Division of Environmental Health and Engineering

Final Report

Energy Efficiency Upgrades for Sanitation Facilities in Selawik, Alaska

U.S. Department of Energy Award Number :
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FINAL REPORT

Project Title: Energy Efficiency Upgrades for Sanitation Facilities in Selawik, Alaska

Recipient: Alaska Native Tribal Health Consortium (ANTHC)

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Executive Summary

The Native Village of Selawik is a federally recognized Alaskan tribe, located at the mouth of the Selawik River, about 90 miles east of Kotzebue in northwest Alaska. Due to the community's rural location and cold climate, it is common for electric rates to be four times higher than the cost urban residents pay. These high energy costs were the driving factor for Selawik pursuing funding from the Department of Energy in order to achieve significant energy cost savings.

The main objective of the project was to improve the overall energy efficiency of the water treatment/distribution and sewer collection systems in Selawik by implementing the retrofit measures identified in a previously conducted utility energy audit. One purpose for the proposed improvements was to enable the community to realize significant savings associated with the cost of energy. Another purpose of the upgrades was to repair the vacuum sewer system on the west side of Selawik to prevent future freeze-up problems during winter months.

By upgrading the existing water treatment/distribution and vacuum sewer collection systems to operate more efficiently, the project significantly reduced Selawik's dependence on fuel oil as well as reducing electrical costs thus supporting the community in its quest for independence from external economic pressures. This project has provided Selawik the opportunity to have a more affordable and sustainable water and sewer system. This in turn enables tribal members to continue to live in their traditional lands and pursue their subsistence lifestyle.

Completion of this DOE funded project, and completion of additional energy efficiency upgrades funded by other partners, has resulted in an operational and maintenance cost savings of over $217,000 per year. Savings have been realized through the reduced consumption of fuel, reduced electrical demand, and reduced labor costs. Regular preventative maintenance of system components is recommended for the realization of long term benefits of this project. Changes to the utility ordinance and improved operation and maintenance preparedness, training, and response will also help to realize long term benefits.

Project Overview

Background

Selawik is located at the mouth of the Selawik River, about 90 miles east of Kotzebue. It lies 670 miles northwest of Anchorage. The community, which encompasses 2.5 square miles of land and 0.9 square miles of water, was developed across the Selawik River onto three banks linked by bridges. The sanitation utilities of interest consist of a building that houses both the water treatment plant and vacuum sewer plant and an above-ground system of arctic pipes that houses water and sewer mains and service lines.

The community of Selawik has two governing bodies, the Native Village of Selawik and the City of Selawik. The Native Village of Selawik is a federally recognized Alaskan tribe organized under the Indian Reorganization Act (IRA). The Selawik IRA, as a local government body in the community, has initiated a number of construction projects (local housing, clinic, etc.) and programs (recycling, environmental awareness, etc.) to benefit its members. The City of Selawik is a second class city within the Northwest Arctic Borough. The City of Selawik owns the water and sewer utility. The City has contracted with the Alaska Native Tribal Health Consortium's (ANTHC's) Alaska Rural Utility Collaborative (ARUC) to manage and operate the water and sewer utility.

ANTHC is a non-profit consortium of tribes from throughout the State of Alaska; ANTHC provides public health services. The Division of Environmental Health and Engineering (DEHE) is the second largest division of ANTHC. DEHE has resources in the areas of project management, engineering, construction, and tribal utility support, among others. DEHE plans, designs, and constructs water and sewer systems, washeterias, and clinics in rural Alaska and supports the tribal health facility network of hospitals and clinics throughout Alaska. DEHE also operates the Alaska Rural Utility Collaborative (ARUC), a successful and sustainable utility management program for water systems in rural communities.

Due to escalating energy costs, ANTHC and its tribal stakeholders are changing the way they approach business in rural Alaska. Today, ANTHC's goal is to reduce the long-term O&M costs of the sanitation facilities as much as possible, while maintaining the health benefits to its stakeholders. ANTHC's long-term vision includes assisting communities to upgrade their

sanitation facilities to become more energy efficient, remotely monitoring energy use at the sanitation facilities, and promoting system sustainability by training local operators.

Selawik has some of the highest utility fees in the state. The community of Selawik's most important and urgent energy goal is to achieve significant cost savings from the proposed installation project. The cost of fuel oil in Selawik is tremendously high, sometimes reaching over $5/gallon, which increases the costs of heating, sanitation, and electrical services for the community residents. It is common for electric rates to be more than $0.50 per kilowatt-hour in many rural Alaska villages, which is four times higher than the cost that urban residents pay.

Considering the high energy costs, Selawik's long-term energy vision is to reduce their dependence on fossil fuels (diesel) and use locally available resources, such as wind and waste heat. The community of Selawik has been actively pursuing funding for projects that will help reduce their energy costs.

Although the Selawik IRA and the City of Selawik have experience with administering grants, the Native Village of Selawik and City of Selawik partnered with Alaska Native Tribal Health Consortium (ANTHC), the grant recipient, for this project because the installation portion of the project required engineering design and construction within existing sanitation facilities. Under this grant, ANTHC was responsible for the project management, technical aspects, and financial tracking of the project.

ANTHC was also working with the City of Selawik and the Native Village of Selawik to complete water treatment plant upgrades to improve treatment and also reduce the cost of treating the water. A portion of a grant from the Indian Health Service for the water treatment plant upgrade was used as match for the DOE grant request. In addition to receiving funding from DOE, Selawik received a grant from the State of Alaska. This allowed comprehensive energy efficiency improvements to be completed instead of limiting the energy efficiency improvements to the scope defined in the DOE request.

The project was designed by ANTHC staff engineers and constructed by force account labor using village hires, supervised by an ANTHC superintendent.

Project Objectives

The project in Selawik was part of a larger effort to upgrade the community's primary sanitation utility—the water treatment and vacuum sewer plant. The main objective of the project was to improve the overall energy efficiency of the water treatment/distribution and sewer collection systems in Selawik by implementing the retrofit measures as identified in the Utility Energy Audit (Attachment A). One purpose of the proposed improvements was to enable the community to achieve significant savings associated with the cost of energy for operating the water and sewer utility. Another purpose was to repair the vacuum sewer system on the west side of Selawik to prevent future freeze-up problems during the winter.

To fulfill the main project objectives, the following scope items were identified:

- Provide an engineering design for the identified energy efficiency measures
- Make upgrades at the water treatment/vacuum sewer plant according to the engineering design
- Develop a leak detection testing and repair program for the glycol heat trace and vacuum sewer collection systems.

Activities (Tasks) Performed

To accomplish the main objective of improving the overall energy efficiency of the water treatment/distribution and sewer collection systems the following retrofit measures (tasks) were implemented.

Task 1 – Provided an engineering design for the energy efficiency retrofits. The design consisted of mechanical, electrical, and civil engineering drawings and details that were used as construction plans to implement the upgrades at the water treatment/vacuum sewer plant.

Task 2 – Completed upgrades to the interior of the water treatment and vacuum sewer plant, include the following measures:

1. Modified the piping, storage and controls on the existing glycol heat trace system within the plant for the three vacuum sewer lines that experience freeze-up.
2. Maximized the recovered heat that can be used within the plant by installing temperature sensors and boiler controllers.
3. Installed new controllers that added hydronic heat to the water storage tank, raw water line, and the vacuum glycol lines that are compatible with the existing sensor wells on each of these components. This included retrofits to the recovered heat system to maximize the recovered heat benefit.
4. Retrofitted interior florescent fixture lighting and replaced with LED lamps
5. Recommissioned the vacuum pumps according to the manufacturer's instructions, adjusted the settings between pumps to reduce pump run times and installed an alarm on the pumps that will alert the operator of excessive run times.
6. Eliminated heat tape on the circulating water distribution loops by determining and shutting off the breaker that feeds the water loop.

Task 3 – Developed a leak detection testing and repair program. Inspected glycol heat trace and the vacuum sewer collection lines for areas of air infiltration and made necessary repairs to restore the integrity of both systems.

Conclusions and Recommendations

Through new technologies and improvements to the water and sewer system, ANTHC was able to reduce Selawik's water/sewer expenses by 32% which equals approximately $217,227[*] per year. The reduction in energy costs was considerably more than was originally projected at $63,690 per year.

Breakdown of the cost savings are as follows:

- Electricity Savings: 68% savings or $146,719 saved annually. The project decreased electricity usage by 45%, which resulted in a 68% cost savings due to the effect of PCE electricity subsidies from the state.
- Fuel Savings: 50% savings or $40,352 annually. Installing updated technology in the recovered heat system resulted in roughly doubling the amount of heat obtained from the power plant. This reduced fuel usage from 20,000 gallons of fuel per year to 10,000 gallons.
- Labor Savings: 15% savings or $30,156 annually. Labor costs decreased due to improved reliability of the water and sewer system and decreased freeze-ups of service lines and mains. The labor savings are expected to increase in the future, as the reliability portion of the project was recently completed.

Lessons Learned

1. As part of the comprehensive energy efficiency upgrades significant portions of the utilidor and arctic pipe were releveled to improve the operational efficiency of the vacuum sewer system. Additional investigation into the seasonal movement of the system is recommended. After completion of the releveling, sections of the system continued to move while some sections appeared to move very little. Investigation of the ground conditions in these locations as well as observations of seasonal variations is recommended. Additionally, a review of the construction methodology should be reviewed. Older portions of the system appeared to move more than new portions of the system. One theory is the depth of the helical pier foundation system varies between the two sections of the system and that the newer system's anchors are installed deeper. Understanding the variables as they relate to pipe/utilidor movement within the system will allow others to better design future installations to be more resistant to movement and thus result in a more efficient installation.

[*] The DOE project was completed in conjunction with funding from the State of Alaska in order to complete comprehensive energy efficiency upgrades; this included all energy upgrades identified in the audit previously completed. Energy efficiency scope funded by the State of Alaska included vacuum sewer utilidor releveling, utilidor junction box insulation, arctic box insulation, and water service line circulation pump replacement.

2. The water and sewer system in Selawik consists of numerous junction boxes which are insulated boxes where pipes change direction, valving is located or service lines connect. There are also insulated arctic boxes at each home where the pipe penetrates the home. These boxes were all reinsulated as part of the comprehensive energy efficiency upgrades (see note above, funding from the State of Alaska). This work was completed in the first season of construction. In the second year, it was observed that these boxes moved and required reinsulating. It is recommended this be identified as part of a preventative maintenance plan and completed annually.

3. Leaks in the vacuum system were repaired. Upon completion of this effort, the operation of the vacuum pumps was reduced from two pumps operating almost continuously to one pump operating about 18 hours per day as observed by ANTHC's onsite superintendent. Within six months to a year, the pump operation time had returned to pre-repair operational times.

   ANTHC assessed this observation and determined the leaks were primarily occurring in the in-home vacuum valves. One to two valve failures, or as few as 10 partial valve failures, can result in the observed pump operational times. Homeowners were not reporting the leaks because the ordinance for the utility places the financial responsibility for repair of in-home components on the homeowner; vacuum valves cost between $700 and $1200 to replace. Consequently, homeowners were waiting to report failures until the sewer service was completely non-functional.

   ARUC is currently working on revising the utility ordinance to shift responsibility of vacuum valve maintenance, repair and replacement on the utility. Additionally, ARUC will train personnel to repair vacuum valves in order to minimize replacement costs. It is recommended that a leak detection program be implemented resulting in annual inspection of all valves and piping. This will reduce the operational costs associated with the vacuum pumps.

Photographs

Photo 1: *Selawik crew pulling new glycol lines on the vacuum sewer main*

Photo 2: *New glycol heat trace piping installed*

Photo 3: *Vacuum sewer main (realignment and heat trace installation underway)*

Photo 4: *Hydronic heat add piping in the water treatment plant before insulation was installed*

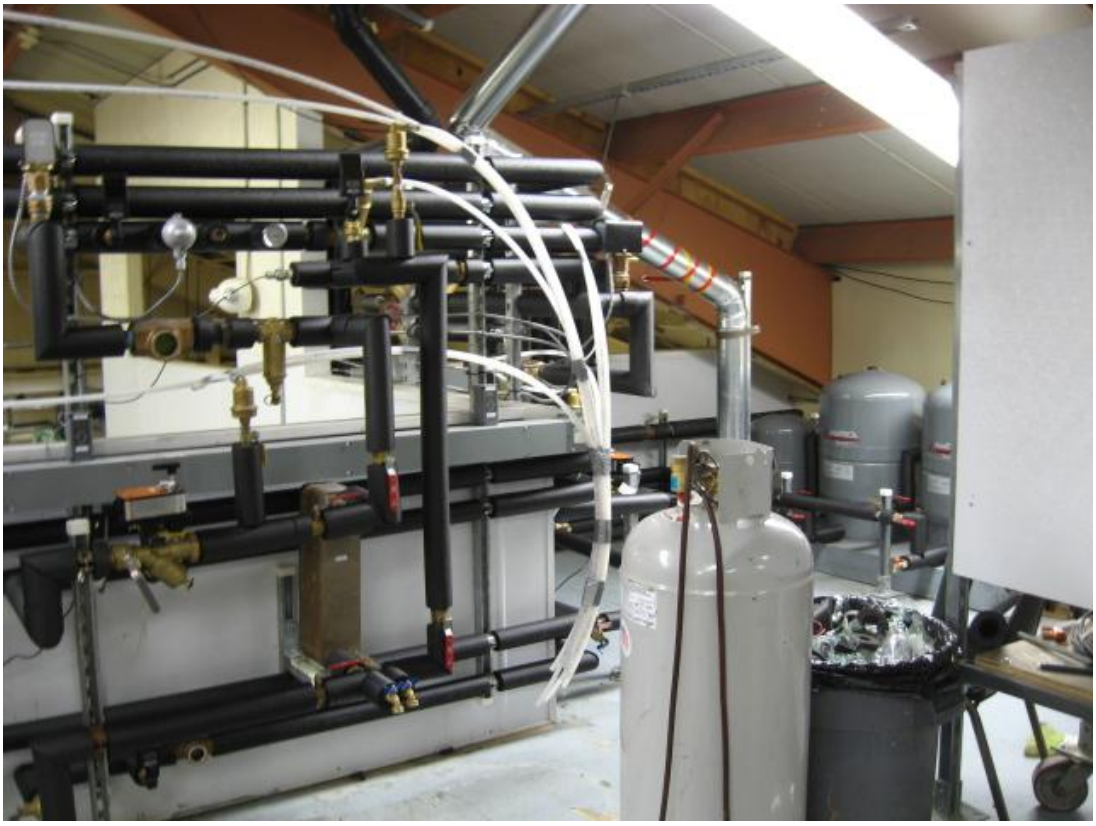

Photo 5: *Hydronic heat add piping in the water treatment plant after insulation was installed*

Photo 6: *Damaged freight – one of the many logistical challenges working in Bush Alaska*

Photo 7: *Junction box – reinsulation of these boxes improved efficiency*

Photo 8: *Recovered heat module*

Photo 8: *Vacuum utilidor with service line and arctic box in the background*

Appendix

ANTHC identified new technologies that could reduce energy use in the Selawik water and sewer system. ANTHC assisted Selawik in receiving $1.4 million in State of Alasak and US Department of Energy grants, and helped install improvements including high efficiency pumps, boilers, and upgraded heat recovery systems. These energy improvements have decreased Selawik water/sewer expenses by 32%.

Energy project results in Selawik

Electricity Savings: 68% savings or $146,719 saved annually

This project decreased electricity usage by 45%, resulted in a 68% cost savings due to the effect of PCE electricity subsidies from the state.

Fuel savings: 50% savings or $40,352 saved annually

Installing updated technology in the recovered heat system resulted in roughly doubling the amount of heat obtained from the power plant. This reduced fuel usage from 20,000 gallons of fuel per year to 10,000 gallons.

Labor: 15% savings or $30,156 annually

Labor costs decreased due to improved reliability of the water and sewer system and decreased freeze-ups of service lines and mains. The labor savings are expected to increase in the future, as the reliability portion of the project was completed last.

Savings from Selawik energy project: $217,227 per year equaling 32% of total water/sewer budget

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