low voltage release attachment and properly sized overcurrent protection in each of the three phases.

11. POWER FACTOR

Where Customer has power or heating equipment installed that operates at low power factor, Customer will furnish, at his own expense, suitable corrective equipment to maintain a power factor of 90% lagging, or higher.

Customer will install and maintain in conjunction with any fluorescent lighting, neon lighting, or other lighting equipment having similar load characteristics, auxiliary or other corrective apparatus that will correct the power factor of such lighting equipment to not less than 90% lagging.

12. PROTECTION OF SERVICE

Where the Customer's use of any devices that have a detrimental effect upon the service rendered to other Customers or upon Company equipment and causes voltage fluctuation of the 60 Hertz wave, clipping of the current, or voltage wave - thereby producing harmonics or a cyclic pulsation between one and sixty Hertz (1 and 60 Hertz), Customer will furnish at his own expense necessary equipment to limit such voltage fluctuation, harmonics, or pulsations so that they will not interfere with other Customers or Company equipment. Where the interference cannot be corrected, the use of such devices must be discontinued.

13. CONTINUOUS SERVICE

Company will make reasonable provisions to insure satisfactory and continuous service, but does not guarantee a continuous supply of electric energy or that the voltage, wave form or frequency of the supply will not fluctuate. The Company shall not be liable for damages occasioned by interruption, failure to commence delivery, or voltage, wave form or frequency fluctuation caused by interruption or failure of service or delay in commencing service due to accident or breakdown of plant, lines, or equipment, strike, riot, act of God, order of any court or judge granted in any bonafide adverse legal proceedings or action or any order of any commission or tribunal having jurisdiction; or, without limitation by the preceding enumeration, any other act or things due to causes beyond its control, to the negligence of the Company, its employees, or contractors, except to the extent that the damages are occasioned by the gross negligence or willful misconduct of the Company.

In like manner, should the Customer's premises be rendered wholly unfit for the continued operation of the Customer's plant or business, due to any of the causes mentioned above, the Customer's contract, if any, will thereupon be suspended until such time as the plant or premises will have been reconstructed, and reconcepted, and reconcepted by the Customer for the purpose of his business.

14. INTENTIONAL INTERRUPTION OF SERVICE

The Company may without notice and without liability to Customer interrupt service to Customer when in the Company's sole judgment such interruption:

(a) Will prevent or alleviate an emergency threatening to disrupt the operation of the Company's system; or

(b) Will lessen or remove possible danger to life or property; or

(c) Will aid in the restoration of electric service; or

(d) Is required to make necessary repairs to or changes in the Company's facilities.

Customer may request, in writing, that Company provide notice of intentional interruption of service by contact at an address and telephone number provided in such written request by Customer and Company will exercise reasonable diligence to give such notice but does not warrant that notice will be given in every case of intentional interruption.

15. METERING

The electricity used will be measured by a meter or meters to be furnished and installed by the Company at its expense and bills will be calculated upon the registration of such meters. Meters include all measuring instruments. Meter installations will be made in accordance with the service standards set forth in the Company's Meter and Service Installations Handbook. Customer will provide a sufficient and proper space in a clean and safe place, accessible at all times and free from vibration, for the installation of Company's meters. Company will furnish all meter bases and/or metering enclosures to be installed by Customer on supply side of service equipment to be metered.

Meters will be tested as reasonably necessary in accordance with the Company's Meter Testing Policy, Sheet No. 104.

16. PROTECTION OF COMPANY'S PROPERTY AND ACCESS TO PREMISES

The Customer will protect the Company's property on the Customer's premises from loss or damage and will permit no one who is not an agent of the Company to remove or tamper with the Company's property.

The Company will have the right of access to the Customer's premises at all reasonable times for the purpose of installing, reading, inspecting, or repairing any meters or devices owned by Company or for the purpose of removing its property.

17. AGENTS CANNOT MODIFY AGREEMENT

No agent has power to amend, modify, or waive any of these Terms and Conditions, or to bind the Company by making any promises or representations not contained herein.

18. SUPERSEDE PREVIOUS TERMS AND CONDITIONS

B. Natural Gas Energy Cost Analysis

*Gas Service Contract:* The RRAD is currently supplied natural gas for process and heating by ENRON Gas Services Group, based in Dublin, OH. The current contract calls for the billing rate to be figured monthly, based on the published prices in the F.E.R.C.'s Gas Market Report, Prices of Spot Gas Delivered to Pipelines. This contract has been in place since the first of September, 1994, and is described by ENRON on page A-12. ENRON has included the billing history for the RRAD as well, for the current contract period to date.

*Avoided Cost:* In order to convert gas energy savings or penalties into cost savings or penalties, the *Avoided Cost of Gas* ( $C_G$ ) is determined. Since the gas costs vary monthly as described above, the avoided cost of gas energy will be determined by averaging the billing history provided by ENRON on page A-12 as follows:

$$C_G = \frac{\text{Tot. Billing}}{\text{Tot. Use}} \frac{\$}{\text{MMBTU}}$$

$$C_G = \frac{(3,867 + 12,313 + 14,707)}{(2,045 + 6,875 + 7,350)} = \frac{\$1.89}{\text{MMBTU}}$$

---

## Facsimile Cover Sheet

**To:** Chris Pieper  
**Company:**  
**Phone:**  
**Fax:** 817-335-1025

**From:** Rose Keller  
**Company:** Enron Access  
**Phone:** 614-792-6063  
**Fax:** 614-792-6049

**Date:** 11/23/94 02:46 PM  
**Pages including this  
cover page:** 1

**Comments:** Chris, per our conversation, below is the pricing for the Red River Army Depot from 9/94 - 11/94.

9/94	2045 MMBtu X 1.891 = \$3,867.10
10/94	6875 MMBtu X 1.791 = \$12,313.13
11/94	7350 MMBtu X 2.001 = \$14,707.35

The contract runs through 3/95, and is based on the following pricing: Inside F.E.R.C.'s Gas Market Report, Prices of Spot Gas Delivered to Pipelines. This is a natural gas industry publication pricing report that is published at the first of each month.

Should you have any further questions, please feel free to call me at the number listed above.

## REFERENCES

1. Average fuel factor =  $(0.01716 + 0.01905 + 0.02021 + 0.01716) / 4 = 0.01839$

APPENDIX B  
DETAILED CALCULATIONS

APPENDIX B  
DETAILED CALCULATIONS

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APPENDIX B  
DETAILED CALCULATIONS

A. Annual Heating and Cooling Percentage Calculations

The percentage of the year that the building's heating systems are in operation ( $H_H$ ) and the percentage of the year that the building's cooling systems are in operation ( $H_C$ ) were determined to be used in the heating energy penalty and the cooling energy savings calculations. For the purposes of this study, all building heating systems are assumed to operate whenever the outside air temperature is below 60 F and all building cooling systems are assumed to operate whenever the outside air temperature is above 70 F. These annual hours were obtained from Engineering Weather Data, TM 5-785. The weather data in this technical manual with the closest proximity to RRAD was obtained from Perrin AFB in Sherman, Texas. This data showed an annual total of 3,455 hours below 60 F and 3,701 hours above 70 F. Using these figures, the values of  $H_H$  and  $H_C$  were determined as follows:

$$H_H = \frac{3,455 \text{ hrs}}{8,760 \text{ hrs}} = 0.39 \qquad H_C = \frac{3,701 \text{ hrs}}{8,760 \text{ hrs}} = 0.42$$

B. Heating and Cooling System Efficiencies

In order to calculate the heating energy penalties and cooling energy savings, the heating and cooling system efficiencies were estimated. The buildings surveyed had various types of cooling and heating systems as is shown on the Building Data Sheets in Appendix C. The cooling systems ranged from DX split systems, to small chilled water hydronic systems, to no cooling system at all. The heating systems ranged from gas fired unit heaters, to gas fired furnaces, to small hot water hydronic systems. The ages of these HVAC systems also varied greatly from building to building.

In order to simplify the calculations, all cooling systems will be assumed to have an Energy Efficiency Ratio (EER) of 7 BTU/W-hr, and all gas fired heating systems will be assumed to have an efficiency ( $EFF_H$ ) of 70%. These values will be used in the savings calculations as follows:

$$EER = \frac{7 \text{ BTU}}{\text{W-hr}} \qquad EFF_H = 0.70$$

C. Annual Hours of Lighting Operation

The production and administrative areas of the RRAD facility are operated basically 4 days per week, and 10 hours per day. The facility is operational year round, 52 weeks per year. For the purposes of this study, the annual Lighting Operational Period ( $H$ ) is calculated as follows:

Assumptions:

10 hrs per day  
4 days per week  
52 weeks per year

$$H = \frac{10 \text{ hrs}}{\text{day}} \times \frac{4 \text{ days}}{\text{week}} \times \frac{52 \text{ wks}}{\text{yr}} = \frac{2,080 \text{ hrs}}{\text{yr}}$$

D. Total Lighting Energy Consumption

The total annual lighting energy consumption for the RRAD areas studied was computed to be used as a yardstick against calculated ECO energy savings. The data for this calculation were taken from the data sheets included in Appendix C. The following sample calculation illustrates the procedure used.

Sample Calculation: Building 323 (from data sheets, see Appendix C)  
 Room 3, Soldering  
 18 fixtures  
 4 lamps per fixture  
 40 watts per lamp  
 1.2 ballast factor

$$18 \text{ fixtures} \times \frac{4 \text{ lamps}}{\text{fixture}} \times \frac{40 \text{ W}}{\text{lamp}} \times 1.2 \text{ ballast factor} \times \frac{2,080 \text{ hrs}}{\text{yr}} \times \frac{1 \text{ KW}}{1,000 \text{ W}} = 7,188 \frac{\text{KWH}}{\text{yr}}$$

The room by room summation of lighting energy consumption, based on the data sheets, is shown on the following pages. The total lighting energy consumption for the buildings studied, based on these room by room calculations, was determined as follows:

Total Lighting Energy Consumption (KWH/yr):

196,820	Bldg. 323
227,457	Bldg. 468
168,308	Bldg. 15
94,857	Bldg. 441
42,208	Bldg. 133
56,191	Bldg. 245
55,976	Bldg. 315
132,191	Bldg. 321
746,786	Bldg. 345
211,286	Bldg. 421
<hr/>	
1,932,080	KWH/yr

In unit of energy (BTUs), this is as follows:

$$\frac{1,932,080 \text{ KWH}}{\text{yr}} \times \frac{3,413 \text{ BTU}}{\text{KWH}} \times \frac{1 \text{ MMBTU}}{1,000,000 \text{ BTU}} = 6,594.1 \frac{\text{MMBTU}}{\text{yr}}$$

Divided between the 12 months of the year, this is as follows:

$$\frac{1,932,080 \text{ KWH}}{\text{yr}} \times \frac{1 \text{ yr}}{12 \text{ mos}} = 161,006.1 \frac{\text{KWH}}{\text{mo}}$$

Building 323

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	SHOP	190	4	40	INDUSTRIAL FLUOR	2080	75,878
2	OFFICE	4	4	40	LAY-IN FLUOR	2080	1,597
3	SOLDERING	18	4	40	LAY-IN FLUOR	2080	7,188
4	BREAK ROOM	15	2	40	LAY-IN FLUOR	2080	2,995
5	MENS RESTROOM	9	2	40	LAY-IN FLUOR	2080	1,797
5	MENS RESTROOM	1	2	40	VANITY FLUOR	2080	200
6	WOMEN'S RESTROOM	2	2	40	LAY-IN FLUOR	2080	399
6	WOMEN'S RESTROOM	1	2	40	VANITY FLUOR	2080	200
7	HALL	4	2	40	LAY-IN FLUOR	2080	799
8	OFFICE	1	2	40	LAY-IN FLUOR	2080	200
9	OFFICE	1	2	40	LAY-IN FLUOR	2080	200
10	PAINT BOOTH	24	4	40	LAY-IN FLUOR	2080	9,585
11	PAINT BOOTH	24	4	40	LAY-IN FLUOR	2080	9,585
12	DRYING ROOM	20	1	150	EXP. PROOF, INC.	2080	6,240
13	DRYING ROOM	20	1	150	EXP. PROOF, INC.	0	0
14	PAINT BOOTH	34	4	40	INDUSTRIAL, FLUOR	2080	13,578
15	PAINT BOOTH	34	4	40	INDUSTRIAL, FLUOR	2080	13,578
16	PAINT SHOP	40	1	300	SOCKET, INC.	2080	24,960
16	PAINT SHOP	40	1	175	SOCKET, MERC	2080	17,472
17	PAINT STORAGE	10	1	300	EXP. PROOF, INC.	2080	6,240
18	HALL	3	1	100	SOCKET, INC.	2080	624
19	JANITOR'S CLOSET	1	1	100	SOCKET, INC.	260	26
20	MEN'S RESTROOM	2	1	150	SOCKET, INC.	2080	624
21	OFFICE	1	1	175	SOCKET, MERC	2080	437
22	WOMEN'S RESTROOM	2	1	150	SOCKET, INC.	2080	624
23	OFFICE	4	1	175	SOCKET, MERC	2080	1,747
24	STORAGE	1	1	150	SOCKET, INC.	260	47
SUBTOTAL, BUILDING 323							196,820

Building 468

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
3A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
3B	OFFICE	6	4	40	LAY-IN, FLUOR	2080	2,396
4	COMPUTER LAB	8	4	40	LAY-IN, FLUOR	2080	3,195
5	COMPUTER LAB	6	4	40	LAY-IN, FLUOR	2080	2,396
5A	COMPUTER LAB	5	2	40	POLY-WRAP, FLUOR	2080	998
6	COMPUTER LAB	2	4	40	LA-IN, FLUOR	2080	799
6A	COMPUTER LAB	12	3	40	POLY-WRAP, FLUOR	2080	3,594
7	COMPUTER LAB	8	4	40	LAY-IN, FLUOR	2080	3,195
8	STAIR	1	1	300	SOCKET, INC.	2080	624
10	MEN'S RESTROOM	2	2	40	LAY-IN, FLUOR	2080	399
11	WOMEN'S RESTROOM	2	2	40	LAY-IN, FLUOR	2080	399
12	WOMEN'S RESTROOM	5	4	40	LAY-IN, FLUOR	2080	1,997
13	LOBBY	10	4	40	LAY-IN, FLUOR	2080	3,994
14	CORRIDOR	4	2	40	LAY-IN, FLUOR	2080	799
15	STAIR	1	2	40	LAY-IN, FLUOR	2080	200
17	MEN'S RESTROOM	5	4	40	LAY-IN, FLUOR	2080	1,997
18	CORRIDOR	8	2	40	LAY-IN, FLUOR	2080	1,597
68	BREAK ROOM	12	4	40	LAY-IN, FLUOR	2080	4,792
69A	CLASSROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
69B	CLASSROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
70A	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
75	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
76	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
77	WOMEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
79	MEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
80	CORRIDOR	4	2	40	LAY-IN, FLUOR	2080	799
81	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799

Building 468 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
82A	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
82B	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
83	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
85	CORRIDOR	2	2	40	LAY-IN, FLUOR	2080	399
86	STAIR	1	2	40	LAY-IN, FLUOR	2080	200
70B	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
71	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
72A	AUDITORIUM	24	4	40	LAY-IN, FLUOR	260	1,198
72B	COMPUTER LAB	12	4	40	LAY-IN, FLUOR	2080	3,994
72C	CAD LAB	6	4	40	LAY-IN, FLUOR	2080	2,396
72D	CAD LAB	6	4	40	LAY-IN, FLUOR	2080	2,396
72E	CORRIDOR	8	2	40	LAY-IN, FLUOR	2080	1,597
73	CORRIDOR	4	2	40	LAY-IN, FLUOR	2080	799
74A	CLASSROOM	20	2	40	LAY-IN, FLUOR	2080	3,994
74B	CLASSROOM	24	2	40	LAY-IN, FLUOR	2080	4,792
88	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
90A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
90B	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
90C	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
90D	CLASSROOM	6	4	40	LAY-IN, FLUOR	2080	2,396
91	CLASSROOM	6	4	40	LAY-IN, FLUOR	2080	2,396
92	HALL	2	4	40	LAY-IN, FLUOR	2080	799
93	MAIL ROOM	3	4	40	LAY-IN, FLUOR	2080	1,198
94	STORAGE	4	4	40	LAY-IN, FLUOR	260	200
95A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
95B	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
95C	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799

Building 468 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
95D	HALL	3	4	40	LAY-IN, FLUOR	2080	1,198
96A	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
96B	HALL / STORAGE	2	4	40	LAY-IN, FLUOR	2080	799
97	STAIR	2	4	40	LAY-IN, FLUOR	2080	799
98	CLASSROOM	12	4	40	LAY-IN, FLUOR	2080	4,792
99	OFFICE / LIBRARY	12	4	40	LAY-IN, FLUOR	2080	4,792
101	LIBRARY	18	4	40	LAY-IN, FLUOR	2080	7,188
103	VAULT	2	2	40	LAY-IN, FLUOR	2080	399
104	LIBRARY	4	4	40	LAY-IN, FLUOR	2080	1,331
106	STORAGE	4	4	40	LAY-IN, FLUOR	260	200
107	LIBRARY	19	4	40	LAY-IN, FLUOR	2080	7,588
110	WOMEN'S RESTROOM	5	4	40	LAY-IN, FLUOR	2080	1,997
113A	CORRIDOR	4	4	40	LAY-IN, FLUOR	2080	1,597
113B	CORRIDOR	2	2	40	LAY-IN, FLUOR	2080	399
114	OFFICE	3	2	40	LAY-IN, FLUOR	2080	599
115	MEN'S RESTROOM	5	4	40	LAY-IN, FLUOR	2080	1,997
117A	CLASSROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
117B	CLASSROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
118	CLASSROOM	8	4	40	LAY-IN, FLUOR	2080	3,195
119	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
120	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
121A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
121B	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
122	CORRIDOR	6	2	40	LAY-IN, FLUOR	2080	1,198
123	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
124	STAIR	1	4	40	LAY-IN, FLUOR	2080	399
126	CLASSROOM	12	4	40	LAY-IN, FLUOR	2080	4,792

Building 468 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
126	CLASSROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
127	CLASSROOM	12	4	40	LAY-IN, FLUOR	2080	4,792
127	CLASSROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
128	COMPUTER LAB	12	4	40	LAY-IN, FLUOR	2080	4,792
129	CLASSROOM	8	4	40	LAY-IN, FLUOR	2080	3,195
129	CLASSROOM	3	2	40	LAY-IN, FLUOR	2080	599
130	CORRIDOR	1	2	40	LAY-IN, FLUOR	2080	200
132	MEN'S RESTROOM	3	2	40	LAY-IN, FLUOR	2080	599
133	JANITOR'S CLOSET	1	2	40	LAY-IN, FLUOR	260	21
134	CLASSROOM	10	4	40	LAY-IN, FLUOR	2080	3,994
135	CORRIDOR	5	2	40	LAY-IN, FLUOR	2080	998
136A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
136B	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
136C	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
136D	HALL	3	4	40	LAY-IN, FLUOR	2080	1,198
137	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
138A	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
138B	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
138C	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
138D	HALL	3	4	40	LAY-IN, FLUOR	2080	1,198
139	CLASSROOM	13	3	40	PENDENT, FLUOR	2080	3,894
19	CONFERENCE	8	3	40	SURFACE, FLUOR	2080	2,396
20	RESTROOM	1	2	40	SURFACE, FLUOR	2080	200
21	HAZARDOUS WASTE	1	2	40	SURFACE, FLUOR	2080	200
22	EYE EXAM	4	3	40	SURFACE, FLUOR	2080	1,198
23	EYE EXAM	6	3	40	SURFACE, FLUOR	2080	1,797
23	EYE EXAM	2	2	60	GLOBE, INC.	2080	499

Building 468 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
24	HEARING	6	3	40	SURFACE, FLUOR	2080	1,797
25	HEARING CLOSET	1	2	60	GLOBE, INC.	260	31
26	ENTRY, SERVICE SINK	2	2	100	GLOBE, INC.	2080	832
27	EXAM	4	3	40	SURFACE, FLUOR	2080	1,198
28	X-RAY STORAGE	2	4	40	SURFACE, FLUOR	2080	799
29	X-RAY	7	4	40	SURFACE, FLUOR	2080	2,796
31	MEDICINE STORAGE	1	4	40	POLY-WRAP, FLUOR	260	50
32	DARK ROOM	1	4	40	POLY-WRAP, FLUOR	2080	399
33	NURSE'S OFFICE	4	4	40	POLY-WRAP, FLUOR	2080	1,331
34	ENTRY	1	1	250	SOCKET, INC.	2080	520
37	LOBBY	4	3	75	SURFACE, FLUOR	2080	2,246
37	LOBBY	4	2	75	LAY-IN, FLUOR	2080	1,498
38	OFFICE	4	2	40	LAY-IN, FLUOR	2080	799
39	OFFICE	12	2	40	LAY-IN, FLUOR	2080	2,396
40	EXAM	4	4	40	LAY-IN, FLUOR	2080	1,597
41	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
42	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
43	EXAM	8	4	40	LAY-IN, FLUOR	2080	3,195
44	ENTRY	1	4	40	LAY-IN, FLUOR	2080	399
46	LAB	6	4	40	LAY-IN, FLUOR	2080	2,396
48	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
49	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
50	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
51	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
52	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
53	EXAM	2	4	40	LAY-IN, FLUOR	2080	799
54	STORAGE	1	4	40	LAY-IN, FLUOR	260	50

Building 468 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
55	STORAGE	2	4	40	LAY-IN, FLUOR	260	100
56	OFFICE	1	4	40	LAY-IN, FLUOR	2080	399
57	NURSE'S STATION	6	4	40	LAY-IN, FLUOR	2080	2,396
59	RECORDS	2	4	40	SURFACE, FLUOR	2080	799
59	RECORDS	1	1	75	SURFACE, FLUOR	2080	187
60	RESTROOM	1	2	40	SURFACE, FLUOR	2080	200
61	RESTROOM	2	2	60	SOCKET, INC.	2080	499
62	RESTROOM	1	2	40	SURFACE, FLUOR	2080	200
63	RESTROOM	2	2	60	SOCKET, INC.	2080	499
64	HOLDING	2	1	250	SOCKET, INC.	2080	1,040
65	WAITING	2	2	75	STRIP, FLUOR.	2080	749
66	HALL	1	2	40	LAY-IN, FLUOR.	2080	200
67	CORRIDOR	6	2	40	PENDENT, FLUOR.	2080	1,198
67	CORRIDOR	1	4	40	PENDENT, FLUOR.	2080	399
SUBTOTAL, BUILDING 468							227,457

### Building 15

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
2	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
3	OFFICE	6	4	40	LAY-IN, FLUOR.	2080	2,396
4	OFFICE	13	4	40	LAY-IN, FLUOR.	2080	5,192
5	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
6	CONFERENCE	16	4	40	LAY-IN, FLUOR.	2080	6,390
7	RESTROOM	1	3	40	LAY-IN, FLUOR.	2080	300
8	COFFEE ROOM	1	4	40	LAY-IN, FLUOR.	2080	399
9	CONFERENCE	27	2	40	LAY-IN, FLUOR.	2080	5,391
11	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
12	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
14	MAIL ROOM / STORAGE	22	4	40	LAY-IN, FLUOR.	2080	8,786
15	LOBBY	4	4	40	LAY-IN, FLUOR.	2080	1,597
16	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
18	JANITOR	1	1	200	SOCKET, INC.	260	52
19	MEN'S RESTROOM	4	2	40	LAY-IN, FLUOR.	2080	799
20	OFFICE / COPY	4	4	40	LAY-IN, FLUOR.	2080	1,597
21	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
22	COPY	1	4	40	LAY-IN, FLUOR.	2080	399
23	STORAGE	1	1	50	SOCKET, INC.	260	13
24	OFFICE	3	4	40	LAY-IN, FLUOR.	2080	1,198
24A	OFFICE	4	4	40	LAY-IN, FLUOR.	260	200
25	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
26	OFFICE AREA	11	4	40	LAY-IN, FLUOR.	2080	4,393
27	OFFICE	5	4	40	LAY-IN, FLUOR.	2080	1,997
28	OFFICE	5	4	40	LAY-IN, FLUOR.	2080	1,997
29	OFFICE AREA	42	4	40	LAY-IN, FLUOR.	2080	16,773

Building 15 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
30	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
30A	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
31	OFFICE AREA	6	4	40	LAY-IN, FLUOR.	2080	2,396
32	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
33	CORRIDOR / STAIR	7	4	40	LAY-IN, FLUOR.	2080	2,796
34	CORRIDOR	7	4	40	LAY-IN, FLUOR.	2080	2,796
35	COFFEE ROOM	1	1	75	LAY-IN, FLUOR.	2080	187
36	OFFICE	22	4	40	LAY-IN, FLUOR.	2080	8,786
37	WORK ROOM	2	4	40	LAY-IN, FLUOR.	2080	799
38	OFFICE	6	4	40	LAY-IN, FLUOR.	2080	2,396
40	ENTRY	1	4	40	LAY-IN, FLUOR.	2080	399
40A	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
41	OFFICE	24	4	40	LAY-IN, FLUOR.	2080	9,585
42	STORAGE	2	1	200	SOCKET, INC.	260	104
43	STORAGE	1	4	40	LAY-IN, FLUOR.	2080	399
44	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
45	OFFICE	9	2	40	LAY-IN, FLUOR.	2080	1,797
46	BREAK ROOM	5	2	40	LAY-IN, FLUOR.	2080	998
47	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
48	OFFICE	3	4	40	LAY-IN, FLUOR.	2080	1,198
49	RECORD STORAGE	1	2	75	STRIP, FLUOR.	2080	374
50	RECORD STORAGE	2	1	100	SOCKET, INC.	2080	416
51	WOMEN'S RESTROOM	10	2	40	LAY-IN, FLUOR.	2080	1,997
52	OFFICE AREA	58	4	40	LAY-IN, FLUOR.	2080	23,163
53	OFFICE	3	4	40	LAY-IN, FLUOR.	2080	1,198
54	VAULT	3	2	40	INDUSTRIAL, FLUOR.	2080	599
55	BREAK ROOM	3	4	40	LAY-IN, FLUOR.	2080	1,198

**Building 15 (Continued)**

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
56	OFFICE	18	4	40	LAY-IN, FLUOR.	2080	7,188
56A	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
57	STORAGE	2	4	40	LAY-IN, FLUOR.	2080	799
57A	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
58	STORAGE	2	4	40	LAY-IN, FLUOR.	260	100
59	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
60	WORK ROOM	4	4	40	LAY-IN, FLUOR.	2080	1,597
61	WOMEN'S RESTROOM	5	2	40	LAY-IN, FLUOR.	2080	998
62	MEN'S RESTROOM	5	2	40	LAY-IN, FLUOR.	2080	998
63	JANITOR'S CLOSET	1	1	150	SOCKET, INC.	260	39
64	CONFERENCE	4	4	40	LAY-IN, FLUOR.	2080	1,597
65	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
66	OFFICE	3	4	40	LAY-IN, FLUOR.	2080	1,198
67	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
67A	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
<b>SUBTOTAL, BUILDING 15</b>							<b>168,308</b>

Building 441

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	LOBBY	2	4	40	LAY-IN, FLUOR	2080	799
1	LOBBY	1	1	100	SOCKET, INC.	2080	208
2	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
3	OPEN OFFICE	20	4	40	LAY-IN, FLUOR	2080	7,987
4	MEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
5	JANITOR'S CLOSET	1	1	100	SOCKET, INC.	260	26
6	WOMEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
7	OFFICE	1	4	40	LAY-IN, FLUOR	2080	399
8	OPEN OFFICE	36	4	40	LAY-IN, FLUOR	2080	14,377
9	OPEN OFFICE	36	4	40	LAY-IN, FLUOR	2080	14,377
10	RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
10	RESTROOM	1	2	40	VANITY, FLUOR	2080	200
11	OFFICE	12	4	40	LAY-IN, FLUOR	2080	4,792
12	SHOP / STORAGE	10	1	400	LOW-BAY, HPS	2080	9,984
12	SHOP / STORAGE	2	2	75	STRIP, FLUOR	2080	749
13	MEN'S RESTROOM	3	4	40	LAY-IN, FLUOR	2080	1,198
13	MEN'S RESTROOM	1	2	40	VANITY, FLUOR	2080	200
14	MEN'S RESTROOM	3	4	40	LAY-IN, FLUOR	2080	1,198
14	MEN'S RESTROOM	1	2	40	VANITY, FLUOR	2080	200
15	STORAGE	1	2	40	LAY-IN, FLUOR	2080	200
16	PLATING	17	1	175	LOW-BAY, MERC	2080	7,426
16	PLATING	1	2	40	INDUSTRIAL, FLUOR	2080	200
17	SAND BLASTING	15	1	175	LOW-BAY, MERC	2080	6,552
18	STORAGE VAULT	6	1	175	LOW-BAY, MERC	2080	2,621
19	STORAGE VAULT	6	1	175	LOW-BAY, MERC	2080	2,621
20	SHOP	8	3	40	INDUSTRIAL, FLUOR	2080	2,396
21	MACHINE SHOP	15	1	300	SOCKET, INC.	2080	9,360

**Building 441 (Continued)**

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
22	BREAK ROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
23	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
24	OFFICE	8	2	40	LAY-IN, FLUOR	2080	1,597
SUBTOTAL,BUILDING 441							94,857

**Building 133**

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	MEN'S RESTROOM	1	2	40	STRIP, FLUOR	2080	200
2	WOMEN'S RESTROOM	1	1	150	SOCKET, INC.	2080	312
3	TOOL CRIB	6	2	40	STRIP, FLUOR	2080	1,198
3	TOOL CRIB	2	2	110	STRIP, FLUOR	2080	1,098
4	OFFICE	2	2	75	STRIP, FLUOR	2080	749
5	OFFICE	2	2	40	STRIP, FLUOR	2080	399
5	OFFICE / BREAK ROOM	2	2	75	STRIP, FLUOR	2080	749
6	CORRIDOR / LOCKERS	1	2	40	STRIP, FLUOR	2080	200
7	OPEN BAY MACHINING	58	1	175	LOW-BAY, MERC.	2080	25,334
7	OPEN BAY MACHINING	7	1	150	INDUSTRIAL, INC.	2080	2,184
8	OFFICE	10	4	40	POLY-WRAP, FLUOR	2080	3,994
9	TOOL CRIB	6	2	40	STRIP, FLUOR	2080	1,198
10	WORK ROOM	5	4	40	POLY-WRAP, FLUOR	2080	1,997
10	WORK ROOM	1	2	40	POLY-WRAP, FLUOR	2080	200
11	WORK ROOM	6	4	40	POLY-WRAP, FLUOR	2080	2,396
<b>SUBTOTAL, BUILDING 133</b>							<b>42,208</b>

Building 245

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	CONFERENCE	6	4	40	LAY-IN, FLUOR.	2080	2,396
2	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
3	SHOP	65	2	40	INDUSTRIAL, FLUOR.	2080	12,979
4	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
5	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
6	CORRIDOR	2	1	150	SOCKET, INC.	2080	624
7	ENTRY	2	2	40	INDUSTRIAL, FLUOR.	2080	399
8	TOOL CRIB	4	2	40	INDUSTRIAL, FLUOR.	2080	799
9	TOOL CRIB	2	2	40	INDUSTRIAL, FLUOR.	2080	399
10	OFFICE	3	3	40	LAY-IN, FLUOR.	2080	899
11	OFFICE AREA	3	3	40	LAY-IN, FLUOR.	2080	899
12	WOMEN'S RESTROOM	2	1	200	SOCKET, INC.	2080	832
12	WOMEN'S RESTROOM	1	4	40	POLY-WRAP, FLUOR.	2080	399
13	MEN'S RESTROOM	9	1	200	SOCKET, INC.	2080	3,744
14	OFFICE	6	4	40	LAY-IN, FLUOR.	2080	2,396
15	OFFICE	4	3	40	LAY-IN, FLUOR.	2080	1,198
16	OFFICE	16	3	40	LAY-IN, FLUOR.	2080	4,792
18	OFFICE	2	3	40	LAY-IN, FLUOR.	2080	599
19	OFFICE	2	3	40	LAY-IN, FLUOR.	2080	599
20	OFFICE	2	3	40	LAY-IN, FLUOR.	2080	599
21	OFFICE	3	4	40	LAY-IN, FLUOR.	2080	1,198
22	SHOP	30	2	40	INDUSTRIAL, FLUOR.	2080	5,990
22	SHOP	4	3	40	INDUSTRIAL, FLUOR.	2080	1,198
23	SHOP	15	1	200	SOCKET, INC.	2080	6,240
23	SHOP	8	2	40	INDUSTRIAL, FLUOR.	2080	1,597
23	SHOP	1	1	250	LOW-BAY, HPS	2080	624
24	BREAK ROOM	4	2	40	POLY-WRAP, FLUOR.	2080	799
SUBTOTAL, BUILDING 245							56,191

Building 315

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	MANUFACTURING	75	1	1000	HIGH BAY, HPS	2080	187,200
2	MANUFACTURING	20	1	400	LOW-BAY, HPS	2080	19,968
3	MANUFACTURING	10	1	400	LOW-BAY, HPS	2080	9,984
4	MANUFACTURING	2	1	400	LOW-BAY, HPS	2080	1,997
5	TOOL MANUFACTURING	8	4	40	POLY-WRAP, FLUOR.	2080	3,195
6	TOOL ROOM	9	2	75	STRIP, FLUOR.	2080	3,370
7	BREAK ROOM	10	2	40	POLY-WRAP, FLUOR.	2080	1,997
8	CONFERENCE ROOM	5	2	40	POLY-WRAP, FLUOR.	2080	998
9	MECHANICAL ROOM	1	1	200	SOCKET, INC.	260	52
10	OPEN OFFICE	26	4	40	LAY-IN, FLUOR	2080	10,383
11	BREAK AREA	2	1	300	SOCKET, INC.	2080	1,248
12	JANITOR'S CLOSET	1	4	40	LAY-IN, FLUOR	2080	399
13	HALL	3	2	40	LAY-IN, FLUOR	2080	599
14	WOMEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
14	WOMEN'S RESTROOM	1	2	40	VANITY, FLUOR	2080	200
15	TOOL STORAGE	4	4	40	LAY-IN, FLUOR	2080	1,597
16	MEN'S RESTROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
16	MEN'S RESTROOM	1	2	40	VANITY, FLUOR	2080	200
17	STAIR WELLS	3	1	200	SOCKET, INC.	2080	1,248
18	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
19	WOMEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
20	MEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
21	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
22	OPEN OFFICE	26	4	40	LAY-IN, FLUOR	2080	10,383
23	HALL	2	1	200	SOCKET, INC.	2080	832
24	HALL	2	1	175	SOCKET, MERC.	2080	874
25	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799

**Building 315 (Continued)**

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
26	OPEN OFFICE	23	4	40	LAY-IN, FLUOR	2080	9,185
27	COFFEE BAR	1	4	40	LAY-IN, FLUOR	2080	399
28	CAD WORK AREA	16	4	40	LAY-IN, FLUOR	2080	6,390
29	COMPUTER ROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
30	STAIR	1	1	160	SOCKET, MERC.	2080	399
31	ELEVATOR SHAFT	1	1	100	SOCKET, INC.	2080	208
<b>SUBTOTAL, BUILDING 315</b>							<b>55,976</b>

Building 321

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	RETRIVER	4	2	75	STRIP, FLUOR.	2080	1,498
2	CONTROL ROOM	8	4	40	POLY-WRAP, FLUOR.	2080	3,195
3	OFFICE	6	4	40	LAY-IN, FLUOR.	2080	2,396
4	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
5	OFFICE	6	4	40	LAY-IN, FLUOR.	2080	2,396
6	STORAGE / SHELVING	109	1	400	LOW BAY, MH	2080	108,826
6	STORAGE / SHELVING	255	1	400	LOW BAY, MERC.	2080	254,592
7	MEN'S RESTROOM	5	4	40	LAY-IN, FLUOR.	2080	1,997
7	MEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
8	OFFICE	8	4	40	LAY-IN, FLUOR	2080	3,195
9	BREAK ROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
10	WOMEN'S RESTROOM	4	4	40	LAY-IN, FLUOR	2080	1,597
11	STAIRS	3	1	200	SOCKET, INC.	2080	1,248
12	STAIRS	3	1	200	SOCKET, INC.	2080	1,248
13	WOMEN'S RESTROOM	5	4	40	LAY-IN, FLUOR.	2080	1,997
13	WOMEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
14	LOCKERS	1	1	200	SOCKET, INC.	2080	416
15	MEN'S RESTROOM	13	4	40	LAY-IN, FLUOR.	2080	5,192
15	MEN'S RESTROOM	3	2	40	VANITY, FLUOR.	2080	599
16	OFFICE	6	2	40	INDUSTRIAL, FLUOR	2080	1,198
17	MEN'S RESTROOM	1	4	40	LAY-IN, FLUOR.	2080	399
17	MEN'S RESTROOM	1	2	40	VANITY, FLUOR.	2080	200
18	WOMEN'S RESTROOM	1	4	40	LAY-IN, FLUOR.	2080	399
18	WOMEN'S RESTROOM	1	2	40	VANITY, FLUOR.	2080	200
19	HALL	2	2	40	LAY-IN, FLUOR.	2080	399
20	HALL	1	2	40	INDUSTRIAL, FLUOR.	2080	200
21	MECHANICAL ROOM	1	1	200	SOCKET, INC.	260	52

Building 321 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
22	OPEN OFFICE	14	4	40	LAY-IN, FLUOR.	2080	5,591
23	DARK ROOM / FILM	8	2	40	INDUSTRIAL, FLUOR	2080	1,597
23	DARK ROOM / FILM	2	2	40	SAFE LIGHT, FLUOR	2080	399
24	DARK ROOM / CAMERA	2	2	75	INDUSTRIAL, FLUOR	2080	749
24	DARK ROOM / CAMERA	1	2	40	SAFE LIGHT, FLUOR	2080	200
25	PRINTING	16	2	75	INDUSTRIAL, FLUOR	2080	5,990
25	PRINTING	5	1	200	SOCKET, INC.	2080	2,080
26	OFFICE	5	4	40	INDUSTRIAL, FLUOR	2080	1,997
26	OFFICE	13	2	75	INDUSTRIAL, FLUOR	2080	4,867
27	OFFICE	8	4	40	LAY-IN, FLUOR.	2080	3,195
28	HALL	5	1	175	MERC.	2080	2,184
29	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
30	OFFICE	4	4	40	LAY-IN, FLUOR.	2080	1,597
31	OPEN OFFICE	13	4	40	LAY-IN, FLUOR.	2080	5,192
32	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
33	BREAK ROOM	10	2	40	LAY-IN, FLUOR.	2080	1,997
34	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
35	OFFICE	5	4	40	LAY-IN, FLUOR.	2080	1,997
36	COPY	4	4	40	LAY-IN, FLUOR.	2080	1,597
37	OFFICE	2	4	40	LAY-IN, FLUOR.	2080	799
38	OFFICE	7	4	40	LAY-IN, FLUOR.	2080	2,796
39	OFFICE	1	2	75	INDUSTRIAL, FLUOR.	2080	374
39	OFFICE	1	4	40	INDUSTRIAL, FLUOR.	2080	399
40	STORAGE	2	1	200	SOCKET, INC.	2080	832
41	STORAGE	5	2	75	STRIP, FLUOR.	2080	1,872
41	STORAGE	6	1	200	SOCKET, INC.	2080	2,496
42	SHOP	20	1	175	MERC.	2080	8,736

**Building 321 (Continued)**

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
43	SHOP	60	2	75	INDUSTRIAL, FLUOR.	2080	22,464
44	SEWING SHOP	11	4	40	INDUSTRIAL, FLUOR.	2080	4,393
45	SHOP	3	1	400	LOW-BAY, HPS	2080	2,995
45	SHOP	10	1	175	LOW-BAY, MERC	2080	4,368
46	SHOP	18	4	40	INDUSTRIAL, FLUOR.	2080	7,188
47	SHOP	41	1	400	LOW-BAY, MERC	2080	40,934
48	SHOP	2	1	400	LOW-BAY, HPS	2080	1,997
48	SHOP	10	1	175	LOW-BAY, MERC	2080	4,368
49	SHOP	18	2	75	INDUSTRIAL, FLUOR	2080	6,739
50	SHOP	3	2	75	INDUSTRIAL, FLUOR	2080	1,123
50	SHOP	3	4	40	INDUSTRIAL, FLUOR	2080	1,198
51	SHOP	3	1	175	SOCKET, MERC.	2080	1,310
51	SHOP	2	1	200	SOCKET, INC.	2080	832
<b>SUBTOTAL, BUILDING 321</b>							<b>132,191</b>

Building 345

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	STAIRS	2	1	200	SOCKET, INC.	2080	832
2	WOMEN'S RESTROOM	6	2	40	LAY-IN, FLUOR.	2080	1,198
2	WOMEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
3	SHOP	15	1	400	LOW-BAY, HPS	2080	14,976
4	STAIRS	2	1	200	SOCKET, INC.	2080	832
5	MEN'S RESTROOM	6	2	40	LAY-IN, FLUOR.	2080	1,198
5	MEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
6	MAIN ASILE	12	1	400	LOW-BAY, HPS	2080	11,981
7	SHOP	42	1	1000	HIGH BAY, HPS	2080	104,832
8	SHOP	28	1	400	LOW-BAY, HPS	2080	27,955
9	SHOP	8	1	400	LOW-BAY, HPS	2080	7,987
10	MEN'S RESTROOM	6	2	40	LAY-IN, FLUOR.	2080	1,198
10	MEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
11	STAIRS	2	1	200	SOCKET, INC.	2080	832
12	ELECTRIC SHOP	2	2	75	SURFACE, FLUOR	2080	749
13	HALL	1	2	75	STRIP, FLUOR.	2080	374
14	SHOWERS	2	1	200	SOCKET, INC.	2080	832
15	MAIN ASILE	18	1	400	LOW-BAY, HPS	2080	17,971
16	MAIN ASILE	12	1	400	LOW-BAY, HPS	2080	11,981
17	PLATING SHOP	50	1	250	LOW-BAY, HPS	2080	31,200
18	SHOP	30	1	400	LOW-BAY, HPS	2080	29,952
19	WOMEN'S RESTROOM	6	2	40	LAY-IN, FLUOR.	2080	1,198
19	WOMEN'S RESTROOM	2	2	40	VANITY, FLUOR.	2080	399
20	STAIRS	2	1	200	SOCKET, INC.	2080	832
21	SHOP	27	1	400	LOW-BAY, HPS	2080	26,957
22	SHOP	72	1	1000	HIGH BAY, HPS	2080	179,712
23	SHOP	190	1	400	LOW-BAY, HPS	2080	189,696

Building 345 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
24	SHOP	6	4	40	POLY-WRAP, FLUOR	2080	2,396
25	SHOP	18	4	40	POLY-WRAP, FLUOR	2080	7,188
26	OFFICE	2	4	40	POLY-WRAP, FLUOR	2080	799
27	SHOP	15	4	40	POLY-WRAP, FLUOR	2080	5,990
28	SHOP	15	4	40	POLY-WRAP, FLUOR	2080	5,990
29	SHOP	15	4	40	POLY-WRAP, FLUOR	2080	5,990
30	SHOP	20	4	40	POLY-WRAP, FLUOR	2080	7,987
31	OFFICE	5	4	40	POLY-WRAP, FLUOR	2080	1,997
32	OFFICE	15	4	40	POLY-WRAP, FLUOR	2080	5,990
33	BREAK AREA	3	1	175	LOW-BAY, MH	2080	1,310
34	PARTS	10	1	175	LOW-BAY, MH	2080	4,368
34	PARTS	16	2	75	INDUSTRIAL, FLUOR	2080	5,990
35	CRANKSHAFT GRINDING	14	1	400	LOW-BAY, HPS	2080	13,978
36	SHOP	8	1	1000	HIGH BAY, HPS	2080	19,968
38	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
39	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
40	COMPUTER ROOM	2	4	40	LAY-IN, FLUOR	2080	799
41	OPEN OFFICE	10	4	40	LAY-IN, FLUOR	2080	3,994
42	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
43	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
44	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
45	HALL / LOBBY	2	4	40	LAY-IN, FLUOR	2080	799
46	OFFICE	3	4	40	LAY-IN, FLUOR	2080	1,198
47	OFFICE	6	4	40	LAY-IN, FLUOR	2080	2,396
48	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
49	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
50	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799

Building 345 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
51	MEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
51A	MECHANICAL ROOM	2	1	100	SOCKET, INC.	260	52
52	HALL / COFFEE	1	4	40	LAY-IN, FLUOR	2080	399
53	WOMEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
54	HALL	3	4	40	LAY-IN, FLUOR	2080	1,198
55	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
56	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
57	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
58	OFFICE	2	4	40	LAY-IN, FLUOR	2080	799
59	OPEN OFFICE	6	4	40	LAY-IN, FLUOR	2080	2,396
60	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
61	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
62	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
63	OFFICE	6	4	40	LAY-IN, FLUOR	2080	2,396
64	HALL	4	1	100	SOCKET, INC.	2080	832
65	SHOP	40	4	40	INDUSTRIAL, FLUOR	2080	15,974
66	LIBRARY	8	4	40	INDUSTRIAL, FLUOR	2080	3,195
67	SHOP	8	1	1000	HIGH BAY, HPS	2080	19,968
68	DINING ROOM	17	2	40	LAY-IN, FLUOR	2080	3,395
69	OFFICE	27	4	40	LAY-IN, FLUOR	2080	10,783
70	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
71	SHOP	14	1	1000	HIGH BAY, HPS	2080	34,944
72	SHOP	12	1	1000	HIGH BAY, HPS	2080	29,952
73	TEST LAB	36	4	40	LAY-IN, FLUOR	2080	14,377
74	SHOP	10	1	1000	HIGH BAY, HPS	2080	24,960
75	RESTROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
75	RESTROOM	2	2	40	VANITY, FLUOR	2080	399

Building 345 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
76	SHOP	15	1	100	LOW-BAY, HPS	2080	3,744
77	SHOP	10	1	1000	HIGH BAY, MERC	2080	24,960
78	SHOP	22	1	400	LOW BAY, MH	2080	21,965
79	RESTROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
79	RESTROOM	2	2	40	VANITY, FLUOR	2080	399
80	SHOP	35	1	1000	HIGH BAY, MH	2080	87,360
81	SHOP	8	1	400	LOW BAY, MH	2080	7,987
82	SHOP	19	1	400	LOW BAY, MH	2080	18,970
83	SHOP	19	1	1000	HIGH BAY, MH	2080	47,424
84	SHOP	12	1	1000	HIGH BAY, MH	2080	29,952
85	SHOP	72	1	400	LOW BAY, MH	2080	71,885
86	SHOP	18	1	1000	HIGH BAY, MH	2080	44,928
87	SHOP	44	1	400	LOW BAY, MH	2080	43,930
88	SHOP	12	1	1000	HIGH BAY, MH	2080	29,952
88	SHOP	48	1	250	SOCKET, MH	2080	29,952
89	SHOP	68	1	1000	HIGH BAY, MH	2080	169,728
89	SHOP	28	1	400	LOW-BAY, MERC	2080	27,955
89	SHOP	2	1	200	SOCKET, INC.	2080	832
90	SHOP	28	1	400	LOW BAY, MERC	2080	27,955
91	SHOP	22	1	400	LOW BAY, MH	2080	21,965
92	RESTROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
92	RESTROOM	2	2	40	VANITY, FLUOR	2080	399
93	RESTROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
93	RESTROOM	6	2	40	VANITY, FLUOR	2080	1,198
94	CANTEEN	16	2	40	LAY-IN, FLUOR	2080	3,195
SUBTOTAL, BUILDING 345							746,786

Building 421

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
1	TEST LAB	48	2	40	POLY-WRAP, FLUOR	2080	9,585
2	RESTROOM	1	1	150	SOCKET, INC.	2080	312
3	MECHANICAL ROOM	2	1	100	SOCKET, INC.	260	52
4	TEST LAB	24	2	40	POLY-WRAP, FLUOR	2080	4,792
5	TEST LAB	15	2	40	SURFACE, FLUOR	2080	2,995
6	OFFICE	4	2	40	SURFACE, FLUOR	2080	799
7	OFFICE	4	4	40	SURFACE, FLUOR	2080	1,597
8	OFFICE	4	2	40	SURFACE, FLUOR	2080	799
8A	ENTRY	1	2	40	SURFACE, FLUOR	2080	200
9	HALL	3	2	40	POLY-WRAP, FLUOR	2080	599
10	JANITOR'S CLOSET	1	1	100	SOCKET, INC.	260	26
11	MEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
12	WOMEN'S RESTROOM	2	4	40	LAY-IN, FLUOR	2080	799
12	WOMEN'S RESTROOM	1	4	40	POLY-WRAP, FLUOR	2080	399
13	BREAKROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
14	HALLWAY, COPY	3	2	40	LAY-IN, FLUOR	2080	599
15	OFFICE	6	4	40	POLY-WRAP, FLUOR	2080	2,396
16	ENTRY	1	2	40	POLY-WRAP, FLUOR	2080	200
17	ENTRY	1	2	40	POLY-WRAP, FLUOR	2080	200
18	SHOP	7	2	40	POLY-WRAP, FLUOR	2080	1,398
19	SHOP	48	2	40	POLY-WRAP, FLUOR	2080	9,585
20	SHOP	60	2	40	POLY-WRAP, FLUOR	2080	11,981
21	CIRCUIT BD. SHOP	24	2	40	LAY-IN, FLUOR	2080	4,792
22	SHOP	8	2	75	INDUSTRIAL, FLUOR	2080	2,995
23	SHOP / PARTS	28	2	40	POLY-WRAP, FLUOR	2080	5,591
24	SMALL PARTS SHOP	30	1	250	LOW-BAY, MH	2080	18,720
24	SMALL PARTS SHOP	60	1	250	LOW-BAY, MERC	2080	37,440

Building 421 (Continued)

ROOM NO.	ROOM FUNCTION	EXIST. FIXTURE QTY.	LAMPS PER FIXTURE	LAMP WATTS	FIXTURE DESCRIPTION	EXIST. ANNUAL HOURS	EXIST. ANNUAL ENERGY KWH/YR
25	MEN'S RESTROOM	4	2	40	STRIP, FLUOR	2080	799
26	WOMEN'S RESTROOM	2	2	40	STRIP, FLUOR	2080	399
27	JANITOR'S CLOSET	1	1	100	SOCKET, INC.	260	26
28	OFFICE	4	4	40	POLY-WRAP, FLUOR	2080	1,597
29	OFFICE	1	4	40	POLY-WRAP, FLUOR	2080	399
30	OFFICE	2	4	75	INDUSTRIAL, FLUOR	2080	1,498
31	OFFICE	2	4	75	INDUSTRIAL, FLUOR	2080	1,498
32	OFFICE	4	4	75	INDUSTRIAL, FLUOR	2080	2,995
33	SHOP	54	2	40	POLY-WRAP, FLUOR	2080	10,783
34	SHOP	110	2	40	POLY-WRAP, FLUOR	2080	21,965
35	SHOP	24	2	40	POLY-WRAP, FLUOR	2080	4,792
36	OFFICE	2	4	75	SURFACE, FLUOR	2080	1,498
36	OFFICE	2	4	40	SURFACE, FLUOR	2080	799
37	SHOP	8	4	40	POLY-WRAP, FLUOR	2080	3,195
38	STORAGE	6	2	40	POLY-WRAP, FLUOR	2080	1,198
39	MODULAB	14	3	40	INDUSTRIAL, FLUOR	2080	4,193
40	BREAK ROOM	6	2	40	LAY-IN, FLUOR	2080	1,198
41	LOCKERS	2	2	40	LAY-IN, FLUOR	2080	399
42	COMPUTER ROOM	23	4	40	LAY-IN, FLUOR	2080	9,185
43	WOMEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
44	MEN'S RESTROOM	1	4	40	LAY-IN, FLUOR	2080	399
45	OFFICE	1	4	40	LAY-IN, FLUOR	2080	399
46	OFFICE	4	4	40	LAY-IN, FLUOR	2080	1,597
47	INSTRUMENTATION	32	4	40	LAY-IN, FLUOR	2080	12,780
48	SHOP	15	1	400	LOW-BAY, HPS	2080	14,976
SUBTOTAL, BUILDING 421							211,286

APPENDIX C  
DATA FORMS

APPENDIX C  
DATA FORMS

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# BUILDING DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10-18-94 SURVEYOR: PIEPER, C.A. FACILITY: RRAD 1 OF 2

BLDG. NO.	BUILDING USE	GROSS SQFT	NO. OF FLOORS	APPROX. AGE	YEARS LEFT	COOLING SYSTEM			HEATING SYSTEM			
						TYPE	EER	MOSYR	TYPE	EFF %	MOSYR	% BLDG
323	VEHICLE REHAB	59,392	1	1942	20	NONE	/	/	CENTRAL BOILER PLANT	70	4 1/2	100
468	SCHOOL / CLINIC	59,614	2	1954	20	PACKAGED RTU	7	5	GAS FURNACE	70	4 1/2	100
15	POST HQ	31,267	3	1942	20	SPLIT SYSTEMS	7	5	GAS FURNACE	70	4 1/2	100
441	SMALL ARMS REPAIR & WHS.	37,267	1	1942	20	SPLIT SYSTEMS	7	5	CENTRAL BOILER PLANT	70	4 1/2	100
133	MISC. TRADE WORK	13,654	1	1942	20	NONE	/	/	GAS U.H. & FURN.	70	4 1/2	100
245	MAINT. BLDG. / SHOPS	15,827	1	1955	20	RTU	7	5	GAS U.H. & FURN.	70	4 1/2	100
315	VEHICLE REHAB DEPT.	43,776	3	1942	20	NONE	/	/	CENTRAL BOILER PLANT	70	4 1/2	100
321	BODY SHOP	123,648	2	1942	20	NONE	/	/	CENTRAL BOILER PLANT	70	4 1/2	100

NOTES:

EER = COOLING SYSTEM EFFICIENCY (BTU/WATT), EFF = HEATING SYSTEM EFFICIENCY, MOSYR. = ANNUAL MONTHS OF OPERATION

# BUILDING DATA SHEET

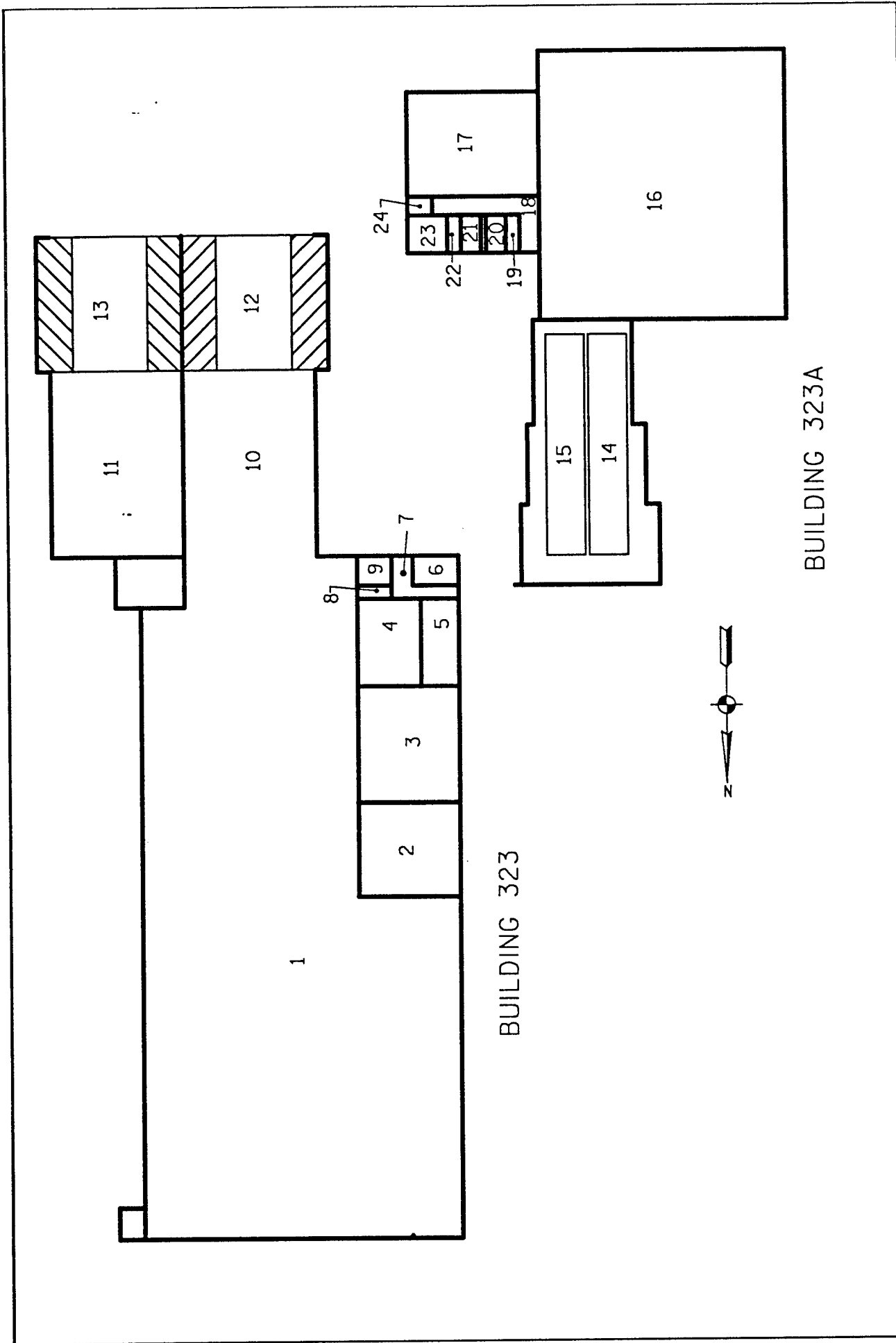
Hult-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10-18-94 SURVEYOR: PIGGER, C.A. FACILITY: RRAD Z OF Z

BLDG. NO.	BUILDING USE	GROSS SQFT	NO. OF FLOORS	APPROX. AGE	YEARS LEFT	COOLING SYSTEM			HEATING SYSTEM			
						TYPE	EER	MOS/YR	TYPE	EFF %	MOS/YR	% BLDG
345	VEHICLE REBUILD & GUN SHOP	370688	3	1942	20	CENTRAL CHILLER	7	5	CENTRAL BOILER PLANT	70	4 1/2	100
421	FACILITY MAINT.	51,456	2	1942	20	PACKAGED MULTIZONE	7	5	CENTRAL BOILER PLANT	70	4 1/2	100

NOTES:

EER = COOLING SYSTEM EFFICIENCY (BTU/WATT), EFF = HEATING SYSTEM EFFICIENCY, MOS/YR. = ANNUAL MONTHS OF OPERATION



BUILDING  
323 & 323A

RED RIVER ARMY  
DEPOT

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FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT - ZOLLARS  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: Nov. 1994 SURVEYOR: TAL BUILDING: #323 RED RIVER

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	IBSDY	DYWK	ECO DESCRIPTION
1 SHOP	15	190	4	F40	INDUSTRIALS	10	4	max. @ 12'-0"
2 OFFICE	50	4	4	F40	LAY IN	10	4	
3 ORDERING	60	18	4	F40	LAY IN	10	4	
4 BREAK ROOM	35	15	2	F40	LAY IN	10	4	
5 MEN'S R.R. & LOCKERS	45	9	2	F40	LAY IN	10	4	
6 WOMEN'S REST ROOM	50	1	2	F40	VANITY	10	4	
7 HALL	25	4	2	F40	LAY IN	10	4	
8 OFFICE	35	1	2	F40	LAY IN	10	4	
9 OFFICE	35	1	2	F40	LAY IN	10	4	
10 PAINT BOOTH	50	24	4	F96/Ha 110w.	LAY IN	10	4	
11 PAINT BOOTH	50	24	4	F96 H.O. 110w.	LAY IN	10	4	NOT USED!!

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

2

DATE: Nov. 1994 SURVEYOR: THL BUILDING: #323 R.R.

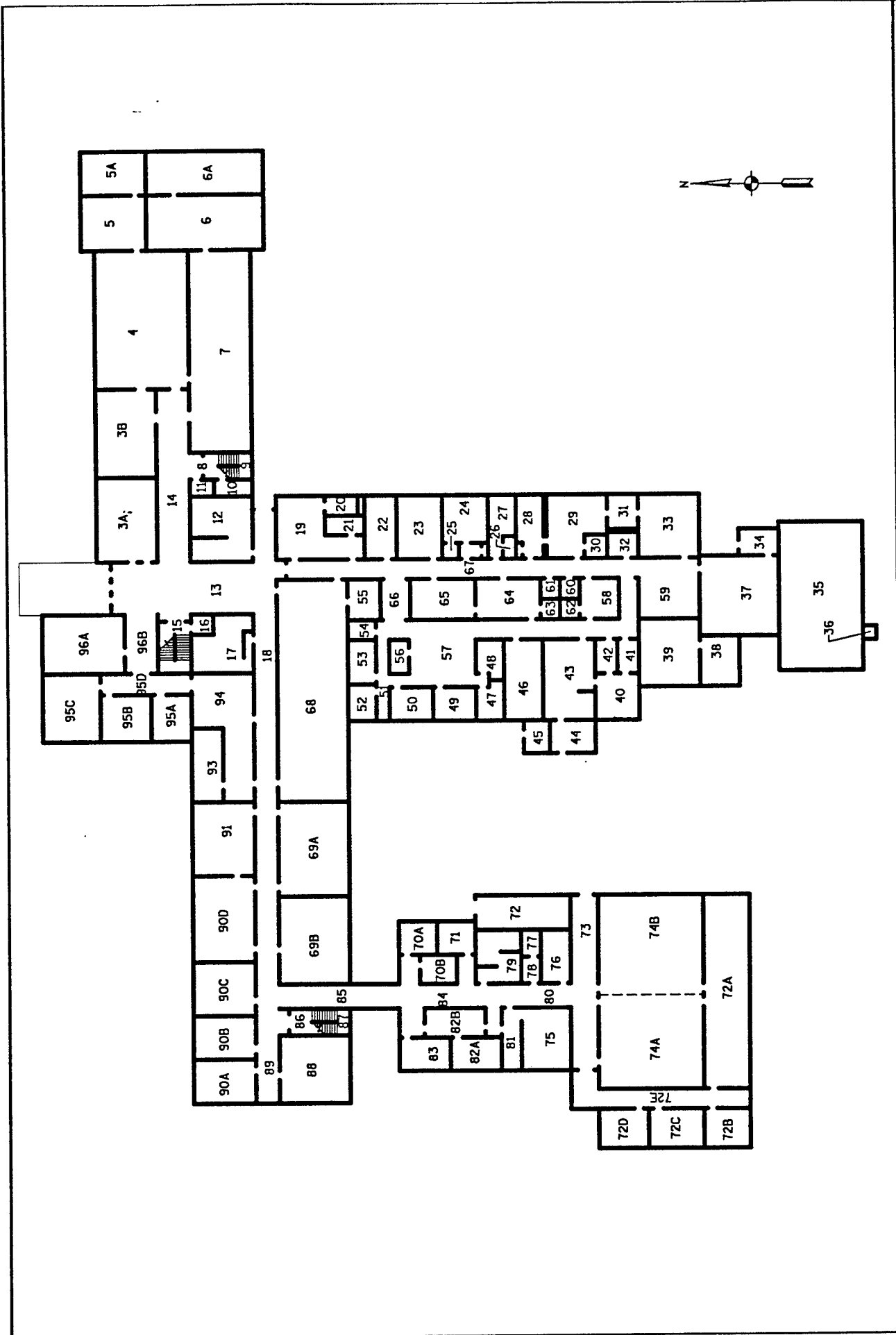
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
12 DRYING ROOM	15	20	1	150w. A-21	SOCKET EXP. PROOF	10	4	
13 DRYING ROOM	15	20	1	150w. A-21	SOCKET EXP PROOF	—	—	NOT USED!!
14 PAINT BOOTH	25	34	4	F40	INDUSTRIALS	10	4	
15 PAINT BOOTH	25	34	4	F40	INDUSTRIALS	10	4	
16 PAINT SHOP	40	40	1	300w. P.S. 175w. M.Y.	SOCKET SOCKET	10	4	60% CHANGE-OUT 40%
17 PAINT STORAGE	15	10	1	300w. P.S. INC.	SOCKET EXP. PROOF	10	4	
18 HALL	10	3	1	100w. A19	SOCKET	10	4	FIXTURE CHANGE-OUT
19 JAN. CLOSET	10	1	1	100w. A19	SOCKET	10	4	FIXTURE CHANGE-OUT
20 MEN'S REST ROOM	10	2	1	150w. A21	SOCKET	10	4	FIXTURE CHANGE-OUT
21 OFFICE	15	1	1	175w. M.Y.	SOCKET	10	4	FIXTURE CHANGE-OUT
22 WOMEN'S REST ROOM	10	2	1	150w. A21	SOCKET	10	4	FIXTURE CHANGE-OUT

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

3

DATE: Nov. 1994 SURVEYOR: THC BUILDING: # 323 R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WAIMS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
23 OFFICE	25	4	1	175w. M.Y.	SOCKET	10	4	FIXTURE CHANGE-OUT
24 STORAGE	10	1	1	150w. A21	SOCKET	10	4	FIXTURE CHANGE-OUT
WINDOWS & SKYLIGHTS >								REMOVE PAINT

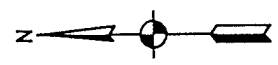
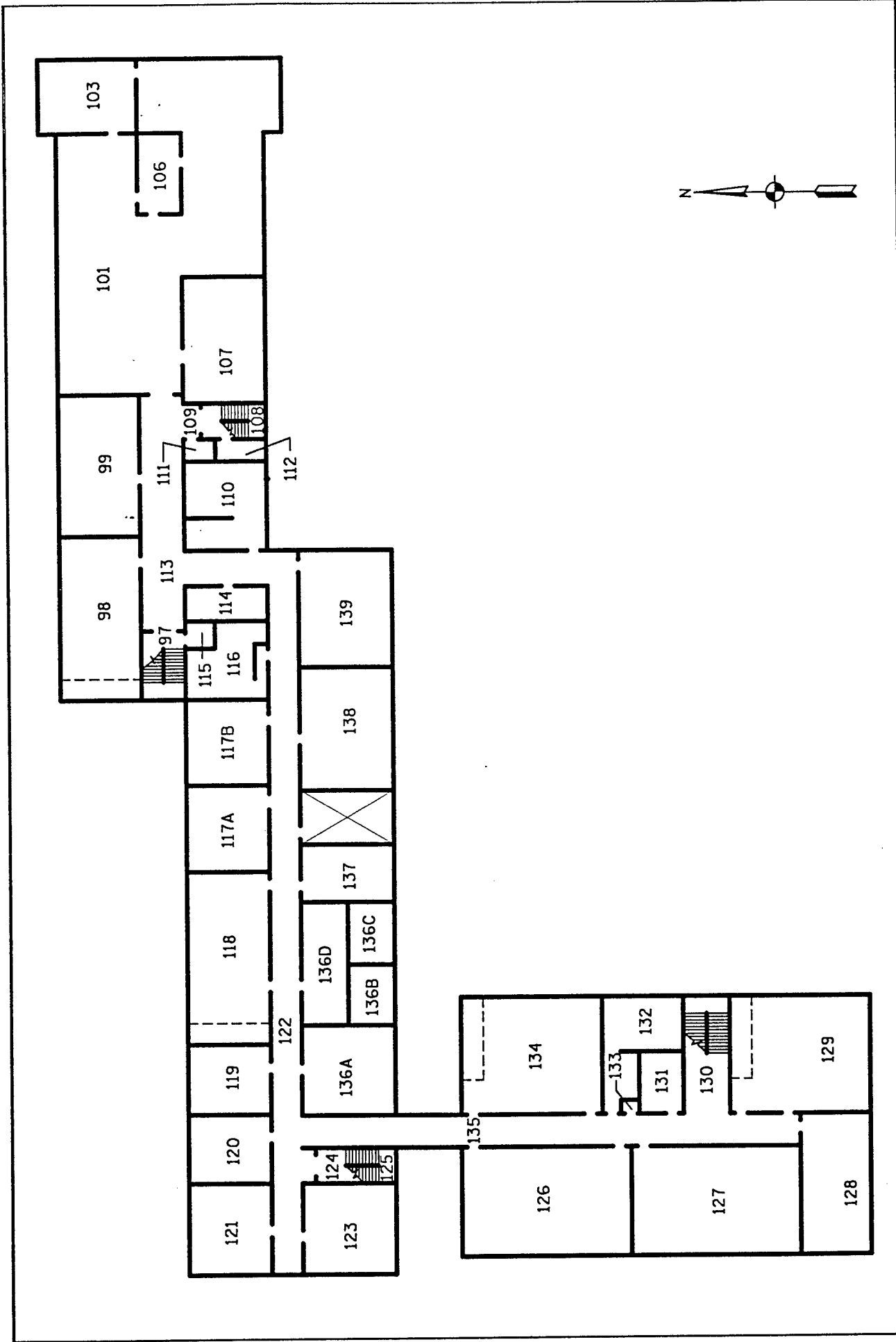


RED RIVER ARMY  
DEPOT

BUILDING  
468 - FIRST FLOOR PLAN

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT-ZOLLARS  
ENGINEERS/ARCHITECTS



BUILDING  
468 - SECOND FLOOR PLAN

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE:	SURVEYOR:	BUILDING:									
10/94	LUCKETT	#468	ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
#3A	OFFICE	70	4	4	F40	LAY-IN	10	4			
#3B	OFFICE	70	6	4	F40	LAY-IN	10	4			
#4	COMPUTER LAB	65	8	4	F40	LAY-IN	10	4			
#5	COMPUTER LAB	65	6	4	F40	LAY-IN	10	4			
#5A	COMPUTER WORK AREA	15	5	2	F40	POLY-WRAP	10	4			
#6	COMPUTER LAB	30	2	4	F40	LAY-IN	10	4			
#6A	COMPUTER WORK AREA	45	12	3	F40	POLY-WRAP	10	4			
#7	COMPUTER LAB	50	8	4	F40	LAY-IN	10	4			
#8	STAIR	30	1	1	300w. P's INC.	SOCKET	10	4			
#10	MEN'S REST RM.	75	2	2	F40	LAY-IN	10	4			
#11	WOMEN'S REST RM.	75	2	2	F40	LAY-IN	10	4			

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#12 WOMEN'S REST RM	85	5	4	F40	LAY-IN	10	4	
#13 LOBBY	50	10	4					
#14 CORRIDOR	30	4	2					
#15 STAIR	25	1	2					
#17 MEN'S REST RM.	100	5	4					
#18 CORRIDOR	15	8	2	F40	LAY-IN	10	4	
#19 → #67 US ARMY CLINIC								
#68 BREAK ROOM	65	12	4	F40	LAY-IN	10	4	
#69A CLASSRM.	80	4	4					
#69B CLASSRM.	80	4	4					
#70A OFFICE	90	2	4	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#75 OFFICE	75	4	4	F40	LAY-IN	10	4	
#76 OFFICE	80	3	4	F40	LAY-IN	10	4	
#77 WOMEN'S REST RM.	75	2	4	F40	LAY-IN	10	4	
#79 MEN'S REST RM.	65	2	4	F40	LAY-IN	10	4	
#80 CORRIDOR	30	4	2	F40	LAY-IN	10	4	
#81 OFFICE	40	2	4	F40	LAY-IN	10	4	
#82A OFFICE	100	3	4	F40	LAY-IN	10	4	
#82B OFFICE	100	3	4	F40	LAY-IN	10	4	
#83 OFFICE	100	3	4	F40	LAY-IN	10	4	
#85 CORRIDOR	30	2	2	F40	LAY-IN	10	4	
#86 STAIR	15	1	2	F40	LAY-IN	10	4	

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #408

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#70B OFFICE	90	2	4	F40	LAY-IN	10	4	
#71 OFFICE	90	2	4	F40	LAY-IN	10	4	
#72A AUDITORIUM	25	24	4	F40	LAY-IN			
	25	4	1	100W. INC. SPOTS	STAGE SPOTS BOOTH SPOTS			
#72B COMPUTER LAB	40	12	4	F40	LAY-IN	10	4	DIMMING BALLAST
#72c CAP LAB	50	6	4	F40	LAY-IN	10	4	
#72D CAP LAB	50	6	4	F40	LAY-IN	10	4	
#72E CORRIDOR	30	8	2	F40	LAY-IN	10	4	
#73 CORRIDOR	30	4	2	F40	LAY-IN	10	4	
#74A GLASS ROOM	40	20	2	F40	LAY-IN	10	4	
#74B GLASS ROOM	40	24	2	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: # 468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#88 OFFICE	90	4	4	F40	LAY-IN	10	4	
#90A OFFICE	80	4	4					
#90B OFFICE	90	4	4					
#90C OFFICE	80	4	4					
#90D CLASS ROOM	80	6	4					
#91 CLASS ROOM	80	6	4					
#92 HALL	65	2	4					
#93 MAIL ROOM	50	3	4					
#94 STORAGE	60	4	4					
#95A OFFICE	55	4	4					
#95B OFFICE	70	4	4	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
#95c OFFICE	55	2	4	F40	LAY-IN	10	4	
#95D HALL	40	3	4					
#96A OFFICE	50	2	4					
#96B HALL/STORAGE	40	2	4					
#97 STAIR	30	2	4					
#98 CLASS ROOM	90	12	4					
#99 OFFICE/LIBRARY	125	12	4					
#101 LIBRARY	100	18	4					
#103 VAULT	50	2	2					
#104 LIBRARY	100	4	4					
#106 STORAGE	50	2	2	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #400

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	IHS/DY	DYWK	ECO DESCRIPTION
# 107 LIBRARY	100	19	4	F40	LAY-IN	10	4	
# 110 WOMEN'S REST RM.	75	5	4					
# 113A CORRIDOR	30	4	4					
# 113B CORRIDOR	30	2	2					
# 114 OFFICE	40	3	2					
# 115 MEN'S REST RM.	85	5	4					
# 117A CLASS ROOM	80	4	4					
# 11 B CLASS ROOM	80	4	4					
# 118 CLASS ROOM	60	8	4					
# 119 OFFICE	80	4	4					
# 120 OFFICE	80	4	4	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
# 121A OFFICE	60	4	4	F40	LAY-IN	10	4	PANELED WALLS
# 121B OFFICE	50	2	4					
# 122 CORRIDOR	30	6	2					
# 123 OFFICE	90	4	4					
# 124 STAIR	15	1	4					
# 126 CLASS ROOM	40	12 6	4 2					
# 127 CLASS ROOM	40	12 6	4 2					DIMMING BALLAST
# 128 COMPUTER LAB	40	12	4					
# 129 CLASS ROOM	40	8 3	4 2					
# 130 CORRIDOR	30	1	2					
# 132 MEN'S ROOM	40	3	2	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYAWK	ECO DESCRIPTION
#133 JANITOR CLOSET	25	1	2	F40	LAY-IN	10	4	
#134 CLASS ROOM	40	10	4					
#135 CORRIDOR	35	5	2					
#136A OFFICE	100	4	4					
#136B OFFICE	80	2	4					
#136C OFFICE	80	2	4					
#136D HALL	60	3	4					
#137 OFFICE	100	4	4					
#138A OFFICE	100	4	4					
#138B OFFICE	80	2	4					
#138C OFFICE	80	2	4	F40	LAY-IN	10	4	

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
# 138D HALL	60	3	4	F40	LAY-IN	10	4	
# 139 CLASS ROOM	50	13	3	F40	PENDANT MTP, LOUVERED	—	—	OLDER CLASSROOM

F 4

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #468 US ARMY CLINIC

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#19 CONFERENCE	55	8	3	F40	LOUVERED DIRECT & INDIRECT	10	4	
#20 REST ROOM	40	1	2					
#21 HAZARDOUS WASTE	40	1	2					
#22 EYE EXAM	45	4	3					
#23 EYE EXAM	65	6 2	3 2	60W. INC.				
#24 HEARING	50	6	3					
#25 HEARING CLOSET	10	1	2	60W. INC.	SOCKET			
#26 ENTRY/ SERVICE SINK	15	2	2	100W. INC.	SOCKET			
#27 EXAM	40	4	3	F40	LOUVERED DIRECT/INDIRECT			
#28 X-RAY STORAGE	30	2	4					
#29 X-RAY	50	7	4	F40		10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #408 CLINIC

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#31 MEDICINE STORAGE	55	1	4	F40	POLY-WRAP	10	4	
#32 DARK ROOM	55	1	4					
#33 NURSE'S OFFICE	100	4	4					
#34 ENTRY		1	1	250W. INC.	SOCKET			
#37 LOBBY	60	4	3	75W. 8'-0"	SURF. MTD.	10	4	
	60	4	2	F40	1' x 4' RECESSED	10	4	
#38 OFFICE	50	4	2	F40	RECESSED			
#39 OFFICE	50	12	2	F40	RECESSED			
#40 EXAM	125	4	4	F40	LAY-IN			
#41 OFFICE	90	2	4					
#42 EXAM	90	2	4					

F 4

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #460 CLINIC

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WAITS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
#43 EXAM	100	8	4	F40	LAY-IN	10	4	
#44 ENTRY	30	1	4					
#46 LAB	80	6	4					
#48 EXAM	100	2	4					
#49 EXAM	100	2	4					
#50 EXAM	100	2	4					
#51 EXAM	100	2	4					
#52 EXAM	100	2	4					
#53 EXAM	100	2	4					
#54 STORAGE	30	1	4					
#55 STORAGE	50	2	4	F40	LAY-IN	10	4	

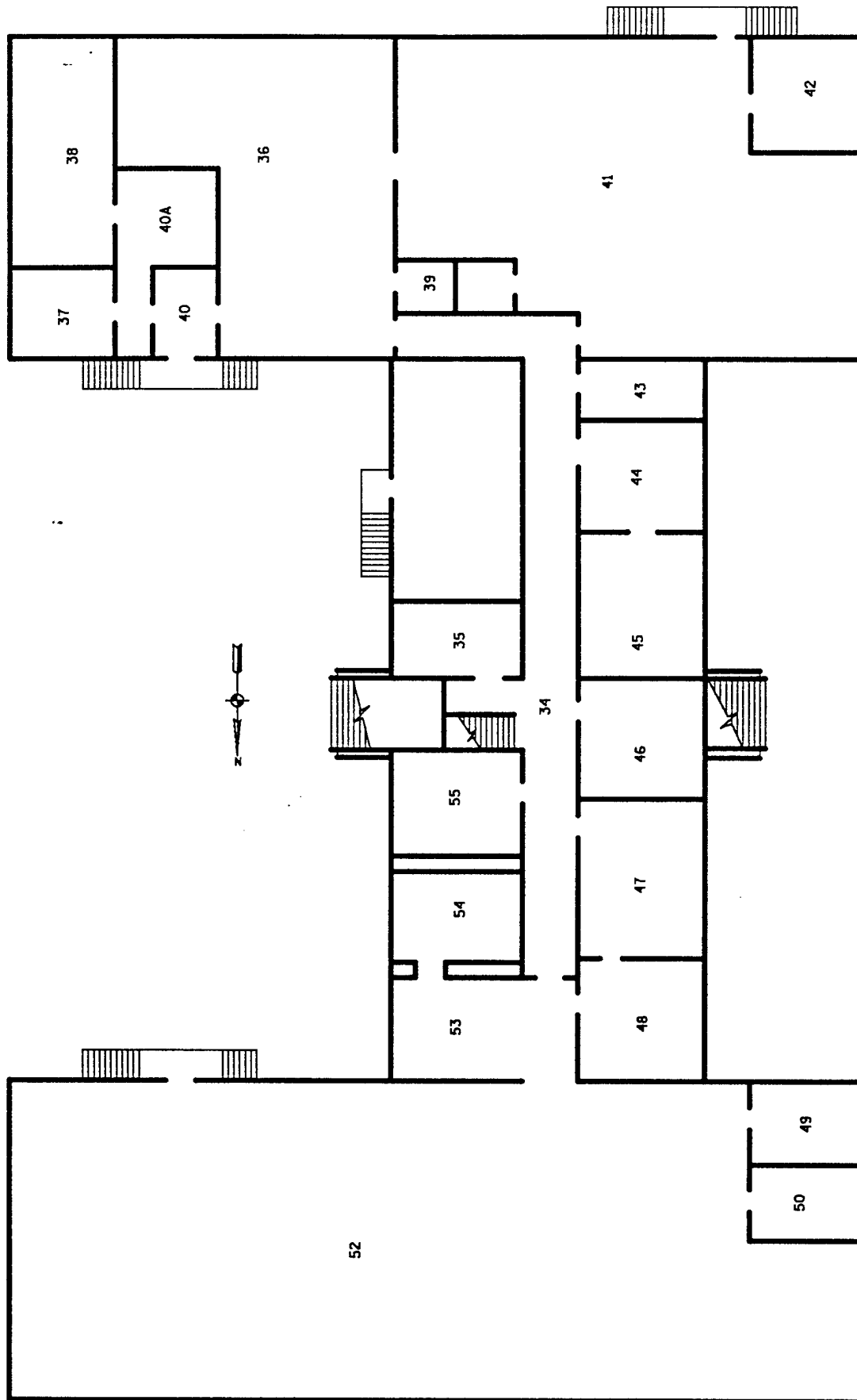
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Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #68 CLINIC

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#56 OFFICE	75	1	4	F40	LAY-IN	10	4	
#57 NURSES STATION	100	6	4					
#59 RECORDS	60	2	4		SURFACE MTD.			
#60/62 REST ROOMS	60	1	1	75W. 8'-0"	SURFACE MTD			
#61/63 REST ROOMS	50	1	2	F40	SURFACE MTD.			
#64 HOLDING	15	2	2	60W. INC.	SOCKET			
#65 WAITING	20	2	1	250W. INC.	RINGED SOCKET			
#66 HALL	60	2	2	75W. 8'-0"	STRIPS			
#67 CORRIDOR	30	1	2	F40	LAY-IN			
	20	6	4	F40	PENDANT MTD. FLUOR.	10	4	

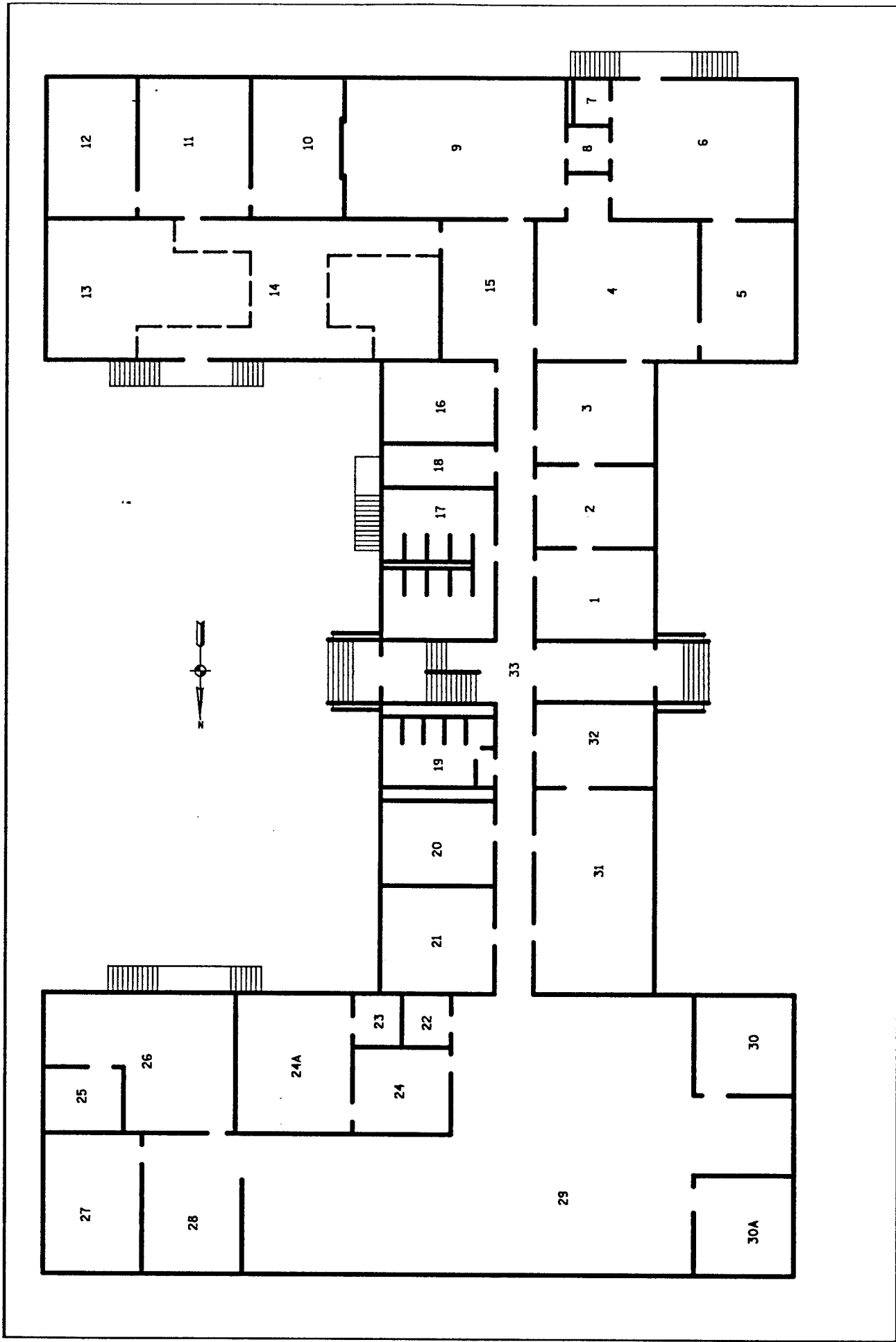


BUILDING  
15 - GROUND FLOOR

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)35-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS

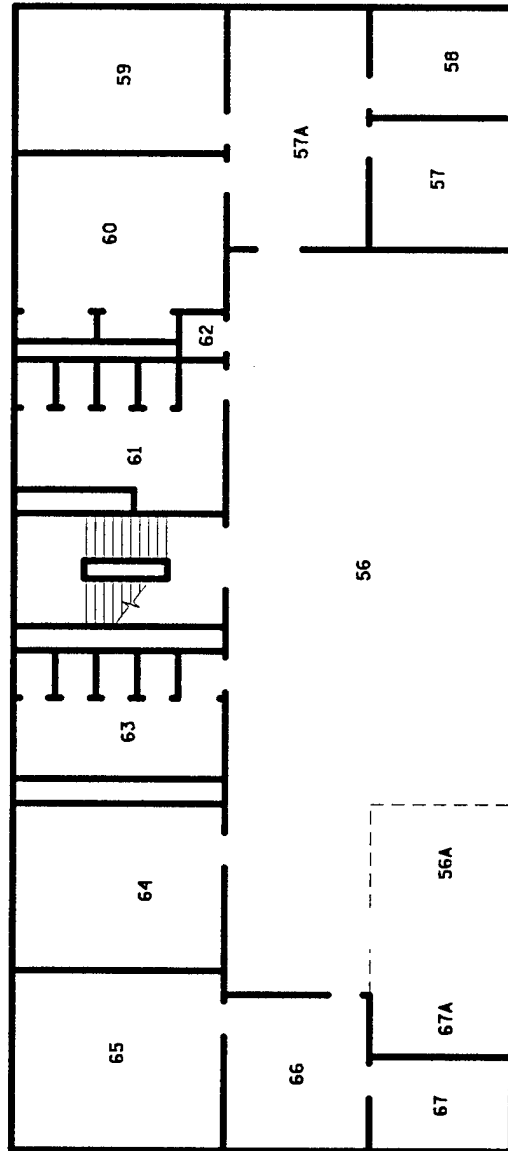


BUILDING  
15 - FIRST FLOOR

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS



**HUITT ~ ZOLIARS**  
ENGINEERS/ARCHITECTS

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

**RED RIVER ARMY  
DEPOT**

**BUILDING  
15 - SECOND FLOOR**

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #15

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#1 OFFICE	50	4	4	F40	DROP LENS	10	4	
#2 OFFICE	55	4	4	F40	LAY-IN			
#3 OFFICE	75	6	4		DROP LENS			
#4 OFFICE	80	13	4					
#5 OFFICE	75	4	4					
#6 CONFERENCE ROOM	100	16	4		LAY-IN			
#7 REST ROOM	75	1	3		LAY-IN			
#8 COFFEE ROOM	70	1	4		DROP LENS			
#9 CONFERENCE ROOM	50	27	2					
#11 OFFICE	60	4	4					
#12 OFFICE	60	4	4	F40	DROP LENS	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE:	SURVEYOR:	BUILDING:	HTS/DY	DYWK	ECO DESCRIPTION			
10/94	LUCKETT	#15						
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
#14 MAIL ROOM/STORAGE	50	22	4	F40	DROP LENS	10	4	YELLOWED LENS
#15 LOBBY	35	4	4					
#16 OFFICE	60	4	4					
#18 JANITOR	20	1	1	200w. Ps. INE.	SOCKET			
#19 MEN'S REST RM.	50	4	2	F40	LAY-IN			
#20 OFFICE/COPY	80	4	4		LAY-IN			
#21 OFFICE	65	4	4		DROP LENS			
#22 COPY	45	1	4		CHAIN MTD.			
#23 STORAGE	20	1	1	150w. INE.	SOCKET			
#24 OFFICE	75	3	4	F40	LAY-IN			
#24A OFFICE	50	4	4	F40	DROP LENS	10	4	

3 # 7

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: # 15

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
# 25 OFFICE	35	2	4	F40	DROP LENS	10	4	
# 26 OFFICE AREA	50	11	4					(2) CEILING FANS WITH LIGHT KITS (100WATTS)
# 27 OFFICE	50	5	4					YELLOWED LENS
# 28 OFFICE	60	5	4					
# 29 OFFICE AREA	50	42	4					
# 30 OFFICE	50	4	4					
# 30A OFFICE	50	4	4					
# 31 OFFICE AREA	40	6	4					
# 32 OFFICE	60	4	4					
# 33 CORRIDOR/STAIR	30	9	4					
# 34 CORRIDOR	65	7	4	F40	DROP LENS	10	4	OVERLIT

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: # 15

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
# 35 COFFEE ROOM	20	1	1	75w. 8'-0"	STRIP	10	4	
# 36 OFFICE	50	22	4	F40	LAY-IN			
# 37 WORK ROOM	70	2	4					
# 38 OFFICE	80	6	4					
# 40 ENTRY	15	1	4					
# 40A OFFICE	50	2	4	F40	LAY-IN POLY-WRAP			
# 41 OFFICE	45	24	4	F40	LAY-IN			
# 42 STORAGE	20	2	1	200w. P.S. INC.	SOCKET			
# 43 STORAGE	25	1	4	F40	LAY-IN			
# 44 OFFICE	40	4	4	F40	LAY-IN			
# 45 OFFICE	50	9	2	F40	DROP LENS	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #15

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#46 BREAK ROOM	50	5	2	F40	DROP LENS	10	4	
#47 OFFICE	40	4	4	F40	LAY-IN			
#48 OFFICE	70	3	4					
#49 RECORD STORAGE	30	1	2	75W. 8'-0"	STRIP			
#50 RECORD STORAGE	20	2	1	100W. INC.	SOCKET			
#51 WOMEN'S REST RM.	50	10	2	F40	LAY-IN			
#52 OFFICE AREA	70	58	4					
#53 OFFICE	50	3	4					
#54 VAULT	40	3	2		INDUSTRIAL			
#55 BREAK ROOM	72	3	4		LAY-IN			
#56 OFFICE	60	18	4	F40	LAY-IN	10	4	

**ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET**

Hutt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #15

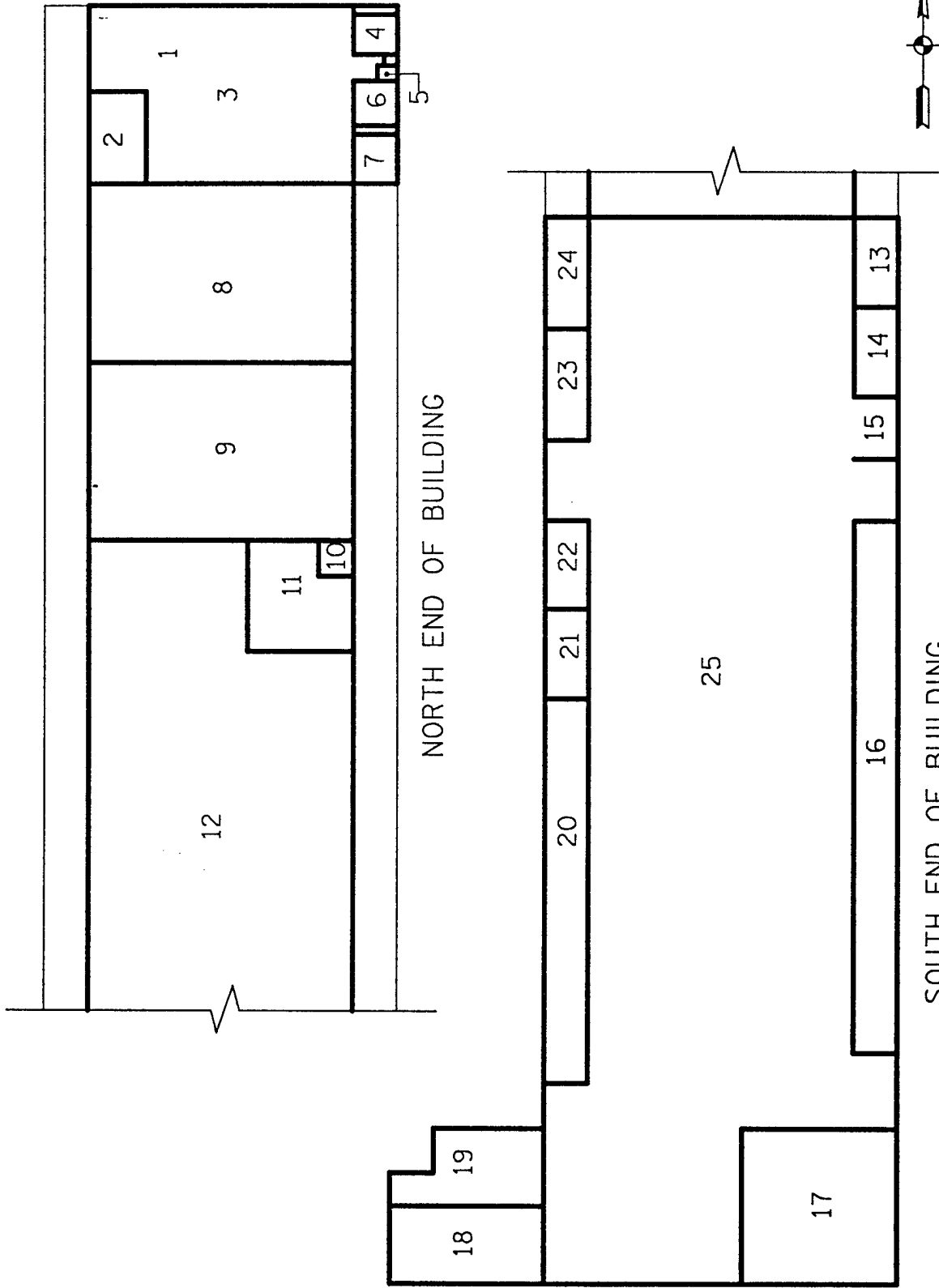
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#56A OFFICE	60	4	4	F40	LAY-IN	10	4	
#57 STORAGE	100	2	4					DELAMP
#57A OFFICE	60	4	4					
#58 STORAGE	75	2	4					DELAMP
#59 OFFICE	75	4	4					
#60 WORK ROOM	80	4	4					
#61 WOMEN'S REST RM.	75	5	2					
#62 MEN'S REST RM.	75	5	2					
#63 JANITOR	15	1	1	150 w. INC.	SOCKET			
#64 CONFERENCE	80	4	4	F40	LAY-IN			
#65 OFFICE	75	4	4	F40	LAY-IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #15

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#66 OFFICE	50	3	4	F40	LAY-IN	10	4	
#67 OFFICE	70	4	4					
#67A OFFICE	65	4	4					



BUILDING  
441

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

**HUITT ~ ZOLLARS**  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: NOV. 1994 SURVEYOR: THL BUILDING: #441 RED RIVER

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
1 LOBBY	20	2	4	F40	LAY IN	10	4	
		1	1	100w. A19	SOCKET			REPLACE FIXTURE
2 OFFICE	50	4	4	F40	LAY IN	10	4	
3 OPEN OFFICE	40	20	4	F40	LAY IN	10	4	
4 MEN'S REST ROOM	30	1	4	F40	LAY IN	10	4	SENSOR
5 JAN. CLOSET	10	1	1	100w. A19	SOCKET			REPLACE
6 WOMEN'S REST ROOM	30	1	4	F40	LAY IN	10	4	SENSOR
7 OFFICE	30	1	4	F40	LAY IN	10	4	
8 OPEN OFFICE	45	36	4	F40	LAY IN	10	4	MODULAR FURN.
9 OPEN OFFICE	45	36	4	F40	LAY IN	10	4	
10 REST ROOM	40	1	4	F40	LAY IN	10	4	SENSOR
		1	2	F40	VANITY			
11 OFFICE	65	12	4	F40	LAY IN	10	4	

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

2

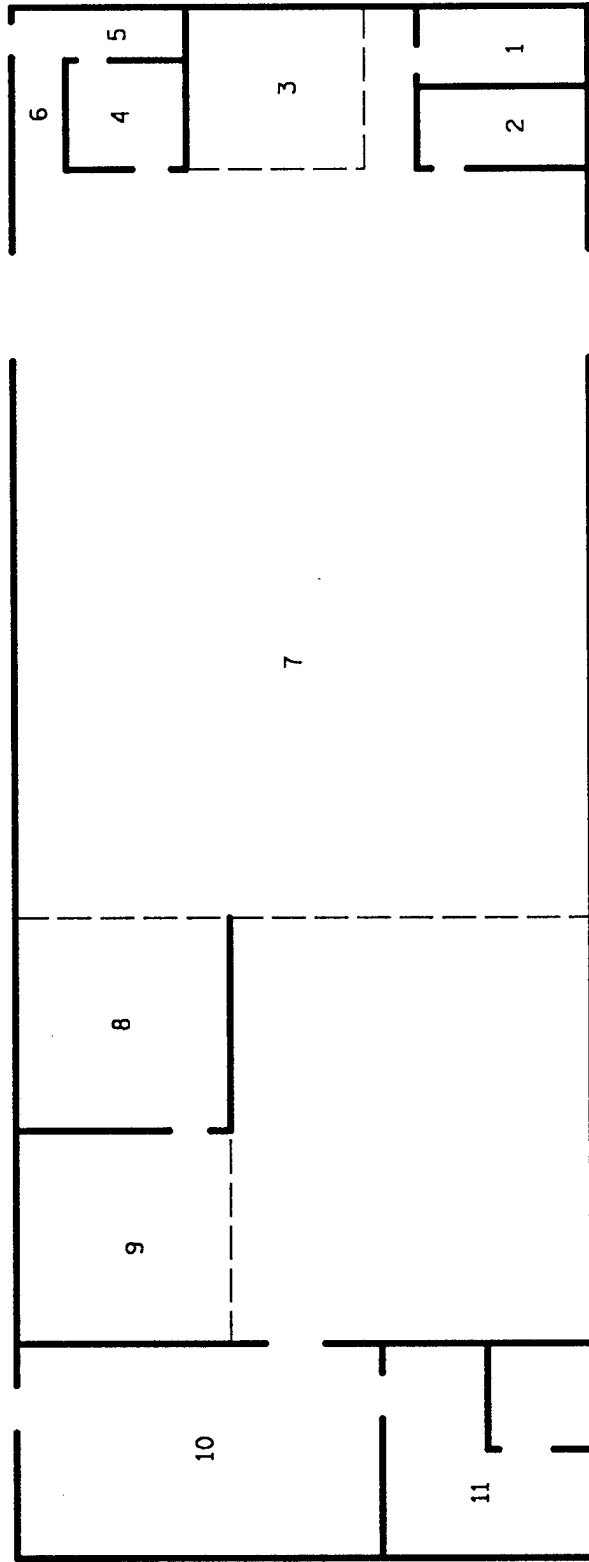
DATE: <u>Nov. 1994</u>	SURVEYOR: <u>THC</u>	BUILDING: <u>#441</u>	R.F.R.						
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION	
12 SHOP/STORAGE	25	10	1	400w. HPS	Low BAY w/ PROP LENS	10	4		
	25	2	2	F96 75w.	STRIP	10	4		
13 MEN'S REST RM.	60	3	4	F40	LAY IN VANITY	10	4	DE-LAMP SENSOR	
14 WOMEN'S REST RM.	60	3	4	F40	LAY IN VANITY	10	4	DE-LAMP SENSOR	
15 STORAGE	25	1	2	F40	INDUSTRIAL	10	4		
16 PLATING	25	17	1	175w. M.V.	Low BAY w/ VAPOR LENS	10	4	CHANGE-OUT	
	25	1	2	F40	INDUSTRIAL w/ VAPOR LENS	10	4		
17 SAND BLAST	20	15	1	175w. M.V.	Low. BAY w/ VAPOR LENS	10	4	CHANGE-OUT	
18 STORAGE VAULT	25	6	1	175w. M.V.	Low BAY w/ GLASS LENS	10	4		
19 STORAGE VAULT	25	6	1	175w. M.V.	Low BAY w/ GLASS LENS	10	4		
20 SHOP	30	8	3	F40	INDUSTRIAL	10	4		

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

3

DATE: NOV. 1994 SURVEYOR: THL BUILDING: # 441 R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
21 MACHINE SHOP	35	15	1	300w. P.S.	SOCKET	10	4	CHANGE OUT
22 BREAK ROOM	25	4	4	F40	LAY IN	10	4	SENSOR
23 OFFICE	25	2	4	F40	LAY IN PARA CUBE	10	4	
24 OFFICE	25	8	2	F40	INDUSTRIAL	10	4	



BUILDING  
133

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLIARS  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

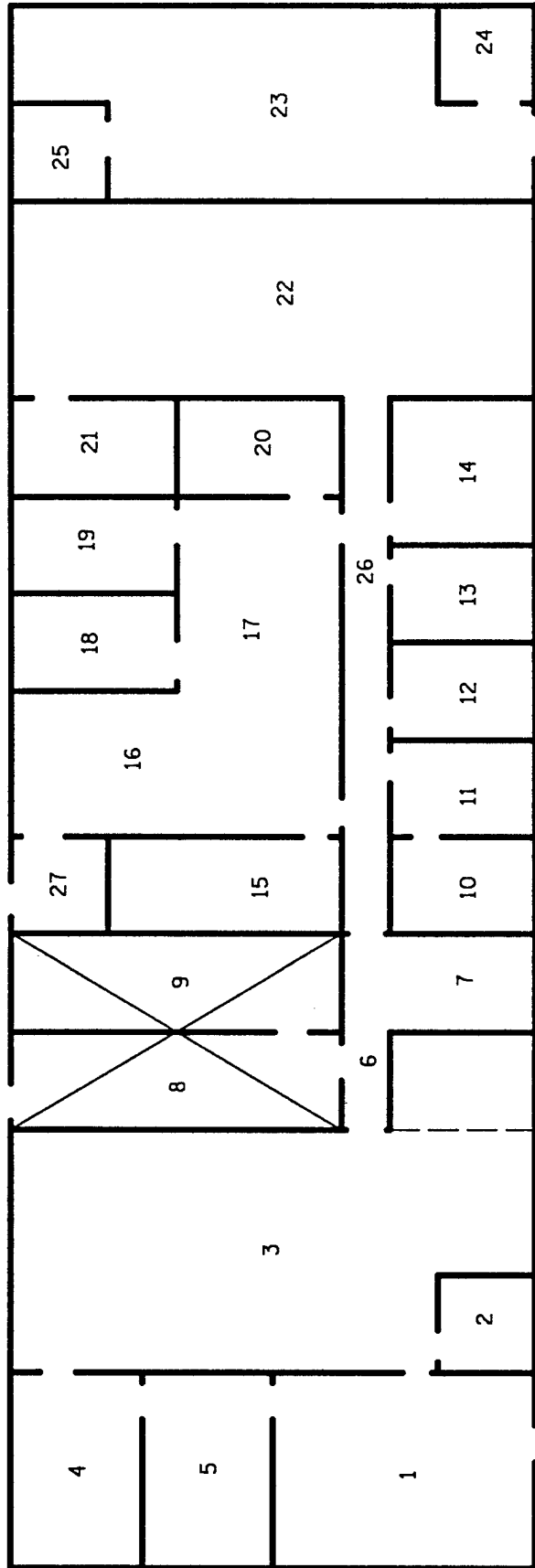
DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #133 ALLIED TRADES

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#1 MEN'S REST RM.	50	1	2	F40	STRIP	10	4	
#2 WOMEN'S REST RM.	8	1	1	150W. PS INC.	SOCKET			
#3 TOILET CRIB	25	6	2	F40	STRIP			
#4 CRIB	25	2	2	110W. HO 8'-0"	STRIP			
#5 OFFICE	55	2	2	75W. 8'-0"	STRIP			
#6 OFFICE	45	2	2	F40	STRIP			
OFFICE BREAK RM	45	2	2	75W. 8'-0"	STRIP			
#6 CORRIDOR LOCKERS	15	1	2	F40	STRIP			
#7 OPEN BAY MACHINING	50	58	1	175W. MERC. VAPOR	LOW BAY			
	50	7	1	150W. INC.	INDUSTRIAL EGRESS			
#8 OFFICE	100	10	4	F40	POLY-WRAP			

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #133 ALLIED TRADES

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	IIRS/DY	DYWK	ECO DESCRIPTION
# 9 TOOL CRIB	25	6	2	F40	STRIP			
# 10 WORK ROOM	30	5	4	F40	POLY-WRAP			
WORK ROOM	30	1	2	F40	POLY-WRAP			
# 11 WORK ROOM	25	6	4	F40	POLY-WRAP			



BUILDING  
245

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

**HUITT ~ ZOLLARS**  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #245 RESOURCE MGT.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYAWK	ECO DESCRIPTION
#1 CONFERENCE ROOM	40	6	4	F40	LAY-IN	10	4	
#2 OFFICE	40	2	4	F40	LAY-IN	10	4	
#3 SHOP	40	65	2	F40	CHAIN MTD. INDUSTRIALS	10	4	
#4 OFFICE	60	4	4	F40	LAY-IN	10	4	
#5 OFFICE	60	4	4	F40	LAY-IN	10	4	
#6 CORRIDOR	10	2	1	150w. INC.	SOCKET	10	4	
#7 ENTRY	15	2	2	F40	INDUSTRIAL	10	4	
#8 TOOL CRIB	40	4	2	F40	INDUSTRIAL	10	4	
#9 TOOL CRIB	40	2	2	F40	INDUSTRIAL	10	4	
#10 OFFICE	100	3	3	F40	PARABOLIC	10	4	
#11 OFFICE AREA	90	3	3	F40	PARABOLIC	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: #245

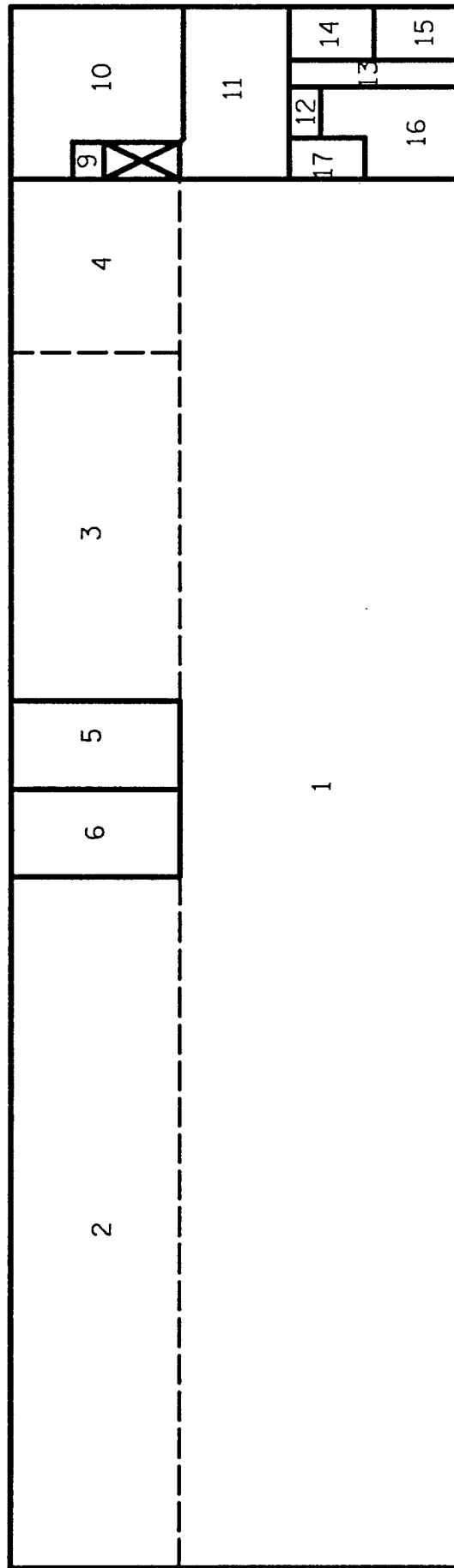
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
#12 WOMEN'S REST RM.	60	2	1	200w. P's. INC.	SOCKET	10	4	
	60	1	4	F40	POLY-WRAP	10	4	
#13 MEN'S REST RM.	30	9	1	200w. P's INC.	SOCKET	10	4	
#14 OFFICE	100	6	4	F40	DROP LENS	10	4	
#15 OFFICE	85	4	3	F40	PARABOLIC	10	4	
#16 OFFICE	60	16	3	F40	PARABOLIC	10	4	
#18 OFFICE	70	2	3	F40	PARABOLIC	10	4	
#19 OFFICE	50	2	3	F40	PARABOLIC	10	4	
#20 OFFICE	50	2	3	F40	PARABOLIC	10	4	
#21 OFFICE	60	3	4	F40	DROP LENS	10	4	
#22 SHOP	25	30 4	2 3	F40	INDUSTRIALS	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: 10/94 SURVEYOR: LUCKETT BUILDING: # 245

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
# 23 SHOP	50	15	1	200w. P's. INC.	SOCKET (EXPLOSION PROOF)	10	4	(OLD PAINT AREA)
SHOP	50	8	2	F40	INDUSTRIALS	10	4	
SHOP	50	1	1	250w. HPS	LOW BAY W/LENS	10	4	(FORMER TEST)
# 24 BREAK ROOM	30	4	2	F40	POLY-WRAP	10	4	
# 25 STORAGE	5	1	1	200w. P's. INC.	SOCKET	10	4	

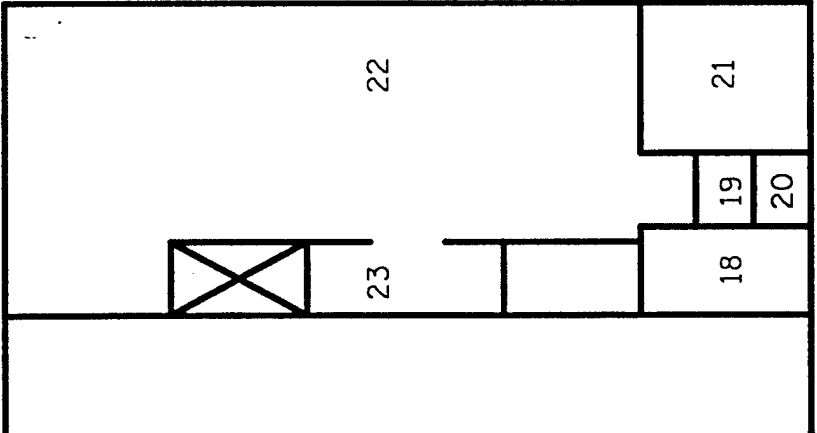


BUILDING  
315 FIRST FLOOR

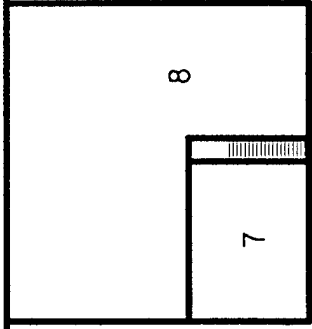
RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

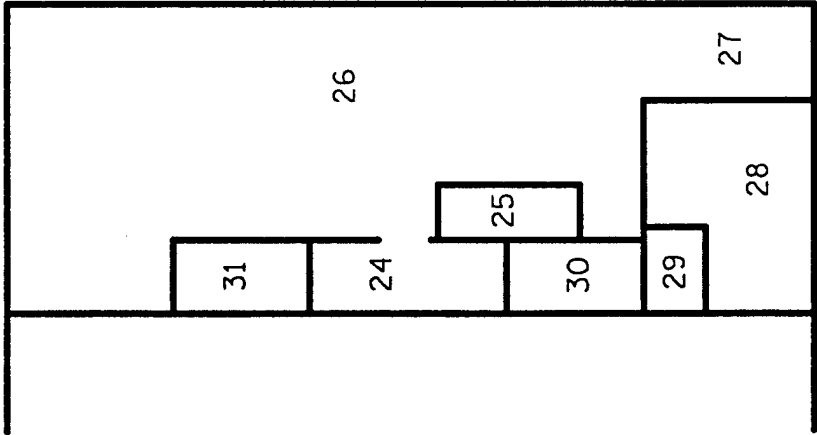
**HUITT ~ ZOLLARS**  
ENGINEERS/ARCHITECTS



SECOND FLOOR



MEZZANINE



THIRD FLOOR

BUILDING  
315 MEZZ., 2nd, & 3rd

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

DATE: NOV. 1994 SURVEYOR: THL BUILDING: # 315 RED RIVER

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
1 MANUF.	30	75	1	1000W. HPS	HIGH BAY OPEN REF.	10	4	MTD. AT 30'-0"
2 MANUF.	40	20	1	400W. HPS	LOW BAY OPEN REF.	10	4	MTD. AT 20'-0"
3 MANUF.	40	10	1	400W. HPS	LOW BAY OPEN REF.	10	4	MTD. AT 20'-0"
4 MANUF.	50	2	1	400W. HPS	LOW BAY DROP LENS	10	4	MTD. AT 20'-0"
5 TOOL MANUF.	65	8	4	F40	POLY WRAP	10	4	
6 TOOL ROOM	45	9	2	F96 75W.	STRIP	10	4	
7. BREAK ROOM	45	10	2	F40	POLY WRAP	10	4	
8 CONF. ROOM	30	5	2	F40	POLY WRAP	10	4	
9 MECH. ROOM	10	1	1	200W. P.S.	SOCKET	10	4	CHANGE-OUT FIXTURE
10 OPEN OFFICE	55	26	4	F40	LAY IN DROP LENS	10	4	
11 BREAK AREA	10	2	1	300W. P.S.	SOCKET	10	4	CHANGE-OUT FIXTURE

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

2

DATE: Nov. 1994 SURVEYOR: THL BUILDING: # 315 R.R.

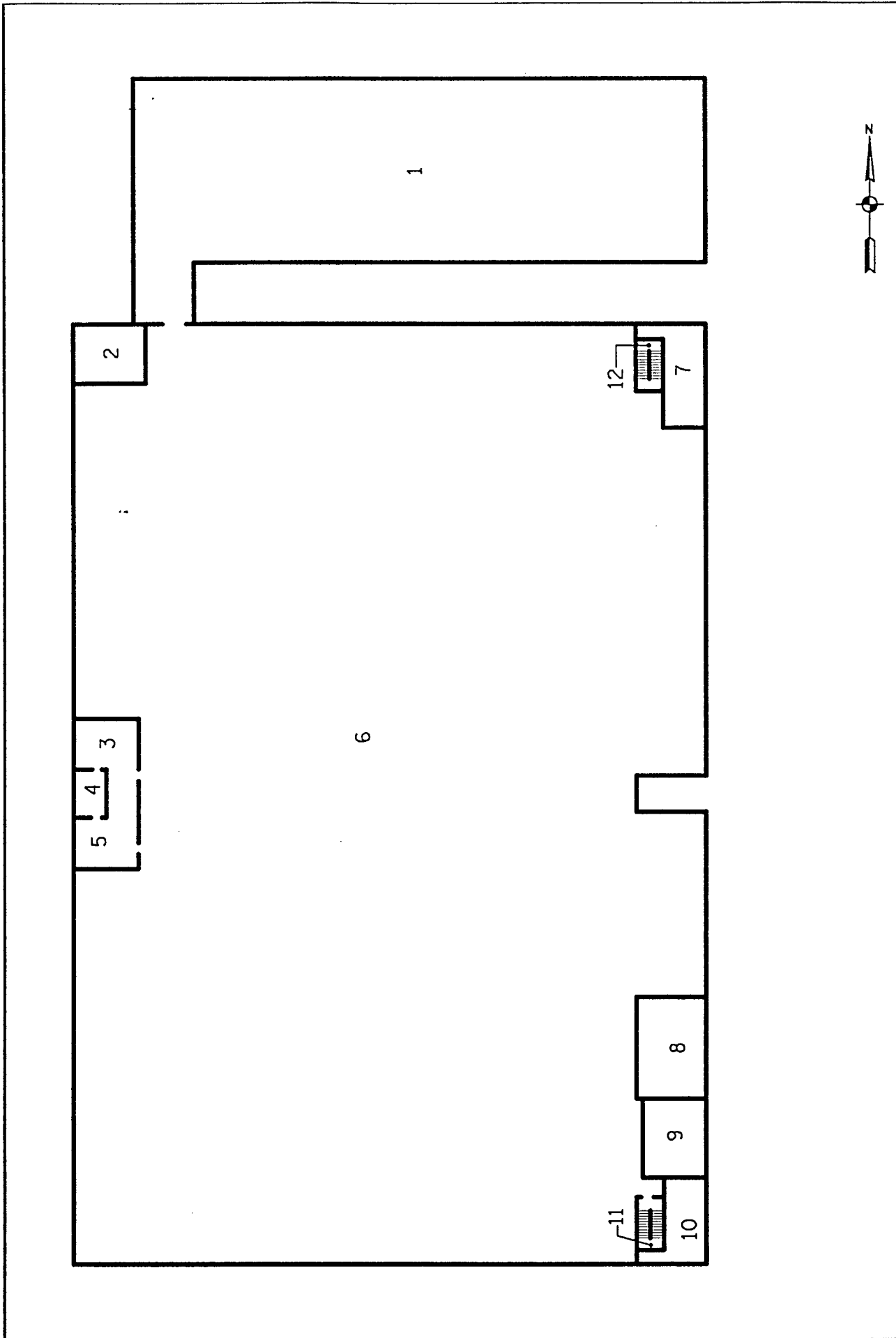
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
12 JAN. CLOSET	60	1	4	F40	LAY IN	—	—	DE-LAMP
13 HALL	25	3	2	F40	LAY IN	10	4	
14 WOMEN'S REST RM	35	2 1	4 2	F40 F40	LAY IN VANITY	10	4	
15 TOOL STORAGE	50	4	4	F40	LAY IN	10	4	
16 MEN'S REST ROOM	65	4 1	4 2	F40 F40	LAY IN VANITY	10	4	DE-LAMP
17 STAIR WELLS	10	3	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT TO FL. FIXTURE
18 OFFICE	65	3	4	F40	LAY IN	10	4	
19 WOMEN'S REST RM.	45	1	4	F40	LAY IN	10	4	
20 MEN'S REST RM.	45	1	4	F40	LAY IN	10	4	
21 OFFICE	60	4	4	F40	LAY IN	10	4	
22 OPEN OFFICE	55	26	4	F40	LAY IN	10	4	MODULAR FURN.

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

3

DATE: Nov, 1994 SURVEYOR: JHL BUILDING: # 315 R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
23 HALL	10	2	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT
24 HALL	8	2	1	175w. M.V.	SOCKET	10	4	CHANGE-OUT
25 OFFICE	65	2	4	F40	LAY IN	10	4	
26 OPEN OFFICE	45	23	4	F40	LAY IN	10	4	MODULAR FURN.
27 COFFEE BAR	50	1	4	F40	LAY IN	10	4	
28 C.A.D. WORK AREA	25	16	4	F40	LAY IN	10	4	MASKED LENS ≠ LAMPS
29 COMPUTER ROOM	25	4	4	F40	LAY IN	10	4	MASKED LENS ≠ LAMPS
30 STAIR	6	1	1	160w. M.V.	SOCKET	10	4	CHANGE-OUT
31 ELEVATOR SHAFT	5	1	1	100w. A19	SOCKET	—	—	

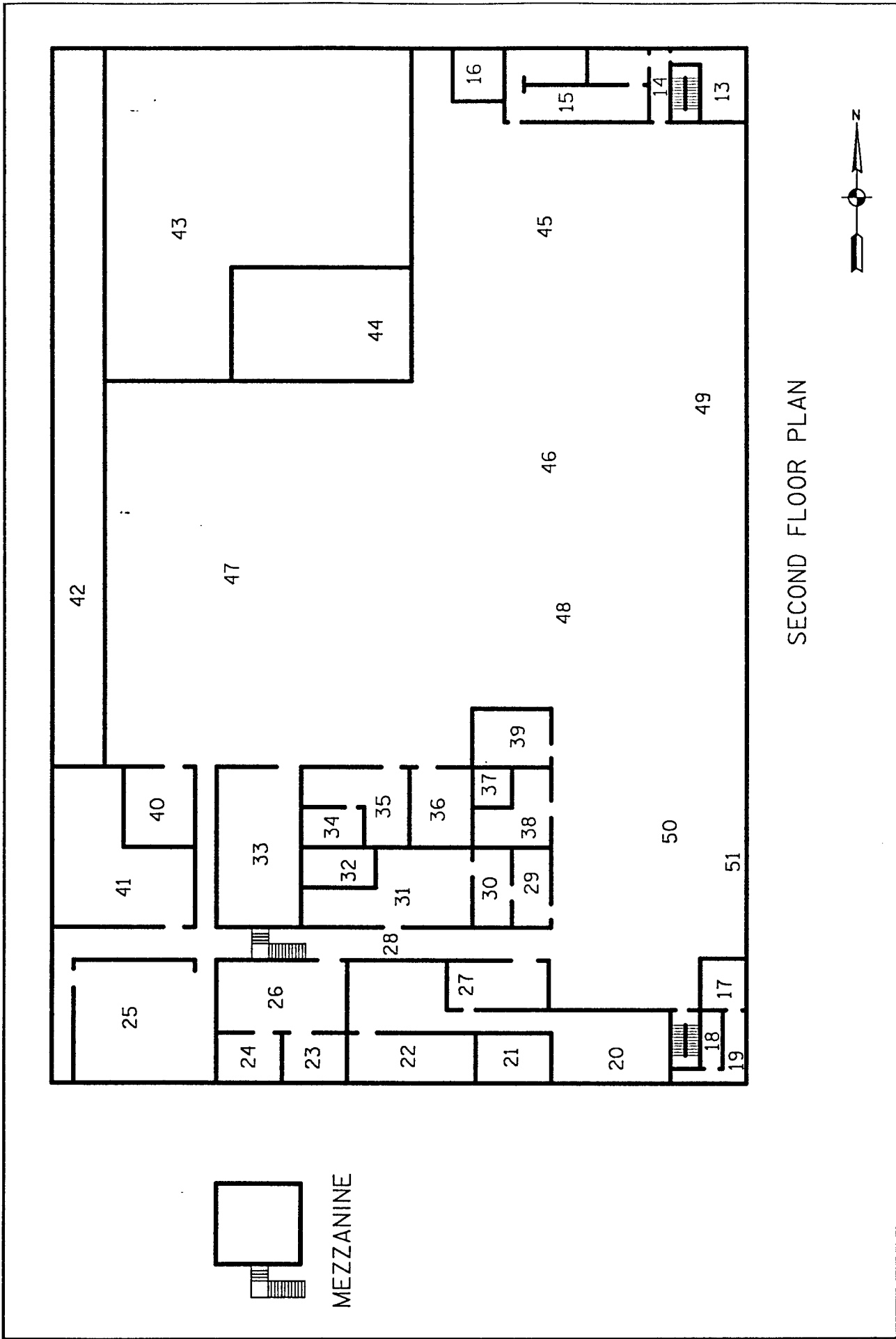


BUILDING  
321 FIRST FLOOR

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS



SECOND FLOOR PLAN



<p><b>HUITT ~ ZOLLARS</b> ENGINEERS/ARCHITECTS</p> <p>512 MAIN STREET, SUITE 1500 FORT WORTH, TEXAS 76102-3922 (817)335-3000/METRO 429-1291</p>	<p><b>RED RIVER ARMY DEPOT</b></p>	<p><b>BUILDING</b> 321 2nd FLOOR &amp; MEZZ.</p>
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# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TAK BUILDING: # 321 RED RIVER

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
1 RETREYIER	5	4	2	F96 75w.	STRIPS	10	4	
2 CONTROL ROOM	75	8	4	F40	POLY WRAP	10	4	
3 OFFICE	50	6	4	F40	LAY IN w/ DROP LENS	10	4	
4 OFFICE	50	4	4	F40	LAY IN w/ DROP LENS	10	4	
5 OFFICE	50	6	4	F40	LAY IN w/ DROP LENS	10	4	
6 STORAGE/ SHELVING	25	364	1	400w. M.H.#MN.	LOW BAY OPEN REF.	10	4	MTO. @ 16'-0"; LOTS OF SHELVING CHANGE-OUT M.V. TO M.H.
7 MEN'S REST ROOM	55	5	4	F40	LAY IN	10	4	
8 OFFICE	35	2	2	F40	VANITY	10	4	
9 BREAK ROOM	35	8	4	F40	LAY IN DROP LENS	10	4	
10 WOMEN'S REST ROOM	35	4	4	F40	LAY IN	10	4	
11 STAIRS	10	3	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

2

DATE: NOV. 1994

SURVEYOR: THL

BUILDING: # 321

R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
12 STAIRS	10	3	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT TO FL.
13 WOMEN'S REST RM.	45	5 2	4 2	F40 F40	LAY IN VANITY	10	4	
14 LOCKERS	10	1	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT TO FL.
15 MEN'S RESTROOM	75	13 3	4 2	F40 F40	LAY IN VANITY	10	4	DE-LAMP
16 OFFICE	60	6	2	F40	INDUSTRIAL	10	4	
17 MEN'S REST ROOM	45	1 1	4 2	F40 F40	LAY IN VANITY	10	4	
18 WOMEN'S REST ROOM	45	1 1	4 2	F40 F40	LAY IN VANITY	10	4	
19 HALL	15	2	2	F40	LAY IN	10	4	
20 HALL	20	1	2	F40	INDUSTRIAL	10	4	
21 MECH. ROOM.	10	1	1	200w. P.S.	SOCKET	—	—	
22 OPEN OFFICE	45	14	4	F40	LAY IN			

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TKL BUILDING: #321 RR. 3

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FITTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
23 DARK ROOM/ FILM PROCESS.	35	8	2	F40	INDUSTRIAL/ SAFE LIGHT	10	4	
24 DARK ROOM/ CAMERA	35	2	2	F96 75w. F40	STRIP/ SAFE LIGHT	10	4	
25 PRINTING	45	16	2	F96 75w.	INDUSTRIALS	10	4	CHANGE-OUT
26 PRINTING	45	5	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT
27 OFFICE	50	5	4	F40	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" FL.
28 HALL	60	13	2	F96 75w	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" FL.
29 OFFICE	60	8	4	F40	LAY IN	10	4	CHANGE-OUT TO FL.
30 OFFICE	20	5	1	175w. M.V.	OPEN REF.	10	4	
31 OFFICE	60	4	4	F40	LAY IN	10	4	
32 OFFICE	60	4	4	F40	LAY IN	10	4	
33 OFFICE	60	13	4	F40	LAY IN	10	4	
34 OFFICE	65	2	4	F40	LAY IN	10	4	

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: NOV. 1994 SURVEYOR: TAL BUILDING: # 321 R.R. 4

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
33 BREAK ROOM	30	10	2	F40	LAY IN	10	4	SENSOR
34 OFFICE	65	2	4	F40	LAY IN	10	4	
35 OFFICE	65	5	4	F40	LAY IN	10	4	
36 COPY	30	4	4	F40	LAY IN	10	4	
37 OFFICE	65	2	4	F40	LAY IN	10	4	
38 OFFICE	65	7	4	F40	LAY IN	10	4	
39 OFFICE	40	1	2	F96 75w.	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" FL.
		1	4	F40	INDUSTRIAL			
40 STORAGE	10	2	1	200w. P.S.	SOCKET	10	4	CHANGE-OUT TO FL.
41 STORAGE	30	5	2	F96 75w.	STRIP /	10	4	CHANGE-OUT TO FL.
		6	1	200w. INC.	SOCKET			
42 SHOP	30	20	1	175w. M.Y.	OPEN REFL.	10	4	CHANGE-OUT TO FL.
43 SHOP	35	60	2	F96 75w.	INDUSTRIAL	10	4	

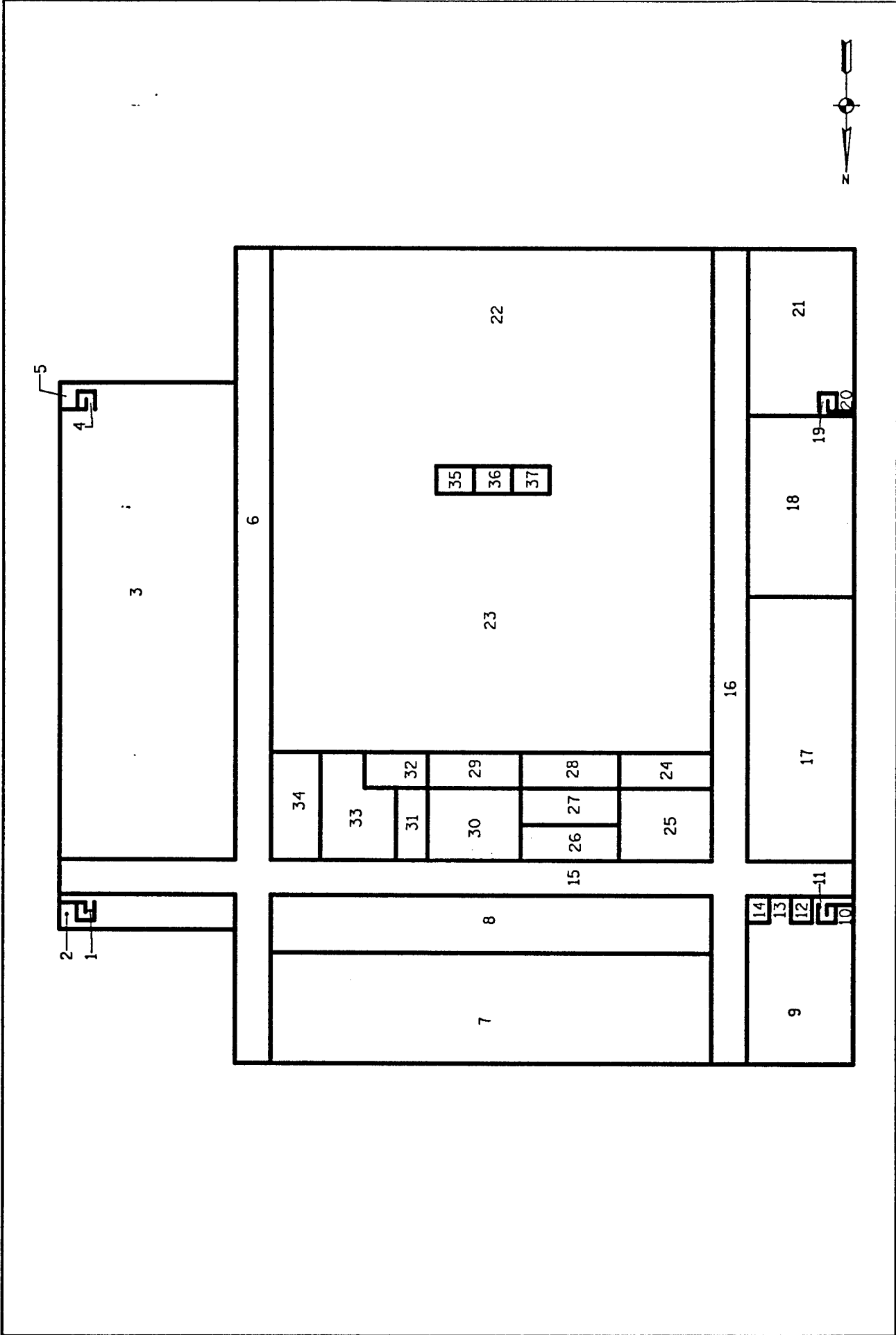
# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

*Huitt-Zollars, Inc.*  
CONSULTING ENGINEERS

5

DATE: Nov. 1994 SURVEYOR: TKL BUILDING: # 321 RR.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
44 SEWING SHOP	40	11	4	F40	INDUSTRIAL	10	4	
45 SHOP	20	3 10	1 1	400w. HPS 175w. M.V.	OPEN REFL.	10	4	CHANGE-OUT TO HPS
46 SHOP	35	18	4	F40	INDUSTRIAL	10	4	
47 SHOP	10	41	1	400w. M.V.	OPEN REFL. DOWN LTS.	10	4	CHANGE-OUT TO HPS
48 SHOP	15	2 10	1 1	400w. HPS 175w. M.V.	OPEN REFL.	10	4	CHANGE-OUT TO HPS
49 SHOP	20	18	2	F96 75w	INDUSTRIAL	10	4	
50 SHOP	20	3 3	2	F96 75w	STRIPS	10	4	
			4	F40	INDUSTRIAL			
51 SHOP	20	3 2	1	175w. M.V.	SOCKET	10	4	CHANGE-OUT TO FL.
			1	200w. INC.	SOCKET			

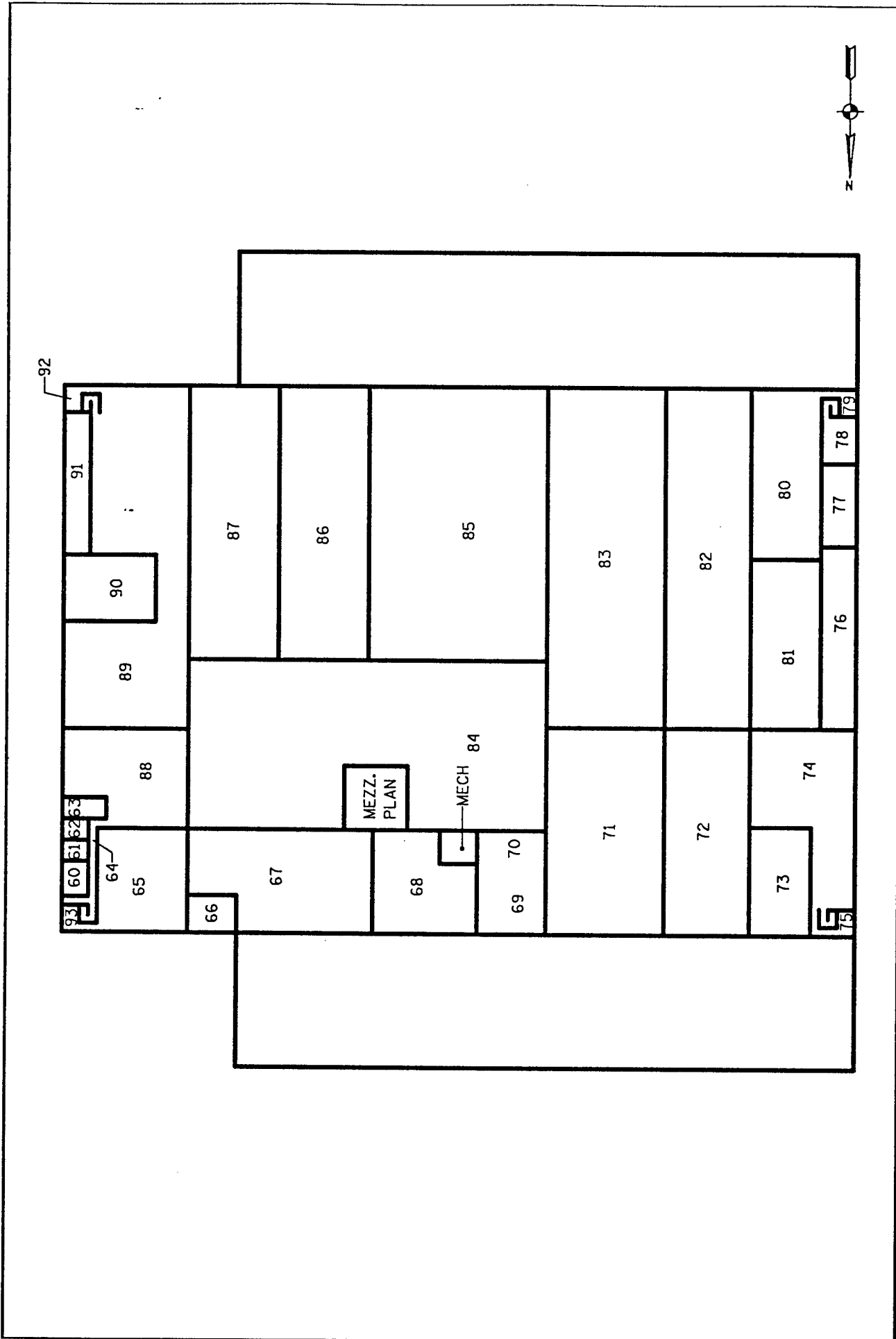


BUILDING  
345 - FIRST FLOOR

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS

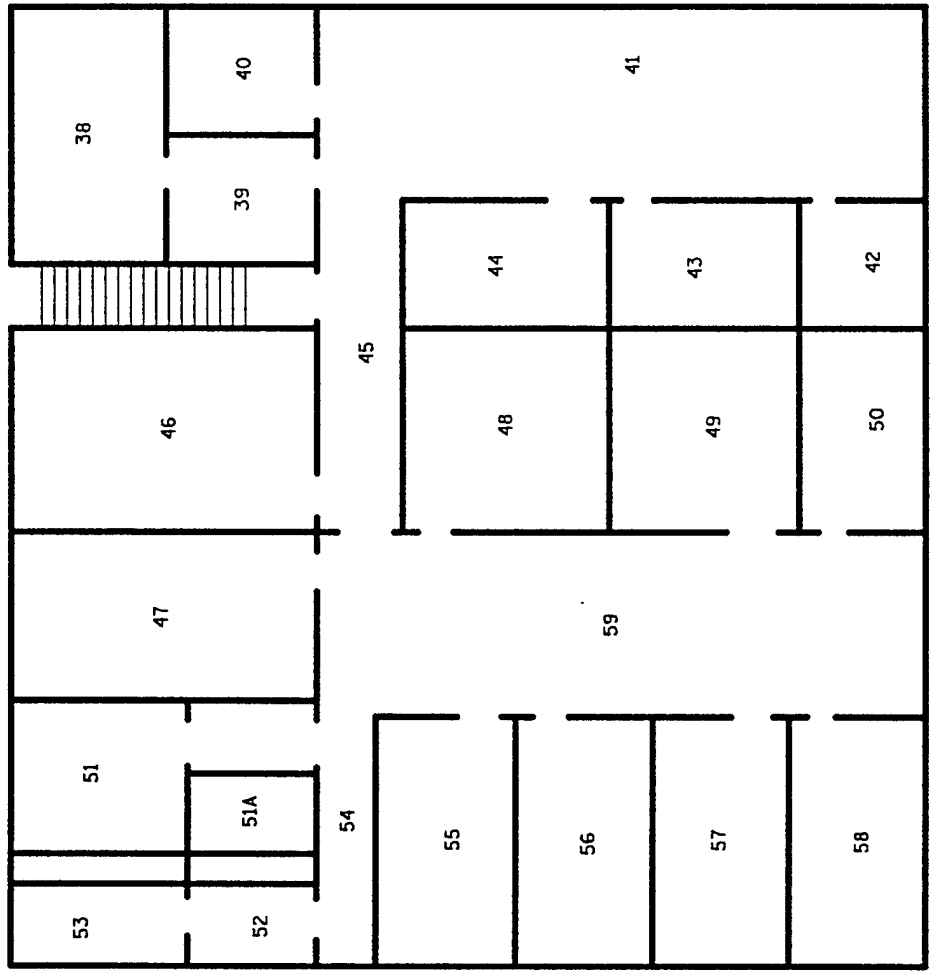


512 MAIN STREET, SUITE 1500  
 FORT WORTH, TEXAS 76102-3922  
 (817)335-3000/METRO 429-1291

**HUITT ~ ZOLLARS**  
 ENGINEERS/ARCHITECTS

**RED RIVER ARMY  
 DEPOT**

BUILDING  
 345 - SECOND FLOOR



BUILDING  
345 - MEZZANINE

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1291

HUITT ~ ZOLLARS  
ENGINEERS/ARCHITECTS

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: NOV. 1994 SURVEYOR: JHL

BUILDING: # 345 RED RIVER

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
1 STAIRS	10	2	1	200w. P.S.	SOCKET	10	4	REPLACE
2 WOMEN'S REST ROOM	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	
3 SHOP	35	15	1	400w. HPS	LOW BAY W7 LENS	10	4	
4 STAIRS	10	2	1	200w. P.S.	SOCKET	10	4	REPLACE
5 MEN'S REST ROOM	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	
6 MAIN ASILE	35	12	1	400w. HPS	LOW BAY W7 LENS	10	4	
7 SHOP	30	42	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	MTD. @ 40'-0"
8 SHOP	45	28	1	400w. HPS	LOW BAY W7 LENS	10	4	MTD @ 12'-0"
9 SHOP	30	8	1	400w. HPS	LOW BAY OPEN REFL.	10	4	
10 MEN'S REST ROOM	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	
11 STAIRS	10	2	1	200w. P.S.	SOCKET	10	4	REPLACE

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitz-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: JHL BUILDING: #345 R.R. 2

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
12 ELEC. SHOP	35	2	2	F96 75w.	LOUYER	10	4	
13 HALL	20	1	2	F96 75w.	STRIP.	10	4	
14 SHOWERS	10	2	1	200w. P.S.	SOCKET	10	4	REPLACE
15 MAIN ASILE	35	18	1	400w. HPS.	LOW BAY W7 LENS	10	4	
16 MAIN ASILE	35	12	1	400w. HPS.	LOW BAY W7 LENS	10	4	
17 PLATING SHOP	25	50	1	250w. HPS	LOW BAY W7 DROP LENS	10	4	
18 SHOP	40	30	1	400w. HPS	LOW BAY W7 LENS	10	4	MTD. @ 20'-0"
19 WOMEN'S REST ROOM	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	
20 STAIRS	10	2	1	200w. P.S.	SOCKET	10	4	REPLACE
21 SHOP	40	27	1	400w. HPS	LOW BAY W7 LENS	10	4	MTD. @ 20'-0"
22 SHOP	50	72	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	MTD. @ 40'-0"

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

*Huite-Zollars, Inc.*  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TAL BUILDING: #345 R.R. 3

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYAWK	ECO DESCRIPTION
23 SHOP	40	190	1	400w. HPS	Low BAY w/7 LENS	10	4	
24 SHOP	45	6	4	F40	POLY WRAP	10	4	
25 SHOP	65	18	4	F40	POLY WRAP	10	4	
26 OFFICE	35	2	4	F40	POLY WRAP	10	4	
27 SHOP	50	15	4	F40	POLY WRAP	10	4	
28 SHOP	50	15	4	F40	POLY WRAP	10	4	
29 SHOP	50	15	4	F40	POLY WRAP	10	4	
30 SHOP	65	20	4	F40	POLY WRAP	10	4	
31 OFFICE	40	5	4	F40	POLY WRAP	10	4	
32 OFFICE	65	15	4	F40	POLY WRAP	10	4	
33 BREAK AREA	15	3	1	175w. M.H.	Low BAY OPEN REFL.	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TKL BUILDING: # 345 R.R. 4

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
34 PARTS	35	10	1	175w. M.H.	LOW BAY OPEN REF.	10	4	
	35	16	2	F96 75w.	INDUSTRIALS	10	4	
35 CRANKSHAFT GRINDING	45	14	1	400w. HPS	LOW BAY OPEN REF.	10	4	MTD. @ 15'-0"
36 SHOP	60	8	1	1000w. HPS	HIGH BAY OPEN REF.	10	4	
37 PAINT BOOTH								NO ACCESS
38 OFFICE	35	4	4	F40	LAY IN	10	4	
39 OFFICE	40	2	4	F40	LAY IN	10	4	
40 COMPUTER ROOM	40	2	4	F40	LAY IN	10	4	
41 OPEN OFFICE	35	10	4	F40	LAY IN W/ DROP LENS	10	4	
42 OFFICE	40	2	4	F40	LAY IN W/ DROP LENS	10	4	
43 OFFICE	35	2	4	F40	LAY IN W/ DROP LENS	10	4	

2ND LEVEL

**ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET**

*Huitt-Zollars, Inc.*  
CONSULTING ENGINEERS

5

DATE: Nov. 1994

SURVEYOR: TKL

BUILDING: # 345

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
44 OFFICE	35	2	4	F40	LAY IN WT DROP LENS	10	4	
45 HALL/ LOBBY	30	2	4	F40	LAY IN	10	4	
46 OFFICE	55	3	4	F40	LAY IN	10	4	
47 OFFICE	60	6	4	F40	LAY IN	10	4	
48 OFFICE	80	2	4	F40	LAY IN	10	4	
49 OFFICE	80	2	4	F40	LAY IN	10	4	
50 OFFICE	80	2	4	F40	LAY IN	10	4	
51 MEN'S RR.	40	2	4	F40	LAY IN	10	4	
51A MECH. ROOM	10	2	1	100W. A19	SOCKET	-	-	REPLACE
52 HALL/ COFFEE	30	1	4	F40	LAY IN	10	4	
53 WOMEN'S	40	1	4	F40	LAY IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TKL BUILDING: #345 R.R. 6

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYAWK	ECO DESCRIPTION
54 HALL	30	3	4	F40	LAY IN	10	4	
55 OFFICE	80	2	4	F40	LAY IN	10	4	
56 OFFICE	80	2	4	F40	LAY IN	10	4	
57 OFFICE	80	2	4	F40	LAY IN	10	4	
58 OFFICE	80	2	4	F40	LAY IN	10	4	
59 OPEN OFFICE	50	6	4	F40	LAY IN	10	4	
60 OFFICE	80	4	4	F40	LAY IN	10	4	
61 OFFICE	80	4	4	F40	LAY IN	10	4	
62 OFFICE	80	4	4	F40	LAY IN	10	4	
63 OFFICE	80	6	4	F40	LAY IN	10	4	
64 HALL	5	4	1	100w. M.V.	SOCKET	10	4	REPLACE

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

*Huitt-Zollars, Inc.*  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TKL BUILDING: # 345 R.R. 7

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
65 SHOP	45	40	4	F40	INDUSTRIALS	10	4	
66 LIBRARY	40	8	4	F40	INDUSTRIALS	10	4	
67 SHOP	50	8	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	
68 DINNING ROOM	40	17	2	F40	LAY IN DROP LENS	10	4	
69 OFFICE	75	27	4	F40	LAY IN	10	4	NEW CONST.
70 OFFICE	75	4	4	F40	LAY IN	10	4	NEW CONST.
71 SHOP	50	14	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	MTD. @ 18'-0"
72 SHOP	70	12	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	
73 TEST LAB	80	36	4	F40	LAY IN	10	4	
74 SHOP	30	10	1	1000w. HPS	OPEN REFL. HIGH BAY	10	4	
75 Rest Room	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

*Huitt-Zollars, Inc.*  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TAL BUILDING: #345 R.R. 8

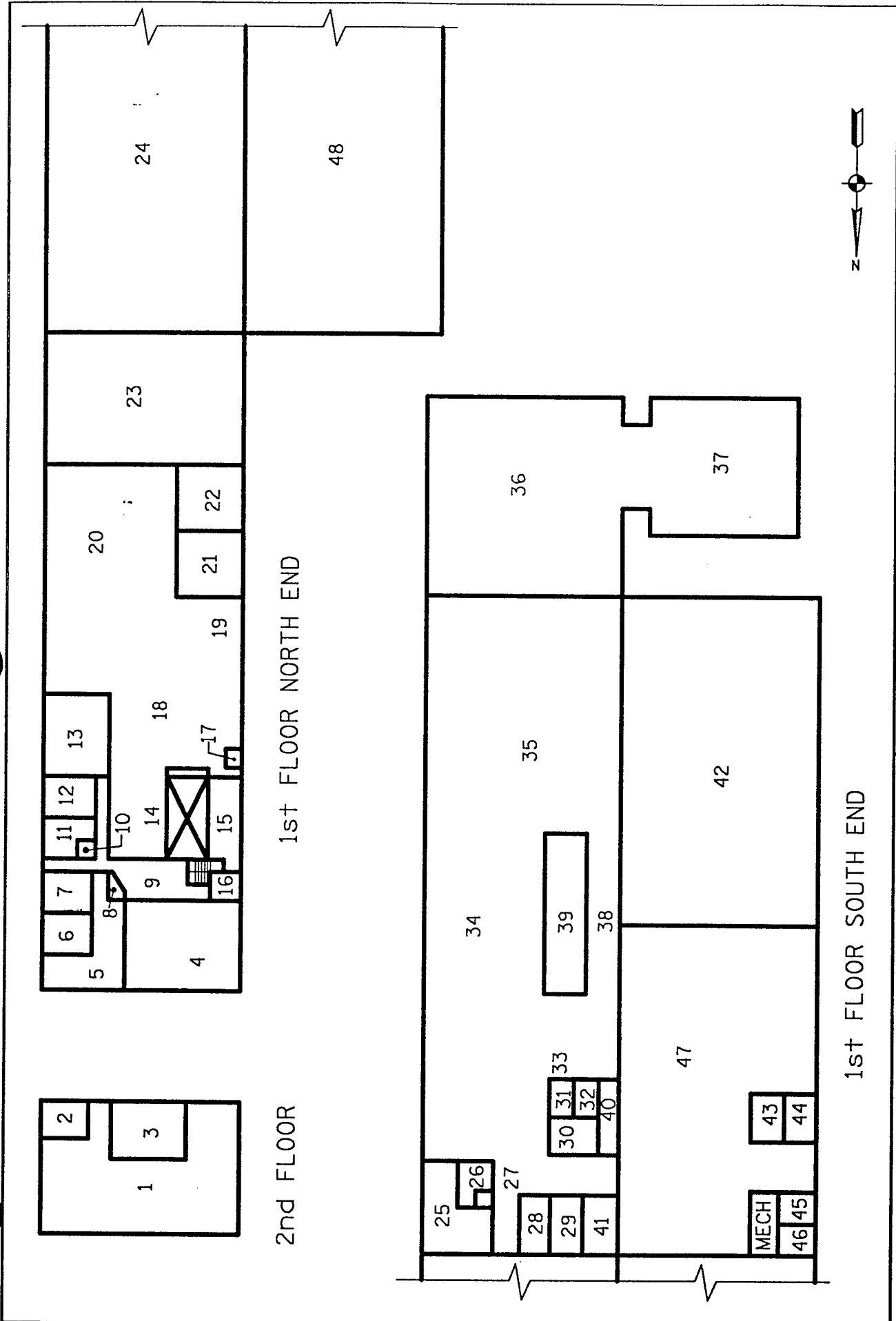
ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
76 SHOP	50	15	1	100w. HPS	Low BAY EXP. PROOF	10	4	
77 SHOP	40	10	1	1000w. M.V.	HIGH BAY OPEN REFL.	10	4	REPLACE W/7 METAL HALIDE
78 SHOP	35	22	1	400w. M.H.	Low BAY OPEN REFL.	10	4	
79 REST ROOM	50	6 2	2 2	F40 F40	LAY IN VANITY	10	4	
80 SHOP	40	35	1	1000w. M.H.	HIGH BAY OPEN REFL.	10	4	
81 SHOP	35	8	1	400w. M.H.	Low BAY OPEN REFL.	10	4	
82 SHOP	35	19	1	400w. M.H.	Low BAY OPEN REFL.	10	4	
83 SHOP	40	19	1	1000w. M.H.	HIGH BAY OPEN REFL.	10	4	
84 SHOP	40	12	1	1000w. HPS	HIGH BAY OPEN REFL.	10	4	
85 SHOP	45	72	1	400w. M.H.	Low BAY OPEN REFL.	10	4	
86 SHOP	40	18	1	1000w. M.H.	HIGH BAY OPEN REFL.	10	4	

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TAC BUILDING: #345 R.P. 9

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
87 SHOP	40	44	1	400w. M.V.	LOW BAY OPEN REFL.	10	4	REPLACE W/7 M.H.
88 SHOP	25	12	1	1000w. M.H.	HIGH BAY OPEN REFL.	10	4	
	25	48	1	250w. M.H.	SOCKET	10	4	
89 SHOP	35	68	1	1000w. M.H.	HIGH BAY OPEN REFL.	10	4	
	35	28	1	400w. M.V. 200w. P.S.	LOW BAY / SOCKET	10	4	REPLACE W/7 M.H. REPLACE W/7 M.H.
90 SHOP	35	28	1	400w. M.V.	LOW BAY	10	4	REPLACE W/7 M.H.
91 SHOP	35	22	1	400w. M.H.	LOW BAY	10	4	
92 REST Room	50	6	2	F40 F40	LAY IN VANITY	10	4	
93 REST Room	50	6	2	F40 F40	LAY IN VANITY	10	4	
94 CANTEEN	45	16	2	F40	LAY IN W/7 DROP LENS	10	4	



BUILDING  
421 NORTH & SOUTH

RED RIVER ARMY  
DEPOT

512 MAIN STREET, SUITE 1500  
FORT WORTH, TEXAS 76102-3922  
(817)335-3000/METRO 429-1251

**HUITT ~ ZOLLARS**  
ENGINEERS/ARCHITECTS

1st FLOOR SOUTH END

1st FLOOR NORTH END

2nd FLOOR

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: NOV. 1994 SURVEYOR: THL

BUILDING: # 421 N-S R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYAWK	ECO DESCRIPTION
1 TEST LAB	95	48	2	F40	SURF. MTD. POLY WRAP	10	4	NEW
2 REST ROOM	10	1	1	150W. A19	SOCKET	10	4	CHANGE-OUT
3 MECH. ROOM	10	2	1	100W. A19	SOCKET	—	—	CHANGE-OUT
4 TEST LAB	90	24	2	F40	PEND. MTD. POLY WRAP	10	4	NEW
5 TEST LAB	80	15	2	F40	FLUSH MTD. W7 LENS	10	4	NEW
6 OFFICE	60	4	2	F40	FLUSH MTD. W7 LENS	10	4	NEW
7 OFFICE	80	4	4	F40	FLUSH MTD. W7 LENS	10	4	NEW
8 OFFICE	60	4	2	F40	FLUSH MTD. W7 LENS	10	4	NEW
8A ENTRY	40	1	2	F40	FLUSH MTD. W7 LENS	10	4	NEW
9 HALL	40	3	2	F40	POLY WRAP	10	4	
10 JAN. CLOSET	10	1	1	100W. A19	SOCKET	—	—	CHANGE-OUT

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: NOV. 1994 SURVEYOR: THL BUILDING: # 421N-S R.R. 2

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
11 MEN'S REST ROOM	40	2	4	F40	LAY IN	10	4	
12 WOMEN'S REST ROOM	60	2 1	4 4	F40 F40	LAY IN POLY WRAP	10	4	
13 BREAK ROOM	35	6	2	F40	LAY IN	10	4	
14 HALLWAY/ COPY	35	3	2	F40	LAY IN	10	4	
15 OFFICE	90	6	4	F40	PEND. MTD. POLY WRAP	10	4	
16 ENTRY	50	1	2	F40	POLY WRAP	10	4	
17 ENTRY	50	1	2	F40	POLY WRAP	10	4	
18 SHOP	65	7	2	F40	PEND. MTD. POLY WRAP	10	4	
19 SHOP	65	48	2	F40	PEND. MTD. POLY WRAP	10	4	
20 SHOP	80	60	2	F40	PEND. MTD. POLY WRAP	10	4	
21 CIRCUIT BD. SHOP	100	24	2	F40	LAY IN	10	4	

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

*Huitt-Zollars, Inc.*  
CONSULTING ENGINEERS

DATE: Nov. 1994 SURVEYOR: TAL BUILDING: # 421 N-S R.R. 3

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
22 SHOP	55	8	2	F96 75w.	INDUSTRIAL	10	4	CHANGE-OUT
23 SHOP/PARTS	70	28	2	F40	PEND. MTD. POLY WRAP	10	4	
24 SMALL PART SHOP	70	90	1	250w. M.H.# MV.	LOW BAY W/LENS	10	4	CHANGE-OUT MERC. VAPOR
25 MEN'S REST ROOM	40	4	2	F40	STRIPS	10	4	
26 WOMEN'S REST ROOM	30	2	2	F40	STRIPS	10	4	
27 JAN. CLOSET	10	1	1	100w. A19	SOCKET	—	—	CHANGE-OUT
28 OFFICE	60	4	4	F40	POLY WRAP	10	4	
29 OFFICE	50	1	4	F40	POLY WRAP	10	4	
30 OFFICE	80	2	4	F96 75w	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" P.W.
31 OFFICE	80	2	4	F96 75w.	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" P.W.
32 OFFICE	120	4	4	F96 75w.	INDUSTRIAL	10	4	CHANGE-OUT TO 4'-0" P.W.

# ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitte-Zollars, Inc.  
CONSULTING ENGINEERS

DATE: NOV. 1994 SURVEYOR: TAL BUILDING: #421 N-S R.R. 4

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DY/WK	ECO DESCRIPTION
33 SHOP	65	54	2	F40	PEND. MTD. POLY WRAP	10	4	
34 SHOP	70	110	2	F40	PEND. MTD. POLY WRAP	10	4	
35 SHOP	70	24	2	F40	PEND. MTD. POLY WRAP	10	4	
36 OFFICE	60	2 2	4 4	F96 75w. F40	LOUVER	10	4	CHANGE-OUT TO 4'-0" P.W.
37 SHOP	50	8	4	F40	POLY WRAP	10	4	
38 STORAGE	60	6	2	F40	POLY WRAP	10	4	
39 MODULAB	55	14	3	F40	INDUSTRIAL OVER LENS	10	4	
40 BREAK ROOM	40	6	2	F40	LAY IN	10	4	
41 LOCKERS	30	2	2	F40	LAY IN	10	4	
42 COMPUTER ROOM	45	23	4	F40	LAY IN	10	4	
43 WOMEN'S REST RM.	30	1	4	F40	LAY IN	10	4	

ENERGY CONSERVATION OPPORTUNITY (ECO) DATA SHEET

Huitt-Zollars, Inc.  
CONSULTING ENGINEERS

5

DATE: Nov. 1994 SURVEYOR: TRK BUILDING: #421 N-S R.R.

ROOM NO. AND USE	AVG. FC	QTY FIXTURES	LAMPS PER FIXTURE	LAMP WATTS AND TYPE	FIXTURE DESCRIPTION	HRS/DY	DYWK	ECO DESCRIPTION
44 MEN'S REST RM.	30	1	4	F40	LAY IN	10	4	
45 OFFICE	25	1	4	F40	LAY IN W/ DROP LENS	10	4	
46 OFFICE	45	4	4	F40	LAY IN W/ DROP LENS	10	4	
47 INSTRUMENTAL	40	32	4	F40	LAY IN W/ DROP LENS	10	4	
48 SHOP	55	15	1	400w. HPS	LOW BAY OPEN REF.	10	4	

APPENDIX D  
RECOMMENDED ECO CALCULATIONS

APPENDIX D  
RECOMMENDED ECO CALCULATIONS

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## ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: 1  
DATE: 4/14/94  
ECO TITLE: Replace Existing Incandescent And Mercury Vapor Lighting  
INSTALLATION: Red River Army Depot  
LOCATION: Texarkana, Texas

### A. Summary:

Electrical Energy Savings	214,901	KWH/yr
Electrical Demand Savings	1,126	KW-mo/yr
Natural Gas Energy Penalty	369.0	MMBTU/yr
Net Energy Savings	364.4	MMBTU/yr
Annual Cost Savings	18,494	\$/yr
Total Investment	165,411	\$
Simple Payback	8.9	yrs
SIR	1.65	

### B. ECO Description:

Remove 825 existing incandescent and mercury vapor light fixtures, and replace them with 676 new fluorescent and high pressure sodium light fixtures. The fluorescent fixtures should be specified with electronic ballasts and T8 lamps. Locate the new light fixtures over desks or other work tables as required to provide the design light levels at the work station in each room. This project shall require a new lighting layout design, demolition and removal of existing fixtures, and installation of new fixtures and associated wiring. All switching and circuitry is to remain the same wherever possible.

### C. Discussion:

The facility currently has numerous incandescent and mercury vapor lighting systems in its buildings. These existing light sources are inefficient and should be replaced with more efficient light sources, such as fluorescent and high pressure sodium. Figure D-1 shows the existing light sources identified during the building walk through, and the recommended replacement source for each. New fixtures should be selected by the lighting designer, which use these replacement light sources for each room listed in the savings calculations, on pages D-10 through D-31. Refer to the building maps in Appendix C for room locations. The room numbers listed in the savings calculations correspond to the room numbers on the building maps.

### D. Savings Calculations:

The energy savings calculations were based on the existing annual lighting energy consumption calculations, provided in Appendix B. The existing annual energy consumptions of the incandescent and mercury vapor light fixtures were adjusted to account for the reduced number of fixtures in some rooms, and the higher efficiency of the new fixtures to be installed.

Fixture Upgrade Factors (f): Using manufacturer's lamp data for the existing mercury and incandescent light fixtures, as well as for the suggested replacement light fixtures, the fixture upgrade factors were calculated in Figure D-1 as follows:

$$f = \frac{(\text{input watts})_{\text{NEW}}}{(\text{input watts})_{\text{OLD}}}$$

Figure D-1. Manufacturer's Lamp Data And Calculated Fixture Upgrade Factors

EXIST QTY. AND LAMP	EXIST. LAMP LIFE HRS	EXIST LAMP INITIAL LUMENS	EXIST INPUT WATTS	NEW QTY. AND LAMP	NEW LAMP LIFE HRS	NEW LAMP INITIAL LUMENS	NEW INPUT WATTS	FIXTURE UPGRADE FACTOR
60W INC	1,000	1,060	60	18W FLUOR	20,000	1,250	22	0.37
100W INC	750	1,740	100	25W FLUOR	20,000	2,125	30	0.30
150W INC	1,000	2,650	150	32W FLUOR	20,000	2,850	31	0.21
200W INC	750	3,703	200	(2) 32W FLUOR	20,000	5,700	62	0.31
300W INC	750	6,103	300	(3) 32W FLUOR	20,000	8,550	88	0.29
160W MERC	12,000	2,800	192	32W FLUOR	20,000	2,850	31	0.16
175W MERC	24,000	7,950	210	100W HPS	24,000	9,500	120	0.57
250W MERC	24,000	12,000	300	150W HPS	24,000	16,000	180	0.60
400W MERC	24,000	21,000	480	200W HPS	24,000	22,000	240	0.50
1000W MERC	24,000	57,000	1,200	400W HPS	24,000	50,000	480	0.40

Sample Calculation: 60W incandescent lamp/fixture, retrofit to 18W fluorescent lamp/fixture

From Figure D-1:

new input watts = 22

old input watts = 60

$$f = \frac{(22 \text{ W})}{(60 \text{ W})} = 0.37$$

With the above factors determined, the number of new light fixtures to be installed and the energy savings for each room were calculated on the spreadsheets on pages D-10 through D-31. The following sample calculation demonstrates the procedure followed for each room, based on data from the ECO Data Sheets in Appendix C.

Sample Calculation:

Room #16, Building 323

Exist. fixture quantity = 40 (from data sheets in Appendix C)

Exist. fixture type = 300W incandescent (from data sheets in Appendix C)

Exist. lamp lumens = 6,103 (from Figure D-1)

New lamp lumens = 8,550 (from Figure D-1)

Fixture upgrade factor = 0.29 (from Figure D-1)

- (a) New fixture quantity ( $Q_N$ ):

$$Q_N = Q_E \times \frac{L_O}{L_N}$$

where,

$L_O$  = exist. lamp lumens

$L_N$  = new lamp lumens

$Q_E$  = existing quantity of fixtures in room

$Q_N$  = new quantity of fixtures in room

$$Q_N = 40 \times \frac{6,103}{8,550} = 29 \text{ fixtures}$$

- (b) Lighting Energy Savings ( $\Delta E_L$ ):

$$\Delta E_L = E_O \times \left[ 1 - \frac{Q_N}{Q_E} \times f \right] \frac{KWH}{yr}$$

where,

$E_O$  = exist. annual energy<sup>1</sup> = 24,960 KWH/yr

$$\Delta E_L = 24,960 \times \left[ 1 - \frac{29}{40} \times 0.29 \right] = 19,712 \frac{KWH}{yr}$$

- (c) Cooling Energy Savings ( $\Delta E_C$ ):

$$\Delta E_C = \frac{\Delta E_L \left( \frac{3413 \text{ BTU}}{KWH} \right) H_C}{\left( EER \times \frac{1,000 \text{ watts}}{KW} \right)} \frac{KWH}{yr}$$

where,

$EER^2$  = cooling system efficiency = 7 BTU/W-hr

$H_C^3$  = percentage of year in cooling operation = 0.42

$$\Delta E_C = \frac{19,712 (3,413) 0.42}{(7 \times 1,000)} = 4,037 \frac{KWH}{yr}$$

Note: (Since this building is not cooled, there are no cooling energy savings. The above calculation is shown only to demonstrate the procedure used for buildings which have cooling.)

(d) Heating Energy Penalty ( $\Delta E_H$ ):

$$\Delta E_H = \frac{\Delta E_L \left( \frac{3413 \text{ BTU}}{\text{KWH}} \right) H_H}{EFF_H} \times \frac{1 \text{ MMBTU}}{1,000,000 \text{ BTU}} \frac{\text{MMBTU}}{\text{yr}}$$

where,

$EFF^4$  = heating system efficiency = 0.70

$H_H^5$  = percentage of year in heating operation = 0.39

$$\Delta E_H = \frac{19,712 (3413) 0.39}{(0.70 \times 1,000,000)} = 37 \frac{\text{MMBTU}}{\text{yr}}$$

The results of the room by room calculations are summarized in Figure D-2 below:

Figure D-2. Savings Calculations Summary

BLDG. NO.	QTY. NEW FIXTURES	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR	QTY. OLD FIXTURES
323	100	40,811	0	76	124
468	13	3,201	655	7	13
15	7	438	90	1	7
441	53	16,793	3,440	31	61
133	57	15,105	0	28	66
245	20	8,987	1,841	17	28
315	11	3,343	0	7	12
321	90	39,588	0	75	365
345	84	45,995	9,422	88	84
421	50	20,910	4,282	39	65
<b>TOTALS:</b>	<b>485</b>	<b>195,171</b>	<b>19,730</b>	<b>369</b>	<b>825</b>

The total electrical energy savings ( $\Delta E_E$ ) from the above summary are as follows:

$$\Delta E_E = \Delta E_L + \Delta E_C$$

$$\Delta E_E = (195,171 + 19,730) = 214,901 \frac{KWH}{yr}$$

$$\Delta E_E = \left[ \frac{214,901 KWH}{yr} \times \frac{3,413 BTU}{KWH} \times \frac{1 MMBTU}{1,000,000 BTU} \right] = 733.4 \frac{MMBTU}{yr}$$

The net energy savings ( $\Delta E_N$ ) from the above summary are as follows:

$$\Delta E_N = \Delta E_E - \Delta E_H$$

$$\Delta E_N = (733.4 - 369.0) = 364.4 \frac{MMBTU}{yr}$$

The electrical peak demand savings ( $\Delta D_L$ ) from the reduced lighting load will be as follows:

$$\Delta D_L = \frac{\Delta E_L}{H} \times \frac{12 mos}{yr} \times \frac{KW-mo}{yr}$$

$$\Delta D_L = \frac{195,171}{2,080} \times (12) = 1,126 \frac{KW-mo}{yr}$$

The electrical peak demand cost savings ( $\Delta C_D$ ) from the reduced lighting load will be as follows:

$$\Delta C_D = \Delta D_L \times C_D$$

where,

$$C_D = \text{avoided cost of demand}^6 = \$5.01/KW$$

$$\Delta C_D = (1,126 \times 5.01) = \frac{\$5,641}{yr}$$

Because the total number of lamps and ballasts have been reduced by this ECO, the facility will require less lighting maintenance. The Maintenance Cost Savings ( $\Delta C_M$ ) from this ECO are calculated as follows:

$$\Delta C_M = C_L \times H \times \left[ \frac{Q_I}{L_I} + \frac{Q_M}{L_M} - \frac{Q_F}{L_F} - \frac{Q_H}{L_H} \right] \frac{\$}{yr}$$

where,

- $C_L$  = relamping cost per lamp<sup>7</sup> = \$22/lamp
- $H$  = annual lighting hours<sup>8</sup> = 2,080 hrs/yr
- $L_F$  = rated fluorescent lamp life<sup>9</sup> = 20,000 hrs
- $L_H$  = rated high pressure sodium lamp life<sup>10</sup> = 24,000 hrs
- $L_I$  = rated incandescent lamp life<sup>11</sup> = 1,000 hrs
- $L_M$  = rated mercury lamp life<sup>12</sup> = 24,000 hrs
- $Q_F$  = quantity of new fluorescent lamps = 1,015 (from Figure D-3)
- $Q_M$  = quantity of exist. mercury lamps = 620 (from Figure D-3)
- $Q_H$  = quantity of new high pressure sodium lamps = 293 (from Figure D-3)
- $Q_I$  = quantity of exist. incandescent lamps = 214 (from Figure D-3)

The total number of each type of lamp was calculated on a room by room basis from the savings calculation spreadsheets on pages D-9 through D-30. A summary of the results is shown in Figure D-3 below.

Figure D-3. Lamp Quantity Summary

BLDG. NO.	QTY. EXIST. INC. LAMPS	QTY. EXIST. MERCURY LAMPS	QTY. NEW FLUOR. LAMPS	QTY. NEW HPS LAMPS
323	79	45	165	39
468	22	0	19	0
15	7	0	10	0
441	17	44	35	40
133	8	58	8	49
245	28	0	38	0
315	9	3	18	2
321	21	344	687	52
345	18	66	30	66
421	5	60	5	45
TOTALS:	214	620	1,015	293

$$\Delta C_M = (22) \times (2,080) \times \left[ \frac{214}{1,000} + \frac{620}{24,000} - \frac{1,015}{20,000} - \frac{293}{24,000} \right] = 8,094 \frac{\$}{yr}$$

E. Cost Estimate

The total construction and design costs for this ECO were estimated on page D-8.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the program Life Cycle Cost In Design (LCCID), and data from the above calculations. From this analysis were determined the Total Annual Cost Savings, the Savings to Investment Ratio (SIR), and the Simple Payback Period. The summary sheet for the life cycle cost analysis is shown on page D-9. The results of the analysis are listed in the project summary on page D-1.

### REFERENCES

1. From Appendix B calculations of existing annual energy consumption for this room and building.
2. Reference Appendix B for cooling system efficiency calculation.
3. Reference Appendix B for cooling period calculation.
4. Reference Appendix B for heating system efficiency calculation.
5. Reference Appendix B for heating period calculation.
6. See Appendix A for calculation of demand costs.
7. Reference maintenance supervisor, 1 hr per lamp at labor rate of \$22 per hour.
8. Reference Appendix B, annual lighting period calculation.
9. Per Illumination Engineers Society (IES) lamp data.
10. Per IES lamp data.
11. Per IES lamp data.
12. Per IES lamp data.



LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: RRAD

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID FY95 (92)

INSTALLATION & LOCATION: RRAD      REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03-0185-01 LIGHTING SURVEY STUDY

FISCAL YEAR 1995      DISCRETE PORTION NAME: ECO-2

ANALYSIS DATE: 04-14-95      ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	\$	148351.		
B. SIOH	\$	8159.		
C. DESIGN COST	\$	8901.		
D. TOTAL COST (1A+1B+1C)	\$	165411.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			165411.

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

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 7.44	733.	\$ 5456.	15.08	\$ 82284.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 1.89	-369.	\$ -697.	18.58	\$ -12958.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 5641.	14.88	\$ 83938.
N. TOTAL		364.	\$ 10400.		\$ 153264.

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

A. ANNUAL RECURRING (+/-)		\$	8094.
(1) DISCOUNT FACTOR (TABLE A)		14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	120439.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 120439.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$  \$ 18494.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.94 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 273703.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.65  
 (IF < 1 PROJECT DOES NOT QUALIFY)

**Building 323**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5									
5									
6									
6									
7									
8									
9									
10									
11									
12	6,240	20	6103	8550	0.29	15	4,883	0	9
13									
14									
15									
16	24,960	40	6103	8550	0.29	29	19,712	0	37
16	17,472	40	7950	9500	0.57	34	9,007	0	17
17	6,240	10	6103	8550	0.29	8	4,792	0	9
18	624	3	1740	2125	0.30	3	437	0	1
19	26	1	1740	2125	0.30	1	18	0	0
20	624	2	2650	2850	0.21	2	493	0	1
21	437	1	7950	9500	0.57	1	188	0	0
22	624	2	2650	2850	0.21	2	493	0	1
23	1,747	4	7950	9500	0.57	4	751	0	1
24	47	1	2650	2850	0.21	1	37	0	0
<b>SUBTOTAL, BUILDING 323</b>						<b>100</b>	<b>40,811</b>	<b>0</b>	<b>76</b>

**Building 468**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
3A									
3B									
4									
5									
5A									
6									
6A									
7									
8	624	1	6103	8550	0.29	1	443	0	1
10									
11									
12									
13									
14									
15									
17									
18									
68									
69A									
69B									
70A									
75									
76									
77									
79									
80									
80									
81									

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
126									
127									
127									
129									
129									
129									
130									
132									
133									
134									
135									
136A									
136B									
136C									
136D									
137									
138A									
138B									
138C									
138D									
139									
19									
20									
21									
22									
23									
23	499	2	2120	2125	0.30	2	349	71	1

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
24									
25	31	1	2120	2125	0.30	1	22	0	0
26	832	2	2120	2125	0.30	2	582	0	1
27									
28									
29									
31									
32									
33									
34	520	1	6103	8550	0.29	1	369	0	1
37									
37									
38									
39									
40									
41									
42									
43									
44									
46									
48									
49									
50									
51									
52									
53									
54									

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
55									
56									
57									
59									
59									
60									
61	499	2	2120	2125	0.30	2	349	0	1
62									
63	499	2	2120	2125	0.30	2	349	0	1
64	1,040	2	6103	8550	0.29	2	738	0	1
65									
66									
67									
67									
SUBTOTAL, BUILDING 468						17	4,110	0	8

**Building 15**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5									
6									
7									
8									
9									
11									
12									
14									
15									
16									
18	52	1	3703	5700	0.31	1	36	7	0
19									
20									
21									
22									
23	13	1	1060	1250	0.37	1	8	2	0
24									
24A									
25									
26									
27									
27									
28									
29									

**Building 15 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
30									
30A									
31									
32									
33									
34									
35									
36									
37									
38									
40									
40A									
41									
42	104	2	3703	5700	0.31	2	72	15	0
43									
44									
45									
46									
47									
48									
49									
50	416	2	1740	2125	0.30	2	291	60	1
51									
52									
53									
54									
55									

**Building 15 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
56									
56A									
57									
57A									
58									
59									
60									
61									
62									
63	39	1	2650	2850	0.21	1	31	6	0
64									
65									
66									
67									
67A									
<b>SUBTOTAL, BUILDING 15</b>						<b>7</b>	<b>438</b>	<b>90</b>	<b>1</b>

**Building 441**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
1	208	1	1740	2125	0.30	1	146	30	0
2									
3									
4									
5	26	1	1740	2125	0.30	1	18	4	0
6									
7									
8									
9									
10									
10									
11									
12									
12									
13									
13									
14									
14									
15									
16	7,426	17	7950	9500	0.57	15	3,691	756	7
16									
17	6,552	15	7950	9500	0.57	13	3,315	679	6
18	2,621	6	7950	9500	0.57	6	1,127	231	2
19	2,621	6	7950	9500	0.57	6	1,127	231	2
20									
21	9,360	15	6103	8550	0.29	11	7,369	1,509	14
0									

**Building 441 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
22									
23									
24									
SUBTOTAL,BUILDING 441						53	16,793	3,440	31

**Building 133**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2	312	1	2650	2850	0.21	1	246	0	0
3									
3									
4									
5									
5									
6									
7	25,334	58	7950	9500	0.57	49	13,134	0	25
7	2,184	7	2650	2850	0.21	7	1,725	0	3
8									
9									
10									
10									
11									
<b>SUBTOTAL, BUILDING 133</b>						<b>57</b>	<b>15,105</b>	<b>0</b>	<b>28</b>

**Building 245**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5									
6	624	2	2650	2850	0.21	2	493	101	1
7									
8									
9									
10									
11									
12	832	2	3703	5700	0.31	2	574	118	1
12									
13	3,744	9	3703	5700	0.31	6	2,970	608	6
14									
15									
16									
18									
19									
20									
21									
22									
22									
23	6,240	15	3703	5700	0.31	10	4,950	1,014	9
23									
23									
23									
24									
<b>SUBTOTAL, BUILDING 245</b>						<b>20</b>	<b>8,987</b>	<b>1,841</b>	<b>17</b>

**Building 315**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5									
6									
7									
8									
9	52	1	3703	5700	0.31	1	36	0	0
10									
11	1,248	2	6103	8550	0.29	2	886	0	2
12									
13									
14									
14									
15									
16									
16									
17	1,248	3	3703	5700	0.31	2	990	0	2
18									
19									
20									
21									
22									
23	832	2	3703	5700	0.31	2	574	0	1
24	874	2	7950	9500	0.57	2	376	0	1
24									
25									

**Building 315 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
26									
27									
28									
29									
30	399	1	2800	2850	0.16	1	335	0	1
31	208	1	1740	2125	0.30	1	146	0	0
<b>SUBTOTAL, BUILDING 315</b>						11	3,343	0	7

**Building 321**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5									
6									
6	254,592	255	6103	8550	0.29	183	201,607	0	383
7									
7									
8									
9									
10									
11	1,248	3	6103	8550	0.29	3	886	0	2
12	1,248	3	6103	8550	0.29	3	886	0	2
13									
13									
14	416	1	6103	8550	0.29	1	295	0	1
15									
15									
16									
17									
17									
18									
18									
19									
20									
20									
21	52	1	6103	8550	0.29	1	37	0	0

**Building 321 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
22									
23									
23									
24									
24									
25									
25	2,080	5	6103	8550	0.29	4	1,597	0	3
26									
26									
27									
28	2,184	5	6103	8550	0.29	4	1,677	0	3
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
39									
40									
41									
41	2,496	6	6103	8550	0.29	5	1,893	0	4
42	8,736	20	6103	8550	0.29	15	6,836	0	13

**Building 321 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
43									
44									
45									
45	4,368	10	6103	8550	0.29	8	3,355	0	6
46									
47	40,934	41	21000	22000	0.50	40	20,966	0	40
48									
48	4,368	10	7950	9500	0.57	9	2,127	0	4
49									
50									
50									
51	1,310	3	7950	9500	0.57	3	563	0	1
51	832	2	3703	5700	0.31	2	574	0	1
SUBTOTAL, BUILDING 321						90	39,588	0	75

### Building 345

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	832	2	3703	5700	0.31	2	574	118	1
2									
2									
3									
4	832	2	3703	5700	0.31	2	574	118	1
5									
5									
6									
7									
8									
9									
10									
10									
11	832	2	3703	5700	0.31	2	574	118	1
12									
13									
14	832	2	3703	5700	0.31	2	574	118	1
15									
16									
17									
18									
19									
19									
20	832	2	3703	5700	0.31	2	574	118	1
21									
22									
22									
23									

**Building 345 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
51									
51A	52	2	1740	2125	0.30	2	36	7	0
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									
64	832	4	1740	2125	0.30	4	582	119	1
65									
66									
67									
68									
69									
70									
71									
72									
73									
74									
75									
75									

**Building 345 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
76									
77	24,960	10	57000	50000	0.40	12	12,979	2,658	25
78									
79									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
88									
89									
89	27,955	28	21000	22000	0.50	27	14,477	2,965	28
89	832	2	3703	5700	0.31	2	574	118	1
90	27,955	28	21000	22000	0.50	27	14,477	2,965	28
91									
92									
92									
93									
93									
94									
<b>SUBTOTAL, BUILDING 345</b>						<b>84</b>	<b>45,995</b>	<b>9,422</b>	<b>88</b>

**Building 421**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2	312	1	2650	2850	0.21	1	246	50	0
3	52	2	1740	2125	0.30	2	36	7	0
4									
5									
6									
7									
8									
8A									
9									
10	26	1	1740	2125	0.30	1	18	4	0
11									
12									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
24	37,440	60	12000	16000	0.60	45	20,592	4,217	39

**Building 421 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. FIXTURE LUMENS	NEW FIXTURE LUMENS	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
25									
26									
27	26	1	1740	2125	0.30	1	18	4	0
28									
29									
30									
31									
32									
33									
34									
35									
36									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
<b>SUBTOTAL, BUILDING 421</b>						<b>50</b>	<b>20,910</b>	<b>4,282</b>	<b>39</b>

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: 2  
DATE: 4/14/94  
ECO TITLE: Replace Existing Fluorescent Lighting With Electronic Fluorescent Lighting  
INSTALLATION: Red River Army Depot  
LOCATION: Texarkana, Texas

A. Summary:

Electrical Energy Savings	539,071	KWH/yr
Electrical Demand Savings	2,694	KW-mo/yr
Natural Gas Energy Penalty	915.0	MMBTU/yr
Net Energy Savings	924.8	MMBTU/yr
Annual Cost Savings	30,980	\$/yr
Total Investment	206,512	\$
Simple Payback	6.6	yrs
SIR	2.21	

B. ECO Description:

Remove 441 fluorescent light fixtures from overlit areas, listed in the data sheets in Appendix C. Remove existing magnetic ballasts and T12 lamps in all remaining fluorescent light fixtures and replace them with new electronic ballasts and T8 lamps. The total number of fixtures affected by this ballast and lamp retrofit is 2,873. These remaining upgraded fluorescent fixtures are referred to as 'new fixtures' in the following calculations.

C. Discussion:

The facility currently has much fluorescent lighting in its buildings. These existing light fixtures typically have the T12 lamps and standard magnetic ballasts. Also, many areas were found to be overlighted, when compared to the Illumination Engineers Society (IES) design light levels.

The existing fixtures should be upgraded with new electronic ballasts and T8 lamps. These newer ballasts and lamps are more efficient and use less energy. Also, in areas which are currently overlighted, the quantity of fixtures should be reduced.

D. Savings Calculations:

The energy savings calculations were based on the existing annual lighting energy consumption calculations, provided in Appendix B. The existing annual energy consumptions of the fluorescent light fixtures were adjusted to account for the reduced number of fixtures in some rooms, and the higher efficiency of the upgraded 'new fixtures' with electronic ballasts and T8 lamps. These calculations were performed on both 4' and 8' fluorescent light fixtures.

Fixture Upgrade Factors (f):

$$f = \frac{(\text{ballast input watts})_{NEW}}{(\text{ballast input watts})_{OLD}}$$

where,

$$\begin{aligned}(\text{ballast input watts})_{NEW} &= 62 \text{ watts (for two F32T8, 4' lamps)}^1 \\ &= 110 \text{ watts (for two F96T8, 8' lamps)}^2 \\ (\text{ballast input watts})_{OLD} &= 96 \text{ watts (for two F40T12, 4' lamps)}^3 \\ &= 180 \text{ watts (for two F96T12, 8' lamps)}^4\end{aligned}$$

$$f = \frac{(62 \text{ W})}{(96 \text{ W})} = 0.64 \quad (4' \text{ fixtures})$$

$$f = \frac{(110 \text{ W})}{(180 \text{ W})} = 0.61 \quad (8' \text{ fixtures})$$

With the above factors determined, the number of existing light fixtures to be upgraded and the energy savings for each room were calculated on the spreadsheets on pages D-40 through D-64. The following sample calculation demonstrates the procedure followed for each room, based on data from the ECO Data Sheets in Appendix C.

Sample Calculation: Room #83, Building 468  
Exist. fixture quantity = 3, four foot fixtures (from data sheets)  
Exist. light level = 100 fc (from data sheets)  
New design light level = 50 fc (from IES charts)

(a) New fixture quantity ( $Q_N$ ):

$$Q_N = Q_E \times \frac{fc_N}{fc_O}$$

where,

$fc_N$  = new design footcandles from IES charts  
 $fc_O$  = existing footcandles measured, from data sheets  
 $Q_E$  = existing quantity of fixtures in room  
 $Q_N$  = new quantity of fixtures in room

$$Q_N = 3 \times \frac{50}{100} = 2 \text{ fixtures}$$

(b) Lighting Energy Savings ( $\Delta E_L$ ):

$$\Delta E_L = E_O \times \left[ 1 - \frac{Q_N}{Q_E} \times f \right] \frac{KWH}{yr}$$

where,

$E_O$  = exist. annual energy<sup>5</sup> = 1,198 KWH/yr

$f$  = fixture upgrade factor for 4' fixtures = 0.64 (see above calculation)

$$\Delta E_L = 1,198 \times \left[ 1 - \frac{2}{3} \times 0.64 \right] = 687 \frac{KWH}{yr}$$

(c) Cooling Energy Savings ( $\Delta E_C$ ):

$$\Delta E_C = \frac{\Delta E_L \left( \frac{3413 \text{ BTU}}{KWH} \right) H_C}{\left( EER \times \frac{1,000 \text{ watts}}{KW} \right)} \frac{KWH}{yr}$$

where,

$EER$ <sup>6</sup> = cooling system efficiency = 7 BTU/W-hr

$H_C$ <sup>7</sup> = percentage of year in cooling operation = 0.42

$$\Delta E_C = \frac{687 (3,413) 0.42}{(7 \times 1,000)} = 141 \frac{KWH}{yr}$$

(d) Heating Energy Penalty ( $\Delta E_H$ ):

$$\Delta E_H = \frac{\Delta E_L \left( \frac{3413 \text{ BTU}}{KWH} \right) H_H}{EFF_H} \times \frac{1 \text{ MMBTU}}{1,000,000 \text{ BTU}} \frac{MMBTU}{yr}$$

where,

$EFF$ <sup>8</sup> = heating system efficiency = 0.70

$H_H$ <sup>9</sup> = percentage of year in heating operation = 0.39

$$\Delta E_H = \frac{687 (3413) 0.39}{(0.70 \times 1,000,000)} = 1 \frac{MMBTU}{yr}$$

The results of the room by room calculations are summarized in Table D-4 below:

Figure D-4. Savings Calculations Summary

BLDG. NO.	QTY. NEW FIXTURES	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR	QTY. NEW LAMPS	QTY. OLD LAMPS
323	346	51,645	0	98	322	1,380
468	539	106,441	21,792	216	681	2,352
15	369	79,697	16,319	151	460	1,698
441	143	21,739	4,453	41	149	558
133	39	6,532	0	13	44	130
245	166	18,122	3,710	33	177	442
315	139	24,061	0	45	155	562
321	208	32,286	0	63	331	996
345	357	66,041	13,522	141	428	1,466
421	567	60,356	12,355	114	567	1,436
TOTALS:	2,873	466,920	72,151	915	2,114	11,020

The total electrical energy savings ( $\Delta E_E$ ) from the above summary follows:

$$\Delta E_E = \Delta E_L + \Delta E_C$$

$$\Delta E_E = (466,920 + 72,151) = 539,071 \frac{\text{KWH}}{\text{yr}}$$

$$\Delta E_E = \left[ \frac{539,071 \text{ KWH}}{\text{yr}} \times \frac{3,413 \text{ BTU}}{\text{KWH}} \times \frac{1 \text{ MMBTU}}{1,000,000 \text{ BTU}} \right] = \frac{\text{MMBTU}}{\text{yr}}$$

The net energy savings ( $\Delta E_N$ ) from the above summary are:

$$\Delta E_N = \Delta E_E - \Delta E_H$$

$$\Delta E_N = (1,839.8 - 915.0) = 924.8 \frac{\text{MMBTU}}{\text{yr}}$$

The electrical peak demand savings ( $\Delta D_L$ ) from the reduced lighting load will be as follows:

$$\Delta D_L = \frac{\Delta E_L}{H} \times \frac{12 \text{ mos}}{\text{yr}}$$

where,

H = annual hours of lighting operation<sup>10</sup> = 2,080 hrs/yr

$$\Delta D_L = \frac{466,920}{2,080} \times 12 = 2,694 \frac{\text{KW-mo}}{\text{yr}}$$

The electrical peak demand cost savings ( $\Delta C_D$ ) from the reduced lighting load will be as follows:

$$\Delta C_D = \Delta D_L \times C_D$$

where,

$C_D$  = avoided cost of demand<sup>11</sup> = \$5.01/KW

$$\Delta C_D = (2,694 \times 5.01) = \frac{\$13,497}{\text{yr}}$$

Because the total number of lamps and ballasts have been reduced by this ECO, the facility will require less lighting maintenance. The Maintenance Cost Savings ( $\Delta C_M$ ) from this ECO are calculated as follows:

$$\Delta C_M = C_L \times \frac{H}{L_L} \times (L_{OLD} - L_{NEW})$$

where,

$C_L$  = relamping cost per lamp<sup>12</sup> = \$24/lamp

H = annual lighting hours<sup>13</sup> = 2,080 hrs/yr

$L_L$  = rated lamp life<sup>14</sup> = 20,000 hrs

$L_{OLD}$  = quantity of existing lamps = 11,020

$L_{NEW}$  = quantity of new lamps = 8,807

$$\Delta C_M = 24 \times \frac{2,080}{20,000} \times (11,020 - 8,807) = 5,524 \frac{\$}{\text{yr}}$$

E. Cost Estimate

The total construction and design costs for this ECO were estimated on page D-38.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the program Life Cycle Cost In Design (LCCID), and data from the above calculations. From this analysis were determined the Total Annual Cost Savings, the Savings to Investment Ratio (SIR), and the Simple Payback Period. The summary sheet for the life cycle cost analysis is shown on page D-39. The results of the analysis are listed in the project summary on page D-32.

### REFERENCES

1. Based on Sylvania manufacturer's data for electronic ballast and T8 lamp combinations.
2. Based on Sylvania manufacturer's data for electronic ballast and T8 lamp combinations.
3. Based on Advance manufacturer's data for magnetic ballast and T12 lamp combinations.
4. Based on Advance manufacturer's data for magnetic ballast and T12 lamp combinations.
5. From Appendix B calculations of exist annual lighting energy for this room and building.
6. Reference Appendix B for cooling system efficiency calculation.
7. Reference Appendix B for cooling period calculation.
8. Reference Appendix B for heating system efficiency calculation.
9. Reference Appendix B for heating period calculation.
10. See Appendix B for annual lighting period calculations.
11. See Appendix A for calculation of demand costs.
12. Reference maintenance supervisor, 1 hr per lamp at labor rate of \$22 per hour, plus \$2.00 lamp cost.
13. Reference Appendix B for annual lighting period calculations.
14. Per Sylvania lamp manufacturer's data.

# ENGINEER'S ESTIMATE OF PROBABLE COST

**LOCATION:** Red River Army Depot, Texas  
**PROJECT NO.:** 03-0185.01  
**DATE:** 4/14/95  
**BY:** PIEPER, C.A.  
**CHECKED BY:** X

**PROJECT DESCRIPTION:** ECO-2, Replace Existing Fluorescent Lighting With Electronic Fluorescent Lighting

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Miscellaneous ceiling patching from fixture removal	441	ea.	0.20	30.00	2,646	5.00	2,205	4,851
Demolition of existing fluorescent light fixtures	441	ea.	0.16	30.00	2,117			2,117
Installation of new F32T8 electronic ballasts and sockets	4,248	ea	0.20	30.00	25,488	16.70	70,942	96,430
Installation of new F32T8 lamps	8,496	ea	0.10	30.00	25,488	2.65	22,512	47,997
Installation of new F96T8 electronic ballasts and sockets	156	ea	0.20	30.00	936	29.38	4,583	5,519
Installation of new F96T8 lamps	312	ea.	0.10	30.00	936	10.27	3,204	4,140
<p><b>Note:</b> The material prices were taken from the Energy Efficient Lighting catalog from the Defense General Supply Center, 1-800-DLA-BULB. The labor prices were estimated based on experience with contractors.</p>								

<b>SUBTOTAL</b>	57,608	103,446	161,054
<b>O &amp; P @ 20%</b>	11,522	20,689	24,158
<b>SUBTOTAL</b>	69,130	124,135	185,212
<b>DESIGN @ 6%</b>			11,113
<b>SUBTOTAL</b>			196,325
<b>SIQH @ 5.5%</b>			10,187
<b>TOTAL</b>			\$206,512

**HUITT-ZOLLARS, INC.**  
**ENGINEERS / ARCHITECTS**  
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 FORT WORTH, TEXAS 76102-3922  
 (817) 335-3000 \* FAX (817) 335-1025

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: RRAD

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID    FY95 (92)

INSTALLATION & LOCATION: RRAD      REGION NOS.    6    CENSUS: 3

PROJECT NO. & TITLE: 03-0185-01    LIGHTING SURVEY STUDY

FISCAL YEAR 1995      DISCRETE PORTION NAME: ECO-1

ANALYSIS DATE: 04-14-95    ECONOMIC LIFE 20 YEARS    PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	\$	185212.		
B. SIOH	\$	10187.		
C. DESIGN COST	\$	11113.		
D. TOTAL COST (1A+1B+1C)	\$	206512.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			206512.

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

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 7.44	1840.	\$ 13688.	15.08	\$ 206417.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 1.89	-915.	\$ -1729.	18.58	\$ -32131.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 13497.	14.88	\$ 200835.
N. TOTAL		925.	\$ 25456.		\$ 375121.

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

A. ANNUAL RECURRING (+/-)		\$	5524.
(1) DISCOUNT FACTOR (TABLE A)			14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	82197.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) / COST(-) (4)
d. TOTAL	\$	0.		0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 82197.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) \$ 30980.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.67 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 457318.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.21  
 (IF < 1 PROJECT DOES NOT QUALIFY)

**Building 323**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	75,878	190	15	15	0.64	190	27,316	0	52
2	1,597	4	50	50	0.64	4	575	0	1
3	7,188	18	60	60	0.64	18	2,588	0	5
4	2,995	15	35	15	0.64	7	2,100	0	4
5	1,797	9	45	20	0.64	4	1,286	0	2
5	200	1	45	20	0.64	1	72	0	0
6	399	2	50	20	0.64	1	271	0	1
6	200	1	50	20	0.64	1	72	0	0
7	799	4	25	10	0.64	2	543	0	1
8	200	1	35	35	0.64	1	72	0	0
9	200	1	35	35	0.64	1	72	0	0
10	9,585	24	50	50	0.64	24	3,451	0	7
11	9,585	24	50	50	0.64	24	3,451	0	7
12									
13									
14	13,578	34	25	25	0.64	34	4,888	0	9
15	13,578	34	25	25	0.64	34	4,888	0	9
16									
16									
17									
18									
19									
20									
21									
22									
23									
24									
<b>SUBTOTAL, BUILDING 323</b>						<b>346</b>	<b>51,645</b>	<b>0</b>	<b>98</b>

**Building 468**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
3A	1,597	4	70	70	0.64	4	575	118	1
3B	2,396	6	70	70	0.64	6	863	177	2
4	3,195	8	65	65	0.64	8	1,150	235	2
5	2,396	6	65	65	0.64	6	863	177	2
5A	998	5	15	15	0.64	5	359	74	1
6	799	2	30	30	0.64	2	288	59	1
6A	3,594	12	45	45	0.64	12	1,294	265	2
7	3,195	8	50	50	0.64	8	1,150	235	2
10	399	2	75	10	0.64	1	271	55	1
11	399	2	75	10	0.64	1	271	55	1
12	1,997	5	85	10	0.64	1	1,741	357	3
13	3,994	10	50	15	0.64	3	3,227	661	6
14	799	4	30	10	0.64	2	543	111	1
15	200	1	25	10	0.64	1	72	15	0
17	1,997	5	100	10	0.64	1	1,741	357	3
18	1,597	8	15	10	0.64	6	830	170	2
68	4,792	12	65	15	0.64	3	4,025	824	8
69A	1,597	4	80	75	0.64	4	575	118	1
69B	1,597	4	80	75	0.64	4	575	118	1
70A	799	2	90	50	0.64	2	288	59	1
75	1,597	4	75	50	0.64	3	830	170	2
76	1,198	3	80	50	0.64	2	687	141	1
77	799	2	75	20	0.64	1	543	111	1
79	799	2	65	20	0.64	1	543	111	1
80	799	4	30	10	0.64	2	543	111	1
81	799	2	40	40	0.64	2	288	59	1

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
82A	1,198	3	100	50	0.64	2	687	141	1
82B	1,198	3	100	50	0.64	2	687	141	1
83	1,198	3	100	50	0.64	2	687	141	1
85	399	2	30	10	0.64	1	271	55	1
86	200	1	15	15	0.64	1	72	15	0
70B	799	2	90	50	0.64	2	288	59	1
71	799	2	90	50	0.64	2	288	59	1
72A	1,198	24	25	25	0.64	24	431	88	1
72B	3,994	12	40	40	0.64	12	1,438	294	3
72C	2,396	6	50	50	0.64	6	863	177	2
72D	2,396	6	50	50	0.64	6	863	177	2
72E	1,597	8	30	10	0.64	3	1,214	249	2
73	799	4	30	10	0.64	2	543	111	1
74A	3,994	20	40	40	0.64	20	1,438	294	3
74B	4,792	24	40	40	0.64	24	1,725	353	3
88	1,597	4	90	50	0.64	3	830	170	2
90A	1,597	4	80	50	0.64	3	830	170	2
90B	1,597	4	90	50	0.64	3	830	170	2
90C	1,597	4	80	50	0.64	3	830	170	2
90D	2,396	6	80	75	0.64	6	863	177	2
91	2,396	6	80	75	0.64	6	863	177	2
92	799	2	65	10	0.64	1	543	111	1
93	1,198	3	50	50	0.64	3	431	88	1
94	200	4	60	5	0.64	1	168	34	0
95A	1,597	4	55	50	0.64	4	575	118	1
95B	1,597	4	70	50	0.64	3	830	170	2
95C	799	2	55	50	0.64	2	288	59	1

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
95D	1,198	3	40	10	0.64	1	942	193	2
96A	799	2	50	50	0.64	2	288	59	1
96B	799	2	40	10	0.64	1	543	111	1
97	799	2	30	10	0.64	1	543	111	1
98	4,792	12	90	75	0.64	10	2,236	458	4
99	4,792	12	125	75	0.64	8	2,747	563	5
101	7,188	18	100	75	0.64	14	3,610	739	7
103	399	2	50	10	0.64	1	271	55	1
104	1,331	4	100	75	0.64	3	692	142	1
106	200	4	50	10	0.64	1	168	34	0
107	7,588	19	100	75	0.64	15	3,754	769	7
110	1,997	5	75	20	0.64	2	1,486	304	3
113A	1,597	4	30	10	0.64	2	1,086	222	2
113B	399	2	30	10	0.64	1	271	55	1
114	599	3	40	40	0.64	3	216	44	0
115	1,997	5	85	20	0.64	2	1,486	304	3
117A	1,597	4	80	75	0.64	4	575	118	1
117B	1,597	4	80	75	0.64	4	575	118	1
118	3,195	8	60	60	0.64	8	1,150	235	2
119	1,597	4	80	50	0.64	3	830	170	2
120	1,597	4	80	50	0.64	3	830	170	2
121A	1,597	4	60	50	0.64	4	575	118	1
121B	799	2	50	50	0.64	2	288	59	1
122	1,198	6	30	10	0.64	2	942	193	2
123	1,597	4	90	50	0.64	3	830	170	2
124	399	1	15	15	0.64	1	144	29	0
126	4,792	12	40	40	0.64	12	1,725	353	3

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
126	1,198	6	40	40	0.64	6	431	88	1
127	4,792	12	40	40	0.64	12	1,725	353	3
127	1,198	6	40	40	0.64	6	431	88	1
129	3,195	8	40	40	0.64	8	1,150	235	2
129	599	3	40	40	0.64	3	216	44	0
130	200	1	30	10	0.64	1	72	15	0
132	599	3	40	20	0.64	2	343	70	1
133	21	1	25	10	0.64	1	8	2	0
134	3,994	10	40	40	0.64	10	1,438	294	3
135	998	5	35	10	0.64	2	743	152	1
136A	1,597	4	100	50	0.64	2	1,086	222	2
136B	799	2	80	50	0.64	2	288	59	1
136C	799	2	80	50	0.64	2	288	59	1
136D	1,198	3	60	10	0.64	1	942	193	2
137	1,597	4	100	50	0.64	2	1,086	222	2
138A	1,597	4	100	50	0.64	2	1,086	222	2
138B	799	2	80	50	0.64	2	288	59	1
138C	799	2	80	50	0.64	2	288	59	1
138D	1,198	3	60	10	0.64	1	942	193	2
139	3,894	13	50	50	0.64	13	1,402	287	3
19	2,396	8	55	30	0.64	5	1,438	294	3
20	200	1	40	20	0.64	1	72	15	0
21	200	1	40	10	0.64	1	72	15	0
22	1,198	4	45	45	0.64	4	431	88	1
23	1,797	6	65	65	0.64	6	647	132	1

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
24	1,797	6	50	50	0.64	6	647	132	1
27	1,198	4	40	40	0.64	4	431	88	1
28	799	2	30	10	0.64	1	543	111	1
29	2,796	7	50	50	0.64	7	1,007	206	2
31	50	1	55	55	0.64	1	18	4	0
32	399	1	55	55	0.64	1	144	29	0
33	1,331	4	100	50	0.64	2	905	185	2
37	2,246	4	60	15	0.61	1	1,903	390	4
37	1,498	4	60	15	0.64	1	1,258	258	2
38	799	4	50	50	0.64	4	288	59	1
39	2,396	12	50	50	0.64	12	863	177	2
40	1,597	4	125	75	0.64	3	830	170	2
41	799	2	90	50	0.64	2	288	59	1
42	799	2	90	75	0.64	2	288	59	1
43	3,195	8	100	75	0.64	6	1,661	340	3
44	399	1	30	15	0.64	1	144	29	0
46	2,396	6	80	75	0.64	6	863	177	2
48	799	2	100	75	0.64	2	288	59	1
49	799	2	100	75	0.64	2	288	59	1
50	799	2	100	75	0.64	2	288	59	1
51	799	2	100	75	0.64	2	288	59	1
52	799	2	100	75	0.64	2	288	59	1
53	799	2	100	75	0.64	2	288	59	1
54	50	1	30	10	0.64	1	18	4	0

**Building 468 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
55	100	2	50	10	0.64	1	68	14	0
56	399	1	75	50	0.64	1	144	29	0
57	2,396	6	100	75	0.64	5	1,118	229	2
59	799	2	60	50	0.64	2	288	59	1
59	187	1	60	50	0.61	1	73	15	0
60	200	1	50	20	0.64	1	72	15	0
62	200	1	50	20	0.64	1	72	15	0
65	749	2	60	15	0.61	1	521	107	1
66	200	1	30	10	0.64	1	72	15	0
67	1,198	6	20	10	0.64	3	815	167	2
67	399	1	20	10	0.64	1	144	29	0
SUBTOTAL, BUILDING 468						539	106,441	21,792	216

### Building 15

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	1,597	4	50	50	0.64	4	575	118	1
2	1,597	4	55	50	0.64	4	575	118	1
3	2,396	6	75	50	0.64	4	1,374	281	3
4	5,192	13	80	50	0.64	9	2,892	592	5
5	1,597	4	75	50	0.64	3	830	170	2
6	6,390	16	100	30	0.64	5	5,112	1,047	10
7	300	1	75	20	0.64	1	108	22	0
8	399	1	70	15	0.64	1	144	29	0
9	5,391	27	50	30	0.64	17	3,219	659	6
11	1,597	4	60	50	0.64	4	575	118	1
12	1,597	4	60	50	0.64	4	575	118	1
14	8,786	22	50	50	0.64	22	3,163	648	6
15	1,597	4	35	15	0.64	2	1,086	222	2
16	1,597	4	60	50	0.64	4	575	118	1
19	799	4	50	20	0.64	2	543	111	1
20	1,597	4	80	50	0.64	3	830	170	2
21	1,597	4	65	50	0.64	4	575	118	1
22	399	1	45	30	0.64	1	144	29	0
24	1,198	3	75	50	0.64	2	687	141	1
24A	200	4	50	50	0.64	4	72	15	0
25	799	2	35	35	0.64	2	288	59	1
26	4,393	11	50	50	0.64	11	1,581	324	3
27	1,997	5	50	50	0.64	5	719	147	1
28	1,997	5	60	50	0.64	5	719	147	1
29	16,773	42	50	50	0.64	42	6,038	1,236	11

**Building 15 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
30	1,597	4	50	50	0.64	4	575	118	1
30A	1,597	4	40	40	0.64	4	575	118	1
31	2,396	6	40	40	0.64	6	863	177	2
32	1,597	4	60	50	0.64	4	575	118	1
33	2,796	7	30	10	0.64	3	2,029	415	4
34	2,796	7	65	10	0.64	2	2,285	468	4
35	187	1	20	20	0.64	1	67	14	0
36	8,786	22	50	50	0.64	22	3,163	648	6
37	799	2	70	50	0.64	2	288	59	1
38	2,396	6	80	50	0.64	4	1,374	281	3
40	399	1	15	15	0.64	1	144	29	0
40A	799	2	50	50	0.64	2	288	59	1
41	9,585	24	45	45	0.64	24	3,451	707	7
43	399	1	25	10	0.64	1	144	29	0
44	1,597	4	40	40	0.64	4	575	118	1
45	1,797	9	50	50	0.64	9	647	132	1
46	998	5	50	15	0.64	2	743	152	1
47	1,597	4	40	40	0.64	4	575	118	1
48	1,198	3	70	50	0.64	3	431	88	1
49	374	1	30	10	0.64	1	135	28	0
51	1,997	10	50	20	0.64	4	1,486	304	3
52	23,163	58	70	50	0.64	42	12,428	2,545	24
53	1,198	3	50	50	0.64	3	431	88	1
54	599	3	40	10	0.64	1	471	96	1
55	1,198	3	72	15	0.64	1	942	193	2

**Building 15 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
56	7,188	18	60	50	0.64	15	3,354	687	6
56A	1,597	4	60	50	0.64	4	575	118	1
57	799	2	100	10	0.64	1	543	111	1
57A	1,597	4	60	50	0.64	4	575	118	1
58	100	2	75	10	0.64	1	68	14	0
59	1,597	4	75	50	0.64	3	830	170	2
60	1,597	4	80	50	0.64	3	830	170	2
61	998	5	75	20	0.64	2	743	152	1
62	998	5	75	20	0.64	2	743	152	1
64	1,597	4	80	30	0.64	2	1,086	222	2
65	1,597	4	75	50	0.64	3	830	170	2
66	1,198	3	50	50	0.64	3	431	88	1
67	1,597	4	70	50	0.64	3	830	170	2
67A	1,597	4	65	50	0.64	4	575	118	1
SUBTOTAL, BUILDING 15						369	79,697	16,319	151

**Building 441**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	799	2	20	15	0.64	2	288	59	1
1									
2	1,597	4	50	50	0.64	4	575	118	1
3	7,987	20	40	40	0.64	20	2,875	589	5
4	399	1	30	20	0.64	1	144	29	0
5									
6	399	1	30	20	0.64	1	144	29	0
7	399	1	30	30	0.64	1	144	29	0
8	14,377	36	45	45	0.64	36	5,176	1,060	10
9	14,377	36	45	45	0.64	36	5,176	1,060	10
10	399	1	40	20	0.64	1	144	29	0
10	200	1	40	20	0.64	1	72	15	0
11	4,792	12	65	50	0.64	10	2,236	458	4
12									
12	749	2	25	25	0.61	2	292	60	1
13	1,198	3	60	20	0.64	1	942	193	2
13	200	1	60	20	0.64	1	72	15	0
14	1,198	3	60	20	0.64	1	942	193	2
14	200	1	60	20	0.64	1	72	15	0
15	200	1	25	10	0.64	1	72	15	0
16									
16	200	1	25	25	0.64	1	72	15	0
17									
18									
19									
20									
21	2,396	8	30	30	0.64	8	863	177	2

**Building 441 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
22	1,597	4	25	25	0.64	4	575	118	1
23	799	2	25	25	0.64	2	288	59	1
24	1,597	8	25	25	0.64	8	575	118	1
SUBTOTAL,BUILDING 441						144	21,814	4,468	41

**Building 133**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	200	1	50	20	0.64	1	72	0	0
3	1,198	6	25	25	0.64	6	431	0	1
3	1,098	2	25	25	0.61	2	428	0	1
4	749	2	55	50	0.61	2	292	0	1
5	399	2	45	45	0.64	2	144	0	0
5	749	2	45	45	0.61	2	292	0	1
6	200	1	15	15	0.64	1	72	0	0
8	3,994	10	100	50	0.64	5	2,716	0	5
9	1,198	6	25	25	0.64	6	431	0	1
10	1,997	5	30	30	0.64	5	719	0	1
10	200	1	30	30	0.64	1	72	0	0
11	2,396	6	25	25	0.64	6	863	0	2
SUBTOTAL, BUILDING 133						39	6,532	0	13

**Building 245**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	2,396	6	40	30	0.64	5	1,118	229	2
2	799	2	40	40	0.64	2	288	59	1
3	12,979	65	40	40	0.64	65	4,672	957	9
4	1,597	4	60	50	0.64	4	575	118	1
5	1,597	4	60	50	0.64	4	575	118	1
6									
7	399	2	15	15	0.64	2	144	29	0
8	799	4	40	40	0.64	4	288	59	1
9	399	2	40	40	0.64	2	144	29	0
10	899	3	100	50	0.64	2	515	105	1
11	899	3	90	50	0.64	2	515	105	1
12									
12	399	1	60	20	0.64	1	144	29	0
13									
14	2,396	6	100	50	0.64	3	1,629	334	3
15	1,198	4	85	50	0.64	3	623	128	1
16	4,792	16	60	50	0.64	14	2,108	432	4
18	599	2	70	50	0.64	2	216	44	0
19	599	2	50	50	0.64	2	216	44	0
20	599	2	50	50	0.64	2	216	44	0
21	1,198	3	60	50	0.64	3	431	88	1
22	5,990	30	25	25	0.64	30	2,156	442	4
22	1,198	4	25	25	0.64	4	431	88	1
23									
23	1,597	8	50	50	0.64	8	575	118	1
23									
23									
24	799	4	30	15	0.64	2	543	111	1
<b>SUBTOTAL, BUILDING 245</b>						<b>166</b>	<b>18,122</b>	<b>3,710</b>	<b>33</b>

### Building 315

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2									
3									
4									
5	3,195	8	65	65	0.64	8	1,150	0	2
6	3,370	9	45	45	0.61	9	1,314	0	2
7	1,997	10	45	15	0.64	4	1,486	0	3
8	998	5	30	30	0.64	5	359	0	1
9									
10	10,383	26	55	50	0.64	24	4,249	0	8
11									
12	399	1	60	5	0.64	1	144	0	0
13	599	3	25	10	0.64	2	343	0	1
14	799	2	35	20	0.64	2	288	0	1
14	200	1	35	20	0.64	1	72	0	0
15	1,597	4	50	10	0.64	1	1,341	0	3
16	1,597	4	65	20	0.64	2	1,086	0	2
16	200	1	65	20	0.64	1	72	0	0
17									
18	1,198	3	65	50	0.64	3	431	0	1
19	399	1	45	20	0.64	1	144	0	0
20	399	1	45	20	0.64	1	144	0	0
21	1,597	4	60	50	0.64	4	575	0	1
22	10,383	26	55	50	0.64	24	4,249	0	8
23									
24									
24									
25	799	2	65	50	0.64	2	288	0	1

**Building 315 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
26	9,185	23	45	45	0.64	23	3,307	0	6
27	399	1	50	15	0.64	1	144	0	0
28	6,390	16	25	25	0.64	16	2,300	0	4
29	1,597	4	25	25	0.64	4	575	0	1
30									
31									
<b>SUBTOTAL, BUILDING 315</b>						139	24,061	0	45

**Building 321**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	1,498	4	5	5	0.61	4	584	0	1
2	3,195	8	75	50	0.64	6	1,661	0	3
3	2,396	6	50	50	0.64	6	863	0	2
4	1,597	4	50	50	0.64	4	575	0	1
5	2,396	6	50	50	0.64	6	863	0	2
6									
6									
7	1,997	5	55	20	0.64	2	1,486	0	3
7	399	2	55	20	0.64	1	271	0	1
8	3,195	8	35	35	0.64	8	1,150	0	2
9	1,597	4	35	35	0.64	4	575	0	1
10	1,597	4	35	20	0.64	3	830	0	2
11									
12									
13	1,997	5	45	20	0.64	3	1,230	0	2
13	399	2	45	20	0.64	1	271	0	1
14									
15	5,192	13	75	20	0.64	4	4,170	0	8
15	599	3	75	20	0.64	1	471	0	1
16	1,198	6	60	50	0.64	5	559	0	1
17	399	1	45	20	0.64	1	144	0	0
17	200	1	45	20	0.64	1	72	0	0
18	399	1	45	20	0.64	1	144	0	0
18	200	1	45	20	0.64	1	72	0	0
19	399	2	15	10	0.64	2	144	0	0
20	200	1	20	10	0.64	1	72	0	0
21									

**Building 321 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
22	5,591	14	45	45	0.64	14	2,013	0	4
23	1,597	8	35	35	0.64	8	575	0	1
23	399	2	35	35	0.64	2	144	0	0
24	749	2	35	35	0.61	2	292	0	1
24	200	1	35	35	0.64	1	72	0	0
25	5,990	16	45	45	0.61	16	2,336	0	4
25									
26	1,997	5	50	50	0.64	5	719	0	1
26	4,867	13	50	50	0.61	13	1,898	0	4
27	3,195	8	60	50	0.64	7	1,406	0	3
28									
29	1,597	4	60	50	0.64	4	575	0	1
30	1,597	4	60	50	0.64	4	575	0	1
31	5,192	13	60	50	0.64	11	2,380	0	5
32	799	2	65	50	0.64	2	288	0	1
33	1,997	10	30	30	0.64	10	719	0	1
34	799	2	65	50	0.64	2	288	0	1
35	1,997	5	65	50	0.64	4	975	0	2
36	1,597	4	30	30	0.64	4	575	0	1
37	799	2	65	50	0.64	2	288	0	1
38	2,796	7	65	50	0.64	6	1,262	0	2
39	374	1	40	40	0.61	1	146	0	0
39	399	1	40	40	0.64	1	144	0	0
40									
41	1,872	5	30	10	0.61	2	1,415	0	3
41									
42									

**Building 321 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
43	22,464	60	35	35	0.61	60	8,761	0	17
44	4,393	11	40	40	0.64	11	1,581	0	3
45									
45									
46	7,188	18	35	35	0.64	18	2,588	0	5
47									
48									
48									
49	6,739	18	20	20	0.64	18	2,426	0	5
50	1,123	3	20	20	0.61	3	438	0	1
50	1,198	3	20	20	0.64	3	431	0	1
51									
51									
SUBTOTAL BUILDING 321						208	32,286	0	63

### Building 345

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1									
2	1,198	6	50	20	0.64	3	815	167	2
2	399	2	50	20	0.64	1	271	55	1
3									
4									
5	1,198	6	50	20	0.64	3	815	167	2
5	399	2	50	20	0.64	1	271	55	1
6									
7									
8									
9									
10	1,198	6	50	20	0.64	3	815	167	2
10	399	2	50	20	0.64	1	271	55	1
11									
12	749	2	35	35	0.61	2	292	60	1
13	374	1	20	10	0.61	1	146	30	0
14									
15									
16									
17									
18									
19	1,198	6	50	20	0.64	3	815	167	2
19	399	2	50	20	0.64	1	271	55	1
20									
21									
22									
23									

**Building 345 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
24	2,396	6	45	45	0.64	6	863	177	2
25	7,188	18	65	65	0.64	18	2,588	530	5
26	799	2	35	35	0.64	2	288	59	1
27	5,990	15	50	50	0.64	15	2,156	442	4
28	5,990	15	50	50	0.64	15	2,156	442	4
29	5,990	15	50	50	0.64	15	2,156	442	4
30	7,987	20	65	65	0.64	20	2,875	589	5
31	1,997	5	40	40	0.64	5	719	147	1
32	5,990	15	65	50	0.64	12	2,923	599	6
33									
34									
34	5,990	16	35	35	0.61	16	2,336	478	4
35									
36									
38	1,597	4	35	35	0.64	4	575	118	1
39	799	2	40	40	0.64	2	288	59	1
40	799	2	40	40	0.64	2	288	59	1
41	3,994	10	35	35	0.64	10	1,438	294	3
42	799	2	40	40	0.64	2	288	59	1
43	799	2	35	35	0.64	2	288	59	1
44	799	2	35	35	0.64	2	288	59	1
45	799	2	30	10	0.64	1	543	111	1
46	1,198	3	55	50	0.64	3	431	88	1
47	2,396	6	60	50	0.64	5	1,118	229	2
48	799	2	80	50	0.64	2	288	59	1
49	799	2	80	50	0.64	2	288	59	1
50	799	2	80	50	0.64	2	288	59	1

**Building 345 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
51	799	2	40	20	0.64	1	543	111	1
51A									
52	399	1	30	30	0.64	1	144	29	0
53	399	1	40	20	0.64	1	144	29	0
54	1,198	3	30	10	0.64	1	942	193	2
55	799	2	80	50	0.64	2	288	59	1
56	799	2	80	50	0.64	2	288	59	1
57	799	2	80	50	0.64	2	288	59	1
58	799	2	80	50	0.64	2	288	59	1
59	2,396	6	50	50	0.64	6	863	177	2
60	1,597	4	80	50	0.64	3	830	170	2
61	1,597	4	80	50	0.64	3	830	170	2
62	1,597	4	80	50	0.64	3	830	170	2
63	2,396	6	80	50	0.64	4	1,374	281	3
64									
65	15,974	40	45	45	0.64	40	5,751	1,178	11
66	3,195	8	40	40	0.64	8	1,150	235	2
67									
68	3,395	17	40	15	0.64	7	2,500	512	5
69	10,783	27	75	50	0.64	18	6,182	1,266	12
70	1,597	4	75	50	0.64	3	830	170	2
71									
72									
73	14,377	36	80	75	0.64	34	5,687	1,165	11
74									
75	1,198	6	50	20	0.64	3	815	167	2
75	399	2	50	20	0.64	1	271	55	1

**Building 345 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
76									
77									
78									
79	1,198	6	50	20	0.64	3	815	167	2
79	399	2	50	20	0.64	1	271	55	1
80									
81									
82									
83									
84									
85									
86									
87									
88									
88									
89									
89									
89									
90									
91									
92	1,198	6	50	20	0.64	3	815	167	2
92	399	2	50	20	0.64	1	271	55	1
93	1,198	6	50	20	0.64	3	815	167	2
93	1,198	6	50	20	0.64	3	815	167	2
94	3,195	16	45	45	0.64	16	1,150	235	2
<b>SUBTOTAL, BUILDING 345</b>						<b>357</b>	<b>66,041</b>	<b>13,522</b>	<b>141</b>

### Building 421

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
1	9,585	48	95	75	0.64	38	4,729	968	9
2									
3									
4	4,792	24	90	75	0.64	20	2,236	458	4
5	2,995	15	80	75	0.64	15	1,078	221	2
6	799	4	60	50	0.64	4	288	59	1
7	1,597	4	80	50	0.64	3	830	170	2
8	799	4	60	50	0.64	4	288	59	1
8A	200	1	40	15	0.64	1	72	15	0
9	599	3	40	10	0.64	1	471	96	1
10									
11	799	2	40	20	0.64	1	543	111	1
12	799	2	60	20	0.64	1	543	111	1
12	399	1	60	20	0.64	1	144	29	0
13	1,198	6	35	35	0.64	6	431	88	1
14	599	3	35	35	0.64	3	216	44	0
15	2,396	6	90	50	0.64	4	1,374	281	3
16	200	1	50	15	0.64	1	72	15	0
16	200	1	50	15	0.64	1	72	15	0
18	1,398	7	65	65	0.64	7	503	103	1
19	9,585	48	65	65	0.64	48	3,451	707	7
20	11,981	60	80	75	0.64	57	4,697	962	9
21	4,792	24	100	75	0.64	18	2,492	510	5
22	2,995	8	55	55	0.61	8	1,168	239	2
23	5,591	28	70	70	0.64	28	2,013	412	4
24									

**Building 421 (Continued)**

ROOM NO.	EXIST. ANNUAL ENERGY KWH/YR	EXIST. FIXTURE QTY.	EXIST. LIGHT LEVEL FC	NEW LIGHT LEVEL FC	FIXTURE UPGRADE FACTOR	NEW FIXTURE QTY.	LIGHT. ENERGY SAVINGS KWH/YR	COOLING ENERGY SAVINGS KWH/YR	HEATING ENERGY PENALTY MMBTU/YR
25	799	4	40	20	0.64	2	543	111	1
26	399	2	30	20	0.64	2	144	29	0
27									
28	1,597	4	60	50	0.64	4	575	118	1
29	399	1	50	50	0.64	1	144	29	0
30	1,498	2	80	50	0.61	2	584	120	1
31	1,498	2	80	50	0.61	2	584	120	1
32	2,995	4	120	50	0.61	2	2,082	426	4
33	10,783	54	65	65	0.64	54	3,882	795	7
34	21,965	110	70	70	0.64	110	7,907	1,619	15
35	4,792	24	70	70	0.64	24	1,725	353	3
36	1,498	2	60	50	0.61	2	584	120	1
36	799	2	60	50	0.64	2	288	59	1
37	3,195	8	50	50	0.64	8	1,150	235	2
38	1,198	6	60	10	0.64	1	1,070	219	2
39	4,193	14	55	55	0.64	14	1,509	309	3
40	1,198	6	40	15	0.64	3	815	167	2
41	399	2	30	30	0.64	2	144	29	0
42	9,185	23	45	45	0.64	23	3,307	677	6
43	399	1	30	20	0.64	1	144	29	0
44	399	1	30	20	0.64	1	144	29	0
45	399	1	25	25	0.64	1	144	29	0
46	1,597	4	45	45	0.64	4	575	118	1
47	12,780	32	40	40	0.64	32	4,601	942	9
48									
<b>SUBTOTAL, BUILDING 421</b>						<b>567</b>	<b>60,356</b>	<b>12,355</b>	<b>114</b>

APPENDIX E

NON-RECOMMENDED ECO CALCULATIONS

APPENDIX E  
NON-RECOMMENDED ECO CALCULATIONS

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## ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO: 3  
DATE: 4/14/94  
ECO TITLE: Provide Motion Sensor Controls For Lights  
INSTALLATION: Red River Army Depot, Building 323  
LOCATION: Texarkana, Texas

### A. Summary:

Electrical Energy Savings	1,659	KWH/yr
Electrical Demand Savings	0	KW-mo/yr
Natural Gas Energy Penalty	0	MMBTU/yr
Net Energy Savings	5.6	MMBTU/yr
Total Cost Savings	42	\$/yr
Total Investment	1,716	\$
Simple Payback	41.1	yrs
SIR	0.37	

### B. ECO Description:

Install occupancy sensors in various rooms of building 323, listed in Figure E-1. Recircuit the existing light fixtures as required to allow the new sensors to turn off the lights during unoccupied periods. The sensors shall be selected for each individual area, based on the architectural features of the area, such as partitions, shelves, high ceilings, etc. This ECO will require design of the lighting control systems, installation of the sensors and possibly re-circuiting of some of the existing light fixtures.

### C. Discussion:

Many of the buildings surveyed had areas that appear to be unoccupied for portions of the work day, such as restrooms, corridors, offices, storage areas, work areas, etc. The lighting appears to be left on during these unoccupied periods. The amount of time these areas are unoccupied varies from area to area.

Occupancy sensors could be installed in these areas to sense the unoccupied periods, turn off the lights and save the unneeded lighting energy. Since some of these areas have shelving or other partitions throughout, careful consideration should be given to the type of sensor to be used. Application data on the different types of sensors available from a sample manufacturer is included in Appendix G.

However, since the existing lighting systems are recommended to be replaced with higher efficiency light fixtures, the amount of energy saved by the installation of occupancy sensors is reduced. In fact, if the savings calculations take into account the lower energy consumption of the newer lighting systems, the installation of sensors will have a greater than 10 year payback. This is demonstrated by the following calculations, and therefore, this ECO is not recommended for implementation.

- D. Savings Calculations: To demonstrate the low energy savings potential of occupancy sensor installation after newer light fixtures have been installed, calculations were only performed on rooms in building 323. This is considered a typical building at the facility, and the results of this calculation can be extrapolated to the other buildings in the study. The energy savings calculations were performed in Figure E-1, using actual data obtained during the site survey. The following sample calculation demonstrates the procedure followed for each area:

Sample Calculation:

Room #8, office, building 323

Existing annual lighting energy<sup>1</sup> = 200 KWH/yr

New fixture quantity<sup>2</sup> = 1 fixture

Fixture retrofit savings<sup>3</sup> = 72 KWH/yr

- (a) New Annual Energy ( $E_N$ ):

$$E_N = E_O - \Delta E_L$$

where,

$E_O$  = existing annual lighting energy

$\Delta E_L$  = fixture retrofit savings

$$E_N = (200 - 72) = 128 \frac{KWH}{yr}$$

- (b) Lighting Energy Savings ( $\Delta E_S$ ):

$$\Delta E_S = E_N \times (1 - R_O) \frac{KWH}{yr}$$

where,

$R_O$  = room occupied percentage = 75% (estimated)

$$\Delta E_S = 128 \times (1 - 0.75) = 32 \frac{KWH}{yr}$$

- (c) Number of Sensors Required: It was estimated that 1 sensor would be required for every 10 light fixtures. Since this room has only 1 fixture, then only 1 sensor would be required.

Figure E-1. Energy Savings Calculations

ROOM NO.	ROOM FUNCTION	EXIST. ANNUAL ENERGY KWHYR	NEW FIXTURE QTY.	FIXTURE RETROFIT SAVINGS KWHYR	NEW ANNUAL ENERGY KWHYR	ROOM OCCUPIED PERCENT (EST.)	LIGHT. ENERGY SAVINGS KWHYR	NUMBER OF SENSORS (EST.)
1								
2	OFFICE	1,597	4	575	1,022	75	256	1
3								
4	BREAK ROOM	2,995	7	2,100	895	50	448	1
5	MENS RESTROOM	1,797	4	1,286	511	50	256	1
5	MENS RESTROOM	200	1	72	128	50	64	1
6	WOMEN'S RESTROOM	399	1	271	128	50	64	1
6	WOMEN'S RESTROOM	200	1	72	128	50	64	1
7								
8	OFFICE	200	1	72	128	75	32	1
9	OFFICE	200	1	72	128	75	32	1
10								
11								
12								
13								
14								
15								
16								
16								
17								
18								
19								
20	MENS RESTROOM	624	2	493	131	50	66	1
21	OFFICE	437	1	188	249	75	62	1
22	WOMEN'S RESTROOM	624	2	493	131	50	66	1
23	OFFICE	1,747	4	751	996	75	249	1
24								
SUBTOTAL, BUILDING 323							1,659	12

The total energy savings calculated from Figure E-1 are as follows:

$$\Delta E = \frac{1,659 \text{ KWH}}{\text{yr}} \times \frac{3,413 \text{ BTU}}{\text{KWH}} \times \frac{1 \text{ MMBTU}}{1,000,000 \text{ BTU}} = 5.6 \frac{\text{MMBTU}}{\text{yr}}$$

E. Cost Estimate

The total construction costs for this ECO were estimated on page E-5.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the program LCCID and data from the above calculations. The summary sheet for the life cycle cost analysis is shown on page E-6. The results of the analysis are listed in the project summary on page E-1.

#### REFERENCES

1. From Appendix B calculations, see page B-3.
2. From ECO-2 calculations, see page D-40.
3. From ECO-2 calculations, see page D-40.



LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: RRAD

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)      LCCID    FY95 (92)

INSTALLATION & LOCATION: RRAD      REGION NOS.    6    CENSUS: 3

PROJECT NO. & TITLE: 03-0185-01    LIGHTING SURVEY STUDY

FISCAL YEAR 1995      DISCRETE PORTION NAME: ECO-3

ANALYSIS DATE: 04-14-95    ECONOMIC LIFE 20 YEARS    PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	\$	1539.		
B. SIOH	\$	85.		
C. DESIGN COST	\$	92.		
D. TOTAL COST (1A+1B+1C)	\$	1716.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT	\$		0.	
F. PUBLIC UTILITY COMPANY REBATE	\$		0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)	\$			1716.

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

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 7.44	6.	\$ 42.	15.08	\$ 628.
B. DIST	\$ .00	0.	\$ 0.	18.57	\$ 0.
C. RESID	\$ .00	0.	\$ 0.	21.02	\$ 0.
D. NAT G	\$ 1.89	0.	\$ 0.	18.58	\$ 0.
E. COAL	\$ .00	0.	\$ 0.	16.83	\$ 0.
F. PPG	\$ .00	0.	\$ 0.	17.38	\$ 0.
M. DEMAND SAVINGS			\$ 0.	14.88	\$ 0.
N. TOTAL		6.	\$ 42.		\$ 628.

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

A. ANNUAL RECURRING (+/-)				
(1) DISCOUNT FACTOR (TABLE A)			14.88	\$ 0.
(2) DISCOUNTED SAVING/COST (3A X 3A1)				\$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+) COST(-) (4)
d. TOTAL	\$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-) (3A2+3Bd4) \$ 0.

4. FIRST YEAR DOLLAR SAVINGS  $2N3+3A+(3Bd1/(YRS \text{ ECONOMIC LIFE}))$  \$ 42.

5. SIMPLE PAYBACK PERIOD (1G/4) 41.19 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) \$ 628.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .37  
(IF < 1 PROJECT DOES NOT QUALIFY)

APPENDIX F

(EEAP) LIGHTING STUDY SURVEY - SCOPE OF WORK  
AND REVIEW COMMENTS

APPENDIX F  
SCOPE OF WORK AND REVIEW COMMENTS

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DETAILED SCOPE OF WORK  
CONTRACT NO. DACAC63-94-D-0015  
DELIVERY ORDER NO.

1. The Architect-Engineer (A-E) shall furnish all services, material, supplies, plant, labor, equipment, investigations, studies, superintendence and travel as required in connection with the below identified project for design in accordance with the original basic contract and this Detailed Scope of Work. Appendix "A" of the basic contract shall be followed for performance requirements for A-E services. Where this Detailed Scope of Work conflicts with Appendix "A", this Detailed Scope of Work shall govern.

INSTALLATION

PROJECT TITLE

Red River Army Depot

(EEAP) Lighting Survey Study

2. The work and other related data and services required in this Delivery Order shall be accomplished within the time schedule required, in accordance with the subject stated above and scope of work described in paragraph 3 below. The schedule for delivery of data to the Contracting Officer is in calendar days as follows:

	DELIVERY SCHEDULE
a. Interim Submittal(s) and Related data for Studies (See Annex A for Number of Copies)	75 calendar days after receipt of signed D.O.
b. Pre-Final Submittal(s) (12 copies)	85 calendar days after approval of Interim submittal
c. Final Submittal (original and All Data Developed under this submittal)	100 calendar days after approval of the Pre-final

(See Annex "A" page A-1 for Government Furnished Items)

3. The items of work included in this Delivery Order shall be in accordance with criteria furnished at the Scoping Conference held on April 12, 1994 at Red River Army Depot. The services to be provided shall include, but not be limited to, the following Scope of Work.

a. Items of Work: (See the enclosed General and Detailed Scope of Work).

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1.1 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

1.2 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.3 Provide project documentation for recommended ECOs as detailed herein.

1.4 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

2.1 This audit is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this audit.

2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation as relates to lighting, as well as its effects on HVAC systems, and which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The audit shall consider the use of all lighting sources applicable to each building, system, or ECO, including all effects lighting system changes may have on HVAC systems.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAIM-FDF-U, dated 10 Jan 1994 establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

2.6 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP, or O&M funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

2.6.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.6.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.6.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Engineering and Housing will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.

### 3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall immediately be designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the AE in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), labor, supervision and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$300,000, a Savings to Investment Ratio greater than 1.25 and a simple payback period of less than ten years. For ECAM projects, the \$300,000 limitation may not apply; in such cases, the AE shall check with the installation for guidance. The overall project and each discrete part of the project shall have an SIR greater than 1.25. All projects meeting the above criteria shall be arranged as specified in paragraph 2.6.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented), and a Project Development Brochure (PDB). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate or payback period, but which have an SIR greater than 1.25 shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.6.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA, ie, energy savings calculations and cost estimate(s), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. O & M Energy Projects: An O&M Energy project is one that results in needed maintenance or repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings. The criteria are similar to the criteria for ECIP projects, ie, \$300,000 construction cost,  $SIR \geq 1.25$ , and simple payback period of less than ten years. In addition, if the project would replace a system or equipment that is considered 'failed or failing' due solely to obsolete technology or inefficiency, the equipment to be replaced must have been in use for at least three years; and the simple payback period must be three years or less.

b. Low Cost/No Cost Projects. These are projects which the Director of Engineering Services (DES) can perform using his resources. Documentation shall be as required by the DES.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Perform a Limited Site Survey. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. The AE shall document his site survey on forms developed for the survey, or standard forms, and submit these completed forms as part of the report. Light levels shall be measured under typical operating conditions for all areas or spaces being evaluated. All test and/or measurement equipment shall be properly calibrated prior to its use. The requirements for color rendition and current maintenance and relamping practices shall be noted for consideration in the evaluations.

7.2 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. Construction cost estimates shall be provided and shall break out the costs associated with rehab work (architectural, electrical, mechanical) where applicable. Existing and proposed light levels shall be compared with levels recommended by the Illumination Engineering Society (IES) or the Corps of Engineers Architectural and Engineering Instructions (AEI) for the applicable space and activity. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.3 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph 7.4.1, the AE will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par 7.4.2.

7.4 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The AE shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Engineering Services, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.4.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a. All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b. All ECOs which were analysed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study.

The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Engineering Services to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that

they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.4.2 Final Submittal. The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph 7.4.1 shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects.

1) Backup information as specified in par 5.1

2) For any recommendations that would require a different layout of fixtures, a one-line drawing of the area showing circuiting and switching is required.

d. Appendices to include as a minimum:

1) Energy cost development and backup data

2) Detailed calculations

3) Cost estimates

4) Computer printouts (where applicable)

5) Scope of Work

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.
2. Building Data (types, number of similar buildings, sizes, etc.).
3. Present Energy Consumption of Buildings or Systems Studied.
  - o Total Annual Energy Used.
  - o Source Energy Consumption.
    - Electricity - KWH, Dollars, BTU
    - Fuel Oil - GALS, Dollars, BTU
    - Natural Gas - THERMS, Dollars, BTU
    - Propane - GALS, Dollars, BTU
    - Other - QTY, Dollars, BTU
4. Reevaluated Projects Results.
5. Energy Conservation Analysis.
  - o ECOs Investigated.
  - o ECOs Recommended.
  - o ECOs Rejected. (Provide economics or reasons)
  - o ECIP Projects Developed. (Provide list)\*
  - o Non-ECIP Projects Developed. (Provide list)\*
  - o Operational or Policy Change Recommendations.

\* Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.
6. Energy and Cost Savings.
  - o Total Potential Energy and Cost Savings.
  - o Percentage of Energy Conserved.
  - o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

BUILDING #

5	115	328	655	401
85	133	321	1167	411
164	150	323	1169	421
175	154	343	1163	441
135	161	373	1130	493
04	228	377	1116	
241	300	636	1149	
431	312	672	1122	
468	333	957	406	
112	345	939	407	
110	315	935	410	

\*Buildings are prioritized, beginning with Bldg # 15, 85 164 and ending with 401, 411 .....

Interim Submittal Meeting At RRAD  
Review Comments / Minutes  
12/19/95

Present at meeting:

C.A. Pieper, PE	Huitt Zollars, Inc., Project Manager
Brandon Driscoll	ECMD, Electrical Engineer
Gary Dugan	EPD Division, Electrical Engineer
Ross Ramsauer	O&M Division, Mechanical Engineer
Maurice Smith	EPD Division, Electrical Engineer
Bill Moffitt	EPD Division, Mechanical Engineer
Doyle Grider	RRAD, Superintendent of Maintenance

1. Gary Dugan expressed reservations about installing electronic ballasts and T8 lamps in fluorescent lighting at the facility. He stated that problems with harmonic disturbances, generated by electronic ballasts, could overheat electrical system neutral wires. It was suggested that HZ check with the Corps of Engineers for guidance on this matter.
2. Ross Ramsauer requested that HZ check on weather or not this study could be used to apply for project funding from the FEMP.
3. Ross Ramsauer decided that he would circulate the interim submittal report to all parties at the meeting for review and comment. He would follow this review with a letter to HZ directing the final project grouping desired by RRAD.

Responses to Interim Submittal Meeting Comments  
Included in Pre-Final Submittal  
4/6/95

ITEM

RESPONSE

1. After checking with Richard Champagne of the Fort Worth Corps of Engineers office, it was determined that their current guidance is to recommend the installation of electronic ballasts in fluorescent light fixtures. He knew of no technical directive which addresses the concerns raised by Mr. Dugan in the interim meeting.
2. It was determined that the Forms 1391 which are to be generated by HZ for the projects in this study, can be used to request funding from the FEMP. Since FEMP has solicited RRAD to submit funding requests, the projects in this study will be directed toward this funding source.
3. Noted. Letter received on 2/2/95. Will proceed as directed. However, with respect to item 1, the prefinal report will include ECO-2, which calls for installation of electronic ballasts in fluorescent light fixtures.

Interim Submittal Review Letter From RRAD

SDSRR-OC

2 Feb 1995

MEMORANDUM FOR: Huit Zollars, Inc, ATTN: C.A. Pieper

SUBJECT: Red River Army Depot (RRAD) lighting survey

1. Reference phone conversation, 30 January, 1995, regarding EEAP interim report.
2. Request energy conservation opportunity (eco) number one: Replace existing incandescent and mercury vapor lighting, be pursued. Request that the most feasible funding source which fits the criteria of this project also be pursued.
3. The point of contact for this subject is the undersigned, phone (903) 334-3615.

*Ross Ramsauer*  
ROSS RAMSAUER  
Energy Program Manager

OPTIONAL FORM 99 (7-90)

<b>FAX TRANSMITTAL</b>		# of pages = 1
To	CHRIS PEIPER	From ROSS RAMSAUER
Dist./Agency		Phone # 903-334-3615
Fax #	817-385-1025	Fax # 903-334-2764
NSN 7540-01-317-7208		5098-101 GENERAL SERVICES ADMINISTRATION

Responses to Interim Submittal Review Letter From RRAD  
4/6/95

ITEM	RESPONSE
1.	Noted.
2.	Noted. Will proceed as directed, but will also include ECO-2, Install Electronic Ballasts and T8 lamps in Fluorescent Fixtures. The facility may decide later to implement this project. If so, they will have the paperwork.
3.	Noted.

Interim Submittal Review Comments From USAED, Mobile

MOBILE DISTRICT PROJECT REVIEW COMMENTS		Date: 06 Jan 95	Page 1 of 1
To: Richard Champagne Fort Worth District, CRSWF-ED-MP		From: (Section) CESAM-EN-DM (Reviewer) A. Battaglia 205-690-2618	
Project: FY94 Lighting Study Location: Red River Army Depot, Texarkana, TX		Year: FY-94	Line Item No.:
Type of Action: Interim Submittal Review			
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

1. General The overall approach, assumptions, and calculations look very good.
2. General I want to comment on estimating and Life Cycle Cost Analyses, and I want to differentiate between the Contractor's overhead costs and the Government's overhead costs. So, at the risk of insulting the AB's intelligence, I have attached an example of a cost estimate from a previous KEAP study. On this example, all of the contractor's costs for materials, labor, (equipment rental and sub-contracting if needed), overhead, profit, and contingencies are shown and summed into a total construction cost at the lower right hand corner of the sheet. This is the value that should be used in Line 1A, CONSTRUCTION COST, of the LOCA Summary Sheet. Line 1B, STOR, is the government's cost for administering the contract; it should be equal to 5.5% of Line 1A. Line 1C, DESIGN COST, is the government's cost for design; use 6% of Line 1A except for very small or very complex projects. Please make necessary revisions.
3. General The floor plans and BOD data sheets of Appendix C are excellent; they can be used to determine exactly how many fixtures are to be changed out in each room of any particular building. When you prepare the project documentation please include this information. It will make the designer's job much easier.

Responses to Interim Comments From USAED, Mobile  
4/6/95

ITEM

RESPONSE

- |   |   |
|---|---|
| 1 | Noted.  |
| 2 | Concur, see revised cost estimates and LCCA Summary Sheets. |
| 3 | Noted, will proceed as directed.                            |

APPENDIX G  
SAMPLE PRODUCTS

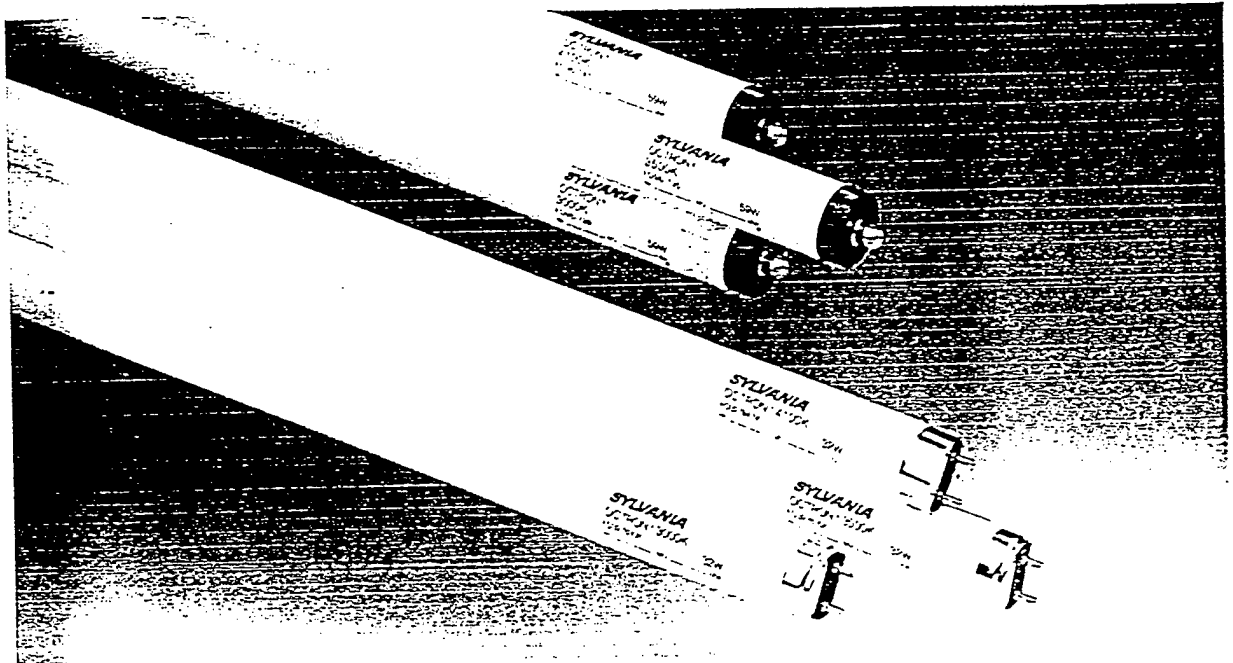
APPENDIX G  
SAMPLE PRODUCTS

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# OCTRON<sup>®</sup>

## Fluorescent Lamps



### The Widest Range of T8 Lamps Available

Through its OCTRON<sup>®</sup> line OSRAM SYLVANIA offers more T8 lamp options than any other manufacturer. This gives architects, lighting designers, engineers, contractors and other specifiers the opportunity to select exactly the right mix of lamps to meet the precise requirements of an application.

All OCTRON lamps have a 20,000 hour average rated life when operated on rapid start ballasts. Lamps are rated at 15,000 hours when operated on instant start ballasts. (These figures are based on three hours of operation per start. Ratings will improve as burning cycles increase. In a typical 10 hour per day application, for example, life ratings on rapid start or instant start ballasts are increased by 35 percent.) Because long life means less frequent lamp replacement and smaller lamp inventories, maintenance costs can be substantially reduced.

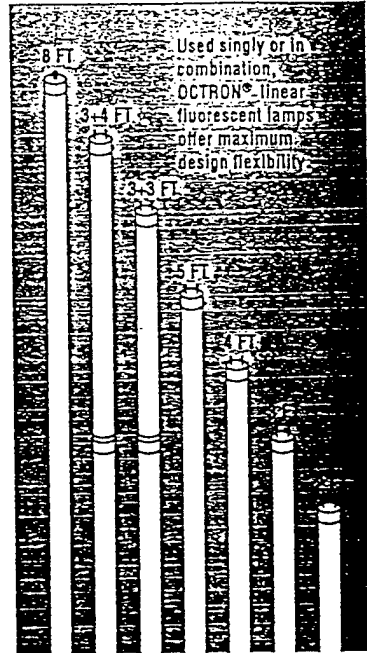
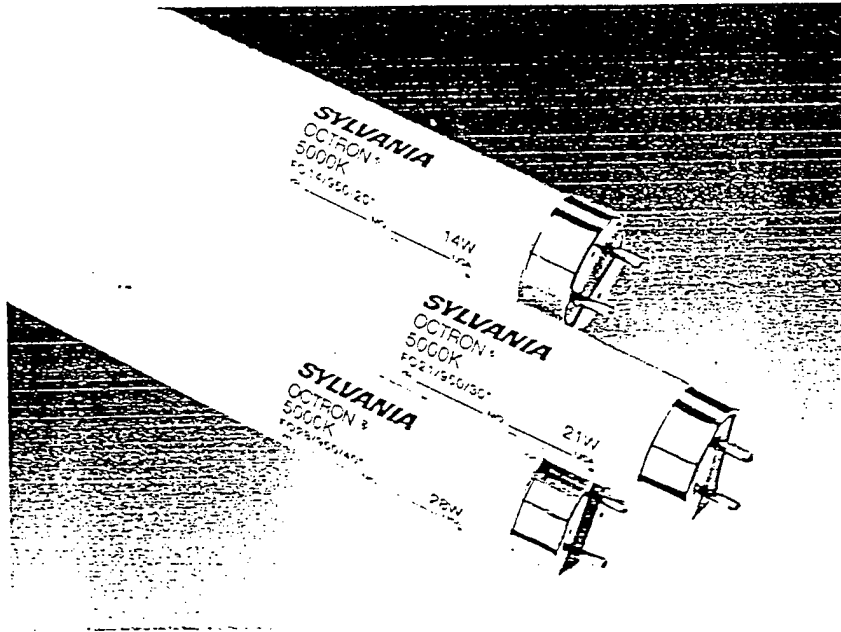
### OCTRON<sup>®</sup> Bipin Linear Lamps

OCTRON bipin linear fluorescent lamps are available in four length/wattage combinations—2-foot (17W), 3-foot (25W), 4-foot (32W) and 5-foot (40W). This means there is an OCTRON T8 lamp to replace any commonly available bipin T12 lamp in any standard linear fluorescent fixture. OCTRON 700 Series lamps are available in four color temperatures—3000K, 3500K, 4100K and 5000K—and have a color rendering index of 75. The 800 Series lamps come in 3000K, 3500K and 4100K colors and have an exceptional CRI of 85.

### OCTRON<sup>®</sup> Single Pin Lamps

The OCTRON family includes an 8-foot single pin T8 lamp. When used in combination with an electronic ballast OCTRON FO96T8 lamps can replace F96T12 systems—saving over 90 watts per two-lamp fixture. The 15,000 hour average rated life of this innovative lamp is 25 percent longer than ordinary F96T12 lamps. In addition, the argon fill gas in OCTRON FO96T8 lamps is less temperature sensitive than the krypton gas commonly used in F96T12/SS lamps. This improves light output in applications where cold air circulates. Available in 700 Series (75 CRI) and 800 Series (85 CRI) versions with a choice of 3000K, 3500K and 4100K colors.

# T8 Linear Fluorescent Lamps



OCTRON 900 Series lamps are the only T8 lamps available that are suitable for color critical applications.

## OCTRON® 900 Series Lamps

The OCTRON® 900 Series offers the industry's only full color spectrum T8 fluorescent lamps. These high performance lamps are designed for a wide variety of color critical applications. Their CRI of 90 is the highest of any fluorescent lamp and they feature a color temperature of 5000K. The American National Standards Institute has specified 5000K light sources for color evaluation

and comparisons. 5000K was chosen because it is the average color of daylight—an almost universal light source. OCTRON 900 Series lamps have a wide range of uses in graphic arts, textile and quality control applications where accurate color evaluation and comparisons are essential. They are also ideal for backlighting displays and translucent signs. OCTRON 900 Series lamps are available in the standard 2-foot, 3-foot, 4-foot and 5-foot lamp lengths as well as special 20-inch, 30-inch and 40-inch versions. Wattages range from 14 to 40 watts. For increased flexibility, different sizes of OCTRON 900 Series lamps may be operated on a single multi-lamp instant start electronic ballast with uniform lamp life

## Understanding OCTRON® T8 Technology

OCTRON T8 lamps can be operated effectively on rapid start magnetic and rapid start electronic ballasts. However, specific elements of OCTRON T8 technology are designed to achieve maximum performance on high frequency, instant start electronic ballasts.

The primary benefit of running OCTRON T8 lamps on electronic ballasts is the ability to use less energy to produce a given amount of light. The energy savings come from the fact that an electronic ballast drives OCTRON T8 lamps at high frequency—20 000 Hz—compared to 60 Hz for

a standard magnetic ballast. The increased frequency improves light output by up to 12 percent, allowing OCTRON lamps to provide dramatic energy cost savings while producing the same output as fluorescent T12 lamps. For even more savings, OCTRON fluorescent lamps may be operated with as little as 140 milliamps of current on instant start electronic ballasts.

# OCTRON® OCTRON® CURVALUME® T8 Fluorescent Lamps

## OCTRON® 700 Series Linear T8 Fluorescent Lamps

Watts	Bulb	Nominal Length (in.)	Base	Item Number	Ordering Abbreviation	Average Rated Life (hours)	Initial Lumens	Color Temp.	CRI
17	T-8	24	Medium Bipin	21849	FO17-730	20000	1325	3000K	75
17	T-8	24	Medium Bipin	21852	FO17-735	20000	1325	3000K	75
17	T-8	24	Medium Bipin	21851	FO17-741	20000	1325	4100K	75
25	T-8	36	Medium Bipin	21851	FO25-730	20000	2125	3000K	75
25	T-8	36	Medium Bipin	21817	FO25-735	20000	2125	3500K	75
25	T-8	36	Medium Bipin	21829	FO25-741	20000	2125	4100K	75
32	T-8	48	Medium Bipin	21852	FO32-730	20000	2850	3000K	75
32	T-8	48	Medium Bipin	21823	FO32-735	20000	2850	3500K	75
32	T-8	48	Medium Bipin	21824	FO32-741	20000	2850	4100K	75
32	T-8	48	Medium Bipin	21809	FO32-750	20000	2850	5000K	75
40	T-8	60	Medium Bipin	21853	FO40-730	20000	3500	3000K	75
40	T-8	60	Medium Bipin	21820	FO40-735	20000	3500	3500K	75
40	T-8	60	Medium Bipin	21827	FO40-741	20000	3500	4100K	75
59	T-8	95	Single Pin	21854	FO95-730	15000	5700	3000K	75
59	T-8	95	Single Pin	21839	FO95-735	15000	5700	3500K	75
59	T-8	95	Single Pin	21840	FO95-741	15000	5700	4100K	75

## OCTRON® 800 Series Linear T8 Fluorescent Lamps

Watts	Bulb	Nominal Length (in.)	Base	Item Number	Ordering Abbreviation	Average Rated Life (hours)	Initial Lumens	Color Temp.	CRI
17	T-8	24	Medium Bipin	21903	FO17-830	20000	1400	3000K	85
17	T-8	24	Medium Bipin	21904	FO17-835	20000	1400	3500K	85
17	T-8	24	Medium Bipin	21905	FO17-841	20000	1400	4100K	85
25	T-8	36	Medium Bipin	21913	FO25-830	20000	2225	3000K	85
25	T-8	36	Medium Bipin	21914	FO25-835	20000	2225	3500K	85
25	T-8	36	Medium Bipin	21915	FO25-841	20000	2225	4100K	85
32	T-8	48	Medium Bipin	21923	FO32-830	20000	3000	3000K	85
32	T-8	48	Medium Bipin	21924	FO32-835	20000	3000	3500K	85
32	T-8	48	Medium Bipin	21925	FO32-841	20000	3000	4100K	85
36	T-8	48	Medium Bipin	21930	FO36-830	20000	3450	3000K	85
36	T-8	48	Medium Bipin	21931	FO36-835	20000	3450	3500K	85
36	T-8	48	Medium Bipin	21932	FO36-841	20000	3450	4100K	85
40	T-8	60	Medium Bipin	21938	FO40-830	20000	3775	3000K	85
40	T-8	60	Medium Bipin	21939	FO40-835	20000	3775	3500K	85
40	T-8	60	Medium Bipin	21940	FO40-841	20000	3775	4100K	85
59	T-8	95	Single Pin	21897	FO95-830	15000	6000	3000K	85
59	T-8	95	Single Pin	21898	FO95-835	15000	6000	3500K	85
59	T-8	95	Single Pin	21899	FO95-841	15000	6000	4100K	85

## OCTRON® 900 Series Linear T8 Fluorescent Lamps

Watts	Bulb	Nominal Length (in.)	Base	Item Number	Ordering Abbreviation	Average Rated Life (hours)	Initial Lumens	Color Temp.	CRI
14	T-8	20	Medium Bipin	21858	FO14-950-20	20000	750	5000K	90
17	T-8	24	Medium Bipin	21871	FO17-950-24	20000	800	5000K	90
21	T-8	30	Medium Bipin	21869	FO21-950-30	20000	1000	5000K	90
25	T-8	36	Medium Bipin	21872	FO25-950-36	20000	1250	5000K	90
28	T-8	40	Medium Bipin	21870	FO28-950-40	20000	1400	5000K	90
32	T-8	48	Medium Bipin	21850	FO32-950-48	20000	1675	5000K	90
40	T-8	60	Medium Bipin	21873	FO40-950-60	20000	2200	5000K	90

# Ordering Information

## OCTRON® CURVALUME® 700 Series T8 Fluorescent Lamps

Watts	Bulb	Nominal Length (in.)	Base	Item Number	Ordering Abbreviation	Average Rated Life (hours)	Initial Lumens	Color Temp.	CRI
16	T-8	10.5	Medium Bipin	21792	FBO16/730	20000	1225	3000K	75
16	T-8	10.5	Medium Bipin	21800	FBO16/735	20000	1225	3500K	75
16	T-8	10.5	Medium Bipin	21802	FBO16/741	20000	1225	4100K	75
24	T-8	16.5	Medium Bipin	21794	FBO24/730	20000	2025	3000K	75
24	T-8	16.5	Medium Bipin	21810	FBO24/735	20000	2025	3500K	75
24	T-8	16.5	Medium Bipin	21804	FBO24/741	20000	2025	4100K	75
31	T-8	22.5	Medium Bipin	21796	FBO31/730	20000	2750	3000K	75
31	T-8	22.5	Medium Bipin	21807	FBO31/735	20000	2750	3500K	75
31	T-8	22.5	Medium Bipin	21806	FBO31/741	20000	2750	4100K	75
31	T-8	22.5	Medium Bipin	21819	FBO31/750	20000	2550	5000K	75
32	T-8	22.5	Medium Bipin	21957	FBO32/730/6	20000	2550	3000K	75
32	T-8	22.5	Medium Bipin	21958	FBO32/735/6	20000	2550	3000K	75
32	T-8	22.5	Medium Bipin	21959	FBO32/741/6	20000	2550	4100K	75

## OCTRON® CURVALUME® 800 Series T8 Fluorescent Lamps

Watts	Bulb	Nominal Length (in.)	Base	Item Number	Ordering Abbreviation	Average Rated Life (hours)	Initial Lumens	Color Temp.	CRI
16	T-8	10.5	Medium Bipin	21634	FBO16/830	20000	1300	3000K	85
16	T-8	10.5	Medium Bipin	21635	FBO16/835	20000	1300	3500K	85
16	T-8	10.5	Medium Bipin	21636	FBO16/841	20000	1300	4100K	85
24	T-8	16.5	Medium Bipin	21674	FBO24/830	20000	2125	3000K	85
24	T-8	16.5	Medium Bipin	21675	FBO24/835	20000	2125	3500K	85
24	T-8	16.5	Medium Bipin	21676	FBO24/841	20000	2125	4100K	85
31	T-8	22.5	Medium Bipin	21677	FBO31/830	20000	2900	3000K	85
31	T-8	22.5	Medium Bipin	21678	FBO31/835	20000	2900	3500K	85
31	T-8	22.5	Medium Bipin	21679	FBO31/841	20000	2900	4100K	85
32	T-8	22.5	Medium Bipin	21970	FBO32/830/6	20000	3000	3000K	85
32	T-8	22.5	Medium Bipin	21971	FBO32/835/6	20000	3000	3500K	85
32	T-8	22.5	Medium Bipin	21972	FBO32/841/6	20000	3000	4100K	85

### Sample Specifications

#### OCTRON®

Lamps shall be SYLVANIA OCTRON® (FO17, FO25, FO32, FO36\*, FO40, FO96) having a T8 bulb and \_\_\_\_\_ (medium bipin, single pin\*\*) bases. Lamps shall have a correlated color temperature of \_\_\_\_\_ (3000K, 3500K, 4100K, 5000K) and a color rendering index of \_\_\_\_\_ (75, 85). They are to be operated on \_\_\_\_\_ (magnetic rapid start, electronic instant start, electronic rapid start) ballasts.

\*Available only in 800 Series  
\*\*FO36 only

#### OCTRON® CURVALUME®

Lamps shall be SYLVANIA OCTRON® CURVALUME® (FBO16, FBO24, FBO31, FBO32\*) having a \_\_\_\_\_ (1 1/4", 6") leg spacing and medium bipin bases. Lamps shall have a correlated color temperature of \_\_\_\_\_ (3000K, 3500K, 4100K, 5000K) and a color rendering index of \_\_\_\_\_ (75, 85). They are to be operated on \_\_\_\_\_ (magnetic rapid start, electronic instant start, electronic rapid start) ballasts.

\*FBO32 is the only CURVALUME lamp with 6" leg spacing

#### OCTRON® 900 Series

Lamps shall be SYLVANIA OCTRON 900 Series fluorescent lamps having medium bipin bases. Lamps shall have a correlated color temperature of 5000K and a color rendering index of 90. Lamp lengths shall be \_\_\_\_\_ (20", 24", 30", 36", 40", 48", 60"). Lamps shall be operated on \_\_\_\_\_ (magnetic rapid start, electronic instant start, electronic rapid start) ballasts.

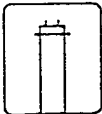
### For Orders And General Information

OSRAM SYLVANIA National Customer Support Center, 16725 N. Union Street, Westfield, IN 46074

Industrial/Commercial	Phone: 800/255-5042	Specialty Lamps Markets	Phone: 800/762-7191
	Fax: 800/255-5043		Fax: 800/762-7192
Consumer Products	Phone: 800/842-7010	National Accounts:	Phone: 800/562-4671
	Fax: 800/842-7011	Industrial/Commercial	Phone: 800/562-4672
		Consumer Products	Fax: 800/562-4674

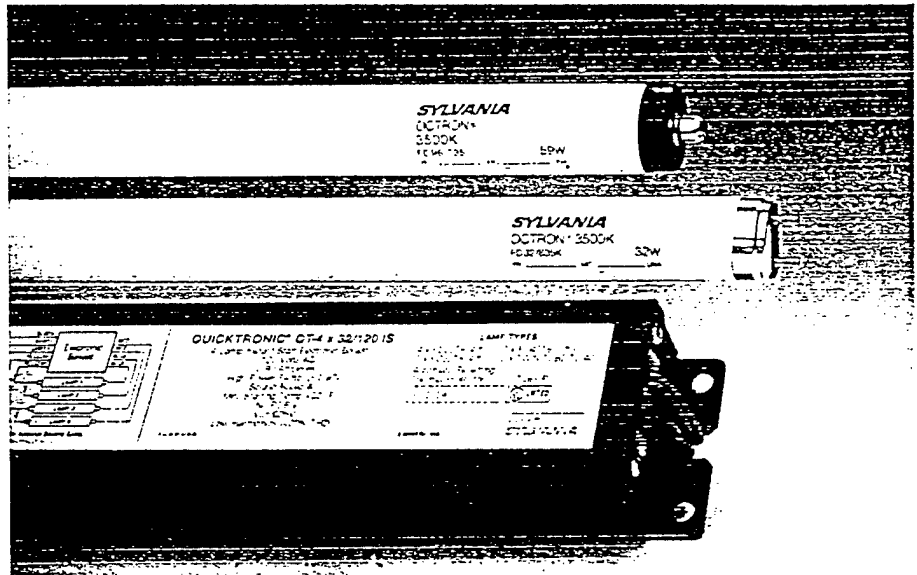
# Electronic Lighting Systems

## The System Solution



### A Complete Range of Fluorescent Systems

OSRAM SYLVANIA offers a QUICKTRONIC® system to provide optimum performance with every OCTRON® and OCTRON® CURVALUME® T8 lamp. There are also QUICKTRONIC systems for DULUX® L and F96T12 lamps. All QUICKTRONIC systems have a high ballast factor and high frequency circuitry for maximum light output and efficiency with minimal lamp flicker. Multi-lamp ballasts power up to four lamps with parallel circuitry that keeps remaining lamps lit when one or more fails. QUICKTRONIC systems are ideal for either retrofit or new installations.



### QUICKTRONIC® SYSTEM 32

QUICKTRONIC SYSTEM 32 is designed to use OCTRON 32W T8 fluorescent lamps and provides illumination equal to an F40T12 system with 40 percent less energy usage. It can also operate 17W, 25W and 40W T8 lamps, OCTRON CURVALUME lamps and 40W T5 twin lamps. QUICKTRONIC SYSTEM 32 is available in 120V and 277V versions to drive one, two, three and four-lamp systems. OCTRON and OCTRON CURVALUME T8 lamps are available in 75, 85 and 90 CRI versions and provide energy savings, high luminous efficacy and excellent color rendition. The DULUX L 40W is a single ended twin tube lamp that provides nearly the same light output as a 4-foot linear lamp.

### QUICKTRONIC® SYSTEM 36

QUICKTRONIC SYSTEM 36 is designed to operate OCTRON 36W T8 lamps. It provides up to 30 percent more lumen output than a standard 32W T8 system. It also operates DULUX L 39W twin tube fluorescent lamps. QUICKTRONIC SYSTEM 36 is a two-lamp system available in 120V and 277V versions. OCTRON 36W T8 lamps are available in 3000K, 3500K and 4100K versions and have a CRI of 85. They provide exceptional luminous efficacy and energy efficiency. The DULUX L 39W single ended twin tube lamp provides nearly the same light output as a 4-foot linear lamp and has an efficacy of up to 81 lumens per watt.

### QUICKTRONIC® SYSTEM 59

QUICKTRONIC SYSTEM 59 is designed to operate OCTRON FC96T8 lamps. It provides illumination equal to F96T12 lamps with 40 percent less energy usage. Because it is smaller and lighter than the F96T12 magnetic ballast it replaces, installation is easier and more flexible. QUICKTRONIC SYSTEM 59 is a two-lamp system available in 120V and 277V versions. OCTRON FC96T8 lamps have a single pin base and are designed to replace F96T12 lamps. OCTRON FC96T8 lamps come in three color temperatures—3100K, 3500K and 4100K and are available in 75 CRI and 85 CRI versions.

# QUICKTRONIC® SYSTEMS

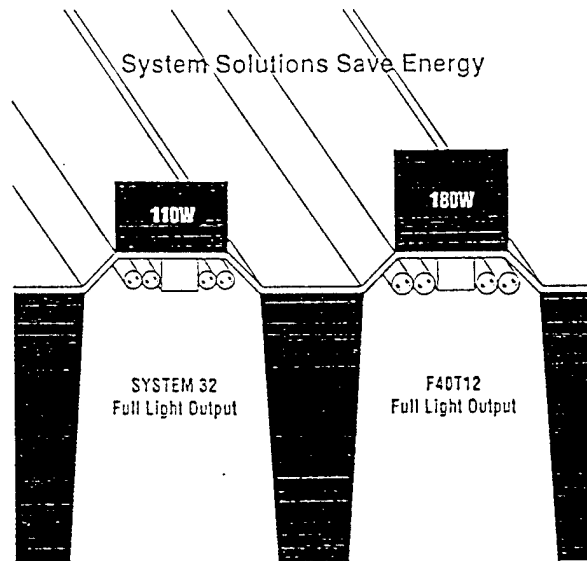
## QUICKTRONIC® SYSTEM 17

QUICKTRONIC® SYSTEM 17 is designed to operate OCTRON® 17W T8 and OCTRON® CURVALUME® 16W lamps with full energy efficiency, high lumen output and low harmonic distortion. QUICKTRONIC SYSTEM 17 is a three-lamp system available in 120V and 277V versions.

OCTRON 17W T8 and OCTRON CURVALUME 16W lamps are available in both 75 and 85 CRI versions. When used in QUICKTRONIC SYSTEM 17 they provide energy savings, high luminous efficacy and excellent color rendering.

## QUICKTRONIC® SYSTEM 96

QUICKTRONIC SYSTEM 96 is designed to operate both standard and energy saving SYLVANIA F96T12 lamps and F96T12/HO lamps. It provides high lumen output, extremely efficient operation and up to 20 percent energy savings when compared to older magnetic ballasts. Other T12, SLIMLINE and H.O. lamps can also be driven. QUICKTRONIC SYSTEM 96 is a two-lamp system available in 120V and 277V versions. SYLVANIA F96T12 SLIMLINE and F96T12 High Output lamps are available in a range of colors with up to 80 CRI. Standard and energy saving versions are available.



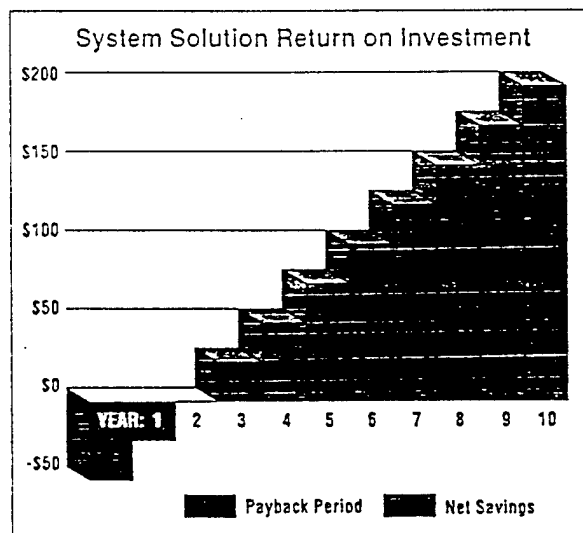
Power Input vs. Light Output for QUICKTRONIC® System 32 Compared to F40T12 System.

## QUICKTRONIC® SYSTEM 55

QUICKTRONIC SYSTEM 55 is designed to operate DULUX® L 55W twin tube fluorescent lamps. It provides up to 50 percent more lumen output than standard T5 twin lamps with no loss in system efficiency. This is the ideal system for high lumen indirect, cove and 2x2 fixtures.

QUICKTRONIC SYSTEM 55 is offered as a one or two-lamp system in 120V and 277V versions.

DULUX L 55W twin tube lamps provide up to 50 percent more light output than standard T5 twin lamps. DULUX L lamps offer an efficacy of up to 81 lumens per watt and are available in 3000K, 3500K and 4100K versions.



10 Year Payback on QUICKTRONIC® System 32 vs. F40T12 System

# OSRAM SYLVANIA

System Solutions

## Ordering Information

### QUICKTRONIC<sup>®</sup> Electronic Systems for Fluorescent Lamps

Item Number	Ordering Abbreviation	Voltage (VAC)	Lamp Type	No of Lamps	Input Wattage (W)	Ballast Factor	%THD
49255	QT1X32/120/S	120	32W-T8	1	31	.93	<20
49257	QT1X32/277/S	277	32W-T8	1	31	.93	<20
49270	QT2X32/120/S	120	32W-T8	2	62	.95	<20
49268	QT2X32/277/S	277	32W-T8	2	62	.95	<20
49258	QT3X32/120/S	120	32W-T8	3	68	.93	<20
49260	QT3X32/277/S	277	32W-T8	3	68	.93	<20
49255*	QT4X32/120/S	120	32W-T8	4	110	.87	<20
49253	QT4X32/277/S	277	32W-T8	4	110	.87	<20
49262	QT2X35/120/S	120	35W-T8	2	78	1.05	<20
49267	QT2X35/277/S	277	35W-T8	2	78	1.05	<20
49340	QT2X59/120/S	120	59W-T8	2	105	.85	<20
49345	QT2X59/277/S	277	59W-T8	2	105	.85	<20
49252	QT3X17/120/S	120	17W-T8	3	50	.95	<20
49253	QT3X17/277/S	277	17W-T8	3	50	.95	<20
49250	QT2X95/120/S	120	F95T12	2	135	.88	<20
49254	QT2X95/277/S	277	F95T12	2	135	.88	<20
49255	QT2X95/120/HO	120	F95T12/HO	2	210	.87	<20
49251	QT2X95/277/HO	277	F95T12/HO	2	210	.87	<20
49267	QT2X55/120/S	120	55W DuLux L	2	110	1.00	<20
49268	QT2X55/277/S	277	55W DuLux L	2	110	.91	<20

### ACCUTRONIC<sup>™</sup> Low Voltage DC Electronic Systems for Compact Fluorescent Lamps

Item Number	Ordering Abbreviation	Voltage (VAC)	Lamp Type	No of Lamps	Input Wattage (W)	Ballast Factor	%THD
49401	AT7-9/12	12	7-9W DuLux SE & DE	1	10	1.00	
49400	AT7-9/24	24	7-9W DuLux SE & DE	1	10	1.00	

### POWERTRONIC<sup>™</sup> Electronic Systems for HID Lamps

Item Number	Ordering Abbreviation	Voltage (VAC)	Lamp Type	No of Lamps	Input Wattage (W)	Ballast Factor	%THD
49300	PT-DE 70/120	120	70W HQI-DE	1	80	1.00	<10
49301	PT-DE 70/277	277	70W HQI-DE	1	80	1.00	<10

**For Orders  
And General  
Information**

OSRAM SYLVANIA National Customer Support Center, 18725 N. Union Street, Westfield, IN 46074

Industrial/Commercial Phone: 800/255-5042

Fax: 800/255-5043

Consumer Products Phone: 800/842-7010

Fax: 800/842-7011

Specialty Lamps/Markets Phone: 800/762-7191

Fax: 800/762-7192

National Accounts:  
Industrial/Commercial

Phone: 800/562-4671

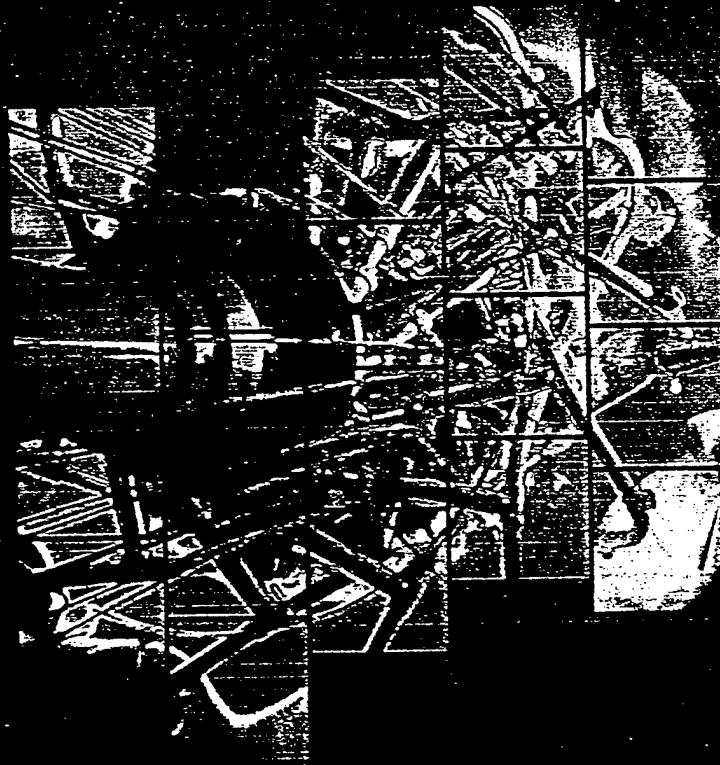
Consumer Products

Phone: 800/562-4672

Fax: 800/562-4674

**University of Wisconsin-Madison/Extension**

**Mechanical  
Engineering and Energy  
Course Schedule**



**January-June 1995**

**Department of Engineering Professional Development  
College of Engineering**

## For More Information or To Enroll

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## General Information

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**Accommodations** Your enrollment confirmation will include hotel/motel information. Advise us at the time of enrollment if you are a person with a disability and desire special accommodations. Requests will be kept confidential.

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**Professional Development Degree** This is an alternative advanced degree for practicing engineers. The courses described in this brochure can apply as credit toward this University of Wisconsin Professional Development degree. Call for details and qualifications.

**Distance Education** Because it is often more convenient for you, we offer several ways for you to take our courses at home or at work. See pages 12-15 for details.

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**Civil and Environmental Engineering**

**Electrical Engineering, Electronics and Telecommunications**

**Manufacturing and Product and Process Engineering**

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Department of Engineering Professional Development

## Industrial Energy Systems (EM4)

May 1-5, 1995 5208D

Successful industrial energy managers have cut energy indices by 25 percent or more. This course will provide methods to help you develop an appropriate energy index for measuring performance and controlling energy costs. You will review the basics of process energy analysis and compare theoretical, potential, and actual performance of industrial energy systems. Your learning will include the latest heat recovery technology, combustion equipment, adjustable speed drives and digital process controls. Plan to work with other energy managers in solving typical industrial energy problems. Topics for this course include:

- energy management performance analysis and forecasting
- process energy analysis techniques
- energy efficiencies of commonly used systems
- optimization of operation and control
- cost-effective retrofits
- latest technology for waste heat utilization
- energy-efficient designs, systems and components for replacement and new construction
- methods for analyzing potential savings.

Fee: \$1145 Director: Keith Kempfski

## Building Energy Systems (EM3)

July 17-21, 1995 5238D

## Developing Effective Energy/Environmental Programs (EM1)

September 11-15, 1995 5773D

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## HVAC Systems for Buildings

### Piping Systems for HVAC

February 20-24, 1995 5015D

This course will develop your understanding of fluid systems encountered in air conditioning of buildings, and specifically of piping systems for water, steam, and refrigerants. Emphasis will be on understanding the factors that influence pipe sizing, balancing, and pump selection to meet the air-conditioning system needs.

Fee: \$1095 Director: Harold Olsen

### Direct Digital Controls for HVAC

February 27-March 3, 1995 5023D  
in Las Vegas, Nevada

June 19-23, 1995 5028D  
in Madison, Wisconsin

This course introduces you to the design and application of direct digital controls (DDC) for commercial and industrial HVAC systems. The course begins with a thorough discussion of the capabilities of system architecture and communication concepts, programming concepts, and performance of peripherals. The course then proceeds to apply DDC to the requirements of air conditioning equipment and distribution systems from packaged rooftop single zone to built-up dual fan VAV systems. Point selection and economic analysis are key points of discussion. The different programming concepts available today (line programming, menu or block programming, and graphical programming) will be discussed and demonstrated. The course concludes with a detailed presentation on the acquisition process, including plans, specifications, and project management. Sample specs and drawings are part of the course material.

Fee: \$1145 Director: Charles Dorgan

## **Energy Management**

Professionals in the energy field can participate in the Energy Management Diploma Program, which focuses on developing management abilities and establishing a workable energy management organization. Each course provides comprehensive coverage of a specific aspect of energy management. You can attend any one course or all, in a sequence convenient to you. Qualified individuals who complete all four courses and an exam may earn an energy management diploma.

*This course exemplifies what I expect from your courses: technically proficient speakers who also provide enjoyable presentations.*

Gerald Menefee  
Director of Community Services  
City of Gladstone, Missouri

For more information or to enroll,  
please call 800-462-0876.

## **Successful Energy Project Analysis and Selection (EM2)**

March 6-10, 1995 5235D

To identify, evaluate or select effective energy conservation measures, you must understand where and how energy is used in your facility. You must analyze utility bills and rate schedules for opportunities to reduce costs. Finally, you must understand your company's investment criteria to ensure that recommended projects are funded. This course will help you develop an organized approach to energy data gathering and analysis in your facility. You will learn how to use key energy management tools—from a thorough and efficient walk-through energy audit to the latest microprocessor-based electronic data collection techniques. You will look at sources of energy use information—in-house technical personnel, consultants, and utility companies—studying the strengths and weaknesses of each and determining the best source of information for your facility. Help ensure good energy calculations and economic analyses by studying:

- what to include in effective energy audit reports
- what auditor experience is necessary
- how to use utility DSM programs
- what procedures and calculations to use
- useful instruments and measurements
- how to analyze utility rates and schedules
- how to calculate energy savings and benefits.

Fee: \$1145 Director: Keith Kempiski

## **Energy Auditing/ Analysis**

*These courses are part of a series that will help you to focus your technical experience on the skills required for auditing or analysis, rather than designing, various building and energy systems. Our auditing courses combine a mix of classroom lectures and on-site fieldwork. You gain both the theoretical background and the practical experience for understanding energy systems found in all types of buildings.*

### **HVAC Systems and Controls**

February 6-10, 1995 5234D

Improvements in HVAC systems and controls are unique because simple or complex changes often result in approximately the same level of performance improvement. Yet, investment costs and paybacks will vary substantially. This course will help you to understand your options and make the best decisions. You will analyze systems, evaluate performance and recommend improvements for comfort and energy conservation. Plan to study these topics and more:

- HVAC system characteristics
- psychrometrics and control of HVAC processes
- air distribution, comfort and indoor air quality
- successful variable air volume retrofit strategies
- temperature controls, energy management and direct digital controls.

The course will build upon material presented in our course, *Fundamentals of Energy Auditing*.

Fee: \$1095 Director: Keith Kempski

### **Fundamentals of Energy Auditing**

April 24-28, 1995 4670D

Auditing of commercial buildings demands skills different from those used with residential structures. This course teaches you a proven approach to doing energy audits. You will review basic systems—HVAC, plumbing, electrical, and building envelope—as they apply to small commercial buildings. Principal topics will include:

- building energy use fundamentals
- energy estimating methods
- HVAC and lighting system basics
- effective data collection and analysis techniques.

Fee: \$995 Director: Don Schramm

### **Commercial/Industrial Energy Analysis**

August 14-18, 1995 5239D

*Subjects were covered well. I appreciated the ample opportunity to practice hands-on the subject material.*

Jeffrey S. Nettesheim  
Utility Engineer  
Village of Germantown, Wisconsin

## Mechanical Engineering and Energy Courses

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### **Central Utility Plants**

#### **Improving Cooling Tower Operation and Cooling Water Treatment**

January 4-6, 1995 5644D

Systems engineering and water treatment considerations for modern water cooling facility operations will be the emphasis for this intensive three-day course. You will study in-depth the causes and correction of water-related cooling system problems.

Fee: \$795 Director: Jack Quigley

#### **Boiler Plant Operation and Orientation**

January 9-11, 1995 5645D

Increase your basic understanding of boiler plant operation and of boiler plant auxiliaries such as turbine systems.

Fee: \$795 Director: Jack Quigley

*Of all the seminars I've taken over the years, this was by far the best because the topic was thoroughly covered—not the usual superficial treatment.*

Richard Yancey  
Quality Assurance Consultant  
I/N TEK  
New Carlisle, Indiana 99

For more information or to enroll,  
please call 800-462-0876.

## ▽ Cogeneration Technology

March 13-17, 1995 5016D

During the last 10 years, significant improvements in cogeneration equipment and cogeneration systems have been made. Today both large and small energy users can benefit from a cogeneration system. Given the increase in electrical demand, cogeneration can produce an economic payback of six months to two years for peak shaving or supplementary power. Longer term paybacks are possible for locations that need large reliable energy sources. This course focuses on concept design and preliminary equipment selection to aid you in decision making and rough plant layout. During the group design sessions you will make individual and group judgments, calculations, and decisions for a given application. Computer software for preliminary analysis will be provided.

Fee: \$1295 Director: Harold Olsen

#### **Basic Boiler Water Treatment**

May 8-10, 1995 5646D

This course provides a basic understanding of low- to medium-pressure boilers for heating or process operations, and steam-generating systems and their components and operating problems. You'll gain a working knowledge of the methods available to protect this costly capital equipment from premature failure or damage by scaling, corrosion, and carryover.

Fee: \$795 Director: Jack Quigley

#### **Boiler Plant Optimization: Basic Concepts and Applications**

June 5-8, 1995 5778D

This practical course presents the fundamental aspects of conventional fuel combustion, with emphasis on how these influence boiler plant operations.

Fee: \$895 Director: Jack Quigley



## Applications

The Watt Stopper manufactures the most complete line of automatic lighting controls. A combination of Ultrasonic, Passive Infrared and Dual Technology sensors can be used to configure any application. For specific information on how the technologies work see "Passive Infrared Sensor Technology", "Ultrasonic Technology", and "Dual Technology" sections under 'technical data'. Some of the most common uses are described here.

### Office Buildings

The Watt Stopper occupancy sensors are the perfect product to control lighting in the office environment. With all three technologies, effective energy savings can be achieved in every space. Our recommendations are:

• OFFICES - WPIR, WJ or WS series wall switches	15-70%	Savings
• OPEN OFFICE SPACES - CI-100, CI-200, W,1000A W2000A, DT-100L	5-25%	Savings
• CONFERENCE ROOMS - W500A, W1000A, DT-100L, CI-100	20-65%	Savings
• COMPUTER ROOMS - DT-100L, WPIR, CI-100	20-65%	Savings
• RESTROOMS - Ultrasonic sensors	30-75%	Savings
• CORRIDORS - CI-100-2, W2000H	30-60%	Savings

### Colleges & Schools

The Watt Stopper occupancy sensors have been very successful in elementary, secondary, and college applications. For schools we recommend:

• LARGE CLASSROOMS - DT-100L, W2000A, CI-100, CI-200	20-75%	Savings
• SMALL CLASSROOMS - W1000A, CI-100, WPIR	0-75%	Savings
• CORRIDORS - CI-100-2, W2000H	30-60%	Savings
• RESTROOMS - Ultrasonic sensors	35-75%	Savings
• TEACHERS OFFICES - WPIR, WJ or WS series wall switches	30-50%	Savings
• GYM'S AND MULTIPURPOSE - DT-100L, CI-100	35-70%	Savings

### Retail & Hotels

The Watt Stopper occupancy sensors help you reduce energy costs while still meeting the special needs of your customers. For the most dramatic savings we recommend:

• STORAGE AREAS - DT-100L, Ultrasonic, WPIR, CI-100, CI-200	45-65%	Savings
• MEETING ROOMS - DT-100L, W500A, W1000A, CI-100, CI-200	40-65%	Savings
• WAREHOUSES - DT-100L, W2000A, CI-100, CI-200	50-75%	Savings

### HVAC, EMS, Light Level & Misc

HVAC and Energy Management Systems can be used in combination with any and all Watt Stopper products. Every sensor can be used to turn lighting on and off in addition to producing information or signals for the other systems.

- HVAC - Use the DT-100L, CI-100 or CI-200 for independent "on" and/or independent "off" for any area.
- EMS - The Watt Stopper sensors can be used to control lighting loads independently or in conjunction with EMS systems.
- Light Level - The DT-100L, CI-100 and CI-200 have a separate output to isolate a circuit for light level control.
- Cold Storage, Outdoor applications: CB-100, CB-200

The Watt Stopper®, Inc.  
2800 De La Cruz Blvd  
Santa Clara, CA 95050  
Tel: (408) 988-5331  
Fax: (408) 988-5373  
National Technical Support  
Piano, Texas: (800) 679-8585

DS 1.04

## APPLICATION – OPEN OFFICE AREA

### Ultrasonic, PIR, and Dual Technology Sensors in Open Office Area & Partitioned Offices

#### Application

1. Check square footage of area.
2. Use coverage templates.
3. Designing for smaller zones results in greater energy savings.
4. Make sure PIR sensors have clear view of the controlled area.
5. Specify time-delay to match activity level of the space.

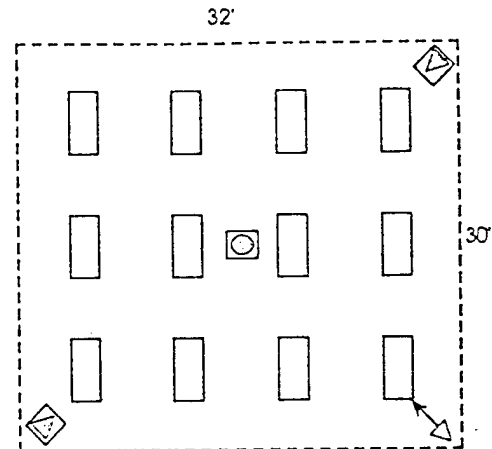
#### Savings




(See enclosed "Timer Test Study")  
 For an open office area with  
 12 - 3 lamp fixtures - 1.44 Kw  
 x \$.10 per Kwh - \$.144 cost per hour

Save 4 hours per day Mon-Fri  
 Save 6.5 hours per weekend

Total hours saved - 26.5 hours x 52 weeks  
 = 1,378 hours per year

1,378 hour x \$.144 cost per hour  
 = \$198.43 ANNUAL SAVINGS



-  Ultrasonic Sensor
-  Dual Technology Sensor
-  CI-100 Passive Infrared Sensor

#### Payback/ROI

Ultrasonic sensor & power pack - \$125.00  
 Installation - \$60.00  
 Total Cost - \$185.00  
 Payback - 11.2 Months  
 ROI - 107%

DT-100L & power pack - \$160.00  
 Installation - \$60.00  
 Total Cost - \$220.00  
 Payback - 13.3 Months  
 ROI - 90%

2 - CI-100 sensors & power pack - \$180.00  
 Installation - \$90.00  
 Total Cost - \$270.00  
 Payback - 16.3 Months  
 ROI - 74%

## APPLICATION – COMMON AREA

### Ultrasonic, PIR, and Dual Technology Sensors in Common Building Areas Larger Than 300 sq ft

#### Application

Conference rooms, computer rooms, maintenance areas, classrooms, vending areas, lunch rooms, copy rooms

1. Check square footage of area.
2. Use coverage templates.
3. Make sure PIR sensors have clear view of the controlled area.
4. Place sensor or "mask" lens so it does not "see" outside the room.
5. Specify time-delay and sensitivity to match activity level of the space.

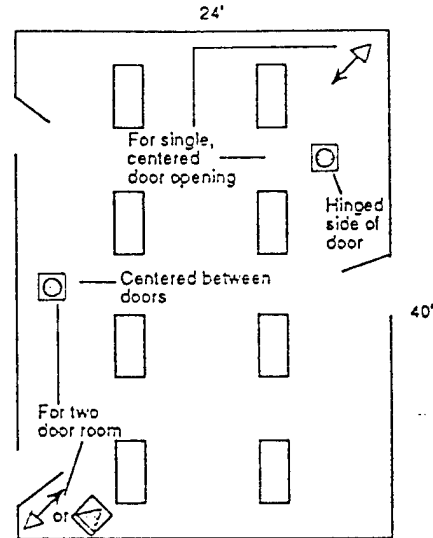
#### Savings

8 - 176 Watt 2' x 4' Troffers  
 - 1.41Kw x \$.10 per Kwh  
 - \$.141 cost per hour

Save 4 hours per day Mon-Fri  
 Save 12 hours per weekend

Total hours saved - 32 hours x 52 weeks  
 - 1,664 hours per year

1,664 hour x \$.141 cost per hour  
 - \$234.62 ANNUAL SAVINGS



- Ultrasonic Sensor
- Dual Technology Sensor
- CI-100 Passive Infrared Sensor

#### Payback/ROI

Ultrasonic sensor & power pack - \$125.00  
 Installation - \$60.00  
 Total Cost - \$185.00  
 Payback - 9.5 Months  
 ROI - 127%

DT-100L & power pack - \$160.00  
 Installation - \$60.00  
 Total Cost - \$220.00  
 Payback - 11.3 Months  
 ROI - 107%

CI-100 & power pack - \$100.00  
 Installation - \$60.00  
 Total Cost - \$160.00  
 Payback - 8.2 Months  
 ROI - 147%

## APPLICATION – AREAS UNDER 300 SQ FT

### PIR Sensors and PIR Automatic Wall Switches in Building Areas of Under 300 Square Feet

#### Application

Offices, computer rooms, maintenance areas, vending areas, copy rooms, utility rooms.

1. Check square footage of area.
2. Use coverage templates.
3. Make sure PIR sensors have clear view of the controlled area.
4. Place sensor or "mask" lens so it does not "see" outside the room.
5. Specify time-delay and sensitivity to match activity level of the space.

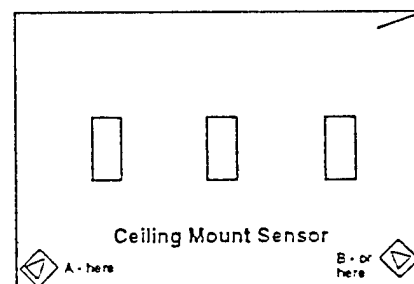
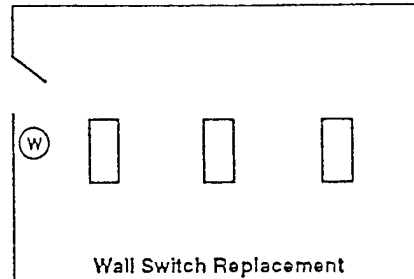
#### Savings

3 - 176 Watt 2' x 4' Troffers  
- .528Kw x \$.10 per Kwh  
- \$.053 cost per hour

Save 4 hours per day Mon-Fri  
Save 12 hours per weekend

Total hours saved - 32 hours x 52 weeks  
- 1,664 hours per year

1,664 hour x \$.053 per hour  
- \$88.19 ANNUAL SAVINGS



W WI or WS Series  
Automatic Wall Switch

▣ WPIR Sensor  
For enclosed office, use placement A or B.  
If the wall on the right does not exist, use  
placement B.

#### Payback/ROI

WI or WS Wall Switch - \$60.00  
Installation - \$20.00  
Total Cost - \$80.00  
Payback - 10.9 Months  
ROI - 110%

WPIR & power pack - \$80.00  
Installation - \$60.00  
Total Cost - \$140.00  
Payback - 19 Months  
ROI - 63%

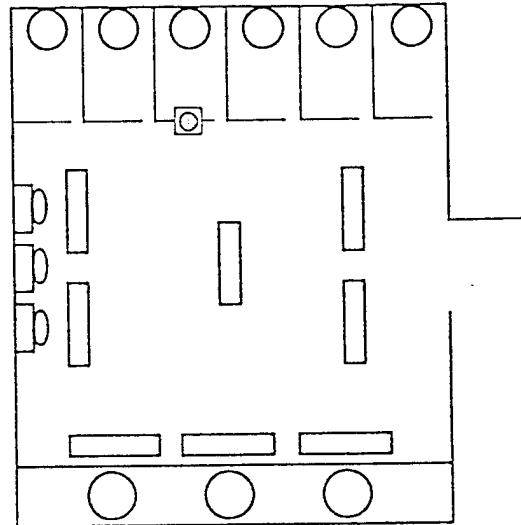
## APPLICATION - RESTROOMS

### Ultrasonic Sensors in Restrooms

#### Application

Large restrooms (with or without partitions).

1. Check square footage of area.
2. Use coverage templates.
2. Place sensor as close as possible to stalls. Ideally, over the top of stall entrance.
3. Make sure ultrasonic sensors are installed 6 to 8 feet away from air supply diffusers.
5. Specify time-delay and sensitivity to match activity level of the space.



 Ultrasonic Sensor

#### Savings

(See enclosed "Timer Test Study")

8 - 80 Watt 2' x 4' Fluorescent fixtures

- .64Kw x .10 per Kwh

- \$.064 cost per hour

(Consider exhaust fan and ballast load)

Save 8 hours per day Mon-Fri

(Typically lights in bathrooms are on 16 to 24 hours a day)

Save 27 hours per weekend

Total hours saved - 67 hours x 52 weeks

- 3,484 hours per year

3,484 hour x \$.064 per hour

- \$222.98 ANNUAL SAVINGS

#### Payback/ROI

Ultrasonic sensor & power pack - \$125.00

Installation - \$60.00

Total Cost - \$185.00

Payback - 9.9 Months

ROI - 121%

## APPLICATION - HALLWAYS

### Ultrasonic and PIR Sensors in Hallways

#### Application

Hallways, corridors, aisleways.

1. Check square footage and ceiling height of area.
2. Use coverage templates.
3. Do not use ultrasonic sensor if ceiling height exceeds 14 feet.
4. CI-100's are recommended for aisleways - do not use ultrasonics.
5. Make sure ultrasonic sensors are installed 6 to 8 feet away from air supply diffusers.
6. Point ultrasonic receiver openings down the hallway. Mount CI-100 with lens facing down the hallway.
7. Specify time-delay and sensitivity to match activity level of the space.

#### Savings

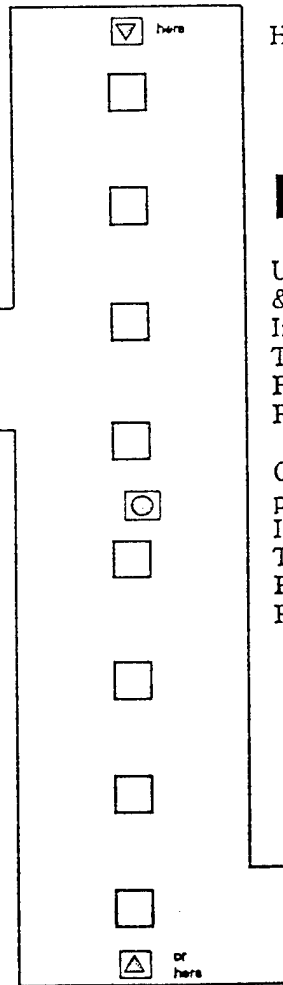
(See enclosed "Timer Test Study")

8 - 80 Watt 2' x 2' Troffers  
 - .64Kw x \$.10 per Kwh  
 - \$.064 cost per hour

Save 12 hours per day Mon-Fri  
 Save 33 hours per weekend

Total hours saved - 93 hours x 52 weeks  
 - 4836 hours per year

4,836 hour x \$.064 per hour  
 - \$309.50 ANNUAL SAVINGS



Hallway length - 80'

#### Payback/ROI

Ultrasonic sensor  
 & power pack - \$125.00  
 Installation - \$60.00  
 Total Cost - \$185.00  
 Payback - 7.2 Months  
 ROI - 166%

CI-100 &  
 power pack - \$100.00  
 Installation - \$60.00  
 Total Cost - \$160.00  
 Payback - 6.2 Months  
 ROI - 193%

- Ultrasonic Sensor
- CI-100 Passive Infrared Sensor

## 18W & 26W Fluorescent Light Fixture

# KENALL

## Herculux™ 4000

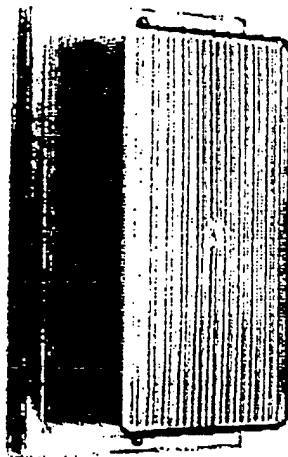
### High Abuse

18W (2x9W) TT

26W (2x13W) TT

28W Quad Tube

Fluorescent



U.L. Listed for Wall  
Damp and Wet Locations

The HERCULUX™ 4000 series is the preferred choice for cold weather, high abuse areas that demand a compact size luminaire with an energy efficient fluorescent lamp source. Typical applications include corridors, stairwells and exterior building locations for schools/universities, park and recreational facilities and commercial buildings.

#### FEATURES

The new 20°F 28W quad tube fluorescent lamp features approximate lumen output of 100W incandescent and is gasketed for outdoor lighting applications.

Low wattage fluorescent source reduces investment and can be recouped in first lamp replacement cycle.

Low profile and shatterproof design, fully gasketed, corrosion resistant to outside elements enables the fixture to be used in a multitude of applications.

#### GENERAL SPECIFICATIONS

**Refractor**—Injection molded polycarbonate lens is clear prismatic and UV stabilized. Nominal thickness .125". Wraparound design encloses and protects all metal parts from the elements.

**Finish**—All prime cold rolled steel materials are phosphato coated and electrostatically finished after all other operations with a 2.5 mil white urethane powder and baked to form a 92% reflective, smooth, glossy, non-corrosive durable coating.

- **Baseplate**—16 gauge prime cold rolled steel with white urethane finish.

- **Gasket**—Sealight design uses high quality closed cell neoprene rubber to block out moisture, dirt and insects.

- **Ballast**—Uses one or two preheat ballasts; no starter to maintain.

Model 4018: two 9WTT, 120V, NPF (25°F).  
Model 4026: two 13WTT, 120V, NPF (32°F).  
Model 4028: one 28WQT, 120V, NPF (-20°F).

- **Lamp** (not included)—Uses energy efficient twin tube or quad tube fluorescent lamps.

Model 4018: two 9W twin tubes.  
Model 4026: two 13W twin tubes.  
Model 4028: one 28W quad tube.

- **Hardware**—Two POSIGRIP tamperproof, stainless steel screws are provided to secure refractor to baseplate.

- **Socket**—Sturdy molded double pin snap-in lampholder.

#### MOUNTING

UL listed for damp and wet locations, wall installations only—lamp base up. We recommend using all four KOs provided in the baseplate for mounting with:

- Four 1/4-20 machine screws with masonry anchors to mount in brick or concrete.

- Four 1/4" lag screws or toggle bolts for mounting in frame construction.

Mounting hardware not included. Please refer to dimensional drawings on page two for exact location of mounting holes. Instruction sheet packaged with each fixture and accessory.

# 18W & 26W Fluorescent Light Fixture

2018 78101

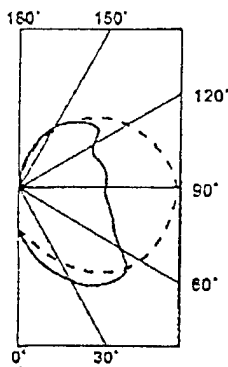
## PHOTOMETRIC DATA

MODEL 4028

One 28W QT  
Efficiency = 62.6%  
Report #ITL41245

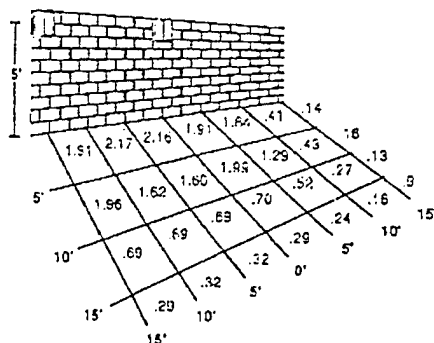
Clear Prismatic Lens  
Uplight = 45.1%

Wall Mounted  
CIE Type Direct-Indirect



Coefficients of Utilization - Zonal Cavity Method  
Effective Floor Cavity Reflectance 0.20

RC	70				90				110			
RW	70	80	90	10	70	80	90	10	70	80	90	10
0	63	63	63	63	54	54	54	46	46	46	46	34
1	54	51	48	45	43	40	38	36	34	32	30	23
2	48	43	38	34	36	32	29	30	27	25	23	17
3	43	37	32	27	31	27	23	25	22	19	17	13
4	38	32	27	22	27	22	19	22	19	16	14	10
5	34	28	23	18	23	18	16	19	16	13	11	8
6	30	25	20	16	21	17	15	17	14	11	9	7
7	27	22	17	13	19	15	13	15	12	9	8	6
8	24	20	15	12	17	13	10	14	11	8	7	5
9	21	18	13	10	15	11	9	13	9	7	6	4
10	18	15	11	8	13	10	8	12	9	6	5	4



## OPERATING SPECIFICATIONS

28WQT

LAMP: 1600 Lumens, 28 Watt, 10,000 Hour Life  
BALLAST: One Preheat, -20°F to 90°F Ambient\*

NUMBER OF LAMPS	1
LINE VOLTAGE (V)	120
MAXIMUM CURRENT (A)	.590
OPERATING CURRENT (A)	.475
INRPT POWER (W)	30
POWER FACTOR	NPF

\*The 28WQT system is specifically designed for cold environments. General use in warm ambient conditions may result in inefficient operation and therefore is not recommended.

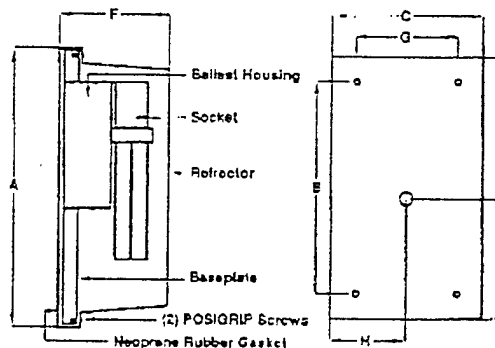
## DIMENSIONS

4000 Series

Width: 6" Depth: 4.125" Height: 10.5"

Side & Cutaway View

Baseplate Back View



Size	A	B	C	D	E	F	G	H
In.	10.5	8.5	6	5.65	4.65	4.125	4	3
cm.	26.67	21.50	15.24	14.35	12.32	10.48	10.16	7.62

## ORDERING INFORMATION

Catalog number	Lens	Wattage (lamp type)	Voltage/power factor	Starting temp (F)	Posigrp screws
4018	Prismatic	16W (2x9WTT)	120/NPF	25°	Two
4026	Prismatic	26W (2x13WTT)	120/NPF	32°	Two
4028	Prismatic	28W (F28QT)	120/NPF	-20°	Two

## ACCESSORY

4000A Seam welded stainless steel surface adaptor for wet locations

## NOTES:

All Kenall high abuse fixtures are provided with POSIGRIP screws. Be sure to order 9500 screwdrivers with all drop shipments of Kenall high abuse fixtures. Availability and specifications subject to change without notice.

Call 1-800-4-KENALL (453-6255) for standard product modification, photometric assistance or reports, product sample requests, technical clarification, product literature and the location or phone number of local sales representative.

### Peace of Mind Guarantee

Kenall high abuse luminaires are designed and built to take exceptional physical punishment. When installed according to our instructions, Kenall will repair or replace any fixture using a polycarbonate reflector, diffuser or lens/housing rendered inoperable due to physical abuse within three years of purchase. Thereafter, Kenall will replace any reflector, diffuser or lens/housing broken during the life of the fixture free, subject to a handling charge equal to 25% of the published list price.

© 1994 Kenall

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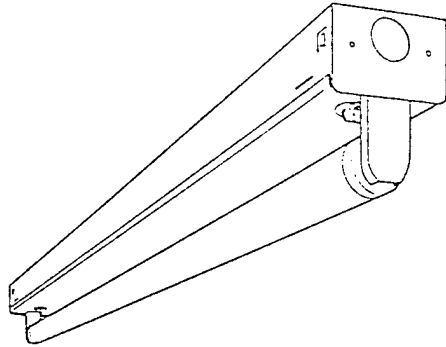
KENALL • 1020 Lakeside Drive • Gurnee, IL 60031 • 708/360-8200 • FAX 708/360-1781

## 32W Fluorescent Light Fixture (specify with T8 lamp electronic ballast)

**STRIP LIGHTS**  
1 LAMP • 1½', 2', 3' OR 4' LENGTH

S

**FEATURES**



Also available in tandem-wired (8') lengths

- Heavy-duty channel, die-formed from code-gauge steel
- Sturdy channel cover secured by captive quarter-turn latch for easy access to wire-way
- High-gloss, baked white enamel finish
- Combination end plate/channel connector furnished with each fixture
- For unit or row installations, surface or suspended mounting

**SPECIFICATIONS**

**Ballast**

Thermally protected, resetting, Class P ballast standard. Sound rating A, CBM ETL certified, UL listed.

**Wiring & Electrical**

AWM, TFN or THHN wire used throughout, rated for required temperatures. Twist-lock lampholders secured by snap-in socket tracks.

**Materials**

All metal parts die-formed from code-gauge steel.

**Finish**

Five-stage, iron phosphate pre-treatment ensures superior paint adhesion and rust resistance. All painted parts finished with polyester enamel (85% gloss, 89% reflectance). Salt spray test 500 hours. Hardness minimum 2H.

UL listed and labeled I.B.E.W.—A.F. of L.

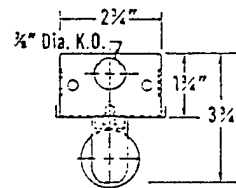
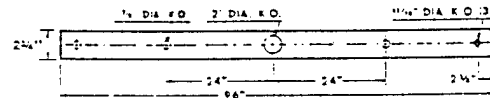
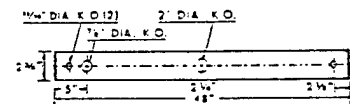
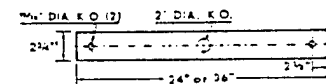
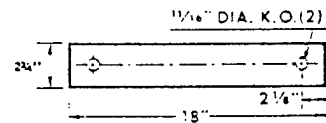
Warranty guaranteed for one year against mechanical defects in manufacture.

**MOUNTING DATA** For unit or row installation, surface or stem mounting

Unit Installation—Minimum of two hangers required

Row Installation—One hanger per channel plus one per row required.

See ACCESSORIES on reverse side for hanging devices



Dimensions and specifications subject to change without notice.

**Approval**

**Job Information**

TYPE \_\_\_\_\_  
Specify Voltage 120, 277



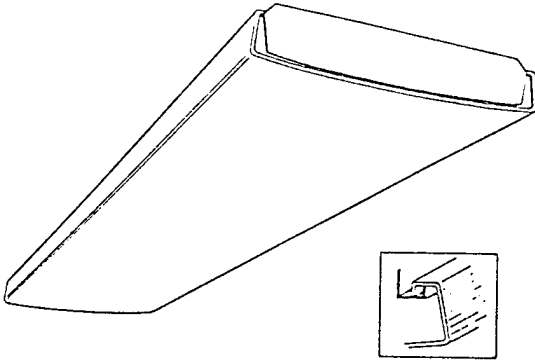
SHEET 5

**2-32W Fluorescent Light Fixture**  
(specify with T8 lamp electronic ballast)

**LOW-PROFILE WRAPAROUND**  
WIDE BODY • 2 LAMPS • 4' RAPID START

**2LB 240**

**FEATURES**



- Also available in tandem-wired (8') length
- Wide-body design (15 3/8") for reduced surface brightness, improved VCP
  - Acrylic prismatic diffuser with sonic-welded, injection-molded, luminous ends
  - Linear side prisms control brightness, pyramidal bottom prisms minimize lamp image
  - Continuous, interlocking support holds diffuser securely, simplifies maintenance
  - For surface or stem mounting, unit or row installation. Plug-in couplers permit row mounting without tools
  - White enamel end plates—woodgrain appliques optional
  - Suitable for mounting on low-density ceilings with SR option

**SPECIFICATIONS**

**Ballast**

Thermally-protected, resetting, Class P, HPF ballast standard. Sound rating A, CSM/ETL certified, UL listed. Advance, GE or Universal installed unless otherwise specified.

**Wiring & Electrical**

AWM, TFN or THHN wire used throughout, rated for required temperatures. 2" diameter K.O. for easy wiring access. Lamp holders snap into channel (individually replaceable without tools).

Input watts: standard 82, energy-saving 65.

**Materials**

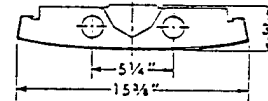
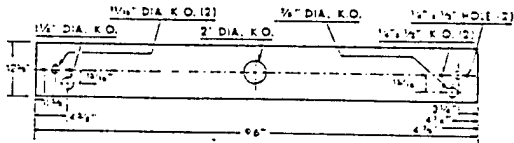
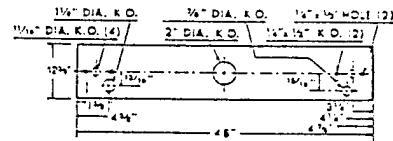
Metal parts die-formed from heavy-gauge steel. Metal gauges: channel and end plates 20-gauge; channel cover 24-gauge. Diffuser is 100% virgin acrylic, .105" thick.

**Finish**

Five-stage, iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Channel finished with high-gloss, baked white enamel (85% gloss, 89% reflectance). Salt spray test 500 hours. Hardness minimum 2H.

UL listed and labeled I.B.E.W.—A.F. of L.

Fixture guaranteed for one year against mechanical defects in manufacture.

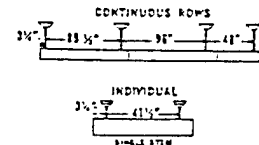
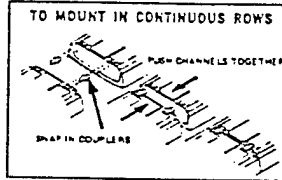


Dimensions and specifications subject to change without notice.

**MOUNTING DATA** For unit or row installation, surface or stem mounting

Unit Installation—One double-stem (4' only) or two single-stem hangers required

Row Installation—One hanger per fixture plus one per row required



See ACCESSORIES on reverse for hanging devices

Approval

Job Information



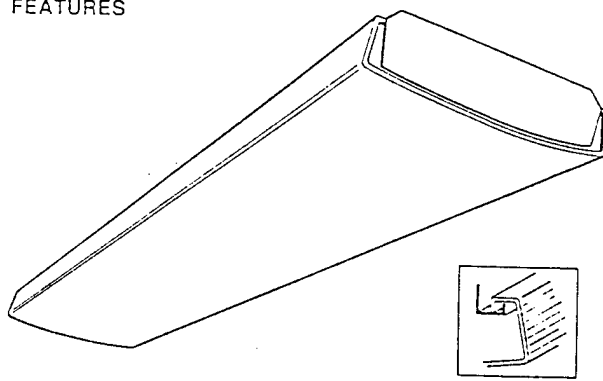
SHEET 2LB 240

**3-32W Fluorescent Light Fixture**  
(specify with T8 lamp electronic ballast)

**LOW-PROFILE WRAPAROUND**  
WIDE BODY • 3 LAMPS • 4' RAPID START

**LB 340**

**FEATURES**



Also available in tandem-wired (8') lengths with (2) 4' lenses

- Acrylic prismatic diffuser with sonic-welded, injection-molded, luminous ends.
- Linear side prisms control brightness, pyramidal bottom prisms minimize lamp image.
- Continuous, interlocking support holds diffuser securely, simplifies maintenance.
- For surface or stem mounting, unit or row installation. Snap-in couplers permit row mounting without tools.
- White enamel end plates — woodgrain appliques available.

**SPECIFICATIONS**

**Ballast Data**

Thermally-protected, resetting, Class P HPF non-PCB, UL listed, CSA certified ballast is standard. Sound rating A. Standard combinations are CBM approved.

**Wiring & Electrical**

Fixture bears UL label and is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures. In and out wiring and circuit identification are standard.

**Materials**

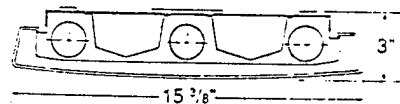
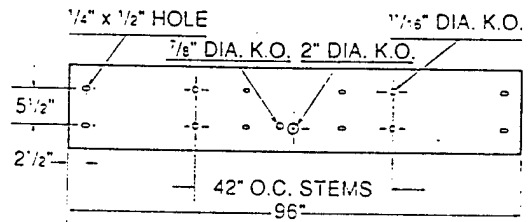
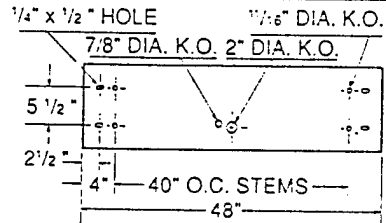
Metal parts die-formed from code-gauge steel. Diffuser is acrylic. No asbestos is used in this product.

**Finish**

Five-stage iron-phosphate, pre-treatment ensures superior paint adhesion with rust resistance. Painted parts finished with high-gloss, baked white enamel.

**Input Wattage**

LB 340 with ES ballasts, std. lamps - 126W  
LB 340 with ES ballasts, ES lamps - 110W



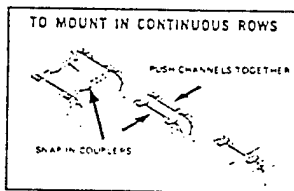
UL listed, CSA certified. Labeled I.E.E.W. - A.F. of L. Guaranteed for 1 year against mechanical defects in manufacture. Dimensions & specifications subject to change without notice.

**MOUNTING DATA** For unit or row installation, surface or stem mounting

**Unit Installation** - Four single-stem hangers required.

**Row Installation** - Four single-stem hangers per fixture required.

**TO MOUNT IN CONTINUOUS ROWS**



See ACCESSORIES on reverse for hanging devices

Approval \_\_\_\_\_

Job Information

Type \_\_\_\_\_  
(Specify 120V, 277V or 347V)



Sheet LB 340

# 100W & 150W High Pressure Sodium Light Fixture

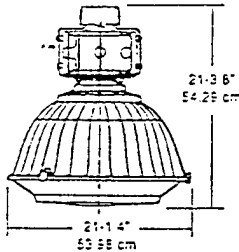
## Low-Bay Industrial Lighting

### ORDERING SEQUENCE

CATALOG NUMBER	VOLTAGE	OPTIONS (Factory Installed)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- |   |   |  |
|---|---|--|
| <input checked="" type="checkbox"/> TXL 50S A20*  | <input type="checkbox"/> 120 <sup>1</sup> | <input checked="" type="checkbox"/> Shipped installed in Fixture                     |
| <input checked="" type="checkbox"/> TXL 70S A20*  | <input type="checkbox"/> 208              | <input type="checkbox"/> SF Single Fuse (120,277V) n/a TB                            |
| <input checked="" type="checkbox"/> TXL 100S A20* | <input type="checkbox"/> 240              | <input type="checkbox"/> DF Double Fuse (208,240,480V) n/a TB                        |
| <input checked="" type="checkbox"/> TXL 150S A20* | <input type="checkbox"/> 277 <sup>2</sup> | <input type="checkbox"/> EC Emergency Circuit (lamp not included)                    |
|   | <input type="checkbox"/> 480              | <input type="checkbox"/> QRS <sup>3</sup> Quartz Restrike System (lamp not included) |
|   | <input type="checkbox"/> TB <sup>4</sup>  | <input type="checkbox"/> QRSTD <sup>3</sup> QRS Time Delay (lamp not included)       |

\*Optional polycarbonate refractor available. Substitute P20 for A20.



WATTS	S/MH	WEIGHT	
		lbs.	kg.
50	1.9	11	5
70	1.8	12	5
100	1.9	14	5
150	1.9	15	7

#### NOTES:

- May also be ordered with 5', 10', 15' cord lengths.
- Multi-Tap Ballast (120,208,240,277V).
- Quartz lamp wattage not to exceed ballast wattage rating. For 50, 70W, use 100W quartz lamp.
- May be ordered as accessory. MUST see Industrial Accessories Sheet for ordering information.
- 36' cable to connect optical to remote ballast.
- Not available with WL option.
- 20 amps standard 480V.
- Provided with dual tap (120/277V) ballast when ordered as 120V or 277V, except w/MRB option.

For Complete Description & Application Information, See Options & Accessories Sheet I-D/A.

#### Shipped Separately <sup>4</sup>

- HKM<sup>4</sup> Fixture Hook - Male
- HKMG<sup>4</sup> Grommetted Fixture Hook - Male
- LPM<sup>4</sup> Fixture Loop - Male
- LPMG<sup>4</sup> Grommetted Fixture Loop - Male
- TPH<sup>4</sup> Thru-Wire Power Hook
- PPH<sup>4</sup> Pendant Power Hook
- UPM<sup>4</sup> Universal Power Module
- UPM1<sup>4</sup> UPM w/Hook Adapter Plate
- UPM2<sup>4</sup> UPM w/Wiring Block
- UPM3<sup>4</sup> UPM w/Hook Adapter Plate & Wiring Block

#### ACCESSORIES (Field Installed)

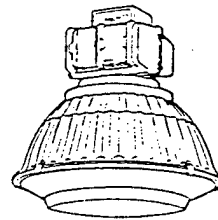
(order as separate line item)

Cat. No.	Description
HKF <sup>4</sup>	Fixture Hook - Female
LPF <sup>4</sup>	Fixture Loop - Female
SCK	Safety Chain Kit
TMB <sup>4</sup>	Twin Mounting Bar (consult factory)

Fixture Type: \_\_\_\_\_

# TXL

HIGH PRESSURE SODIUM  
50/70/100/150W  
10' to 18' Mounting



#### SPECIFICATIONS

**HOUSING** - Rugged, lightweight, die-cast aluminum with dark bronze polyester powder finish. Electrical components are opposed horizontally and heat-sunked to ballast housing for cooler operation.

**BALLAST** - High reactance high power factor, 180°C class H insulation system.

**OPTICS** - Injection molded virgin acrylic lens, fully-fluted anodized aluminum reflector. Positive latch refractor clips facilitate removal for maintenance and cleaning, gasketed refractor and reflector inhibits the entrance of ambient contaminants. All distribution patterns are widespread.

**INSTALLATION** - Pendant splice box threaded for 3/4" conduit (standard). Complete line of mounting options and accessories available.

**LISTING** - UL 1572 listed for -30°C to 40°C ambient operation, & damp locations. 55°C operation available.

**SOCKET** - Porcelain, vertically oriented mogul base socket with copper alloy nickel plated screw shell and center contact. UL listed 1500W - 600V, 4KV pulse rated.

**LITHONIA HI-TEK**  
INDUSTRIAL/OUTDOOR LIGHTING  
A DIVISION OF LITHONIA LIGHTING

2/89  
TXL S1

## 200W & 400W High Pressure Sodium Light Fixture

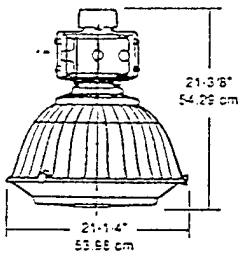
### Low-Bay Industrial Lighting

#### ORDERING SEQUENCE

CATALOG NUMBER	VOLTAGE	OPTIONS (Factory Installed)

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> TXL 200S A20*<br><input type="checkbox"/> TXL 250S A20*<br><input type="checkbox"/> TXL 400S A20* | <input type="checkbox"/> 120<br><input type="checkbox"/> 208<br><input type="checkbox"/> 240<br><input type="checkbox"/> 277<br><input type="checkbox"/> 480<br><input type="checkbox"/> TB <sup>1</sup> | Shipped Installed in Fixture<br><input type="checkbox"/> SF Single Fuse (120,277V) n/a TB<br><input type="checkbox"/> DF Double Fuse (208,240,480V) n/a TB<br><input type="checkbox"/> EC Emergency Circuit (lamp not included)<br><input type="checkbox"/> QRS <sup>2</sup> Quartz Restrike System (lamp not included)<br><input type="checkbox"/> QRSTD <sup>3</sup> QRS Time Delay (lamp not included)<br><input type="checkbox"/> HA 55°C Ambient Operation<br><input type="checkbox"/> CR Corrosion Resistant Finish (polyester)<br><input type="checkbox"/> CRT Corrosion Resistant Finish (teflon)<br><input type="checkbox"/> TEF Teflon Finished Reflector<br><input type="checkbox"/> TOB <sup>4</sup> Thru-Wire Outlet Box<br><input type="checkbox"/> TOBPM <sup>4</sup> Thru-Wire Outlet Box Plug-in<br><input type="checkbox"/> PBP <sup>4</sup> Pendant Box Plug-In<br><input type="checkbox"/> LCPM <sup>4</sup> Loop, Cord & Plug for TPH & PPH<br><input type="checkbox"/> LCSP <sup>1,4,7</sup> Loop, 3' Cord & 15A NEMA Twist Lock Plug<br><input type="checkbox"/> HCSP <sup>1,4,7</sup> Hook, 3' Cord & 15A NEMA Twist Lock Plug<br><input type="checkbox"/> LRCA <sup>1,4</sup> Loop, 3' Cord & Reloc RCA Connector<br><input type="checkbox"/> HRCA <sup>1,4</sup> Hook, 3' Cord & Reloc RCA Connector<br><input type="checkbox"/> LUCP <sup>4</sup> Loop Cord and Plug For UPM1<br><input type="checkbox"/> LUCPSF <sup>4</sup> LUCP w/Single Fuse (dead front) n/a TB<br><input type="checkbox"/> LUCPDF <sup>4</sup> LUCP w/Double Fuse (dead front) n/a TB<br><input type="checkbox"/> UCP <sup>4</sup> Universal Cable & Plug<br><input type="checkbox"/> UCPSF <sup>4</sup> UCP w/Single Fuse (dead front) n/a TB<br><input type="checkbox"/> UCPDF <sup>4</sup> UCP w/Double Fuse (dead front) n/a TB<br><input type="checkbox"/> TR Remote Ballast<br><input type="checkbox"/> TRCP <sup>1,4,7</sup> TR w/Pre-Wired Cable<br><input type="checkbox"/> MRB Magnetic Regulator Ballast (250,400W only)<br><input type="checkbox"/> WL Wet Location UL Label<br><input type="checkbox"/> SSS Stainless Steel Screws<br><input type="checkbox"/> SLR Stainless Steel Lens Rings<br><input type="checkbox"/> CF Charcoal Filter |
|--|--|--|

\* Optional polycarbonate refractor available. Substitute P20 for A20.



WATTS	SMH	WEIGHT	
		lbs.	kg.
200	1.9	17	8
250	1.8	21	9
400	1.6	27	13

**NOTES:**

- <sup>1</sup> May also be ordered with 5', 10', 15' cord lengths.
- <sup>2</sup> Multi-Tap Ballast (120,208,240,277V).
- <sup>3</sup> Quartz lamp wattage not to exceed ballast wattage rating.
- <sup>4</sup> May be ordered as accessory. MUST see Industrial Accessories Sheet for ordering information.
- <sup>5</sup> 35' cable to connect optical to remote ballast.
- <sup>6</sup> Not available with WL option.
- <sup>7</sup> 20 amps standard 480V.

For Complete Description & Application Information, See Options & Accessories Sheet I-O/A.

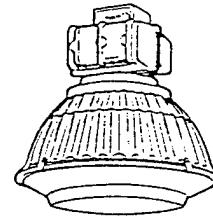
**ACCESSORIES (Field Installed)**  
(order as separate line item)

Cat. No.	Description
HKF <sup>6</sup>	Fixture Hook - Female
LPF <sup>6</sup>	Fixture Loop - Female
SCK	Safety Chain Kit
TMB <sup>6</sup>	Twin Mounting Bar (consult factory)

Fixture Type: \_\_\_\_\_

# TXL

**HIGH PRESSURE SODIUM**  
200/250/400W  
14' to 20' Mounting



**SPECIFICATIONS**

**HOUSING** - Rugged, lightweight, die-cast aluminum with dark bronze polyester powder finish. Electrical components are opposed horizontally and heat-sunk to ballast housing for cooler operation.

**BALLAST** - High power factor. Constant wattage autotransformer, 180° class H insulation system.

**OPTICS** - Injection molded virgin acrylic lens, fully-fluted anodized aluminum reflector. Positive latch refractor clips facilitate removal for maintenance and cleaning, gasketed refractor and reflector inhibits the entrance of ambient contaminants. All distribution patterns are widespread.

**INSTALLATION** - Pendant splice box threaded for 3/4" conduit (standard). Complete line of mounting options and accessories available.

**LISTING** - UL 1572 listed for -30°C to 40°C ambient operation & damp locations. 55°C operation available.

**SOCKET** - Porcelain, vertically oriented mogul base socket with copper alloy nickel plated screw shell and center contact. UL listed 1500W - 600V, 4KV pulse rated.



2/89  
TXL S2