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Comprehensive Energy Audit
of
Barrow Heavy Equipment Shop
3427 C Street
Project # ASRC-BRW-RSA-03B

Prepared for:
The North Slope Borough
Department of Public Works
September 9, 2011

Prepared by:
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Submitted by:

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Date: 9-4-2011

REPORT DISCLAIMERS

The information contained in this report, including any attachments, is intended solely for use by the building owner and the AHFC. No others are authorized to disclose, copy, distribute or retain this report, in whole or part, without written authorization from Richard S. Armstrong, PE, LLC, 2321 Merrill Field Drive, C-6, Anchorage, Ak 99501. Additionally, this report contains recommendations that, in the opinion of the auditor, will cause the owner to realize energy savings over time. All recommendations must be designed by a registered engineer, licensed in the State of Alaska, in the appropriate discipline. Lighting recommendations should all be first reviewed by running a lighting analysis to assure that the recommended lighting upgrades will comply with State of Alaska Statue as well as IES recommendations.

Payback periods may well vary from those forecast due to the uncertainty of the final installed design, configuration, equipment selected, and installation costs of recommended Energy Efficiency Measures (EEMs), or the operating schedules and maintenance provided by the owner. Furthermore, EEMs are typically interactive, so implementation of one EEM may impact the cost savings from another EEM. Neither the auditor, Richard S. Armstrong, PE, LLC, AHFC, or others involved in preparation of this report will accept liability for financial loss due to EEMs that fail to meet the forecasted payback periods.

This audit meets the criteria of an Investment Grade Audit (IGA) per the Association of Energy Engineers definition, and is valid for one year. The life of the IGA may be extended on a case-by-case basis, at the discretion of the AHFC.

IGSs are the property of the State, and may be incorporated into AkWarm-C, the Alaska Energy Data Inventory (ARIS), or other state and/or public information system

Investment Grade Energy Audit
Barrow Heavy Equipment Maintenance Shop

1. **Executive Summary:** The Barrow Heavy Equipment Maintenance Shop is estimated to have been originally constructed in 1983, but it underwent a ventilation and heating upgrade in 1994 based on plans for the remodel/addition project. The facility contains six heavy equipment repair bays, 5 offices, a break room, as well as mezzanine storage. The two end bays have a 26' height and a door on each end of each bay, as compared to the other 4 bays that have an 18' height and only one door per bay. See plans attached. The building is in generally good condition. The 2009 and 2010 annual utility energy consumption reported by BUECI for this building is displayed in Table 1 below. This data is different from the data presented by Nortech because they combined all four shop buildings, whereas this data represents the actual gas consumption for the Heavy Equipment Shop on 3427 C Street with the Warehouse on 3425 C Street since both are on the same gas meter. There are separate electric meters, so the electric data is for this building only.

Table 1

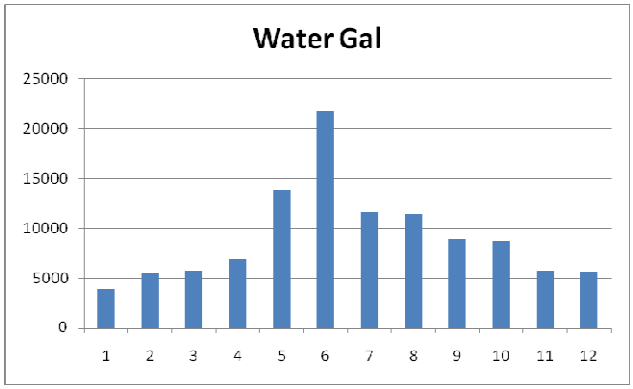
	2009	2009	2010	2010
Utility	Consumption	Cost/Year	Consumption	Cost/Year
Electricity-kWh	210,960	$21,957	188,640	$20,163
Natural Gas-CCF Combined Heavy Shop and Warehouse	46,761	$14,701	43,268	$13,293
Ttl Energy Costs		$36,658		$33,456

A benchmark measure of energy use relative to other similar function buildings in the area is the Energy Use Index (EUI), which takes the total annual energy used by the facility divided by the square footage area of the building, for a value expressed in terms of kBTU/SF. This number can then be compared to other buildings to see if it is about average, higher or lower than similar buildings in the area. Likewise, the Energy Cost Index (ECI) is the cost of all energy used

by the building expressed in $/SF of building area. The comparative values for the subject building are listed in Table 2 below:

Table 2

	Heavy Equipment Maintenance Shop & whse	Barrow Avg	Fire Station #1
Energy Use Index (EUI) kBTU/SF Avg 2009, 2010	379	211	207
Energy Cost Index (ECI) Average 2009, 2010	$3.15	$1.68	$1.92



The natural gas consumption is very high, but it is believed that the use of a gas fired "Hotsy" is the reason for the high consumption. This supposition is confirmed by the very high water consumption during summer months when equipment washing would occur using hot water generated by the "Hotsy".

Various Energy Efficiency Measures (EEMs) have been analyzed for this building to determine if they would be applicable for energy savings with reasonably good payback periods. Those EEMs that have a payback period of less than 8 years, or those that are recommended for code compliance, life cycle replacement, or other reasons are also included. Also, where a lighting upgrade is recommended from T-12 lamps with magnetic ballasts to T-8 lamps with electronic ballasts, then the entire facility should be re-lamped and re-ballasted to maintain a standard lighting parts inventory, regardless of the payback. For example, a storage room that is infrequently used may not show a very good payback for a lighting upgrade, but consistency dictates a total upgrade.

Specific EEMs recommended for this facility are detailed in the attached AkWarm Energy Audit Report along with specific payback

times, as well as estimated installation costs and estimated energy savings. The higher priority items are summarized below:

a. Flourescent Lighting Upgrades: In general, all of the T-12 flourescent lamps, and all of the magnetic ballasts throughout the building should be replaced with new T-8 lamps with electronic ballasts. Typical savings in power consumption varies 10-30% with this upgrade.
b. Lighting Control Upgrades: Many lights were found to be left on with nobody in the space. Occupant controls can sense the presence of workers, and turn the lights on. The controller can then turn the lights off after a programmed time period of no occupancy. These controls can reduce total kWh consumption for the lighting in the order of 30-90%, depending on the amount of time the lights are manually left on.
c. Shop Lighting Upgrades: The shops are lit with high intensity discharge 400 watt HPS lights, 20 fixtures. It is recommended that all fixtures be replaced with new 6-lamp high output fluorescent fixtures that can be switched with occupancy sensors. While the power consumption may rise slightly, the on time will be reduced, which would result in an overall shop lighting energy reduction of about 23%.
d. Exterior Lighting Upgrades: The exterior high pressure sodium lights operate during periods of darkness, which is about half of a year. It is estimated that the use of LED exterior lights can reduce the power consumption by 60%.
e. Setback Thermostats in all spaces: The thermostats were found to be set to 72 degrees F, 24/7. It is recommended that lockable setback thermostats be installed and programmed for occupied temperatures of 72 deg F, and unoccupied temperatures of 60 deg F. This has an estimated payback of 0.4 years for the building,
f. Ventilation: It is recommended that six destratification fans be installed in the shop to put the heat down on the floor level and reduce heating stratification near the ceiling. The estimated payback for theis is 7.6 years.
g. Refrigerator: Newer Energy Star refrigerators use about 411 watts, compared to 1990 versions that used 1,044

watts. While this would have a 7.4 year payback, it is still recommended due to the relatively low cost and quick payback.

In addition to EEMs, various Energy Conservation Measures (ECMs) are recommended since they are policies or procedures that are followed by management and employees that require no capital outlay. Examples of recommended ECMs for this facility include:

- Turn off lights when leaving a room that is not controlled by an occupancy sensor that automatically turns off lights.
- Turn off computers, monitors, printers, faxes, coffee makers, etc when leaving the office for the day.
- Keep overhead doors closed except when they are required to be open for movement of vehicles.

The 11 priority recommendations in the detailed report estimate to save $8,082/year, with an installed cost of $71,980, for a 8.9 year payback. This does not include design or CA services, but overall it does indicate a cost effective energy savings program.

2. Audit and Analysis Background:

a. Program Description: This audit included services to identify, develop, and evaluate energy efficiency measures at the subject building. The scope of this project included evaluating the building shell, lighting, other electrical systems, and heating, ventilating, and air conditioning (HVAC) equipment. Measures were selected such that an overall simple payback period of 8 years or less could be achieved.

b. Audit Description and Methodology: Preliminary audit information was gathered in preparation for the site survey, including benchmark utility consumption data, floor and lighting plans, and equipment schedules where available. A site visit is then performed to inventory and evaluate the actual building condition, including:

i. Building envelope (roof, windows, etc)

ii. Heating, ventilating, and air conditioning

iii. Lighting systems and controls
iv. Building specific equipment
v. Plumbing systems

c. **Method of Analysis:** The information gathered prior to the site visit and at the site visit is entered into AkWarm-C, an energy modeling developed for Alaska Housing Finance Corporation (AHFC) specifically to identify forecasted energy consumption which can be compared to actual energy consumption. AkWarm-C also has some pre-programmed EEM retrofit options that can be analyzed with energy savings forecasted based on occupancy schedules, utility rates, building construction type, building function, existing conditions, and climatic data that is already uploaded to the program based on the zip code of the building. When new equipment is proposed, energy consumption is calculated based on manufacturer's cataloged information.

Cost savings are calculated based on the historical energy costs for the building. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change, but design and construction management costs are excluded. Costs are derived from Means Cost Data, industry publications, experience of the auditor, local contractors and equipment suppliers. Haakensen Electric was consulted for some of the lighting retrofit costs. Maintenance savings are calculated were applicable and are added to the energy savings for each EEM.

The cost and savings are applied and a simple payback and simple return on investment (ROI) is calculated. The simple payback is based on the number of years that it takes for the savings to pay back the net installation cost (Net Installation divided by Net Savings.)

A simple life-time calculation is shown for each EEM. The life-time for each EEM is estimated based on the typical life of the equipment being replaced or altered. The energy savings is extrapolated throughout the life-time of the EEM. The total

energy savings is calculated as the total life-time multiplied by the yearly savings.

d. **Limitations of the Study:** All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. A design professional, licensed to practice in Alaska and in the appropriate discipline, who is following the recommendations, shall accept full responsibility and liability for the results. Budgetary estimates for engineering and design of these projects in not included in the cost estimate for each measure, but these costs generally run around 15% of the cost of the work.

3. **Acknowledgements:** We wish to acknowledge the help of numerous individuals who have contributed information that was used to prepare this report, including:

   a. **Alaska Housing Finance Corporation (Grantor):** AHFC provided the grant funds, contracting agreements, guidelines, and technical direction for providing the audits. AHFC reviewed and approved the final short list of buildings to be audited based on the recommendation of the Technical Service Provider (TSP).

   b. **North Slope Borough (Owner):** The NSB provided building sizing information, two years energy billing data, building schedules and functions, as well as building age.

   c. **Nortech Engineering (Benchmark TSP):** Nortech Engineering compiled the data received from the NSB and entered that data into the statewide building database, called the Alaska Retrofit Information System (ARIS).

   d. **Richard S. Armstrong, PE, LLC (Audit TSP):** This is the TSP who was awarded the projects in the Arctic Slope Regional Corporation, Bering Straits area, and the Nana area. The firm gathered all relevant benchmark information provided

to them by Nortech, cataloged which buildings would have the greatest potential payback, and prioritized buildings to be audited based on numerous factors, including the Energy Use Index (EUI), the Energy Cost Index (ECI), the age of the building, the size of the building, the location of the building, the function of the building, and the availability of plans for the building. They also trained their selected sub-contracted auditors, assigned auditors to the selected buildings, and performed quality control reviews of the resulting audits. They prepared a listing of potential EEMs that each auditor must consider, as well as the potential EEMs that the individual auditor may notice in the course of his audit. Richard S. Armstrong, PE, LLC also performed some of the audits to assure current knowledge of existing conditions.

e. **Energy Audits of Alaska:** This firm has been selected to provide audits under this contract in addition to RSA Engineering. The firm has two mechanical engineers, certified as energy auditors or professional engineers.

4. **Building Description and Function:** The subject building is called the Barrow Heavy Equipment Maintenance Shop. It was originally constructed in 1983, and had a remodel constructed in 1994. The building has one story, with a mezzanine on one side and at the rear.

   a. **Heating System:** The building heating system consists of two Weil McLain 1,674 MBH cast iron gas fired boilers. The boilers provide heat to six vertical unit heaters, baseboard in the offices, and air handlers.

   b. **Ventilation System:** There are large exhaust fans, air handlers, and gas make up air heaters in the building to provide ventilation. A specialty carbon monoxide fan provides exhaust for products of combustion when vehicles are operated for tune-up.

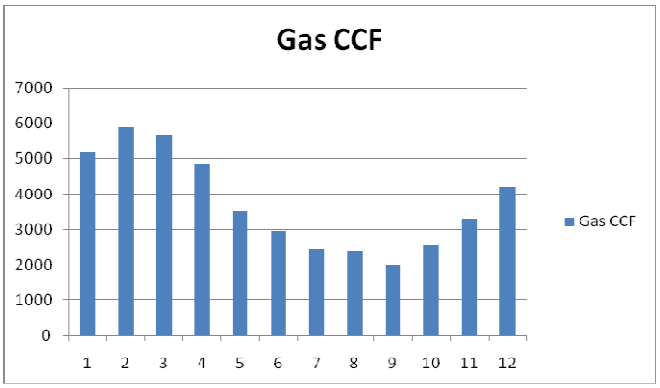
   c. **Plumbing System:** Toilets with lavs are provided for the workers.

d. **Domestic Hot:** How water is generated using a 40 gallon electric hot water heater.

e. **Lighting:** Typical lighting throughout the building is comprised of T-12 fluorescent fixtures, using magnetic ballasts. Exterior lighting utilizes 250 watt high pressure sodium (HPS) wall packs, in addition to existing lighting on the older section.

5. **Historic Energy Consumption:** Energy consumption is modeled within the AkWarm-C program. The program only analyzes 12 months of data, so where 24 months of data are available, the data is averaged and input to AkWarm-C to provide more accuracy. The energy consumption data is presented and graphed in the attached AkWarm-C program results.

Energy consumption was analyzed using two factors: the Energy Cost Index (ECI) and the Energy Use Index (ECU). The energy cost index takes the average cost of gas and electrical energy over the surveyed period of time (typically 2 years) and averages the cost, divided by the square footage of the building. *The ECI for this building is $ 1.92, and the average ECI for all buildings in Barrow that were surveyed is $ 1.68/SF. Fire Station #2, a newer facility in adjacent Browerville has an ECI of $1.51.*



The energy use index (ECU) is the total average electrical and heating energy consumption per year expressed in thousands of BTUs/SF. *The average EUI for all buildings in Barrow that were surveyed is 211 kbtu/sf, and the EUI all four of the C Street Shops is 162 kbtu/sf, compared to 175 for Fire Station #2.*

6. **Energy Efficiency Measures considered or recommended:** The building was examined for application of a multitude of potential EEMs that are discussed below. Those EEMs that appear to have

an application for the subject building are further analyzed for estimated payback periods, either within the AkWarm-C program or separately within this report. The accuracy of the cost estimates and paybacks varies significantly due to a multitude of conditions, but is estimated to be approximately +/- 25%. Assumptions made regarding energy costs and the life of the EEM, noting that post-construction measurement and verification are based on energy savings, not energy cost savings.

Many of the selected EEMs are analyzed within the AkWarm-C program using the schedules and estimated costs input into the model.

7. **Interactive Effects of Projects:** The AkWarm-C program calculates savings assuming that all recommended EEM are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected, in some cases positively, and in others, negatively. For example, if the fan motors are not replaced with premium efficiency motors, then the savings for the project to install variable speed drives (VFDs) on the fans will be increased.

   In general, all projects were evaluated sequentially so that energy savings associated with one EEM would not be attributed to another EEM as well. For example, the night setback EEM was analyzed using the fan and heating load profile that will be achieved after installation of the VFD project is completed. By modeling the recommended projects sequentially, the analysis accounts for interactive effects between the EEMs and does not “double count” savings.

   Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these contribute to the overall cooling demands of the building; therefore lighting efficiency improvements will reduce cooling requirements on air conditioned buildings. Conversely, lighting efficiency improvements are anticipated to increase heating requirements slightly. Heating penalties are included in the lighting project analysis that is performed by AkWarm-C.

8. **Loan Program:** The Alaska Housing Finance Corporation (AHFC) Alaska Energy Efficiency Revolving Loan Fund (AEERLF) is a State of Alaska program enacted by the Alaska Sustainable Energy Act (senate Bill 220, A.S. 18.56.855, "Energy Efficiency Revolving Loan Fund). The AEERLF will provide loans for energy efficiency retrofits to public facilities via the Retrofit Energy Assessment for Loan System (REAL). As defined in 15 AAC 155.605, the program may finance energy efficiency improvements to buildings owned by:

    a. Regional educational attendance areas;
    b. Municipal governments, including political subdivisions of municipal governments;
    c. The University of Alaska;
    d. Political subdivisions of the State of Alaska, or
    e. The State of Alaska

    Native corporations, tribal entities, and subsidiaries of the federal government are ***not*** eligible for loans under this program.

Attachments:

- **Photos**
- **AkWarm-C Report**
- **Equipment Schedule**
- **Building Plan**

ENERGY AUDIT REPORT – PROJECT SUMMARY – Created 9/4/2011 9:13 AM

General Project Information

PROJECT INFORMATION	AUDITOR INFORMATION
Building: Heavy Equipment Shop Building	**Auditor Company:** Richard S. Armstrong, PE, LLC
Address: 3427 C Street	**Auditor Name:** Richard S. Armstrong
City: Barrow	**Auditor Address:** 2321 Merrill Field Drive C-6 Anchorage, Ak 99501
Client Name: Tom Hatcher	
Client Address: 3427 C Street Barrow, Ak 99723	**Auditor Phone:** (907) 229-0331
	Auditor FAX: (907) 276-1751
Client Phone: (907) 852-2611	**Auditor Comment:**
Client FAX:	

Design Data

Building Area: 10,680 square feet	**Design Heating Load:** Design Loss at Space: 945,954 Btu/hour with Distribution Losses: 945,954 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 1,442,003 Btu/hour Note: Additional Capacity should be added for DHW load, if served.
Typical Occupancy: 15 people	**Design Indoor Temperature:** 72 deg F (building average)
Actual City: Barrow	**Design Outdoor Temperature:** -41 deg F
Weather/Fuel City: Barrow	**Heating Degree Days:** 20,370 deg F-days

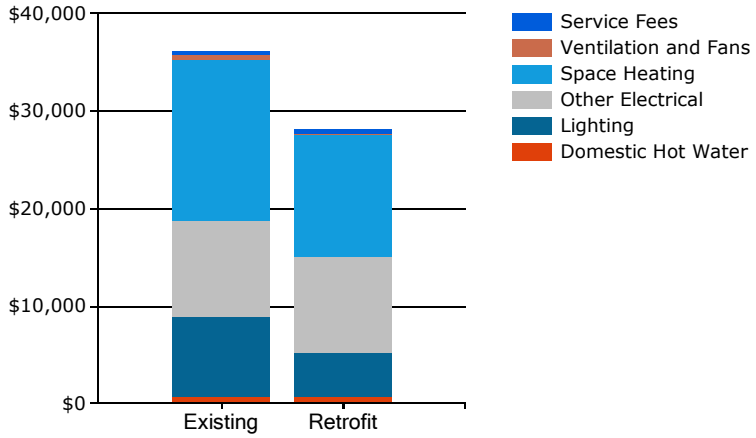
Utility Information

Electric Utility: Barrow Utilities - elec - Commercial - Sm	**Natural Gas Provider:** Barrow Utilities & Electric-gas - Commercial - Sm
Average Annual Cost/kWh: $0.106/kWh	**Average Annual Cost/ccf:** $0.306/ccf

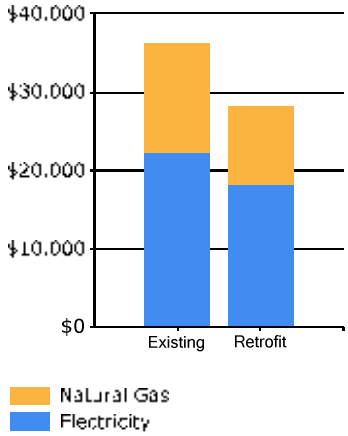
Annual Energy Cost Estimate

Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Service Fees	Total Cost
Existing Building	$16,506	$0	$603	$8,242	$9,968	$0	$0	$494	$409	**$36,223**
With Proposed Retrofits	$12,594	$0	$617	$4,589	$9,784	$0	$0	$148	$409	**$28,141**
SAVINGS	$3,911	$0	-$14	$3,654	$185	$0	$0	$346	$0	**$8,082**

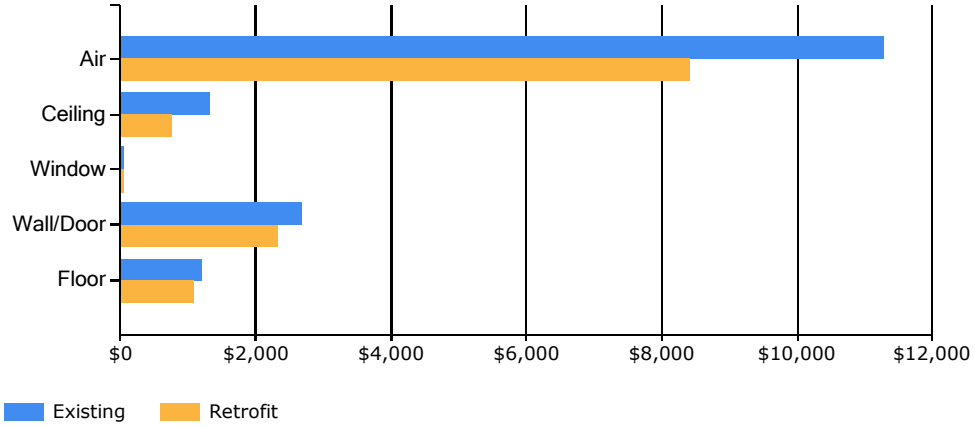
Annual Energy Costs by End Use



Annual Energy Costs by Fuel



Annual Space Heating Cost by Component



PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES

Rank	Feature	Recommendation	Annual Energy Savings	Installed Cost	SIR	Payback (Years)
1	Setback Thermostat: Heavy Equipment Shop	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Heavy Equipment Shop space.	$2,329	$1,000	29.61	0.4
2	Lighting: Breezeway connector lights	Replace with 3 FLUOR CFL, A Lamp 15W	$19	$10	11.88	0.5
3	Lighting: Exterior Lights	Replace with 9 LED 150W Module StdElectronic	$2,339	$2,700	5.53	1.2
4	Ventilation	Add 6 destratification fans in shop areas to push heat to floor	$787	$6,000	1.64	7.6
5	Other Electrical: Reefer	Replace with Residential refrigerator	$162	$1,200	0.86	7.4
6	Air Tightening	Perform air sealing to reduce air leakage by 10%.	$807	$10,000	0.73	12.4
7	Lighting: General shop lighting	Replace with 20 FLUOR (6) T5 45.2" F54W/T5 HO Standard (2) HighLight HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$514	$6,000	0.55	11.7
8	Lighting: Second Floor Mezzanine Parts and Break Room	Replace with 13 FLUOR (2) T8 4' F32T8 32W Standard Program HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$165	$2,100	0.50	12.7
9	Lighting: Office lighting	Replace with 40 FLUOR (4) T8 4' F32T8 32W Standard (2) Program HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$519	$7,000	0.47	13.5
10	Ceiling w/ Attic: Shop Attic	Add R-19 fiberglass batts to attic with Standard Truss.	$380	$28,621	0.29	75.3
11	Exterior Door: 12' wide overhead door - 1each	Remove existing door and install standard pre-hung U-0.16 insulated door, including hardware.	$60	$7,349	0.18	122.8

PRIORITY LIST – RECOMMENDED ENERGY EFFICIENCY MEASURES						
Rank	**Feature**	**Recommendation**	**Annual Energy Savings**	**Installed Cost**	**SIR**	**Payback (Years)**
	TOTAL		**$8,082**	**$71,980**	**1.11**	**8.9**

ENERGY AUDIT REPORT – ENERGY EFFICIENT RECOMMENDATIONS

1. Building Envelope

Insulation

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value	Installed Cost	Annual Energy Savings
10	Ceiling w/ Attic: Shop Attic	Framing Type: Standard Framing Spacing: 24 inches Insulated Sheathing: None Bottom Insulation Layer: None Top Insulation Layer: R-19 Batt:FG or RW, 6 inches Modeled R-Value: 21.1	Add R-19 fiberglass batts to attic with Standard Truss.	$28,621	$380

Exterior Doors – Replacement

Rank	Location	Size/Type/Condition	Recommendation	Installed Cost	Annual Energy Savings
11	Exterior Door: 12' wide overhead door - 1each	Door Type: Metal - urethane, no therm. break Modeled R-Value: 2.5	Remove existing door and install standard pre-hung U-0.16 insulated door, including hardware.	$7,349	$60

Windows and Glass Doors – Replacement

Rank	Location	Size/Type/Condition	Recommendation	Installed Cost	Annual Energy Savings

Air Leakage

Rank	Location	Estimated Air Leakage	Recommended Air Leakage Target	Installed Cost	Annual Energy Savings
6		Air Tightness from Blower Door Test: 40000 cfm at 50 Pascals	Perform air sealing to reduce air leakage by 10%.	$10,000	$807

2. Mechanical Equipment

Mechanical

Rank	Recommendation	Installed Cost	Annual Energy Savings

Setback Thermostat

Rank	Location	Size/Type/Condition	Recommendation	Installed Cost	Annual Energy Savings
1	Heavy Equipment Shop	Existing Unoccupied Heating Setpoint: 72.0 deg F	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Heavy Equipment Shop space.	$1,000	$2,329

Ventilation

Rank	Recommendation	Cost	Annual Energy Savings
4	Add 6 destratification fans in shop areas to push heat to floor	$6,000	$787

3. Appliances and Lighting

Lighting Fixtures and Controls

Rank	Location	Existing	Recommended	Installed Cost	Annual Energy Savings
2	Breezeway connector lights	3 INCAN A Lamp, Std 100W with Occupancy Sensor	Replace with 3 FLUOR CFL, A Lamp 15W	$10	$19
3	Exterior Lights	9 HPS 400 Watt Magnetic with Manual Switching	Replace with 9 LED 150W Module StdElectronic	$2,700	$2,339
7	General shop lighting	20 HPS 400 Watt Magnetic with Manual Switching	Replace with 20 FLUOR (6) T5 45.2" F54W/T5 HO Standard (2) HighLight HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$6,000	$514
8	Second Floor Mezzanine Parts and Break Room	13 FLUOR (2) T12 4' F40T12 34W Energy-Saver Magnetic with Manual Switching	Replace with 13 FLUOR (2) T8 4' F32T8 32W Standard Program HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$2,100	$165
9	Office lighting	40 FLUOR (4) T12 4' F40T12 34W Energy-Saver (2) Magnetic with Manual Switching	Replace with 40 FLUOR (4) T8 4' F32T8 32W Standard (2) Program HighEfficElectronic and Remove Manual Switching and Add new Occupancy Sensor	$7,000	$519

Refrigeration

Rank	Location	Existing	Recommended	Installed Cost	Annual Energy Savings

Other Electrical Equipment

Rank	Location	Existing	Recommended	Installed Cost	Annual Energy Savings
5	Reefer	Residential refrigerator with Other Controls	Replace with Residential refrigerator	$1,200	$162

Cooking/Clothes Drying

Rank	Recommended	Installed Cost	Annual Energy Savings


Attic with R-19 at roof underside


Front view of building

View from mezzanine

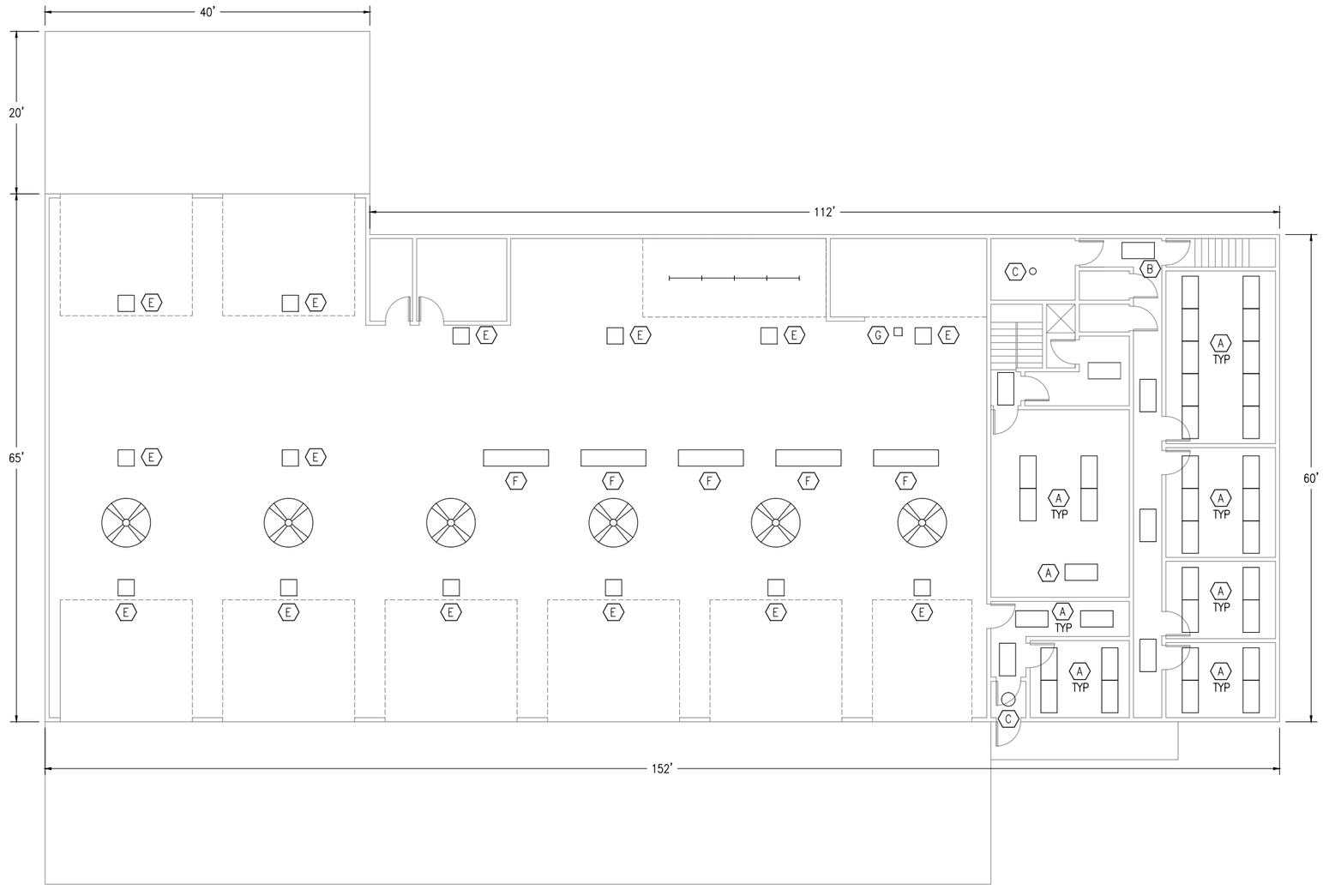

Damaged insulation in attic


Vertical unit heaters typical of all


Ventilation exhaust fan


Front view of building


End two bays with 26' roof height, from rear

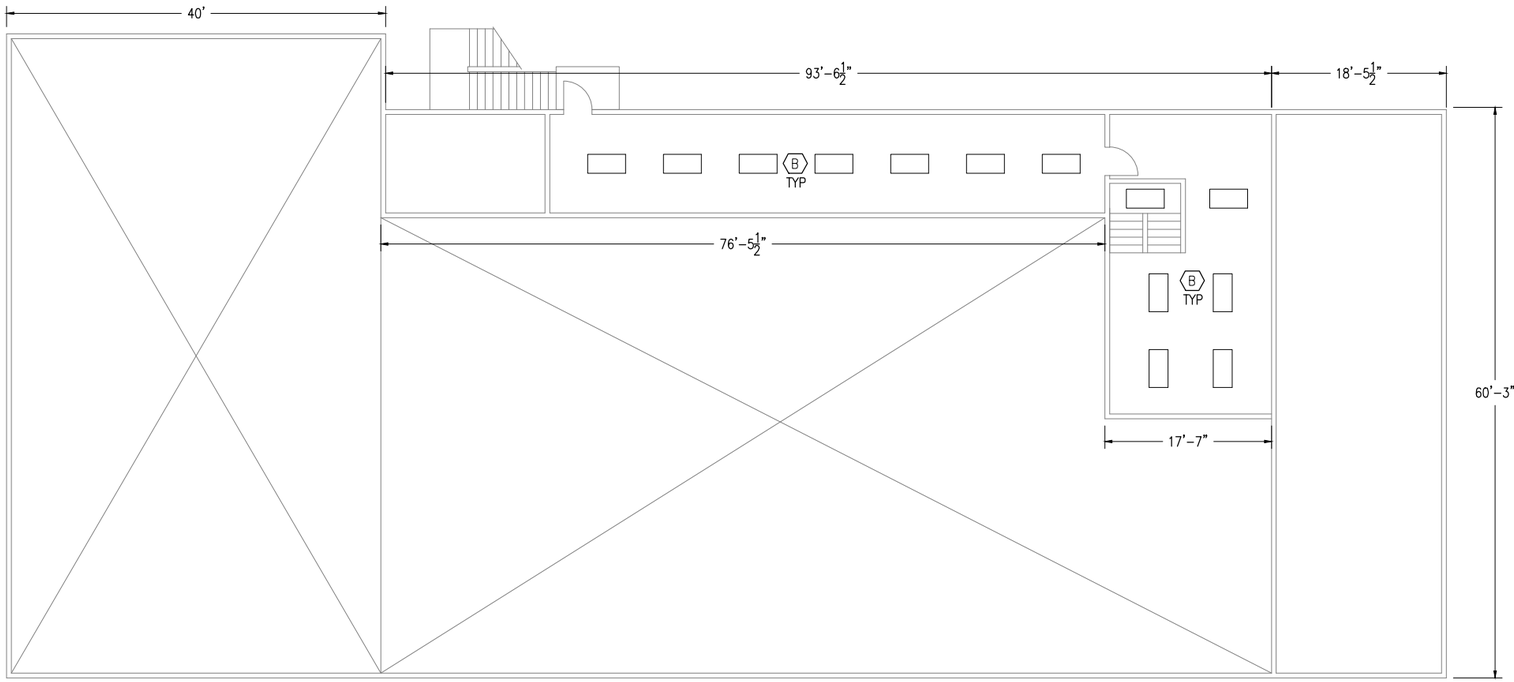


LEGEND

		DESTRATIFICATION FAN
A		4 TUBE T-12, SURFACE
B		2 TUBE T-12, SURFACE
C		INCANDESCENT
D		2 TUBE 4'
E		500W MH
F		2 TUBE 8' T-12
G		150 W QUARTZ
		..

1 3427 C STREET - FIRST FLOOR PLAN

1/8"=1'-0"



LIGHTING LEGEND

B — 2 TUBE T-12, SURFACE

1 3427 C STREET - SECOND FLOOR PLAN

1/8"=1'-0"

SHOP 1 EQUIPMENT SCHEDULES

FAN SCHEDULE

SYMBOL	SERVICE	TYPE	CFM	ESP {1} (IN H2O)	WHEEL TYPE	MOTOR DATA	BASIS OF DESIGN	RPM	BHP	MIN FILTER AREA (SQ FT)	MAX SPL (db) {2}	
SF-1	SHOP AREA MAKE-UP	CENTIFUGAL FAN	8110	1.75	AF	5 HP	TRANE CAFD 22	1109	3.1	—		
SF-2	ADMIN AREA VENTILATION	SMALL CABINET FAN	860	1.25	FC	1/2 HP	PACE SCF-79A	1699	0.39	2.5		
VF-1	MECH ROOM VENTILATION	SMALL CABINET FAN	555	0.75	FC	1/4 HP	PACE SCF-73A	1403	0.16	1.8		
DSF-1,2	DESTRAT. FAN	SMALL CABINET FAN	1700	1	FC	1 HP	PACE SCF-73B	1743	0.73	3.8		W/ VEE FILTER
EF-1	TAILPIPE EXHAUST	UTILITY FAN	3200	1.75	AF	2 HP	CARMON CMB25	1972	1.59	—		

{1} EXTERNAL STATIC PRESSURE. NOTE THAT COILS, FILTERS, & MIXING BOXES ARE CONSIDERED TO BE EXTERNAL TO THE FAN SECTION FOR PURPOSES OF FAN EXTERNAL STATIC PRESSURE DETERMINATION.

{2} MAXIMUM THIRD OCTAVE BAND OUTLET SOUND POWER LEVEL.

HEATING COIL SCHEDULE

SYMBOL	ASSOC. FAN	CFM	CAPACITY (MBH)	ENTERING SOLUTION	EAT (F)	MAX GPM	MAX TUBE PD {1}	MAX AIR PD	MIN FACE AREA	BASIS OF DESIGN	REMARKS