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Remote Alaska Communities Energy Efficiency Competition:

Energy Efficiency Implementation for Holy Cross, Alaska

Project location: Holy Cross, Alaska
Date of report: March 28, 2022
Report submitted by: City of Holy Cross
Award number: DE-EE0007851/0000
Total project costs: $655,744.73

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Acknowledgement

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Disclaimer

Project Partners

Holy Cross Tribal Council
Tanana Chiefs Conference (TCC)
Alaska Native Tribal Health Consortium (ANTHC)
Iditarod Area School District

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Introduction

The Deg Hit'an Athabascan village of Holy Cross is located along the Ghost Creek Slough bank of the Yukon River. Holy Cross is home to almost 170 people who are accustomed to both the advantages and disadvantages of living off the road system - the nearest major road is some 300 miles to the east. On one hand, Holy Cross residents have greater access to practicing traditional activities like subsistence hunting and fishing. Families in the area have fished, hunted, and gathered food together for many generations and the land is imbued with this special history. But compared to Alaskans living on the road system, the residents of Holy Cross pay higher prices for basic necessities since goods are transported via air service and seasonal barge shipments. Holy Cross residents also accumulate higher energy costs, as diesel fuel is the primary fuel source for heating and lighting and costs over $6 per gallon. Affording these high living costs becomes a barrier for Holy Cross residents who want to stay in the village or participate in subsistence activities requiring transportation by boat or ATV.

In 2010, the community used 674,638 kilowatt-hours (kWh) of electricity and 196,739 gallons of diesel, which equated to a combined energy use of 29,452 million British thermal units (MMBtu), about 165 MMBtu per capita. Desiring to reduce their energy consumption, Holy Cross participated in the 2015 U.S. Department of Energy's (DOE) Remote Alaska Communities Energy Efficiency (RACEE) Competition. They and 7 other communities received financial and technical assistance to implement energy savings solutions, including heat recovery and solar PV systems, building insulation, and lighting retrofits. These measures are expected to reduce the community's energy consumption by 15% and costs by over $50,000 annually. By 2021, the community is expected to have decreased electricity use by 100,000 kWh (15% decrease) and 10,000 gallons of diesel. Because of this reduction, the community will spend less on energy costs and is expected to save $100,000 annually. In addition to the realized energy and cost savings, the RACEE project benefitted the Holy Cross labor force. Due to the remote nature of Alaska communities like Holy Cross, jobs are difficult to come by. A majority of the Holy Cross RACEE grant work utilized local labor, providing valued employment for these residents.

Objectives

The project objective was to increase tribal energy security through the implementation of energy efficiency projects. As a grant recipient of the RACEE Competition, the City of Holy Cross committed to reducing their energy use by 15% per capita from 2010 levels by 2020. To accomplish this objective the community made the following goals:

1) Conduct building envelope and HVAC improvements on city buildings;
2) Conduct a community-wide LED lighting retrofit;
3) Install solar photovoltaic (PV) panels on the Tribal Hall;
4) Expand the heat recovery system at the power plant; and
5) Train an operator to maintain the new equipment installed throughout the course of the project.

The City of Holy Cross collaborated with several partners, including the Holy Cross Tribal Council, the Tanana Chiefs Conference (TCC), the Alaska Native Health Consortium (ANTHC), and the Iditarod Area School District, to accomplish these goals.

Description of Activities Performed

Through the RACEE project, and using complementary funding, the City of Holy Cross pursued multiple activities to meet each energy efficiency goal. The project timeline is shown in Table 1.

Weatherization

Several buildings received weatherization through this project. In general, buildings received air-sealing measures around doors and windows and in the crawlspace to prevent cold air from entering the building above, as well as LED lighting. Buildings with air handling systems also received air filters to improve indoor air quality. Multiple buildings received additional insulation for the building envelope.
Lodge - General weatherization upgrades, LED lighting
School - General weatherization upgrades, LED lighting, and new windows
Old Tribal Office - General weatherization upgrades, LED lighting, new windows, new bathroom fans, two 2-inch layers of rigid foam added to the bottom of the floor, two 3-inch layers of rigid foam added to building exterior, R-39 fiberglass batting added to attic space
City Office - General weatherization upgrades, LED lighting, new windows, new bathroom fans
Community Hall - General weatherization upgrades, LED lighting, new windows, new bathroom fans
Youth Center - General weatherization upgrades, LED lighting, new windows, new bathroom fans, 2 inches of rigid foam installed underneath the floor, new front door
Clinic - General weatherization upgrades, LED lighting, new windows, new bathroom fans, 2 inches of rigid foam installed under the floor, more efficient furnace upgrade

Community-wide LED lighting retrofit

Throughout the country, LED lighting has been taking hold due to improved light output and reduced energy costs. Nowhere is this more true than rural Alaska where energy costs are the highest in the nation and lighting is extremely important during the long dark winters. Across Alaska, community-wide LED lighting retrofits are regarded as a quick and cost-effective method of reducing electric bills and reducing diesel use, since electricity is typically generated in diesel power plants in rural Alaska.

In Holy Cross, the community-wide LED lighting retrofit project consisted of the inventory of existing features and the replacement of light bulbs with energy efficient LED bulbs. The lighting retrofit was completed in 56 homes as well as the following city buildings: the Youth Center/IGAP building, the new Tribal Building, the Clinic, City Garage Shop, City Washeteria, Community Hall, City Office, School, Teaching Housing apartments A and B, and Holy Family Church. The commercial Deloycheet, Incorporated Office and lodge/apartments were also included in the retrofit.

Table 1: Project timeline.

Date	Event
April 2017	Project inception
Winter 2017 / 2018	Communications and Data Management Plans completed
Spring 2018	Kickoff meeting in Holy Cross, including a meeting with the Tribal Council to plan the solar PV array and building renovation work; Community LED lighting retrofit began
September 2018	Solar PV installed on the Tribal Hall (commissioned in 2020); Community LED lighting retrofit completed
Spring 2019	Energy efficiency, building envelope, and HVAC improvements began on several tribal buildings
Summer 2019	Holy Cross School receives LED lighting
Fall 2019	Holy Cross Lodge is weatherized, recovery heat loop lines are installed; an audit identifies additional energy savings mechanical work at the Holy Cross School
Winter 2019 / 2020	HVAC improvements are completed at the Clinic, Youth Center, and Tribal Office; the Holy Cross School receives window upgrades and a school contractor repairs the mechanical system as identified in the fall
Spring 2020	Assessment and training trip to Holy Cross, materials for additional upgrades are ordered and shipped
Fall 2020	Holy Cross School weatherization work is completed; Local operator trained to maintain new equipment
Summer 2021	Waste heat recovery system expansion commmissioned

Figure 1: Weatherization improvements in Holy Cross buildings included new windows.

Figures 2 and 3: Weatherization improvements in Holy Cross buildings included exterior insulation under floors (above) and on walls (below).

Tribal Hall Solar PV

TCC reached out to the Alaska Village Electric Cooperative (AVEC), the electric cooperative, to review how much additional solar energy the local isolated grid could absorb. ANTHC had already installed a solar PV system on the water treatment plant. AVEC proposed a 9 kW system with half of it on the east facing roof of the tribal office, the other half on the west facing. TCC sent out a request for proposals for the solar system with those details specified. Figure 4 shows a predicted production of one east-facing and one west-facing 4.5 kW system on an 8/12 roof (approximately 34° roof). The model is PVWatts, at https://pvwatts.nrel.gov/, and is used to estimate solar production worldwide. The model uses local weather data to estimate the solar production based on past weather. For Holy Cross, the nearest weather station in the model is 150 miles away.

Lime Solar was chosen as the vendor for the photovoltaic installation on the Tribal Hall, shown in Figure 5. The vendor is an Alaska-based company. They installed the system on the Tribal Hall in summer of 2018. Due to insurance and issues with the power grid interconnection, the photovoltaic system was not commissioned until the end of summer 2020. Additionally, the project included training a local operator to maintain the new equipment. This supports the Tribe's long term goal of achieving, exceeding, and indefinitely maintaining their energy reduction pledge of 15% by 2020.

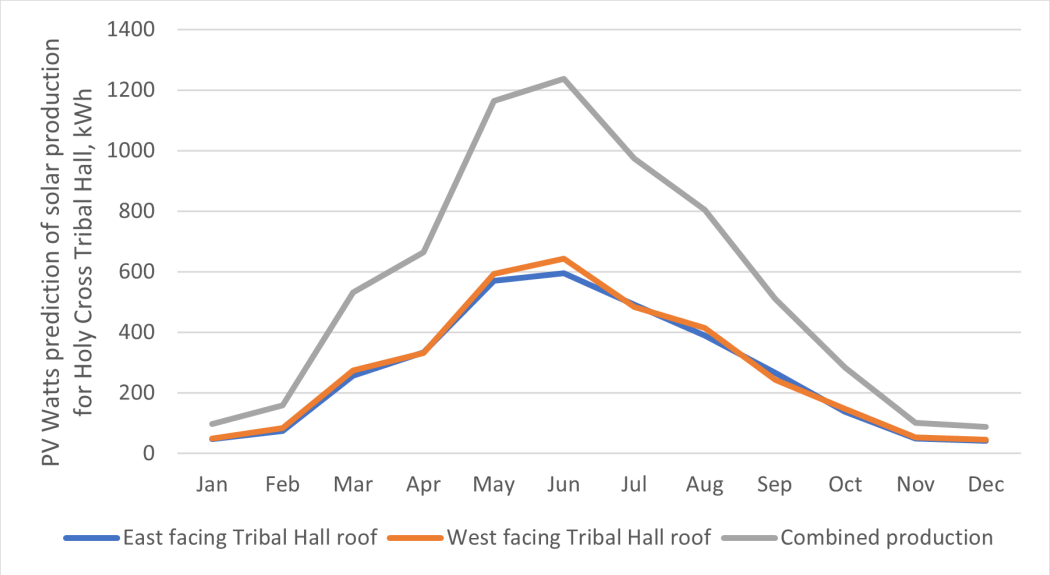

Figure 4: The predicted production for the Tribal Hall solar panel system, generated using the PVWatts online tool.

Figure 5: The Tribal Hall received new solar panels through the RACEE project.

Expansion of waste heat recovery system

Multiple partners collaborated to expand the waste heat recovery system in Holy Cross. The power plant in Holy Cross is managed by Alaska Village Electric Cooperative (AVEC). The Tanana Chiefs Conference (TCC), partnered with the Alaska Native Tribal Health Consortium (ANTHC), applied for and received a USDA grant to add the waste heat to the Water Treatment Plant and the Community Hall. Since the Community Hall is near the City Office, TCC was able to use RACEE funds to add length to the waste heat recovery return line to get the City Office waste heat incorporated with that for the Community Hall, and a single loop from the electric plant supplies both buildings. AVEC had some issues connecting all locations, and the final ones were coming online in summer 2021. Per Justin Curran with AVEC [personal communication, Sep 2, 2021], the "Holy Cross heat recovery [system] is operational and producing heat at 66 kBTU/HR".

In order to produce the same amount of heat that the heat recovery system is producing at present, an additional 3,000 gallons of fuel would have to be burned, since one gallon of diesel has 137,381 BTUs, or 137.38 kBTUs. Then 66 kBTUs per hour means approximately 1/2 gallon of fuel is saved per hour. That is equivalent to 12 gallons per day, or 360 gallons per month. With a 9 month heating season, that translates to 3,240 gallons. Note that this is for all facilities served by the waste heat.

Figure 6: The tank farm serving the power plant and buildings in Holy Cross. A waste heat recovery system was added to the power plant to reduce fuel use. Photo courtesy of AVEC, 2019.

Overview of Data

Holy Cross achieved energy savings through the RACEE project. While fuel usage data was not attainable except for the school, energy reductions from several aspects of the project were verified using electrical data.

Weatherization

The effect of weatherization of the community buildings is difficult to quantify without fuel usage, which was only available for the school (discussed in the section specifically about the school). The billed electricity data for multiple community buildings for 2018 to August 2021 is shown in separate graphs in Figure 7 and combined in Figure 8. Note that the scale varies between graphs. Electricity use decreased in the City Office and the Tribal Building. Other buildings, such as the Washeteria, Youth Center, and Community Hall show increases, which are likely attributed to increase usage of these buildings.

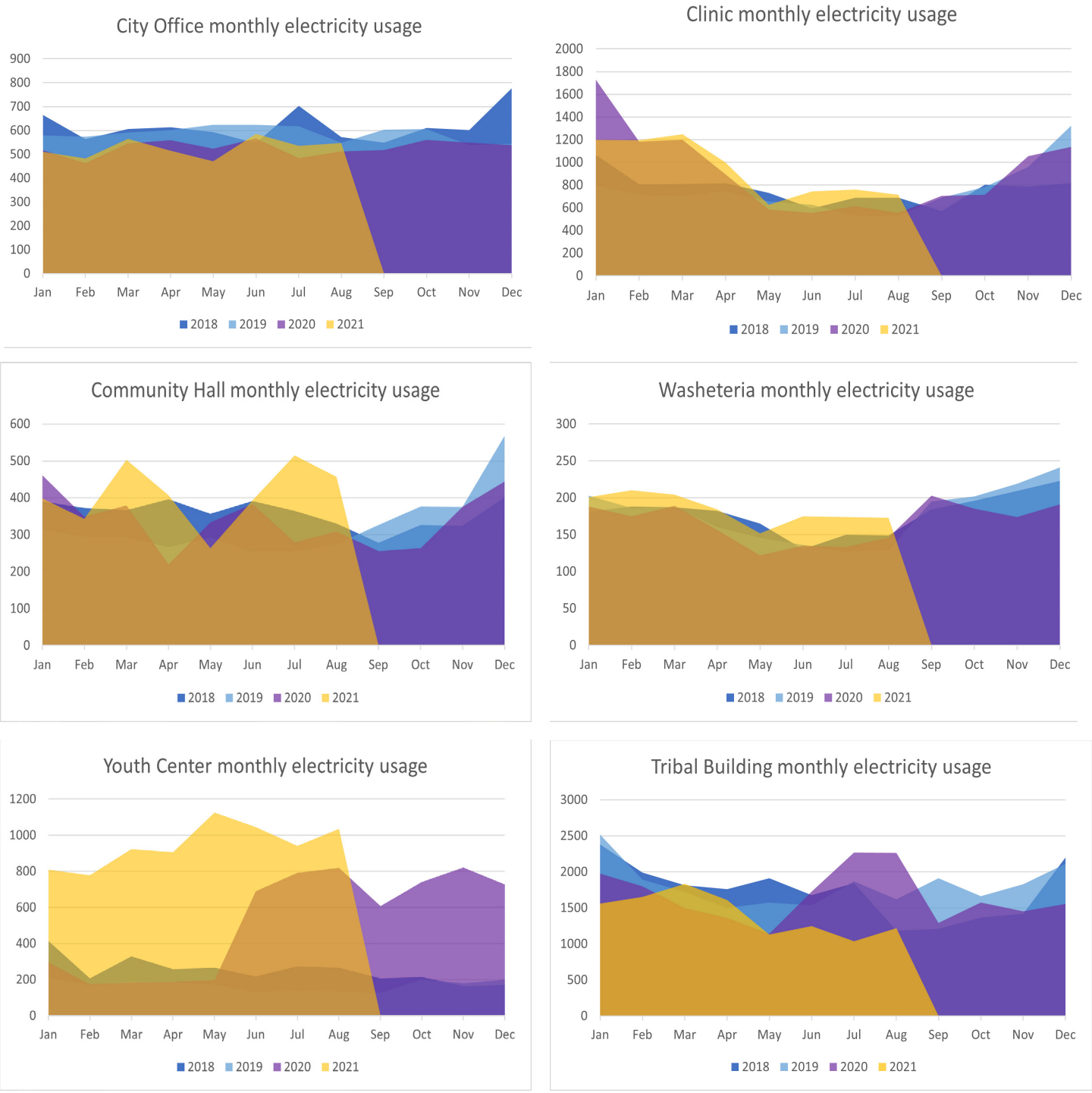

Figure 7: Graphs of electrical usage in kilowatt-hours for several community buildings in Holy Cross, from 2018 through mid-2021. Each building received a LED lighting upgrade and other weatherization upgrades during 2019 through early 2020.

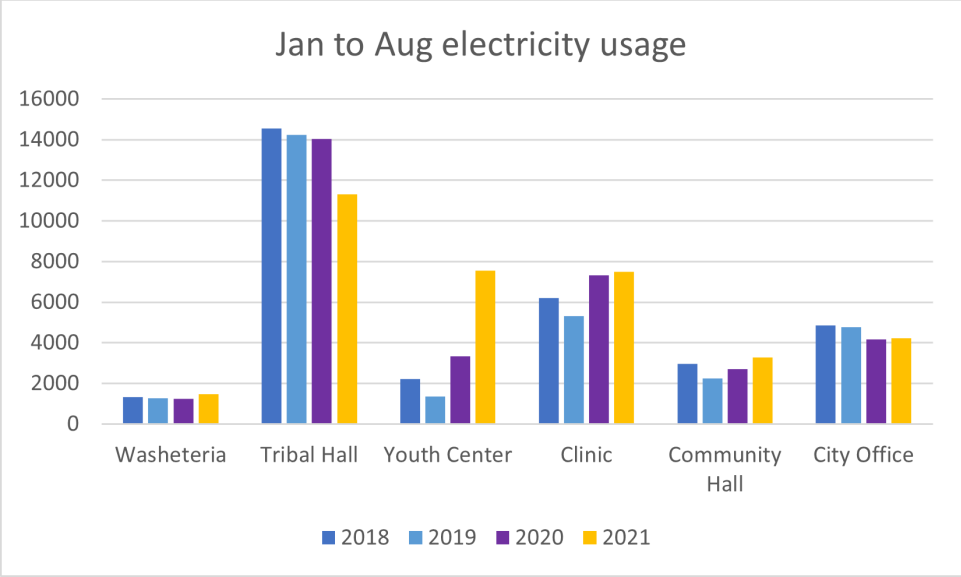

Figure 8: Graphs of electrical usage in kilowatt-hours for several community buildings in Holy Cross, for January through August 2018 through 2021 (the months for which data was available for 2021). Each building received a LED lighting upgrade and other weatherization upgrades during 2019 through early 2020.

Community-wide LED lighting retrofit

The LED lighting upgrade component of the RACEE project exchanged light bulbs for both residential and community buildings. Figure 9 shows the electricity sold in Holy Cross to residential customers [data from the Power Cost Equilization (PCE) website at http://www.akenergyauthority.org/What-We-Do/Power-Cost-Equalization/PCE-Reports-Publications]. There is a decrease over the last decade in power sold to residents. The population of Holy Cross decreased slightly during this time as well. However, the per capita electrical consumption decreased, as shown in Figure 9.

All of the above improvements have decreased the overall electricity use in Holy Cross across all customer bases (residential, commercial, and community buildings). Figure 10 shows the electricity sold to all customers in Holy Cross over the last nine years, per PCE records, decreasing as the community worked to reduce its consumption and improve the energy efficiency of its buildings.

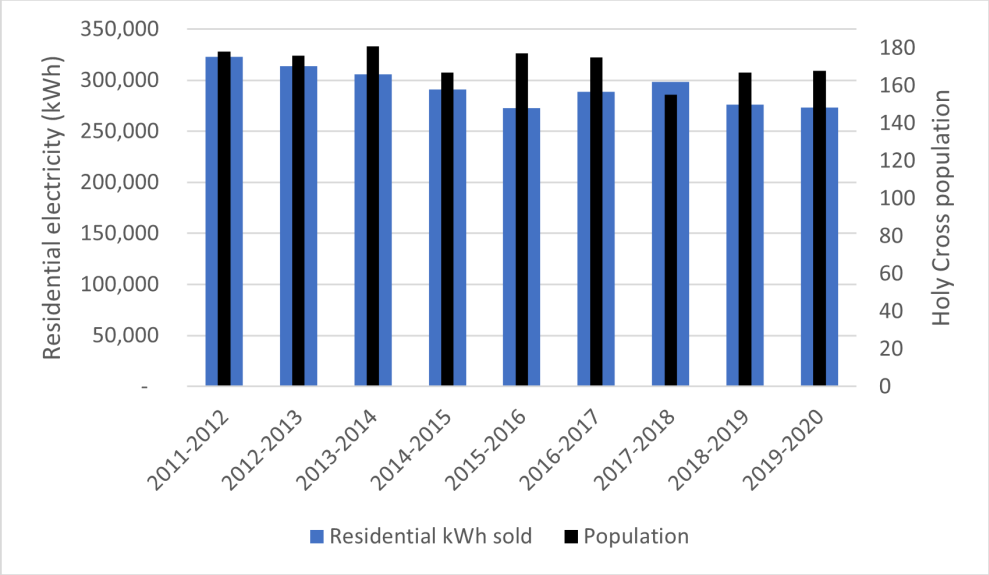

Figure 9: The per capita electric consumption decreased in Holy Cross from 2011 to 2020 as shown by the relative decreases in electrical consumption (blue bars) and population (black bars).

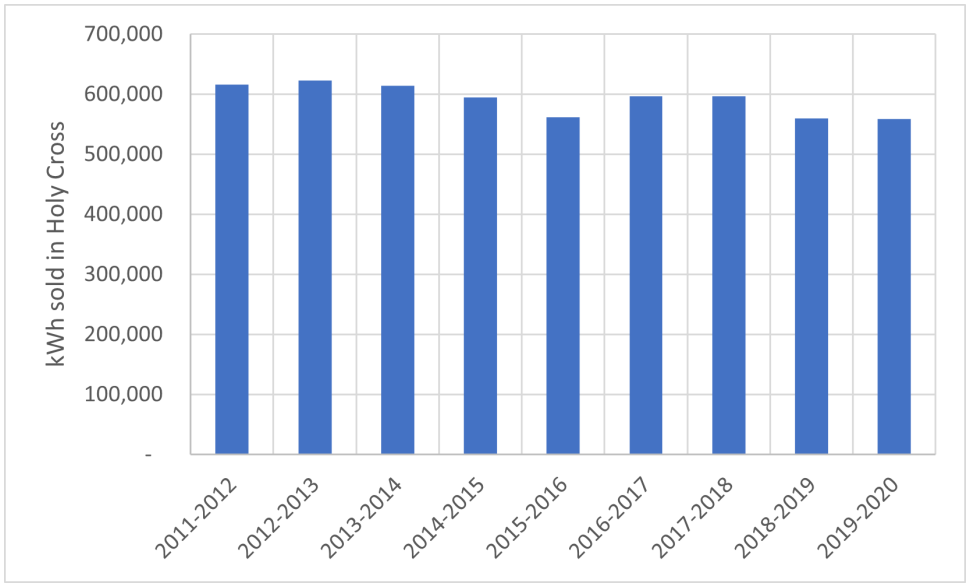

Figure 10: The annual electric usage from all building types decreased in Holy Cross during the last decade.

Data for the last three years during which the LED lighting upgrade took place is shown in Table 2. The table shows the total electricity sold in Holy Cross, as well as the residential electricity sold, and the percent change from the 2017-2018 baseline year. Over the course of two years, both total and residential electricity sold decreased, while the number of people living in the city increased. Specifically, the total electricity sold decreased by 7%, while the residential electricity sold decreased by 9%. During the same period, the population increased by 8%. Calculating the electricity sold per person shows the trends, and those numbers are in the the lower half of the table: the per-capita total electricity sold decreased by 16% over the course of two years, and the per-capita residential electricity decreased by 18%, nearly a fifth of previous residential electricity usage.

Table 2: Previous three years of electricity data for Holy Cross residential and all buildings.

Year	Total electricity (kWh)	% change		Residential electricity (kWh)	% change		Population	% change
2017 - 2018	596,390	-		298,169	-		155	-
2018 - 2019	560,226	-6%		275,948	-8%		167	7%
2019 - 2020	558,520	-7%		273,407	-9%		168	8%
	Total electricity per person (kWh)			**Residential electricity per person (kWh)**				
2017 - 2018	3,847.68	-		1,923.67	-		155	-
2018 - 2019	3,354.65	-15%		1,652.38	-16%		167	7%
2019 - 2020	3,324.52	-16%		1,627.42	-18%		168	8%

Tribal hall solar PV

The solar PV system for the Tribal Building was commissioned during the summer of 2020. The electricity for the building from 2018 through mid-2021 is shown in Figure 11, based on the utility bills for the building. There is an increase in electricity in summer 2020, possibly due to construction or higher usage as the pandemic was reaching a low in cases in Alaska. Summer 2021 saw a decrease in purchased electricity for the building. The building did receive an LED lighting upgrade, which would also be a cause for a decrease in purchased electricity for the building.

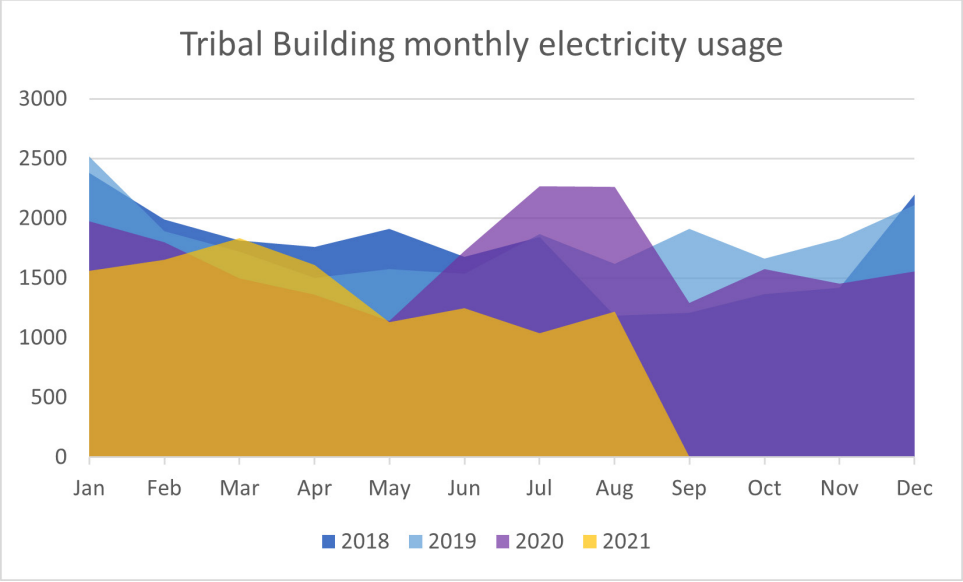

Figure 11: The Holy Cross Tribal Hall electric usage decreased for many months in 2021 compared to previous years.

Expansion of waste heat recovery system

The waste heat recovery system expansion to the City Office was fully commissioned in late summer 2021. Data is not yet available at the time of this report to verify the amount of fuel that the system is offsetting. However, the system as a whole is projected to save over 3,000 gallons of fuel annually, as calculated in the previous section documenting project activities.

Holy Cross School upgrades

The school upgrades reduced fuel and electricity energy use. The fuel use for the July to December timeframe was estimated based on partial logs. The electricity use was combined from the logs as well as a second sheet provided by the school.

The monthly electricity use is shown in Figure 12. Unlike previous figures, months start with the start of the school year in July and continue through the following June. The 2016-2017 school year is shown in dark blue, with following school years in other colors through the partial data available for the current year 2021 - 2022. The electricity use shows a decrease from the first three years on the graph 2016 - 2019 to the last three 2019 - 2022, thanks to improvements done to the building.

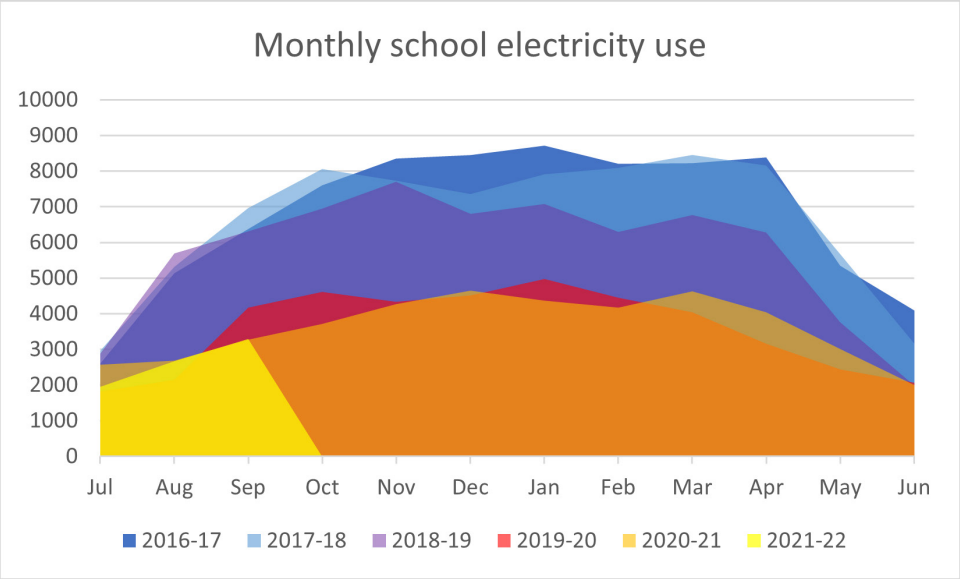

Figure 12: Monthly electricity use from the Holy Cross school decreased starting in the 2019 school year.

The total electricity billed to the school for the five complete years is shown in Figure 13 on the next page, as well as the percent of the 2016-2018 average. The school used approximately 80,000 kWh during 2016 - 2017 and 2017 - 2018 school years. This had decreased to below 50,000 kWh for the 2019 - 2020 and 2020 - 2021 school years, approximately 60% of the original use, or a savings of 40%.

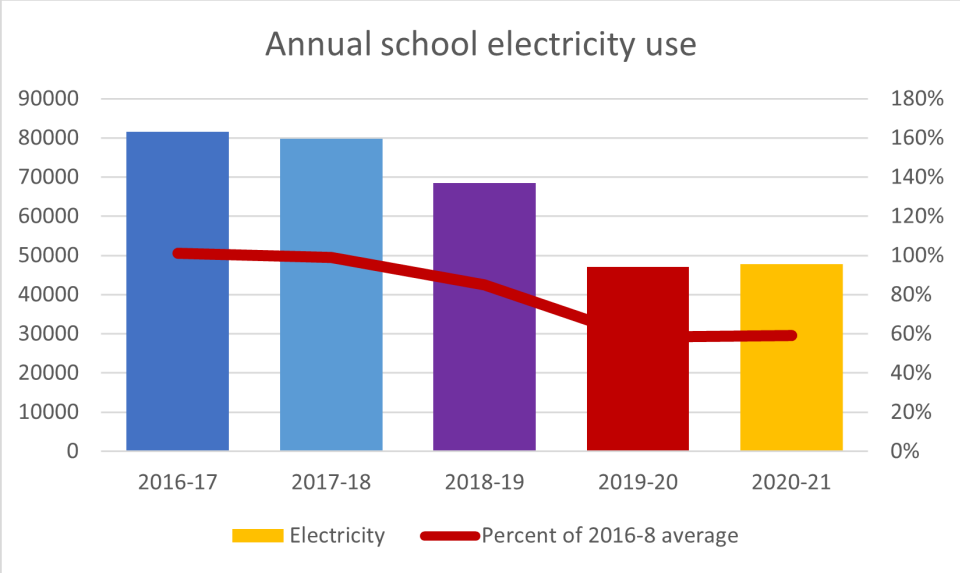

Figure 13: Annual electricity use, in kWh, for the Holy Cross School. It decreases to 60% of the baseline year during the project.

The fuel logs for the school were partially available. The school fuel tanks are refilled approximately once a month, but logs were not available for the second half of school years. Thus, the data for school fuel use for July to December time frame was graphed for the four years available. Figure 14 shows this data, along with the percentage decrease from the 2016 baseline. The school use for the first half of the year decreased to approximately 80% of the baseline year, a savings of 20%.

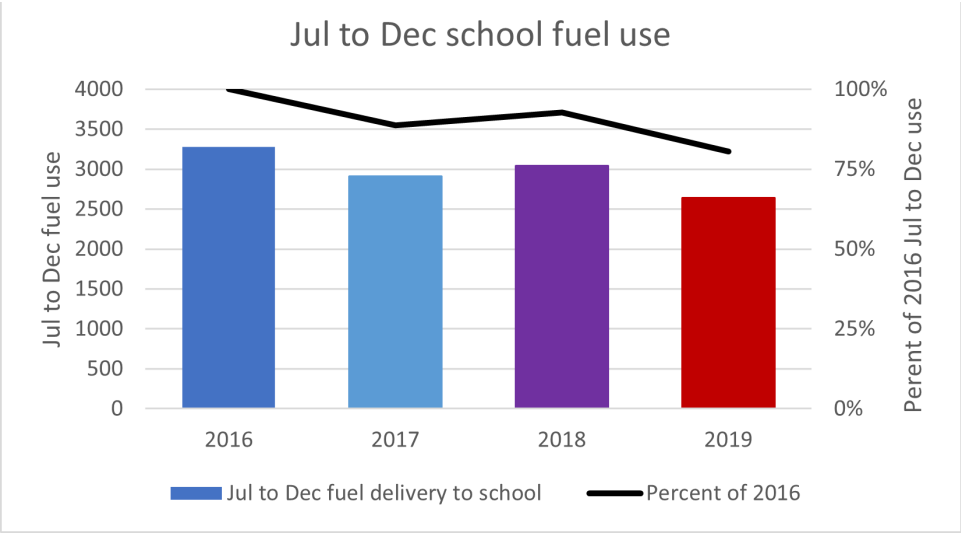

Figure 14: Holy Cross School fuel use for the fall semesters of the school year also saw a decrease over the course of the project.

Conclusion

The City of Holy Cross successfully decreased its electricity and energy use from 2010 to the present because of the RACEE grant. The results of the grant include having the buildings more energy efficient and more comfortable for people to be in, new renewable solar power in Holy Cross, and trained maintenance personnel for building technologies and the solar PV system. The waste heat recovery system is using the heat from the power plant that would otherwise be wasted to heat nearby buildings. The project team overcame multiple challenges, including coordination with other projects that were funded at nearly the same time, delays due to negotiations with the local power utility about the amount of solar energy that the local grid could support, and delays attributed to the COVID-19 pandemic. Additionally, as is almost always the case in rural locations, actual energy numbers are difficult to find. This is especially true for fuel usage, since oftentimes when a barge comes, the fuel must be distributed quickly by filling up tanks, without much time to first establish how much was left in the tank before the new delivery. Due to all these different factors, as well as the last waste heat loops being connected within the past few months, the actual amount of energy saved by the project is not known.

Lessons Learned

Students and staff greatly benefited from improvements to the school's building envelope and other weatherization measures. Staff comfort also increased in the Tribal Hall and buildings throughout the community. The building retrofits helped create an environment more conducive to productivity and resulted in buildings seeing increased use. This was timely because of the COVID-19 pandemic. The new lodge provided a safe place for people to quarantine, and it is now able to house visiting staff who are working on projects in Holy Cross.

Conditions under Covid-19 delayed some building work that required travel to and from Holy Cross. The community entered their first Covid-19 lockdown in June of 2020 and endured several more lockdowns throughout the duration of the project. Ultimately, the project was not significantly delayed thanks to the ability of all partners to remain flexible.

Finally, the project team encourages future energy project teams to put in energy data collection mechanisms in place as much as feasible at the beginning of the project. This is challenging in rural Alaska where unreliable internet and infrequent fuel deliveries make data collection difficult. Nonetheless, trying to put in place mechanisms to collect data at the start of the project can aid with energy savings verification after the retrofits are complete.

Appendix: RACEE Energy and Cost Reducations

RACEE Energy and Cost Reductions Template

RACEE Grantee:	**City of Holy Cross**	
RACEE Award Number:	**EE00007851**	
Period of Performance:	**1/1/2017**	**12/31/2020**
Post-RACEE Data Start/End:	**12/31/2019**	**11/30/2020**
Project Goal(s):	**2) Install solar PV at the tribal office 3) Conduct building envelope and HVAC improvements on the tribe's buildings 4) Conduct a community-wide LED lighting retrofit 5) Train an operator to maintain the new equipment.**	
Total Energy Reduction, %:	**-9.3%**	
Total Energy Cost Savings:	**$41,289.96**	
Total RACEE Budget:	**$655,744.73**	

Overall Energy Consumption

		Overall Consumption		
	Population	**Electricity (kWh)**	**Heat (DGE)**	**Total (MMBtu)**
Baseline 2011-2	178	616,078		2,102.1
Post-RACEE (for dates above)	168	558,520		1,905.7
Total Change	-10	-57,558		-196.4
Percent Change	-6%	-9%		-9%

Per Capita Energy Consumption

		Per Capita Consumption		
	Population	**Electricity (kWh)**	**Heat (DGE)**	**Total (MMBtu)**
Baseline 2010	178	3,461		11.8
Post-RACEE (for dates above)	168	3,325		11.3
Total Change	-10	-137		-0.5
Percent Change	-6%	-4%		-4%

Task 1: expand heat recovery Baseline 2017-2018. Activated late summer 2021. The activation only occurred a few months ago, and there is not sufficient data.	Total Change	Percent Change	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
mmercial - Annual Electricity, kWh				
nmerical - Electricity Cost, per kWh				
Buildings - Annual Electricity, kWh				
uildings - Electricity Cost, per kWh				
Annual Electricity Cost, $				
Annual Energy Used, MMBtu				

Task 2: Solar at Tribal Office Baseline: Aug 2020. Activated: Sep 2020. Comparison with Aug 2021.	*Total Change*	*Percent Change*	August after	August before
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Monthly Electricity, kWh	*-297*	*-60%*	201	498
Electricity Cost, per kWh	*$0.00*	*0%*	$0.24	$0.24
Monthly Electricity Cost, $	*$172*	*0%*	$106	$278
Annual Energy Used, MMBtu	*-12.2*	*-60%*	8.2	20.4

Task 3: Envelope retrofits Baseline Jan-Nov 2017. Activated 2019. Comparison with Jan-Nov 2020 for washeteria, community hall, and city office.	*Total Change*	*Percent Change*	months	Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Annual Electricity, kWh	*-1,808*	*-14%*	11,208	13,016
Electricity Cost, per kWh	*$0.05*	*10%*	$0.56	$0.51
Annual Electricity Cost, $	*$361.68*	*-1%*	$6,276.48	$6,638.16
Annual Energy Used, MMBtu	*-6.2*	*-14%*	38.2	44.4

Task 4: Community-wide LED retrofit Baseline 2011-12. Retrofit occurred 2018. Data is for residential customers for all Holy Cross. Post-retrofit 2019-20.	*Total Saved*	*Percent Change*	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Annual Electricity, kWh	*-49,700*	*-15%*	273,407	323,107
Electricity Cost, per kWh	*-$0.04*	*-7%*	$0.56	$0.60
Annual Electricity Cost, $	*$40,756.28*	*1%*	$153,107.92	$193,864.20
Annual Energy Used, MMBtu	*-169.6*	*-15%*	932.9	1,102.5

Task 5: School improvements Baseline 2016 July to December period. Post-retrofit 2019, Jul-Dec.	*Total Saved*	*Percent Change*	6 months 1 Year After RACEE	6 months 1 Year Baseline
Annual Heating Fuel, gallons	*637*	*-19%*	2,643	3,280
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Annual Electricity, kWh	*-16,932*	*-44%*	21,612	38,544
Electricity Cost, per kWh	*-$0.04*	*-7%*	$0.56	$0.60
Annual Electricity Cost, $	*$11,023.68*	*3%*	$12,102.72	$23,126.40
Annual Energy Used, MMBtu	*-145.3*	*-25%*	436.8	582.1

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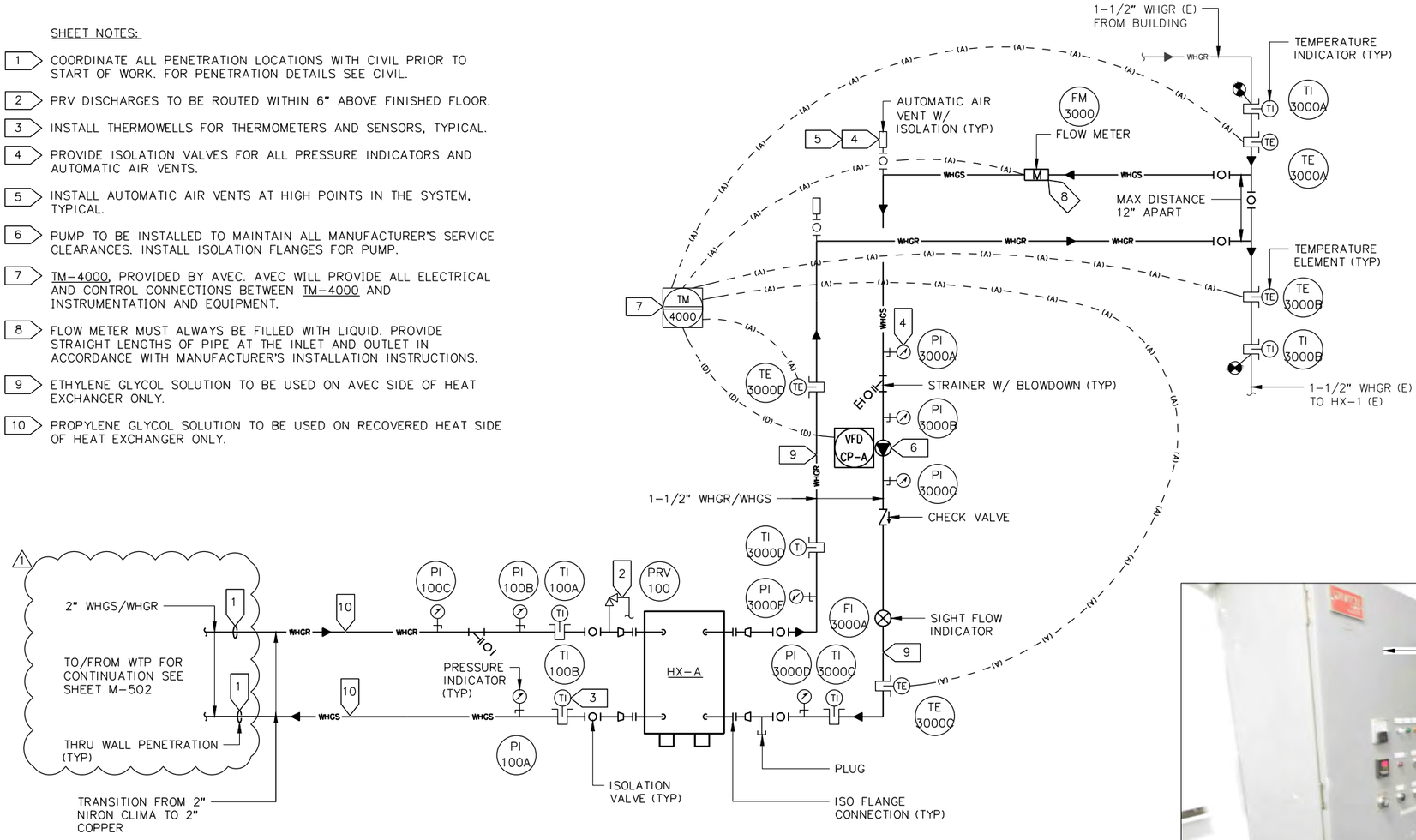
The above tables, coulumns B throgh F, can be copied to a report

SHEET NOTES:

1. COORDINATE ALL PENETRATION LOCATIONS WITH CIVIL PRIOR TO START OF WORK. FOR PENETRATION DETAILS SEE CIVIL.
2. PRV DISCHARGES TO BE ROUTED WITHIN 6" ABOVE FINISHED FLOOR.
3. INSTALL THERMOWELLS FOR THERMOMETERS AND SENSORS, TYPICAL.
4. PROVIDE ISOLATION VALVES FOR ALL PRESSURE INDICATORS AND AUTOMATIC AIR VENTS.
5. INSTALL AUTOMATIC AIR VENTS AT HIGH POINTS IN THE SYSTEM, TYPICAL.
6. PUMP TO BE INSTALLED TO MAINTAIN ALL MANUFACTURER'S SERVICE CLEARANCES. INSTALL ISOLATION FLANGES FOR PUMP.
7. TM-4000, PROVIDED BY AVEC. AVEC WILL PROVIDE ALL ELECTRICAL AND CONTROL CONNECTIONS BETWEEN TM-4000 AND INSTRUMENTATION AND EQUIPMENT.
8. FLOW METER MUST ALWAYS BE FILLED WITH LIQUID. PROVIDE STRAIGHT LENGTHS OF PIPE AT THE INLET AND OUTLET IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
9. ETHYLENE GLYCOL SOLUTION TO BE USED ON AVEC SIDE OF HEAT EXCHANGER ONLY.
10. PROPYLENE GLYCOL SOLUTION TO BE USED ON RECOVERED HEAT SIDE OF HEAT EXCHANGER ONLY.



1 **MECHANICAL SCHEMATICS - AVEC**
SCALE: NTS

SEQUENCE OF OPERATIONS:

THERMAL MONITORING PANEL, TM-4000, WILL ENABLE PUMP, CP-A, WHEN RECOVERED HEAT IS AVAILABLE ON THE AVEC SIDE OF THE HEAT EXCHANGER AS DETERMINED BY, TE-3000A.

WHEN ENABLED PUMP, CP-A WILL RUN AT CONSTANT SPEED.

RECOVERED HEAT WILL BE BYPASSED AND PUMP, CP-A, IS TO BE DISABLED WHEN BUILDING HEAT RETURN TEMPERATURE DROPS BELOW 160°F, AS SENSED BY TE-3000B.

BTU CALCULATION WILL BE PERFORMED BY CALCULATION OF DIFFERENTIAL TEMPERATURE FROM TE-3000C AND TE-3000D. FM-3000 AND DIFFERENTIAL TEMPERATURE WILL BE USED TO CALCULATE FINAL BTU VALUE.

2 **EXHIBIT PHOTO - AVEC**
SCALE: NTS

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07/16/18
REGISTERED PROFESSIONAL ENGINEER

3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING, IF NOT ADJUST SCALES ACCORDINGLY

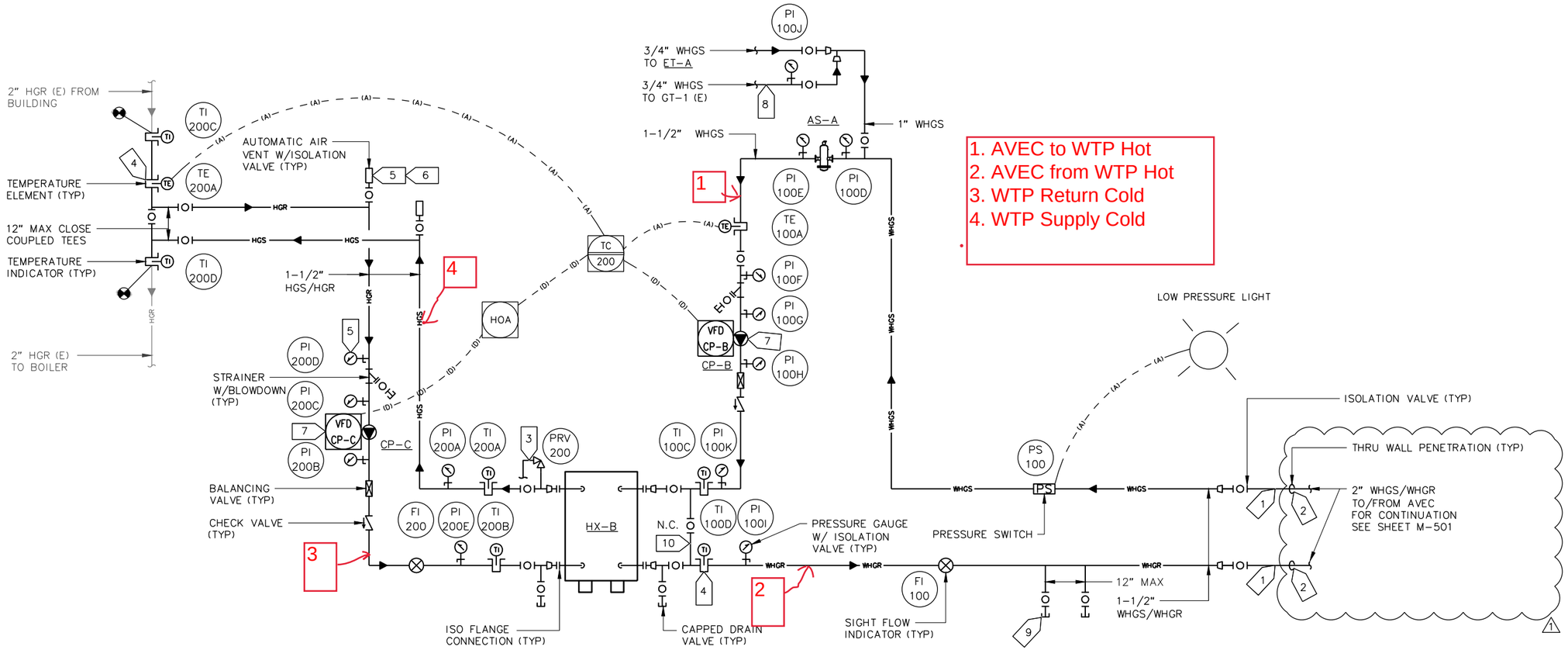
HOLY CROSS, AK
HOLY CROSS HEAT RECOVERY
FINAL DESIGN

MRK	DATE	DESCRIPTION	INIT
1	5/22/19	REVISED PER HCS EXTENSION	

PLAN SET:	AN 14-Z42
PROJ MGR:	TLM
PROJ ENG:	TLM
DRUMS ENG:	CU
DRAWN BY:	EME

SHEET TITLE
MECHANICAL SCHEMATICS - AVEC

M-501
SHEET 11 OF 14



1 MECHANICAL SCHEMATIC - WTP

SCALE: NTS

WATER TREATMENT PLANT SEQUENCE OF OPERATIONS:

RECOVERED HEAT SYSTEM CIRCULATION PUMP, CP-B, TO OPERATE CONTINUOUSLY.

ON LOW PRESSURE, LESS THAN 8 PSI, PRESSURE SWITCH, PS-100, WILL SIGNAL A VISUAL ALARM IN THE WTP.

PUMP, CP-C, IS OPERATED WITH A HOA SWITCH. WHEN HOA IS IN AUTO POSITION, HONEYWELL CONTROLLER, TC-200, TO ENABLE PUMP, CP-C, WHEN THERE IS A 5°F DIFFERENTIAL BETWEEN THE RECOVERED HEAT SUPPLY TEMPERATURE, TE-100A, AND THE BUILDING HEAT RETURN TEMPERATURE, TE-200A. ONCE ACTIVATED, PUMP CP-C TO OPERATE CONTINUOUSLY. PUMP WILL ALSO RUN CONTINUOUSLY WHEN HOA SWITCH IS IN HAND MODE.

HIGH LIMIT SHUT OFF FOR THE WTP BUILDING HEAT SYSTEM OCCURS WHEN THE BUILDING HEATING RETURN TEMPERATURE, TE-200A, EXCEEDS 190°F. PUMP, CP-C, IS DISABLED BY TC-200, WHEN HIGH LIMIT SHUT OFF OCCURS. THE HIGH LIMIT SHUT OFF AUTOMATICALLY RESETS AT 175° (ADJUSTABLE).

WTP HEATING SYSTEM INCLUDING BOILERS, PUMPS, AND CONTROLS WILL OPERATE UNCHANGED.

SHEET NOTES:

1. TRANSITION FROM NIRON NUPI TO COPPER PIPING TO OCCUR JUST BEFORE INSTRUMENTATION INSTALLATION.
2. COORDINATE ALL PENETRATION LOCATIONS WITH CIVIL PRIOR TO START OF WORK. FOR PENETRATION DETAILS SEE CIVIL.
3. PRV DISCHARGES TO BE ROUTED WITHIN 6" ABOVE FINISHED FLOOR.
4. INSTALL THERMOWELLS FOR THERMOMETERS AND SENSORS, TYPICAL.
5. PROVIDE ISOLATION VALVES FOR ALL PRESSURE INDICATORS AND AUTOMATIC AIR VENTS.
6. INSTALL AUTOMATIC AIR VENTS AT HIGH POINTS IN THE SYSTEM, TYPICAL.
7. PUMPS TO BE INSTALLED TO MAINTAIN ALL MANUFACTURER SERVICE CLEARANCES. INSTALL ISOLATION FLANGES FOR PUMPS.
8. FOR CONNECTION TO EXISTING GLYCOL TANK, GT-1 (E), SEE DETAIL 6/M-503.
9. INSTALL TWO TEES MAXIMUM 12" APART WITH ISOLATION VALVE. CAP FOR FUTURE CONNECTION.
10. 1-1/2" MANUAL BYPASS.
11. PROPYLENE GLYCOL SOLUTION ONLY TO BE USED IN HEAT RECOVERY SYSTEM. ETHYLENE GLYCOL IS PROHIBITED.

Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Alaska 99508
(907) 729-3600

STATE OF ALASKA 49 TH
Tracy L. McKeon
ME-11388
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HOLY CROSS HEAT RECOVERY
FINAL DESIGN

MRK	DATE	DESCRIPTION	INIT
1	5/22/19	REVISED PER HGS EXTENSION	

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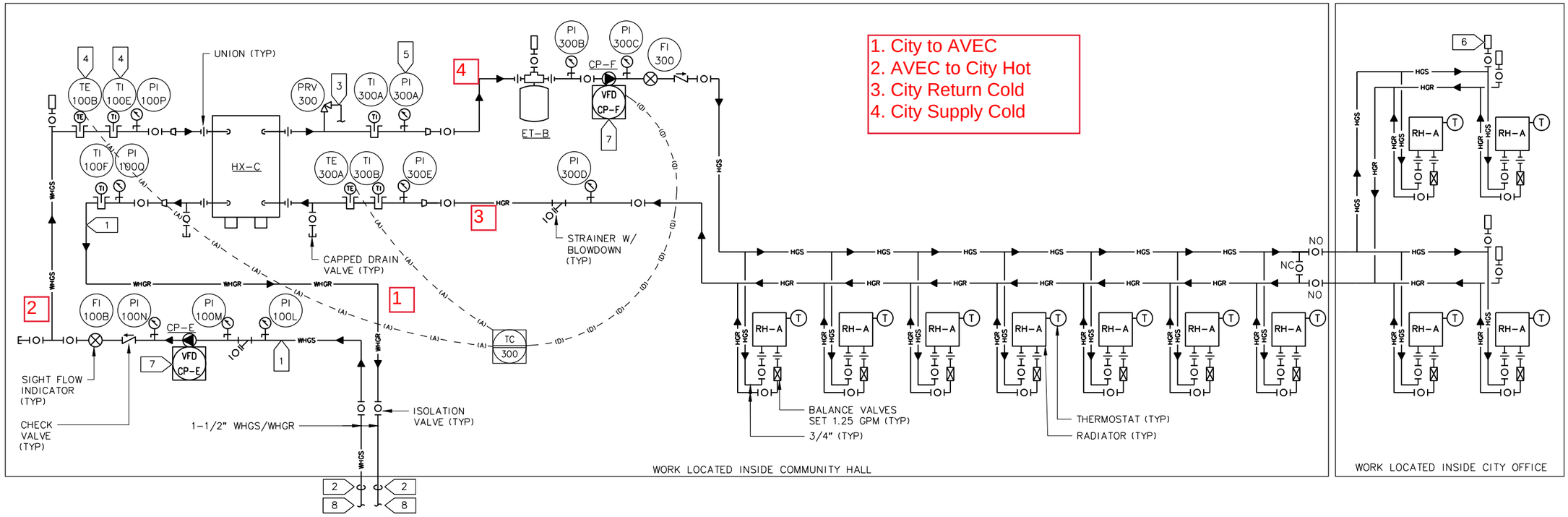
PROJ ENG:	TLM
DRUMS ENG:	CU
DRAWN BY:	EME

SHEET TITLE

MECHANICAL SCHEMATIC - WTP

M-502

SHEET **12** OF **14**



1 MECHANICAL SCHEMATICS - COMMUNITY HALL, CITY OFFICE

SCALE: NTS

COMMUNITY OFFICE/HALL SEQUENCE OF OPERATIONS:

RECOVERED HEAT SYSTEM CIRCULATION PUMP, CP-E, TO OPERATE CONTINUOUSLY.

TC-300 TO ENABLE PUMP CP-F, WHEN RECOVERED HEAT SUPPLY TEMPERATURE, TE-100B, READS MORE THAN 5°F ABOVE THE BUILDING HEAT RETURN TEMPERATURE, TE-300A. ONCE ACTIVATED, PUMP CP-F TO OPERATE IN PROPORTIONAL PRESSURE MODE.

RH-A THERMOSTAT TO OPEN RH-A INTEGRAL CONTROL VALVE WHEN ROOM TEMPERATURE FALLS BELOW SETPOINT AND ALLOW GLYCOL TO CIRCULATE THROUGH RH-A. THERMOSTAT TO CLOSE RH-A INTEGRAL CONTROL VALVE WHEN ROOM TEMPERATURE RISES ABOVE THERMOSTAT SETPOINT.

SHEET NOTES:

1. TRANSITION FROM NIRON CLIMA OUTSIDE TO COPPER PIPING INSIDE TO OCCUR JUST BEFORE INSTRUMENTATION INSTALLATION.
2. COORDINATE ALL PENETRATION LOCATIONS WITH CIVIL PRIOR TO START OF WORK. FOR PENETRATION DETAILS SEE CIVIL.
3. PRV DISCHARGES TO BE ROUTED WITHIN 6" ABOVE FINISHED FLOOR.
4. INSTALL THERMOWELLS FOR THERMOMETERS AND TEMPERATURE SENSORS, TYPICAL.
5. PROVIDE ISOLATION VALVES FOR ALL PRESSURE INDICATORS.
6. INSTALL AUTOMATIC AIR VENTS WITH ISOLATION VALVES AT HIGH POINTS IN THE SYSTEM, TYPICAL.
7. PUMPS TO BE INSTALLED TO MAINTAIN ALL MANUFACTURER SERVICE CLEARANCES. INSTALL ISOLATION FLANGES FOR PUMPS.
8. SEE CIVIL FOR CONTINUATION.
9. PROPYLENE GLYCOL SOLUTION ONLY TO BE USED IN HEAT RECOVERY SYSTEM. ETHYLENE GLYCOL IS PROHIBITED.

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HOLY CROSS, AK
HOLY CROSS HEAT RECOVERY
FINAL DESIGN

MRK	DATE	DESCRIPTION	INIT
1	5/22/19	NEW SHEET FOR HRS EXTENSION	

PLAN SET:	AN 14-Z42
PROJ MGR:	TLM
PROJ ENG:	TLM
DRUMS ENG:	CU
DRAWN BY:	CBB

SHEET TITLE
MECHANICAL SCHEMATICS - COMMUNITY HALL, CITY OFFICE

M-504

SHEET **14** OF **14**