REPORT

COMPREHENSIVE ENERGY AUDIT

For

SELAWIK WATER TREATMENT PLANT AND SANITATION SYSTEM

Selawik, Alaska

DRAFT

Prepared for

The City Selawik, Alaska

And

The Alaska Rural Utility Collaborative (ARUC)

March 7, 2011

Prepared by

Alaska Native Tribal Health Consortium
Energy Projects Group
1901 Bragaw Street, Suite 200
Anchorage, Alaska 99508
Phone: 907-729-3543
cremley@anthc.org

Table of Contents

PREFACE

The Energy Projects Group at the Alaska Native Tribal health Consortium (ANTHC) prepared this document for The City of Selawik, Alaska and the Alaska Rural Utility Collaborative (ARUC). The authors of this report are Carl Remley CEA and CEM, Chris Mercer PE, 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 in February of 2011 by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operators, Henry Coaltrain, Bruce Dexter, and Fred Cleveland, ARUC Statewide Manager John Nichols, and Selawik City Administrator Roger Clark.

1. EXECUTIVE SUMMARY

Table 1.1 Recommended Energy Conservation Measures

Description	Cost	Annual Savings	Simple Payback
Eliminate Use of Heat Tape on Island Utilidors	$0	$75,001	0 years
Eliminate Use of Heat Tape on Arctic Pipe Used for Water Loops	$3,000	$13,924	0.2 years
Add Controls to Pump House Heat Tape	$2,500	$2,684	0.9 years
Maximize Use of Recovered Heat in the Water treatment Plant	$15,000	$2,6125	0.6 years
Replace Water Treatment Plant Heat Add Controls	$7,500	$4,912	1.5 years
Reconfigure the Heat Add System in the Island Vacuum Plant	$4,500	$1,410	3.2 years
Replace interior Lighting in both buildings	$22,777	$2,938	7.8 years
Re-commission the Vacuum Pumps	$5,500	$4,499	1.2 years
Separately Meter the Cable TV Equipment	$10,000	$1,620	6.2 years
Eliminate Use of Electric Heaters in Washeteria and Rest Room	$7,000	$800	8.8 years
Isolate the Standby Boiler in the Water Treatment Plant	$0	$300	0 years
Reduce the Building Shell Leaks in the Island Vacuum Plant	$3,500	$564	6.3 years
TOTAL	**$103,786**	**$134,777**	**1.3 years**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit effort comprised energy engineering services to identify, develop, and evaluate energy efficiency and conservation measures for the Selawik water treatment and sanitation systems located in Selawik, Alaska. The scope of this project includes auditing the entire system including the water treatment plant, the island vacuum plant, the pump house, and both the water distribution system and the vacuum sanitation collection system. Measures were selected such that an overall simple payback period of 10 years or less is achieved. Measures that were evaluated but had longer simple payback periods are included in the non-recommended measures section of this report in order to allow for re-evaluation of these projects should energy prices increase.

2.2 Audit Description and Methodology

On February 2nd and 3rd and again on February 16th, 2011, the Energy Projects Group at ANTHC conducted an on-site audit of the above referenced facilities and systems. Complete facility surveys were conducted including a systematic inspection of the entire system, interviews with plant operators, observation of actual operating procedures, and data collection of all major equipment and structures including nameplate data for major equipment, operating hours of equipment, actual equipment loads over time, maintenance needs, condition of equipment, blower door test of each facility, and thermal imaging of each facility.

Lighting audits were also completed for each facility including complete physical counts of all the fixtures and a determination of fixture configuration.

Some of the major tools used to facilitate the audit included:

- Energy Conservatory Blower Door Test System
- FLIR b50 Infrared Camera
- Extech Video Boroscope
- Bacharach Fyrite Insight Combustion Gas Analyzer
- Dranetz/BMI EP1 Power Monitor

In addition to the physical inspection, the following sources of information were used to obtain the level of detail necessary to accurately understand and analyze the buildings energy use.

- As-built architectural, mechanical and electrical drawings
- Operation and Maintenance manuals for both facilities
- Fiscal year 2010 fuel and electricity use data

2.3 Analysis Methodology

This section describes the main analysis methods used to identify baseline building energy usage and to evaluate energy conservation measures (ECMs).

2.3.1 Energy Engineering Analysis

Following the site visit, energy balances were calculated to determine the distribution of energy use as given in the historical bills. The significant number of separate meters combined with the equipment monitoring done made analyzing the electrical usage easier. The lack of historical data for recovered heat, made the calculation of total heat used more difficult. Electrical, oil and recovered heat consumption were prorated to the end use categories based on a combination of monitoring and calculations of consumption by the system components. This analysis confirms the understanding of how systems are operated. For example, it is a check on the assumed load, cycling factor, or length of operation of the various systems or individual pieces of equipment.

After the balances were completed, potential energy efficiency measures were analyzed and annual savings calculated. Savings calculations are based on reduction in run time of an existing system, improved control of an existing system, or conversion to more efficient equipment.

We recognize that there will be process changes implemented in the water treatment plant in the near future. The impact of these changes were not considered in this audit.

Cost estimates are provided for the proposed conversions or improvements. These are budget estimates based on a combination of quotations and the experience of the auditors on similar projects completed in rural Alaska.

2.3.2 Thermal Imaging

An infrared thermal imaging analysis of the buildings was conducted using a FLIR b50 infrared camera. Several areas of large losses were identified and each are included in the list of energy conservation measures.

2.4 Limitations of Study

The information presented herein is an energy efficiency and conservation study to identify potential energy conservation measures and estimate their costs and savings. In some cases, several methods may achieve the identified savings. This report does not include specific design instructions. It is not intended as a final design document and projects have not been developed to construction design level. The design professional or other persons following the recommendations shall accept responsibility and liability for the results. Budget for engineering and design of these projects is included in the cost estimate for each measure as needed.

3. WATER AND SANITATION SYSTEMS

3.1 Systems Overview

3.1.1 Water System

The water and sanitation systems in the City of Selawik serve 189 connections. The raw water is pumped from the river through a pump house to the water treatment plant as a batch process. The raw water is then filtered, treated, heated, and pumped into an insulated 300,000 storage tank.

A combination of utilidors and arctic pipe are used to form a circulated water system. This circulated system has several loops and is heated with a combination of glycol heat –add via heat exchangers, water tank heat, and heat tape. Pumps are used to both circulate the water and pressurize the system. The heat tape was meant to be used as a method of emergency thaw only, not as a heat add method.

3.1.2 Sanitation System

The vacuum sanitation system is separated into two collection systems. One system with dual pumps is co-located with the water treatment plant. This system is a combination of arctic pipe and utilidors. It is heated with a combination of glycol and heat tape. The second system is located at the island vacuum plant. This vacuum collection system is built with utilidors that contain both water and sewer. The utilidors are heated with a combination of heated water and heat tape. Each of the two systems have a collection tank with a pump that discharges via force main to the sewage lagoon.

3.2 Water Treatment Plant

3.2.1 Facility Construction

The water treatment plant is a 5,700 square foot steel frame building. It is mounted on steel piles and has three inches of foam insulation covered with metal siding and a corrugated metal roof. Floor insulation is minimal and may actually be resulting in snow melting under the building.

The building was originally built in 1973 and has been upgraded and added onto since then with the most recent being in 1995. Overall it is in good condition although the limited amount of insulation is far below standard for a building in the arctic.

The blower door test results on this building clearly indicate it can and should be sealed tighter. This was especially true of all of the doors.

3.2.2 Facility Heating

Heat, both for the building and for process is provided by a combination of two boilers and heat recovered from the nearby AVEC power plant. When operating properly, the recovered heat has the capacity to provide all necessary heat on most but not all days. This was illustrated on a zero degree day in February when the boilers never came on for a twelve hour period.

The two boilers are Weil McClain with model CF 1400 Becket burners. The output capacity of each is 1,250,000 btu/hr. The operating temperature range was 162 to 172. The burner was operating at 84% efficiency with a stack temperature of 415 degrees.

The following items were noted on the boilers. Both the boilers and burners are in good condition. The burners were fouling with soot with heavy accumulation on the air tube burner fins. The nozzles were too small for the boilers as they were below the minimum firing rate. Although the burner was designed for a low/high firing rate, it was not wired appropriately to take advantage of that capability. Finally, heated glycol was being circulated through the second boiler even though it was shut off. This results in excessive radiant losses.

During the discussions with the operator, it was noted that during cold periods, they sometimes adjust the boiler operating temperature such that the heat recovery system is not utilized. This results in inefficient operation.

During the first visit of the audit team, the heat recovery system was operational and providing all the heat required. However, during the second trip, a leak in the circulation system forced a shutdown of the circulation pump and therefore the recovery system was not functioning. It is obviously critical to assure the system is operational to minimize heating costs.

During the second visit of the audit team, electric heaters were being used to heat the old washeteria area and the rest room. One of the heaters was 1,500 watts and the other was 15,000 watts.

3.2.3 Water System

Within the water treatment plant, the water is filtered, treated, heated and then stored. This is accomplished with a batch process. The pumps used to pressurize and circulate the water are located within this plant.

Heat is added to the water through a heat exchanger located near the water tank. The controls on this heat exchanger are not operational.

Another heat exchanger is used to heat a glycol circulation loop to the pump house. The controls for this heat exchanger are not functioning properly either.

3.2.4 Vacuum Sanitation System

Within the water treatment plant, is the vacuum pumps, sanitation holding tank and discharge pumps for approximately half the village. A combination of monitoring the run time of the vacuum pumps and discussions with the manufacturer have illustrated the excessive leaks are present in the vacuum system.

Tests conducted on the vacuum pumps indicated that they were all operating properly and near full capacity.

3.2.5 Other Electrical Loads

The cable TV system for the village is located within the water treatment plant. Measurements of the loads associated with this equipment concluded that it is adding approximately 500 kilowatt-hours of usage to the water treatment plant each month that is not associated with the function of the plant.

3.3. Island Vacuum Plant

3.3.1 Facility Construction

The island vacuum plant is a 1,120 square foot steel frame building. It is mounted on steel piles and has three inches of foam insulation covered with metal siding and a corrugated metal roof. Floor insulation is minimal.

The building was built in approximately 2000 and overall is in good condition. However, the limited amount of insulation is far below standard for a building in the arctic.

The blower door test on this facility helped us identify several leaks that need to be eliminated. They are the exhaust dampers for the emergency generator are not closing properly, the dampers on the fresh air inlet for the emergency generator are not closing properly, the double doors on the front of the building do not latch between doors which results in a significant air leak, the draft damper on # 2 boiler is missing.

3.3.2 Facility Heating

Heat for both the building and the process is provided by a combination of two boilers. There is no recovered heat from the AVEC power plant in this building. The two boilers are Weil McClain with model CF800 Becket burners. The boilers were new when the plant was put into operation in approximately 2002 and are in good condition except for the missing draft damper on # 2 boiler and the stuck damper on #1 boiler. Both boilers need to be cleaned and tuned.

3.3.3 Water System

Water is pumped from the water treatment plant to the island vacuum building. There are no water storage tanks at the island vacuum plant. A separate set of circulation pumps circulates the water loops on the island and heat from the boilers is added as necessary.

This heat-add loop is configured such that the heat is added before the temperature controller. A more efficient control approach would be to add heat based on the loop return temperature. This improvement could be implemented fairly easily. At a minimum, there must be a way to monitor the return temperature.

3.3.4 Vacuum Sanitation System

The main purpose of this building is to house the vacuum system for the island connections to the system. Within this building are the vacuum pumps, sanitation holding tank and discharge pumps for all the connections on the island. A combination of monitoring the run time of the vacuum pumps and discussions with the manufacturer have resulted in the conclusion that there are excessive leaks in the vacuum system. It was also noted that the high vacuum level setting on the controls for the pumps are resulting in excessive run times.

3.4 Water Distribution Loops

The vast majority of the water loops circulated from the water treatment plant are separate from the sanitation lines and run in arctic pipe. The design intent was that the heat-add on the recirculation heat exchanger would keep the water in these lines from freezing. The heat tape was meant to be used in an emergency only.

The water lines in the island are run in a utilidor that also includes the vacuum sanitation piping.

3.5 Vacuum Sanitation Lines

All of the vacuum sanitation lines to the water treatment plant are also run in arctic pipe. As noted above, the vacuum lines on the island are run in a utilidor that includes both the water and sanitation lines.

4. ENERGY USE SUMMARY

Energy data for fiscal year 2010 was used for this energy audit. During this period, the electrical usage for the combined water and sanitation systems was 734,410 kilowatt-hours at a cost of $199,041. This results in an average cost per kilowatt-hour of $0.27.

Combined fuel use during fiscal year 2010 totaled approximately 15,595 gallons at a cost of approximately $57,701. The price per gallon of the fuel was approximately $3.70. In addition, it is estimated that the recovered heat used during this period was the equivalent of 5,125 gallons of fuel. Per the heat sales agreement with AVEC, the approximate value of the fuel is $7,688.

The resulting overall cost of energy used for the combined water and sanitation systems was approximately $264,430.

Understanding just how and where this energy was used is a critical step in identifying both how to reduce consumption and how much could be saved by implementing each energy conservation measure.

Identifying where the electricity was used was accomplished by a combination of two methods. First, the large number of electric meters allowed us to breakdown usage into functional areas. For example, many of the meters only provide electricity to heat tape.

Second, we used a Dranetz/BMI EP1 power monitor to record the run times and power draw of pumps, heaters, and many other loads.

Identifying where the fuel and recovered heat was used was accomplished by a combination of two methods as well. First, we analyzed the available historical records and second, we performed calculations utilizing temperature differences and flow rates.

The remainder of this energy use summary section documents just how the consumed energy was used during fiscal year 2010.

4.1 Electrical Use Summary

As mentioned above, electrical usage for fiscal year 2010 totaled 734,410 kilowatt-hours and that cost a total of $199,041. The following table illustrates the consumption and cost variations throughout the year.

It is obvious from the data in the table, that consumption increased dramatically in the winter months. This increase in consumption is due primarily to the use of electric heaters and electric heat tape. The other factor that becomes obvious from this table is that the cost per kilowatt-hour increases significantly when the consumption increases. This increase in the rate per kilowatt-hour is due to exceeding the allotted kilowatt-hour limit for power cost equalization (PCE).

Table 4.1.1 – Total Electrical Consumption

Month	Kilowatt-hours	Dollars	$/Kilowatt-hour
October	28,895	$4,322	$0.150
November	71,873	$18,520	$0.258
December 2009	103,989	$33,683	$0.324
January 2010	115,877	$38,535	$0.333
February	88,917	$25,672	$0.289
March	99,244	$30,102	$0.303
April	91,731	$26,687	$0.291
May	50,824	$8,151	$0.166
June	21,689	$3,535	$0.163
July	20,043	$3,245	$0.162
August	22,103	$3,517	$0.159
September	19,225	$3,072	$0.160
Totals	734,410	$199,041	$0.271

Power cost equalization or PCE is a state subsidy of the high cost of electricity in rural Alaska. However, there are limits to the consumption that is subsidized. It is obvious from this data that those limits were exceeded in the winter months. The cost per kilowatt-hour with the PCE included is in the $0.15 to $0.16 range as illustrated in October of 2009 and May through September of 2010. The average rate doubles during the winter months illustrating the need to stay within the PCE subsidized rate. This will be factored into the savings used later in this report.

Figure 4.1.1 below is an overview of the breakdown of annual electrical consumption for the entire water and sanitation system. The breakdown of that consumption on a percentage basis is as follows:

• Island Heat Tape	38%
• Heat Tape with Glycol	13%
• WTP Side Heat Tape No Glycol	1%
• Water Treatment Plant	27%
• Island Vacuum Plant	16%
• Pump House	3%
• Heat Recovery and Tank Farm	2%

Combined, heat tape comprised 52% of the total electrical charges in fiscal year 2010. This $102,848 cost is obviously both a major expense and the use of heat tape should be minimized.

Figure 4.1.1 – System Wide Electrical Cost

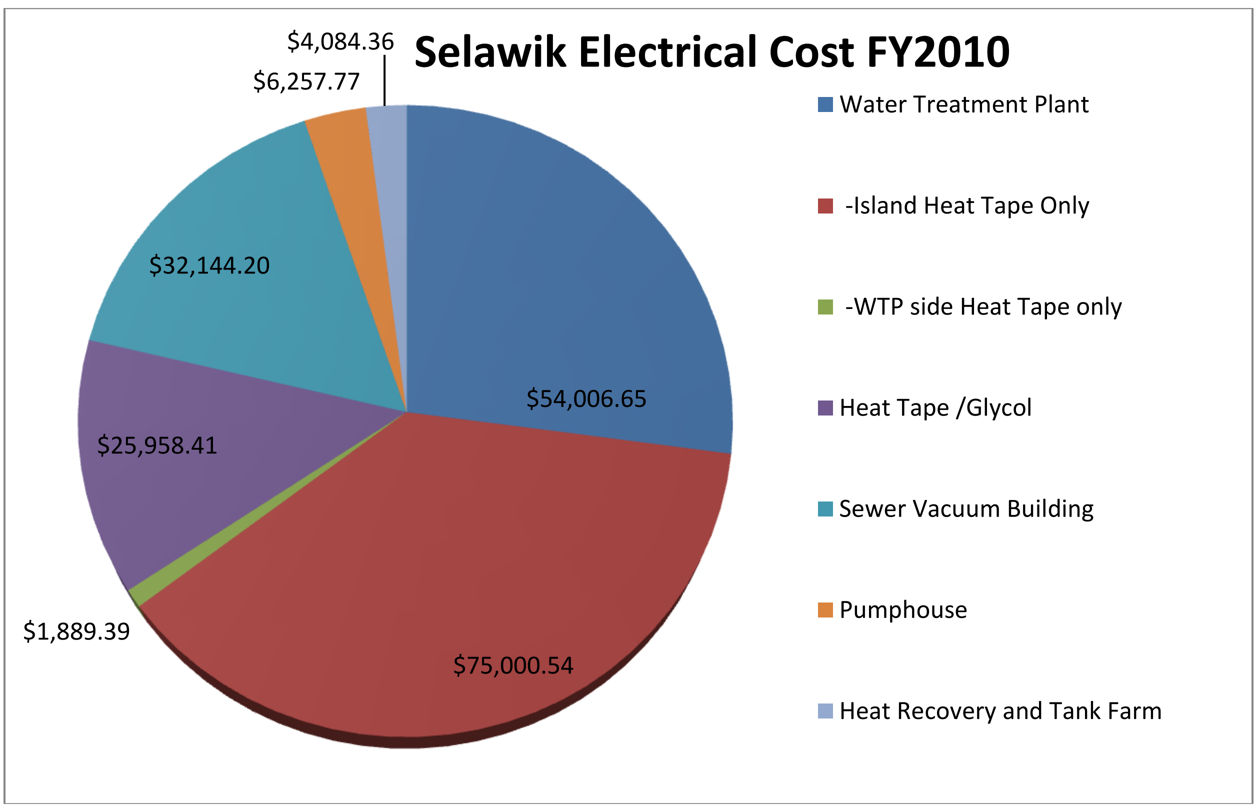


Figure 4.1.2 below is a breakdown of the electricity use at the water treatment plant. This breakdown was derived by measuring the individual loads over time.

The $1,620 spent on operation of the city TV cable electrical equipment is a cost born by the WTP that should not be.

It is obvious from this chart that the $25,383 annual operating cost of the vacuum pumps is a major portion (47%) of the water treatment plant electricity cost each month. Recommendations for reducing those costs are listed later in this report.

Recommendations will also be made on how to reduce the annual lighting cost of approximately $2,700.

Figure 4.1.2

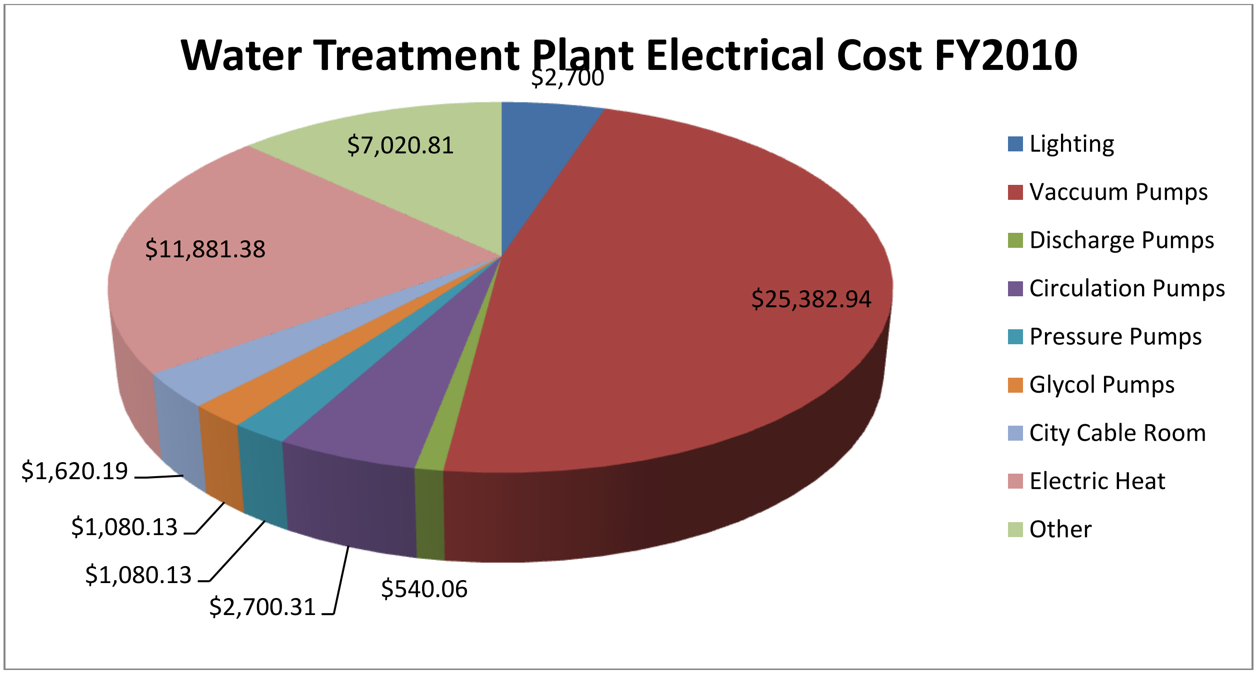


Figure 4.1.3 below is a breakdown of the operating costs of the Island vacuum building. The same lighting and vacuum pump comments made above apply to this plant as well.

Figure 4.1.3

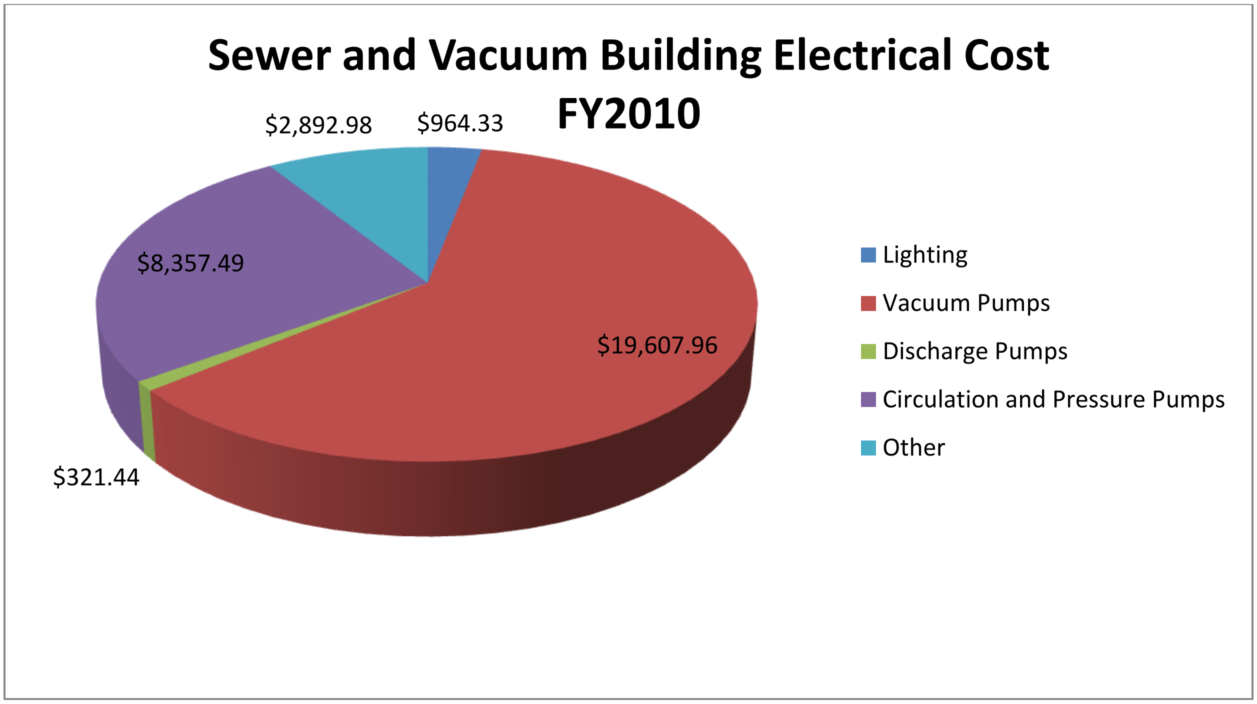


Figure 4.1.4 below is a breakdown of the heat tape used in the entire water and sanitation system. As mentioned earlier, the cost of operating the heat tape was approximately $102,849 in fiscal year 2010. This represents approximately 52% of the annual electricity costs and 39% of the total annual utility costs.

Later in this report, several recommendations are made to drastically reduce these costs.

Figure 4.1.4

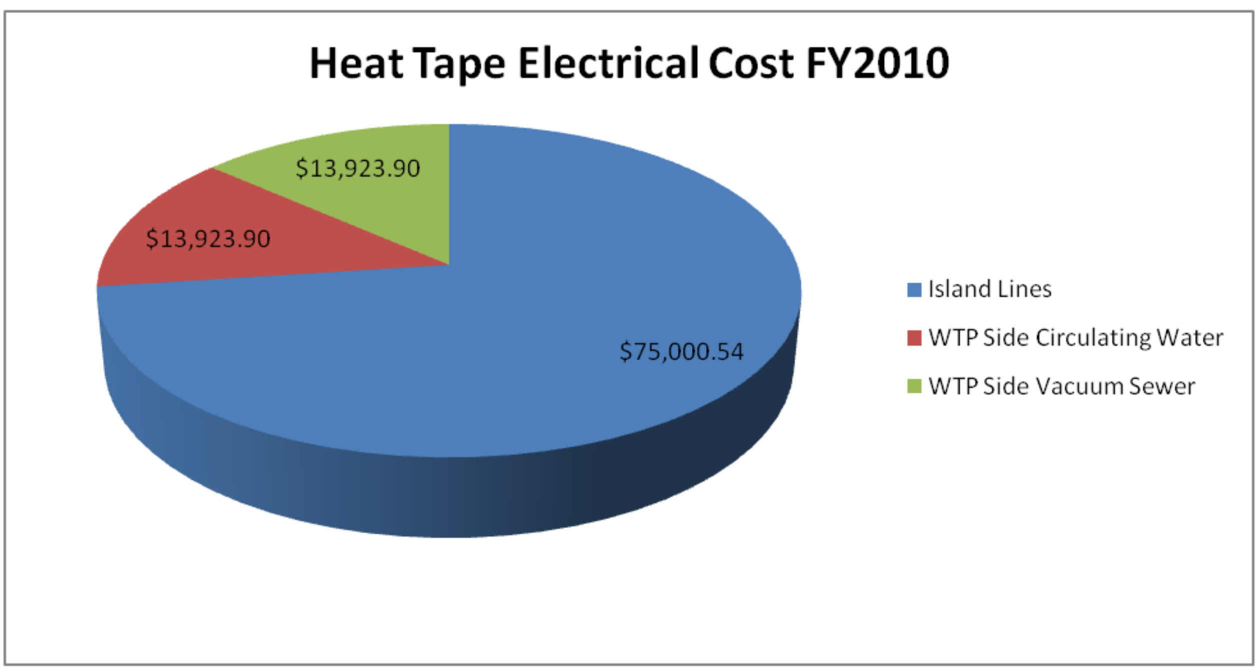
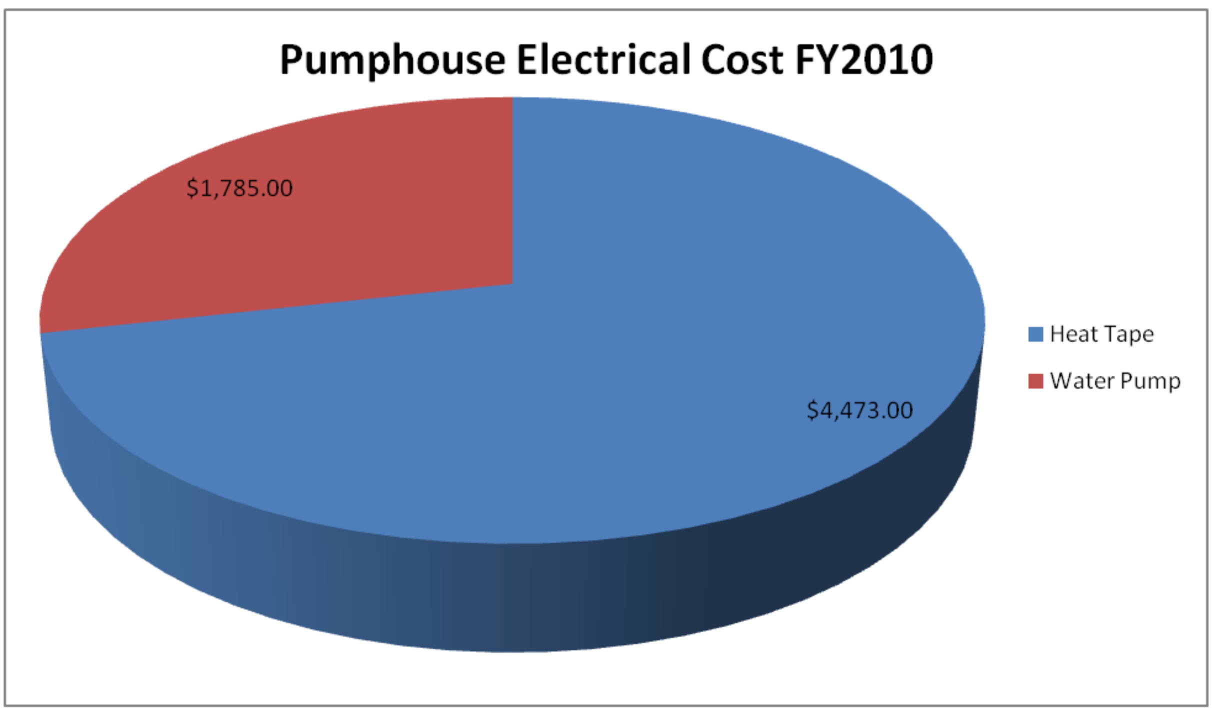


Figure 4.1.5 below is a breakdown of the electricity usage in the pump house. It is obvious that the heat tape loosely coiled in the bottom of the pump house is the major consumer of electricity.

This heat tape cost is not included in the above numbers because the recommendation for how to reduce the cost is different.

The $4,473 used to heat the pump house represents 71% of the annual operating costs of the pump house. The remainder is used to operate the two horsepower pump that pumps the water from the river to the water treatment plant.

Figure 4.1.5



4.2 Fuel Use Summary

As mentioned earlier, the combined fuel use during fiscal year 2010 totaled approximately 15,595 gallons at a cost of approximately $57,701. The average price per gallon of the fuel was approximately $3.70. In addition it is estimated that the recovered heat used during this period was the equivalent of 5,125 gallons of fuel. Per the heat sales agreement with AVEC, the approximate value of the fuel is $7,688. This results in a total consumption equivalent of approximately 20,720 gallons of fuel with a value of approximately $65,390.

It should be noted that AVEC has not invoiced for the value of the recovered heat. It is included in this report because it is contractually owed and because it was actually used.

The following, Table 4.2 is a summary of the approximate fuel usage over time. It should be noted that parts of the table are estimated, especially the recovered heat. No accurate records exist for the actual amount of recovered heat used.

Table 4.2.1 – Fuel Use Summary

Month	WTP Gallons	WTP Recovered	WTP Total	Island Gallons	System Total
October	913		913	392	1,305
November	935	300	1,235	401	1,636
December	1,400	400	1,800	600	2,400
January	1,190	1,800	2,990	794	3,784
February	2,528	400	2,928	1,083	4,011
March	272	2,225	2,497	407	2,904
April	2,576	0	2,576	1,104	3,680
May	0	0	0	0	0
June	0	0	0	0	0
July	0	0	0	0	0
August	0	0	0	0	0
September	700	0	0	300	1,000
Total	10,514	5,125	15,639	5,081	20,720

The recovered heat from the AVEC power plant is only available at the water treatment plant. AVEC has estimated that the heat recovery system has the capacity to deliver the equivalent heat of approximately 17,000 gallons of fuel. During fiscal year 2010, the water treatment plant only used the equivalent of approximately 5,125 gallons of fuel. This is due to a combination of control issues, operator actions, and problems with the delivery system. The heat equivalent to one gallon of recovered heat costs (when invoiced) approximately $1.50 verses the approximate $3,70 per gallon of fuel purchased. If the use of the recovered fuel was maximized, the annual fuel cost would have been reduced by approximately $26,125. This is derived by multiplying the difference in fuel cost of $2.20 per gallon by the additional 11,875 equivalent gallons available.

In the water treatment plant, the heat is being used for the following purposes with the approximate percentage used and associated costs noted. Table 4.2.2 below is an approximation of where the heat was utilized in the water treatment plant. Please note that due to the lack of controls and historical data, this is an estimate based on typical usage and observations made during the audit.

Table 4.2.2 – Water Treatment Plant Fuel Usage

Where Used	Gallons	Percent of Total	Cost
Building Heat	2,344	15	$6,988
Well Line Heat	1,565	10	$4,660
Water Tank Heat	9,386	60	$27,954
Vacuum Lines	2,344	15	$6,988
Total	15,639	100	$46,590

Energy conservation measures have been identified to reduce the consumption and cost of fuel in the water treatment plant and are discussed in detail in that section of the report.

In the island vacuum plant, the heat is being used for the following purposes with the approximate percentage used and associated costs noted. Table 4.2.3 below is an approximation of where the heat was utilized in the island vacuum plant. Please note that due to the lack of controls and historical data, this is an estimate based on typical usage and observations made during the audit.

Table 4.2.3 – Island Vacuum Plant Fuel Usage

Where Used	Gallons	Percent of Total	Cost
Building Heat	1,016	20	$3,760
Add Heat Circ Lines	2,540	50	$9,400
Water Supply Line	762	15	$2,820
San. Discharge Line	762	15	$2,820
Total	5,081	100	$18,800

Energy conservation measures have been identified to reduce the consumption and cost of fuel in the island vacuum plant and are discussed in detail in that section of the report.

5. ENERGY CONSERVATION MEASURES

A large number of energy conservation measures (ECMs) have been identified that if implemented will have a major impact on the operating costs of the water and sanitation systems in the Village of Selawik. These measures are described on the following pages.

The recommendations, savings calculations and estimated implementation costs are derived from design information obtained from the original drawings and specifications, observations made during the on-site audit, discussions with plant operators, detailed measurements and monitoring done during the audit, review of historical consumption data, review of the heat recovery system, quotations and historical knowledge of both energy engineering and water treatment plants.

It should be noted that this report does not include specific design instructions. It is not intended as a final design document and projects have not been developed to construction design level. The design professional or other persons following the recommendations shall accept responsibility and liability for the results. Budget for engineering and design of these projects is included in the cost estimate for each measure as needed.

Energy Conservation Measure

Eliminate Use of Heat Tape on Island Utilidors

Description:

The water and vacuum sanitation lines that serve all the connections on the island are within a common utilidor. By design, the utilidor is heated with the heat in the circulating water. The heat tape was installed and intended to only be used if for some reason the water and sanitation lines froze and needed to be thawed. These heat tapes were left on the entire winter.

It is critical that the heat-add be properly controlled and set before this is implemented.

Savings Potential:

The heat tape for these lines is separately metered. Therefore, the exact consumption is known. This information was gathered from actual AVEC electric bills and is shown in Figure 4.1.1. A total of $75,001 was spent to heat these utilidors with electric heat tape. The entire amount can be saved by making sure they are not used.

Implementation Cost:

There is no cost to implement this recommendation, the existing water plant operators can make sure the circuit breakers that feed this heat tape are shut off on each pole. We do recommend that the appropriate AVEC accounts be closely watched to assure they are not turned back on. A clearly marked permanent note on each panel that feeds this heat trace may be appropriate.

Simple Payback:

Since there is no implementation cost, the simple payback would be immediate.

Energy Conservation Measure
Eliminate Use of Heat Tape on Arctic Pipe Used for Water Loops

Description:

The water lines that run from the water treatment plant, are within an insulated arctic pipe. By design, the arctic pipe is heated with the heat in the circulating water. The heat tape was installed and intended to only be used if for some reason the water line froze and needed to be thawed. These heat tapes were left on the entire winter. It was apparent during the audit that they are still on since the water leaving the water treatment plant was colder than the water returning from the loop.

Savings Potential:

The heat tape for these lines is fed from the same meters that are used to feed the heat tape for the sanitation lines that in nearby arctic pipe. The combined consumption for both sources is known because it is metered. This information was gathered from actual AVEC electric bills. Figure 4.1.4 shows the annual consumption as $13,924 for the water line heat tape. This amount assumes that the breakdown between the water line heat tape and the sanitation line heat tape is approximately equal. That should be the case since all breakers are on.

Implementation Cost:

It is recommended that either an electrician, an engineer, other qualified individual such as an RMW determine which breakers feed the water lines and which breakers feed the sanitation lines and clearly mark them. The breakers that feed the water lines should then be shut off. It is estimated that this effort could be accomplished in a two day trip to Selawik from Anchorage. The total cost of this effort should not exceed $3,000.

Simple Payback:

The simple payback would be the cost divided by the saving or $3,000/$13,924 = 0.2 Years.

Energy Conservation Measure

Add Controls to Pump House Heat Tape

Description:

The heat tape that is used to keep the pump house above freezing so the raw water can be pumped from the river to the water treatment plant is just a large coil of heat tape in the bottom of the pump house with no controls on it. During the audit the pump house was approximately 80 degrees when the outside temperature was zero. The existing glycol heater and back-up electrical heater should be repaired, put back into operation, and the heat tape removed.

Savings Potential:

The pump house is separately metered. As illustrated by Figure 4.1.5, the total consumption of the water pump and the heat tape is $6,258 annually. The pump is 2 horsepower and based on both records and operator discussions, it operates approximately half of the available hours. This results in an annual operating cost of $1,785. The difference between the $6,258 annual usage for the total meter and the pump operating cost of $1,785 is the $4,473 operating cost of the uncontrolled heat tape. A conservative estimate is that 60 percent of the operating cost could be eliminated by installing a heater designed for the application that is properly controlled. The result would be an operating cost in the range of $1,789 and therefore an annual savings of approximately $2,684.

Implementation Cost:

The controls on both the glycol heater and the electric back-up need to be re-commissioned and the excess heat tape removed. The estimated cost to implement this measure is $2,500.

Simple Payback:

The simple payback would be the cost divided by the savings or $2,500/$2,684 = 0.9 Years.

Energy Conservation Measure

Maximize Use of Recovered Heat in the Water treatment Plant

Description:

The heat available for recovery from the AVEC power plant was determined by AVEC to be the equivalent of approximately 17,000 gallons of fuel. At present, the equivalent of approximately 5,125 gallons are being recovered. The necessary operational and control improvements should be made to maximize the use of recovered heat.

Savings Potential:

As discussed in Section 4.2 of this report, the cost of purchased fuel is $3.70 per gallon while the cost of recovered heat is the equivalent of approximately $1.50 per gallon (if invoiced). The additional heat available for recovery is equivalent to approximately 11,875 gallons. At the price difference of $2.20 per gallon, that would result in a savings of approximately $26,125.

Implementation Cost:

Two issues need to be corrected to maximize the use of recovered heat. The first is the temperature sensor that controls the variable speed drive (VSD) on the pump for the recovered heat system needs to be replaced to allow the VSD to properly control the pump. The second is that the controls between the boiler need to be set up such that the operator can't easily set the boiler operating temperature higher than the recovered heat temperature. The temperature sensor required is inexpensive and a relatively inexpensive boiler controller can be installed to properly sequence the heat recovery system and the boilers. A mechanical engineer will be required to determine what improvements are appropriate. This will cost approximately $9,000 is estimated that the materials needed would cost less than $1,000. The only other cost would be installation, setup and training. A total cost of approximately $24,000 including travel would be conservative.

Simple Payback:

The simple payback would be the cost divided by the savings or $24,000/$26,125 = 0.9 Years.

Energy Conservation Measure

Replace Water Treatment Plant Heat Add Controls

Description:

The controls used to add hydronic heat to the water tank, well raw water line, and the vacuum glycol lines are all either inoperable or need to be remounted to accurately sense the temperature of the liquid they should be measuring. The heat exchanger that heats the water tank has no operable control and presently controlled manually. During the audit, the tank temperature was 54 degrees Fahrenheit, a minimum of 10 degrees higher than it needed to be. The controller for the heat exchanger that heats the glycol line for the well water is inappropriate for the sensor well and was measuring water plant ambient temperature. The same was true of some of the vacuum glycol controllers. All of these controllers need to be replaced or at a minimum re-commissioned.

Savings Potential:

The improvements necessary to maximize the use of recovered heat should be implemented prior to this recommendation.   Therefore, the new cost of providing hydronic heat to the water treatment plant would be approximately $20,465. As illustrated in Table 4.2.2, approximately 60 percent of the heat used in the water treatment plant is used to heat the water in the tank and approximately 40% of that can be saved by reducing over-heating of the tank water. Ignoring the savings potential in the well raw water line and the vacuum sanitation lines, the savings would conservatively be 40 percent of the new cost to heat the tank water ($12,279) or $4,912.

Implementation Cost:

The most cost effective method of replacing the controllers would be to purchase and install new controllers that could use the existing sensor wells. Approximately five new controller would be required at a total cost of approximately $2,000. With travel and installation included, the total installed cost would be in the range of $7,500.

Simple Payback:

The simple payback would be the cost divided by the savings or $15,500/$4,912 = 3.2 Years.

Energy Conservation Measure

Reconfigure the Heat Add System in the Island Vacuum Plant

Description:

The heat add system for the circulating water loop on the island presently measures the water temperature after the heat is added instead of before. As a result, there are times when the leaving temperature is higher than it needs to be. The heat-add system should be reconfigured to measure the temperature of the water returning from the loop and adding heat as required.

Savings Potential:

As shown in Table 4.2.3, the heat-add load is approximately half the total load on the island vacuum plant boilers. This results in a current operating cost of the added heat of approximately $9,400. Lowering the temperature to 45 degrees would save a minimum of 15 percent of the estimated $9,400 present operating cost. This would be a savings of at least $1,410.

Implementation Cost:

Implementing this improvement would require the addition of a new well in the return line and the purchase and installation of a new controller.   Including travel, the installed cost would be approximately $4,500.

Simple Payback:

The simple payback would be the cost divided by the savings or $4,500/$1,410 = 3.2 Years

Energy Conservation Measure

Replace interior Lighting in both buildings

Description:

The lighting in both the water treatment plant and the island vacuum plant is almost entirely four lamp, four foot, fluorescent fixtures with energy efficient T12 lamps and energy efficient magnetic ballasts. These fixtures should be retrofitted by eliminating the ballasts and installing new LED lamps.

Savings Potential:

The water treatment plant has a total of 74 fixtures and the island vacuum plant has 24 fixtures for a total of 98 fixtures. The annual operating cost of these fixtures based on operating hours supplied by the operators, is $4,881. If all of these fixtures are retrofitted by eliminating the ballasts and installing LED lamps, the annual operating cost will be reduced to approximately $1,943. This would result in an annual savings of $2,938.

Implementation Cost:

The retrofit cost based on a per lamp cost of $55 and including travel and installation would be approximately $22,777.

Simple Payback:

The simple payback would be the cost divided by the savings or $22,777/$2,938 = 7.8 years.

Energy Conservation Measure

Re-commission the Vacuum Pumps

Description:

During the on-site visits, it became obvious that the vacuum pumps in both facilities are not operating per the original recommendations of the manufacturer. Both the pump staging (lead/lag) settings between the primary and secondary pumps as well as the absolute on and off set points should be adjusted to reduce run times. This should be done with the input of the manufacturer. The manufacturer also recommends an alarm be added on each set of pumps to alert operators of excessive run times.

Savings Potential:

Discussions with the manufacturer have indicated that the run times are excessive and that some of that is due to attempting to reach higher than necessary vacuum levels and improper on/off settings between the lead and lag pumps. The pump load is linear in the vacuum level range we are operating so any decrease in the set point will result in savings. The addition of an alarm on each set of pumps will alert the operators to excessive run times due to leaks. In discussions with the manufacturer, he stated that a 10% savings in power consumption would be a very conservative estimate of what we should expect from a combination of the addition of the alarm and re-commissioning the pump controls.

Figures 4.1.2 and 4.1.3 show the vacuum pump operating cost of the water treatment plant and the island vacuum plant as $25,383 and $19,607 respectively for a total vacuum plant operating cost of $44,990. Ten percent of this would be $4,499.

Implementation Cost:

The manufacturer has stated that most of what we need to implement an excessive run time alarm in each of the plants is already built into the controls. An estimate of $500 for materials to implement the alarms should be adequate. The actual re-commissioning would require an on-site visit by an engineer for a couple days and additional coordination with the manufacturer. The total cost of this effort including travel would be in the range of $5,500.

Simple Payback:

The simple payback would be the cost divided by the savings or $5,500/$4,499 = 1.2 Years

Energy Conservation Measure

Separately Meter the Cable TV Equipment

Description:

At present, the power for the City of Selawik operated cable TV operation is being paid for through the water treatment plant meter. This equipment should either be relocated to a separate building or separately metered.

Savings Potential:

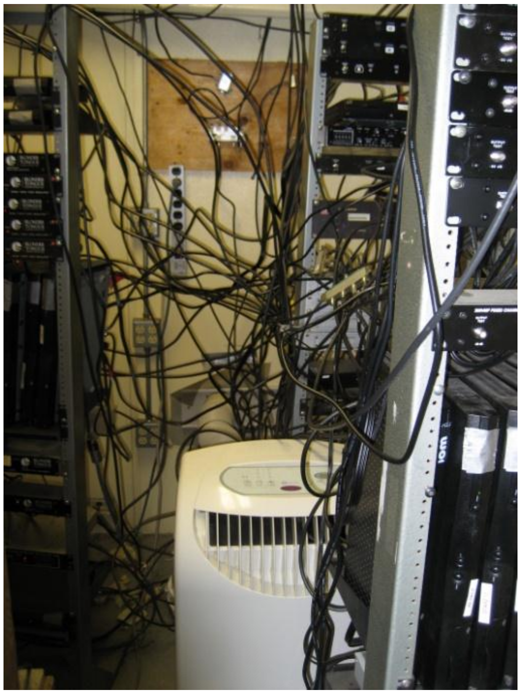
As part of the on-site portion of the energy audit, we metered the consumption of the four circuits that feed the cable TV equipment and have calculated that they consume approximately 500 kilowatt-hours per month or 6,000 kilowatt-hours per year. At the average rate of $0.27 per kilowatt-hour, the annual savings would be $1,620.

Implementation Cost:

Separating the cable TV load would require bringing a new service to the building, installing a meter socket and meter, installing a new panel, and relocating the four circuits to the new panel. It is estimated that this effort would cost in the range of $10,000.

Simple Payback:

The simple payback would be the cost divided by the savings or $10,000/$1,620 = 6.2 Years



Energy Conservation Measure

Eliminate Use of Electric Heaters in Washeteria and Rest Room

Description:

The old washeteria and the nearby restroom are being heated with portable electric heaters. The restroom heater has a capacity of 1,500 watts and the washeteria heater has a capacity of 15,000 watts. These heaters should be removed and the plant hydronic heating system modified to heat both areas with hydronic heat.

Savings Potential:

The water plant operators say the electric heat is only used on cold days. A review of the electrical consumption of the water treatment plant over throughout the year indicates that the usage increases significantly during the winter. Approximately 66,930 total additional kilowatt-hours are used in the winter months. Certainly not all of these kilowatt-hours are used by the heaters since there is a small amount of heat tape fed from the water treatment plant and the boilers run more. Also, we would be replacing the expensive electric heat with less expensive fuel or recovered heat but this heat is not free. A conservative savings estimate of $800 per year appears appropriate.

Implementation Cost:

Installing a new unit heater fed from the existing hydronic heating loop would allow the electric heaters to be eliminated. With a material cost of approximately $1,000, the installed cost including the necessary controls should not exceed $7,000.

Simple Payback:

The simple payback would be the cost divided by the savings or $7,000/$800 = 8.8 Years

Energy Conservation Measure

Isolate the Standby Boiler in the Water Treatment Plant

Description:

Only one boiler is kept on-line at a time in the water treatment plant but both are kept hot. That is, the circulated glycol is split between the two boilers. This is inefficient because it overheats the boiler room, results in excessive convection and radiant losses to them boiler room, and it reduces the flow through the boiler that is in use reducing the overall efficiency of the hydronic system. This second boiler should be isolated by closing the supply and return valves on the boiler.

Savings Potential:

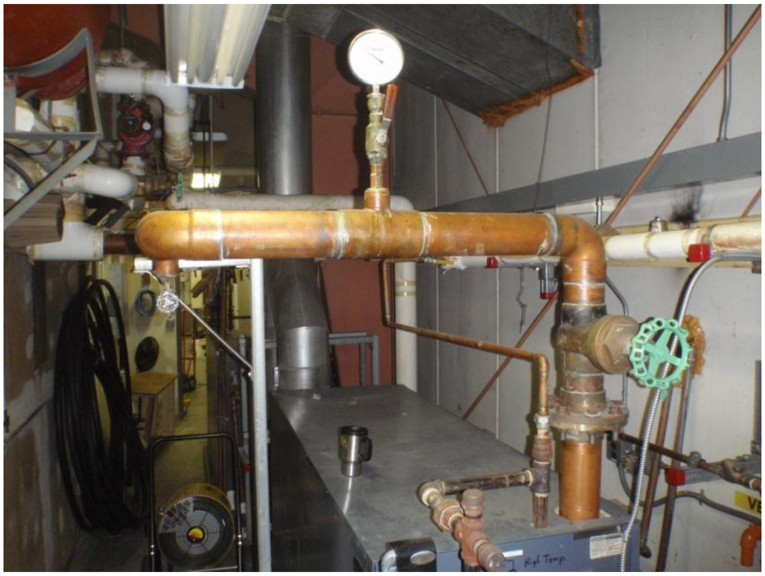
Although it would be very difficult to quantify the exact savings, the combination of radiant and convection losses would be a minimum of $300 per year.

Implementation Cost:

Since all that is required to isolate the boiler would be to close the two valves, there would be no implementation cost.

Simple Payback:

Since there is no implementation cost, the payback would be immediate.



Energy Conservation Measure

Reduce the Building Shell Leaks in the Island Vacuum Plant

Description:

During the blower door test and thermal imaging of the Island Vacuum Plant, several large building leaks were identified that should be repaired. The worst were the intake and exhaust dampers for the emergency generator, the fresh air damper for the building, and the draft damper for the #2 boiler. All of these should be repaired.

Savings Potential:

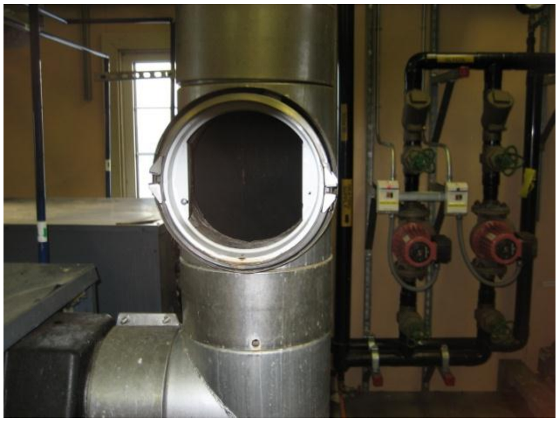
From Table 4.2.3, the approximate total cost to heat the island vacuum plant is $3,760. This is a heating cost per square foot of approximately $3.36 which indicates that the losses through these leaks are significant. A 15% reduction in the overall heating cost would be a conservative estimate. This would be an annual savings of approximately $564.

Implementation Cost:

None of the dampers need to be replaced except the draft damper on boiler #2. The rest can be repaired. The cost to replace the draft damper and repair the others including travel and labor for a qualified mechanical technician would be approximately $3,500.

Simple Payback:

The simple payback would be the cost divided by the savings or $3,500/$564 = 6.2 Years



Areas For Further Study

Reduce the Vacuum Settings on the Vacuum Pumps and Develop a Leak Program

Discussions with the manufacturer of the vacuum pumps indicated that there is potentially significant savings potential on the two vacuum sanitation systems. However, the time to perform the on-site testing and analysis is beyond the scope of this energy audit. It is recommended that additional discussions with the manufacturer of the pumps and additional testing take place to quantify savings achievable by a combination of reducing the vacuum levels to those minimally acceptable to reduce operating costs. It is also recommended that a leak detection and repair program be developed and put in place to minimize vacuum pump operating costs.

Confirm that the Power Cost Equilization Allocation is Correct

Analysis of the historical electric bills clearly illustrate that the power cost equalization limits were exceeded on a regular basis during the winter months on several accounts. A more detailed analysis and discussion with the electric company on the exact method used to allocate the kilowatt-hours available under power cost equalization is warranted but beyond the scope of this energy audit. It is recommended that due to the major impact this allocation has on the monthly electric bills, it be clearly understood and maximized to the extent possible.

Areas Considered But Beyond Payback Limit

Replace Boilers in Water Treatment Plant

The boilers in the water treatment plant are oversized and therefore result in excessive radiant and convection losses as well as additional inefficiencies associated with controls and stack losses. However, if all of the other energy conservation measures recommended in this report (which have shorter paybacks) are implemented the annual operating cost for the heating system will be in the range of $15,553. It would not be possible to replace the existing boilers and have the savings pay for them within a simple payback period of 10 years at present fuel costs.

Please note that there may be other reasons such as remaining useful life that justify boiler replacement.

Retrofit the Glycol Loops in the Arctic Pipe Vacuum Lines

As part of the audit, the cost of operating the electric heat tape was analyzed closely. The annual cost of operating the heat tape that serves the arctic pipe enclosed vacuum lines is approximately $13,924 as identified in Figure 4.1.4. Since the heat tape consumption is metered separately by the electric company, this cost is accurate.
The cost of replacing/retrofitting the glycol lines that should be used to heat the arctic pipe enclosed vacuum lines results in a simple payback period in excess of the 10 year limit.

Please note that there may be other reasons to retrofit/replace the glycol lines in this arctic pipe such as the remaining useful life of the heat tape now in use.