Comprehensive Energy Audit
For
Russian Mission Water Plant

Prepared For

City of Russian Mission

August 8, 2011

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the City of Russian Mission and the Alaska Rural Utility Collaborative (ARUC). The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM), Chris Mercer (CEA), and Gavin Dixon.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted over the past several months by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy efficiency measures. Discussions of site specific concerns and an Energy Efficiency Action Plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water plant Operator James Changsak, and Ms. Marcie Sherer of AVCP.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Russian Mission and the Alaska Rural Utility Collaborative. The scope of the audit focused on Russian Mission Water plant. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual energy costs for the buildings analyzed are $5,394 for electricity, and $7,302 for #1 Oil for total energy costs of $12,696 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy last year. If it did not receive the PCE subsidy the annual electricity cost would have been $13,927 for Electricity and total energy costs would be $22,943 per year.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Russian Mission Water plant. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Building Glycol Circ Pumps	Reduce Pump from setting 3 to setting 1.	$190	$100	12.11	0.5
2	HVAC And DHW	Retrocommisioning of Boilers. This should include insulation of the piping on the primary loops on the boilers, and any other exposed copper piping, reduction in nozzle size, and retrocommisioning of the Tekmar for efficient runtime.	$1,260	$3,200	7.73	2.5
3	Desktop Computer	Turn off computers and monitors when not in use.	$5	$10	4.19	2.1
4	Exterior Lighting	Replace with 2 LED 17W Module Electronic	$113	$250	2.89	2.2
5	Uptown Circulation Pumps	Replace pump motor with premium efficiency motor.	$265	$950	2.77	3.6
6	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$103	$500	3.09	4.9
7	Old town Circulation Pumps	Replace pump motor with premium efficiency motor.	$120	$536	2.27	4.5
	TOTAL, all measures		**$2,056**	**$5,546**	**5.79**	**2.7**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is

an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $2,056 per year, or 16.2% of the buildings' total energy costs. These measures are estimated to cost $5,546, for an overall simple payback period of 2.7 years.

Table 1.2 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.2
Annual Energy Cost Estimate

Description	Space Heating	Space Cooling	Water Heating	Lighting	Other Electrical	Water Storage Tank	Circulation Loops	Ventilation Fans	Service Fees	Total Cost
Existing Building	$2,125	$0	$0	$308	$4,564	$3,235	$2,442	$0	$0	**$12,696**
With All Proposed Retrofits	$806	$0	$0	$195	$3,940	$3,235	$2,442	$0	$0	**$10,640**
SAVINGS	$1,319	$0	$0	$113	$624	$0	$0	$0	$0	**$2,056**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Russian Mission Water plant. The scope of this project included evaluating building shell, lighting and other electrical systems, HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Russian Mission Water plant enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Russian Mission Water plant is 944 square feet.

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of 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. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Russian Mission Water plant

3.1. Building Description

The 944 square foot Russian Mission Water plant was constructed in 1978, with a normal occupancy of 1 or 2 people. The number of hours of operation for this building average four hours per day, considering all seven days of the week.

There is currently a cold storage addition in the form of an attached trailer being added to the Water plant.

<u>Description of Building Shell</u>

The exterior walls are 2x6 construction with 6 inches of polyurethane insulation. The roof is a hot roof with 10 inches of polyurethane insulation. The foundation is an on grade concrete slab. Typical windows in the building are double paned wood frame windows with barbed wire. The doors are metal with EPS insulation.

<u>Description of Heating Plants</u>

The Heating Plants used in the building are:

Weil McClain Gold Oil Boiler

Nameplate Information:	Weil McClain, A/B-WTGO-8, Series 3
Fuel Type:	#1 Oil
Input Rating:	308,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	2.3 %
Heat Distribution Type:	Water
Boiler Operation:	Nov - Jun
Notes:	Boiler Operates about 15 minutes out of every hour in the winter time. 2 ¼” nozzles.

Weil McClain Gold Oil Boiler

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Idle Loss:	2.3 %
Heat Distribution Type:	Water
Boiler Operation:	Nov - Jun
Notes:	Boiler Operates about 15 minutes out of every hour in the winter time. 2 ¼” nozzles.

<u>Space Heating Distribution Systems</u>

The building is heated by the jacket heat loss off the boilers as well as a few rarely used unit heaters.

<u>Waste Heat Recovery Information</u>

A waste heat feasibility study was conducted for the water plant and the teacher housing for the school. The feasibility study is attached as Appendix B.

<u>Description of Building Ventilation System</u>

The existing building ventilation system consists of an open hole in the wall to supply the boilers with sufficient make up air.

<u>Lighting</u>

The building is lit primarily by a few T12 40 watt fluorescent bulbs.

<u>Plug Loads</u>

Plus loads in the building are limited to a single computer and monitor, a rarely used refrigerator, and an old coil electric stove.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: AVEC-Russian Mission - Commercial - Sm

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1 – Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.16/kWh
#1 Oil	$ 3.12/gallon

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Alaska Rural Utility Collaborative pays approximately $12,696 annually for electricity and other fuel costs for the Russian Mission Water plant.

Figure 3.1 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the "Retrofit" bar in the figure to the "Existing" bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

Figure 3.1
Annual Energy Costs by End Use

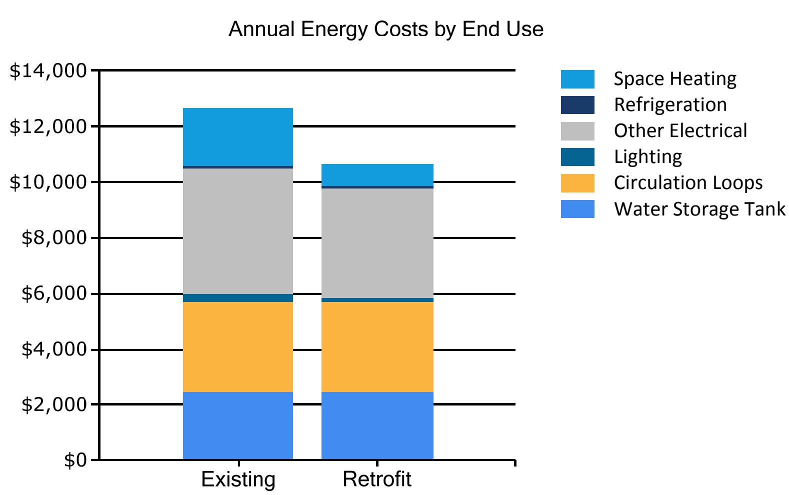


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

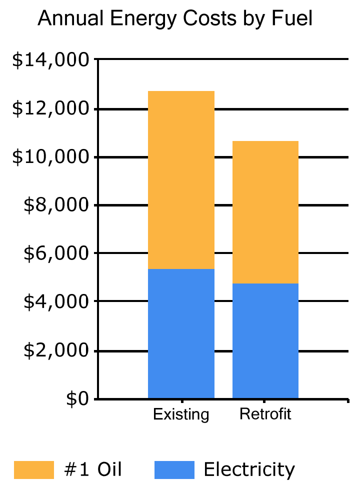
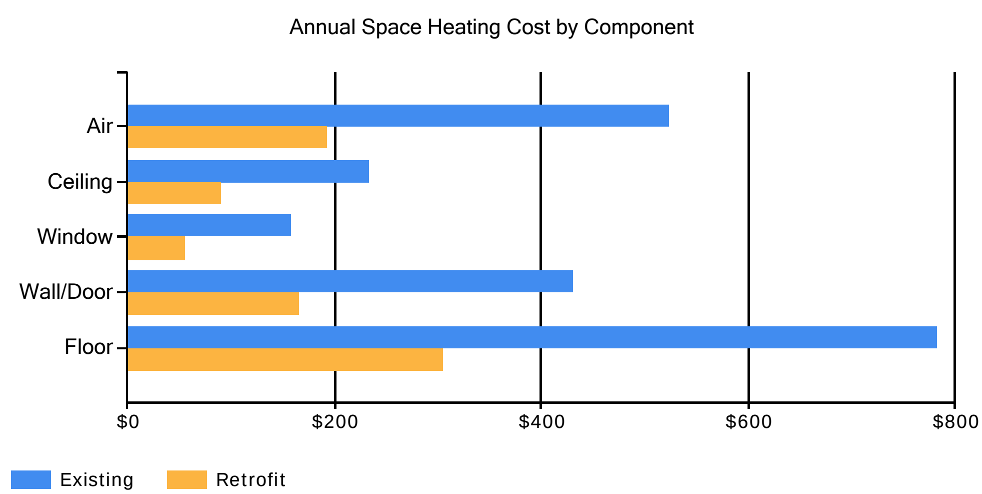


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
Annual Space Heating Cost by Component



The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Other_Electrical	3517	3205	3517	3404	3517	554	572	572	554	2187	3404	3517
Lighting	164	149	164	158	164	158	164	164	158	164	158	164
Refrigeration	11	10	11	11	11	11	11	11	11	11	11	11
Water Storage Tank	58	53	58	56	58	0	0	0	0	58	56	58
Circulation Loops	137	125	137	133	137	0	0	0	0	137	133	137
Space_Heating	216	197	216	209	216	1	1	1	1	115	209	216

Fuel Oil #1 Consumption (Gallons)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Water Storage Tank	129	118	129	125	129	0	0	0	0	129	125	129
Circulation Loops	93	84	93	90	93	0	0	0	0	93	90	93
Space_Heating	80	73	80	77	80	10	7	10	18	8	77	80

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

Building Site EUI = *(Electric Usage in kBtu + Fuel Oil #1 Usage in kBtu)* / *Building Square Footage*

Building Source EUI = *(Electric Usage in kBtu X SS Ratio + Fuel Oil #1 Usage in kBtu X SS Ratio)* / *Building Square Footage*

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Russian Mission Water plant EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	33,713 kWh	115,061	3.340	384,304
#1 Oil	2,340 gallons	308,922	1.010	312,011
Total		**423,983**		**696,315**
BUILDING AREA		944	Square Feet	
BUILDING SITE EUI		449	$kBTU/Ft^2/Yr$	
BUILDING SOURCE EUI		738	**$kBTU/Ft^2/Yr$**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Russian Mission Water plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Russian Mission was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated. Equipment cost estimate calculations are provided in Appendix D.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Russian Mission. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.

• The model does not model HVAC systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail.

Table 4.1
Russian Mission Water plant, Russian Mission, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Other Electrical: Glycol Circ Pumps	Reduce Pump from setting 3 to setting 1.	$190	$100	12.11	0.5
2	HVAC And DHW	Retrocommisioning of Boilers. This should include insulation of the piping on the primary loops on the boilers, and any other exposed copper piping, reduction in nozzle size, and retrocommisiong of the Tekmar for efficient runtime.	$1,260	$3,200	7.73	2.5
3	Other Electrical: Desktop Computer	Turn off computers and monitors when not in use.	$5	$10	4.19	2.1
4	Lighting: Exterior Lighting	Replace with 2 LED 17W Module Electronic	$113	$250	2.89	2.2
5	Other Electrical: Uptown Circulation Pumps	Replace pump motor with premium efficiency motor.	$265	$950	2.77	3.6
6	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$103	$500	3.09	4.9
7	Other Electrical: Old town Circulation Pumps	Replace pump motor with premium efficiency motor.	$120	$536	2.27	4.5
	TOTAL, all measures		**$2,056**	**$5,546**	**5.79**	**2.7**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining

EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among 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 items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1. Energy Efficiency Measure: Seal Air Leaks

Many buildings, especially older ones, have air leaks allowing heated and cooled air to escape when the air pressure differs between the inside and outside of the building. Because these leaks allow unconditioned air to enter as conditioned air is lost, air leaks can be a significant waste of energy and money. They also make the building drafty. Many buildings have hidden air leaks requiring a weatherization technician to find and seal. It is recommended you find a seal-up technician who uses a blower door to help identify where the air is leaking and, after sealing the leaks, verifies the reduction in leakage. Buildings with indoor air pollution caused by combustion heating, tobacco smoking, or moisture problems, may require more ventilation than average buildings.

In this building we examined the opportunity to reduce the buildings air leakage by converting to a ducted air intake system for the boilers. The payback period was too long to be worthwhile. Care should be taken to minimize air leakage by keeping doors closed.

4.4 Heating Measures

4.4.1. EEM Heating Plants and Distribution Systems

A heating system is expected to last approximately 20-25 years, depending on the system. If the system is nearing the end of its life, it is better to replace it sooner rather than later to avoid being without heat for several days when it fails. This way, you will have time to compare bids, check references and ensure the contractors are bonded and insured. Your boilers do not need to be replaced but improvements should be made as recommended below.

Recommendation: Retro-commisioning of Boilers is highly recommended. The current boilers should use much smaller nozzles. The current oversized fuel nozzles are causing excessive boiler cycling, needlessly increasing cycle losses and degrading overall system efficiency. Installation of 1 ½” nozzle is recommended.

This EEM also recommends insulation of the piping on the primary loops on the boilers, and any other exposed copper piping. This may increase runtime on the unit heaters, but that will be offset by the efficiencies gained through less heat loss through the piping.

Additionally, the Tekmar should be reprogrammed and calibrated to allow for alternate lead lag functioning of the boilers, instead of manual switching.

This EEM can be accomplished through a two day trip from utility support staff to provide instruction, work on the Tekmar and assist in system maintenance and improvement.

Estimated Cost: $3,200
Estimate Savings per Year: $1,260

4.4.1.1. EXISTING SYSTEMS

4.4.1.1.1 Weil McClain Gold Oil Boiler
Description: Weil McClain, A/B-WTGO-8, Series 3 heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size : 308,000 BTU/h
Efficiency (Steady State & Idle): 75%
Portion of heat supplied by this unit: 50%
Notes: Boiler Operates about 15 minutes out of every hour in the winter time. 2 1/4 nozzles.

4.4.1.1.2 Weil McClain Gold Oil Boiler
Description: Weil McClain, A/B-WTGO-8, Series 3 heating plant fueled by #1 Fuel Oil, with a Natural draft.
Size : 308,000 BTU/h
Efficiency (Steady State & Idle): 75%
Portion of heat supplied by this unit: 50%
Notes: Boiler Operates about 15 minutes out of every hour in the winter time. 2 1/4 nozzles.

4.4.1.1.3 Unit Heaters

Notes: At present, most space heat is provided by boiler jacket heat, unit heaters rarely come on.

4.4.1.1.3.1 Grundfos Primary

Nameplate: UPS32-80 F, Model C, PC 0405

Notes: set at Level 3 (280 W), Level 1 is 250 W, Level 2 is 260 W.

4.4.2 Programmable Thermostat

Location	Existing Situation	Recommended Improvement	Install Cost	Annual Savings	Notes
Water Treatment Plant	Existing Unoccupied Heating Setpoint: 70.0 deg F	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$500	$103	

Description: Once the Tekmar has been fixed and primary loop piping insulated, a programmable thermostat should be used to control the temperature in the building and manage the runtime of the unit heaters.

4.5 LIGHTING UPGRADES

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1 Lighting Upgrade – Replace Existing Fixtures and Bulbs

Location	Existing Lighting	Recommended Improvement	Install Cost	Annual Savings	Notes
Exterior Lighting	2 INCAN A Lamp, Halogen 75W with Daylight Sensor	Replace with 2 LED 17W Module Electronic	$250	$113	

Description: Replacing the exterior lighting with 17W LED wall packs will greatly increase efficiency. Additionally LEDs are very effective in cold weather and have longer lifespan.

4.6 Appliances

Location	Life in Years	Description	Recommendation	Cost	Savings	Notes
Glycol Circ Pumps	7	Grundfos Circulation Pumps	Turn down operation from level 3 to level 1.	$100	$190	
Desktop Computer	10	Micron PC, Dell Monitor	Turn off computers when not in use.	$10	$5	
Uptown Circulation Pumps	12	Goulds Circ Pump	Replace motor with premium efficiency motor.	$950	$265	
Old town Circulation Pumps	12	Circ Pumps	Replace motor with Premium Efficiency Motor.	$536	$120	

Description: The building circulation pumps are set on setting three, and are operating at a level higher than necessary for the function of the system. Reducing the pumps to operating at level one would be a significant energy savings.

Shutting down computers when not in use will save energy and does not affect the lifespan of the computer. Using energy management settings on windows operating systems can help to ensure application of the retrofit, with little impact.

Replacing with Uptown circulation pump motors with 85% new premium efficiency motors, and the old town circulation loops with 82% new premium efficiency motors would be an excellent savings. Given that these pumps are likely to be replaced soon anyway for proper functioning of the water system. Premium efficiency motors should be installed. Required replacement cost avoidance is NOT included in these calculations, making the payback even faster.

4.7 Water Storage and Circulation Loops

An evaluation of the water storage tank and the various circulation loops in Russian Mission revealed a few energy conservation measures that were not cost effective, or already being worked on.

Insulation on the circulation loop piping up to the water storage tank should be repaired before winter. The operator confirmed this was to be worked on, and we did not include it in this report.

Additionally, an analysis of the insulation on the water storage tank was performed. The roof insulation of the water storage tank is destroyed and nearly useless. However, installing an insulation package to reduce heat loss would be more than a 15 year payback. However, an interim solution involving spray on insulation and plastic sheeting to prevent moisture and weather damage could be a significant savings and highly recommended, even as a stopgap measure. However, should energy costs be so high that a new insulation package for the roof is more affordable it should be done immediately, as the storage tank is currently the single largest heat loss in the water system.

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

Lighting

Illumination Engineering Society - http://www.iesna.org/

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - http://www1.eere.energy.gov/buildings/ssl/

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Heat Pump Water Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

Solar Water Heating

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf

Solar Radiation Data Manual – http://rredc.nrel.gov/solar/pubs/redbook

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http:apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

The Greenest Desktop Computers of 2008 - http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html

Wind

AWEA Web Site – http://www.awea.org

National Wind Coordinating Collaborative – http:www.nationalwind.org

Utility Wind Interest Group site: http://www.uwig.org

WPA Web Site – http://www.windpoweringamerica.gov

Homepower Web Site: http://homepower.com

Windustry Project: http://www.windustry.com

Solar

NREL – http://www.nrel.gov/rredc/

Firstlook – http://firstlook.3tiergroup.com

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

State and Utility Incentives and Utility Policies - http://www.dsireusa.org

Appendix B – Heat Recovery Feasibility Study