City of Ruby
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Remote Alaska Communities Energy Efficiency Competition:

Energy Efficiency for the Gem of the Yukon

Project location: Ruby, Alaska
Date of report: September 30, 2021
Report submitted by: City of Ruby
Award number: DE-EE0007855/0000
Total project costs: $438,060

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Acknowledgement

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Disclaimer

Project Partners

Ruby Tribal Council
Tanana Chiefs Conference

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Introduction

Over the past decade, the City of Ruby has been proactive in working to reduce cost and energy use in the community. Ruby (Tl'aa'ologhe) is a remote city in Alaska located on the south bank of the Yukon River near the Kilbuck-Kuskokwim Mountains, about 50 air miles east of Galena and 230 air miles west of Fairbanks. As of 2019, the community has a population of over 150 people and most of Ruby's residents are Koyukon Athabascan. Ruby has a long history of promoting local efficiency and clean energy in an effort to become more sustainable. Between 2007-2010, the community hosted Alaska's first demonstration of an in-river hydrokinetic test project, sponsored by the Yukon River Inter-Tribal Watershed Council. In 2011, a 5kW solar PV array was installed by the Interior Regional Housing Authority (IRHA). In 2012, the community had a new power plant constructed by the Alaska Energy Authority (AEA) that supplies waste heat to the washeteria, clinic and public safety garage, saving the community more than 4,000 gallons of heating fuel per year. The clinic, constructed by the Tanana Chiefs Conference (TCC), is one of the most energy efficient buildings in the interior and utilizes new building efficiency standards that were passed by the tribes. It has a 5kW solar PV array that provides energy into the local electric grid and offsets approximately 20% of the annual energy use.

Building on this legacy, the City of Ruby entered into the Remote Alaska Communities Energy Efficiency Competition (RACEE) in 2016, pledging to reduce per-capita energy use 15% by 2020. During the second phase of the competition, 13 communities including Ruby were provided funding for tailored technical assistance to measure energy use and create energy efficiency plans.

Objectives

After considering the various opportunities for energy efficiency in the community during phase 2 of the RACEE project, the technical assistance providers and contractors identified several ways that Ruby could achieve the 15% per capita energy use reduction and formulated specific objectives:

(1) reduce energy use in the community by 15% per capita by the year 2020 from 2010 baseline levels;

(2) showcase energy efficient technologies in a manner that can be effectively monitored and shared with other communities;

(3) reduce the cost of electricity for residents of Ruby Alaska; and

(4) improve the balance of the distribution system.

Phase 3 of the competition provided the funding to achieve these goals. The TCC Rural Energy Program has been working with the City of Ruby for the several years on energy efficiency reduction strategies, and offered in-kind project management services to help the city navigate the RACEE phase 3 work.

Description of Activities Performed

Through the RACEE project, and using complementary funding, the City of Ruby pursued the following activities. The first four were part of the original scope; the fifth was approved by DOE after it was determined that the originally planned solar array was too large for the electric grid.

a. Reduced the line loss of their system (summer 2017);
b. Exchanged high-pressure sodium streetlights for LED streetlights (fall 2017);
c. Completed a community-wide LED lighting retrofit and fridge/freezer swap (summer 2018);
d. Installed a solar PV array on the Tribal Office building (summer 2019); and
e. Installed a ground source heat pump (GSHP) at the Tribal Office building (summer 2020).

Line loss reduction

Line loss is a challenge that plagues many rural Alaska utilities that are not part of a larger electrical cooperative. It is wasted energy, generally from a combination of inaccurately metered loads, inaccurately sized or outdated transformers and poor connections. In Ruby, a line-loss assessment during phase 2 of the RACEE project led to a line loss mitigation report completed by Attention To Detail (ATD) Power Solutions. ATD, TCC and Ruby Electric staff tested all of the meters in the community and used an infrared camera to photograph the entire distribution system to identify areas of line loss. In addition, they completed a review of phase imbalances. The Ruby Line Loss Mitigation Report, produced in phase 2 of the RACEE competition, details a strategy to reduce line loss from these areas. The mitigation report predicted measures that would reduce the line loss in Ruby from its current high of 23% to a normal rate for a rural electric utility of 5%. Consequently, reducing line loss also reduces electric rates the utility must charge to stay in business.

The environmental reduction represented by this mitigation measure could total more than 6,000 gal of diesel fuel that does not have to be burned for energy production (using a rate of 13 kwh/gal for the fuel efficiency of the diesel generators). This helps complete the City of Ruby's goal of reducing reliance on imported diesel fuel.

Streetlight conversion from high-pressure sodium lamps to LED lamps

The streetlights in Ruby are not metered except for two by the school. LED replacements for the high-pressure sodium streetlights were ordered in summer 2017. The LED lamps were Cree brand, 5700K spectrum, 42 Watt bulbs. An Intermatic LC4536c photosensor was installed on each one to automatically turn the streetlights on when conditions warranted. The city's lineman installed the LED lamps once they arrived in Ruby in the fall of 2017.

Figure 1: The streetlights in Ruby were converted from high-pressure sodium to LED lamps in Fall 2017.

Community-wide LED lighting and appliance 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. Ruby opted for a community-wide LED lighting retrofit because it could reduce the energy consumption in a community by an estimated 5%. To accomplish this, the City solicited bids from qualified contractors for the conversion of homes and buildings in Ruby from existing fluorescent and incandescent lighting to LED, as well as the replacement of refrigerators and freezers. Alaska Native Renewables LLC was appointed as the contractor for the work and they completed the initial assessment in the community to get a count of bulbs, freezers, and refrigerators. They were also responsible for the purchase and installation of the appliances and LED lights.

The community-wide LED and appliance switch out required coordination with the community in order to first do an inventory of the types of lightbulbs installed for both residences and community buildings as well as an inventory of residential refrigerator and freezer makes and models. The compiled data allowed the contractor and project team to decide which appliances should be replaced. At most one appliance was exchanged per household. The final spreadsheets served as data for contractors to purchase the items, ship them to Ruby, and exchange them in all appropriate houses, a significant undertaking.

The inventory of LEDs in the community occurred in spring 2018. LEDs were subsequently ordered in early summer 2018, and a complete change out was finished by fall of the same year. Table 1 below shows the number of light fixtures and light bulbs exchanged. For bulk ordering, the number ordered was often rounded up so that there were spares in case some new bulbs didn't work or were broken in transit or during installation. The ordered bulbs were simple replacement bulbs, and no fixture needed to be re-wired specifically for LEDs. This gave the option to the homeowner of reverting to the old style lightbulbs if any issues developed. Of 99 housing units in Ruby, 11 already had LED lighting installed, 3 declined to participate, and 18 were not in Ruby (for example, an elder who moved to an elder home).

Table 1: An inventory of the lighting ordered for the community-wide lighting retrofit.

Description	# of Light Fixtures	# of Light Bulbs	Order Amount
Standard 60W/75W Incandescent (or CFL equivalent) with E26 Medium (Standard) Base	269	593	650
T8 Flourescent - 32W - 48" (Med. Bi-Pin Twist & Lock base)	236	712	750
T12 Flourescent - 40W - 48" (Med. Bi-Pin Twist & Lock base)	25	54	60
13W CFL Spiral-Shaped (Sylvania CF13DS/827/ECO) - 2 Pin GX23 Base	13	47	60
Outdoor Halogen or Motion Lights (PAR or similar)	47	77	80
T8 or T12 - 30W - 24" (Med. Bi-Pin Twist & Lock base)	4	10	15
T12 - 8 Feet	16	32	32
Other - Special Orders	19	47	50
TOTALS	629	1,572	1,697

The changeouts of old refrigerators and freezers occurred on a similar timeline to that of lighting. An inventory of the makes, models, and approximate age of all refrigerators and freezers in the city, followed by identification of the oldest ones that were to be replaced, was completed by early 2018. After reviewing EnergyStar calculator data, the project team decided to include refrigerators and freezers manufactured through 2010 for replacement, since significant gains in efficiency occurred for the appliances since that year.

Thirty refrigerators and seventeen freezers were identified for replacement. Of the refrigerators that were being replaced, 6 were of unknown age, 1 was from 1980, 10 were manufactured in 1990's, and 13 were manufactured after 2000. For the freezers, 4 were of unknown age, 1 was from 1980, 3 were from 1990's, and 9 were manufactured after the year 2000. The replacements were ordered, shipped, received in Ruby, and exchanged in late July 2018. Working eight houses per day, scheduled at one per hour, the changeout took six working days to complete. The old refrigerators and freezers had the refrigerant evacuated with the help of the Tanana Chiefs Conference Environmental Health Program and the Ruby Tribal Council.

Tribal Office Solar PV

The fourth component of the Ruby RACEE project was adding solar photovoltaic panels to the newly constructed Tribal building. This PV installation was the third on community buildings in Ruby. In 2011 a 5kW solar PV was installed on the washeteria and in 2012 solar PV panels were also installed on the clinic. In 2019, after calculations and considerations of the capacity of the grid, it was determined that only a smaller photovoltaic project could be installed on the Tribal Office and that the grid could not deal with the larger one originally planned, due to the existence of the other two solar projects that were already in the community.

Figure 2: New solar panels grace the top of the roof of the Ruby Tribal Office.

The Ruby RACEE team requested a change of scope from DOE to install a smaller PV array together with a ground source heat pump to heat the tribal building. This request was approved, and the RACEE project changed the scope from a 10 kW photovoltaic system to a 5 kW system. The system included a battery which stores unused energy during daytime for later use.

The project was sent out for bid, and a bid was accepted in summer 2019. The photovoltaic system installation was completed and commissioned by May 2020 by Renewable Energy Systems of Fairbanks. Later, an issue was identified with the online display for solar production. It is expected that solar production is not impacted, only the data for the online reporting.

Figure 3: The inverter and two batteries for the Tribal Office solar PV system. The batteries store electricity produced during the day to be used at times when their is no sunshine, increasing the amount of solar electricity used by the building.

Tribal Office Ground Source Heat Pump

As noted in the section above, it was determined that the Ruby grid could only accept a smaller photovoltaic array than originally planned, and the additional funds were instead used to install a ground source heat pump. A ground source heat pump uses a refrigeration cycle to move heat from the earth, step it up to a temperature useful for space heating, and distribute it to heat a building and/or domestic hot water. This is similar to a refrigerator, which takes heat from a cold place (the inside of a fridge), steps it to a higher temperature, and sends it as warm air into the kitchen where it is installed. Ground source heat pump systems are more efficient than electric heaters or combustion appliances because they are gathering a portion of their heat from the earth. Whereas burning diesel for heat only can produce as much energy as is inside that fuel (at most 100% efficient), heat pumps can have efficiencies in the 300% range because they gather and move heat instead of creating it from combustion.

The ground source heat pump system in Ruby was designed to provide the Tribal Office with both heat and domestic hot water, with the existing combustion heating system acting as a backup for the coldest days in winter. By using the solar power produced by the photovoltaic system on the roof of the building to offset the electricity use of the heat pump, the building moves towards a net-zero use of electricity.

The bid for the geothermal system went out in late summer 2019, and was awarded to Alaska Geothermal LLC of Fairbanks. The contractor sent the drilling rig to Ruby on the last barge of the season, and completed the drilling in October 2019 as the first snow came. The drill rig went out in the spring on the first barge of the next season. The extensive mechanical work required for the project occurred in winter 2019-2020, though due to the COVID-19 pandemic, was not finalized until summer 2020.

Figure 4: The drill rig used to install the ground loop coils for the ground source heat pump for the Tribal Office in Ruby, Alaska.

Figure 5, left: The header ditch for the ground source heat pump ground loop near the Tribal Office.

Figure 6, below: Contractors completing the dirt work for the installation of the ground loop for the new heating system for the Ruby Tribal Office.

Figure 7, right: The zone valves directing the heat from the ground source heat pump are located in the mechancal room.

Figure 8, below: The ground source heat pump, grey box in the foreground, sits next to the now-back up combustion heating appliances in the mechanical room of the Tribal Office.

Figure 9: The ground loop for the heat pump sits buried underground next to the Tribal Office after the installation is complete.

Overview of Data

From 2010 to 2018 and 2019, the City of Ruby, encompassing residential, commercial, community facilities, as well as state facilities, decreased the energy usage from ~660,000 kWh to just over 600,000 kWh for the latest data available.

By sector, this data is not as clear. First, no data is available by residential, commercial, or state sector for the base year 2010. Second, some buildings, including the Tribal Office building, were initially classified as one type - commercial (perhaps because it was under construction), then changed to a different type - community facilities. And specifically that building did not exist in 2010. It is not clear how many such changes there are in total. Another consideration is that the fuel use for these sectors is not shown. With the installation of the ground source heat pump, the Tribal Office will see increased electricity use which should more than offset the decrease in heating oil used for heating the building.

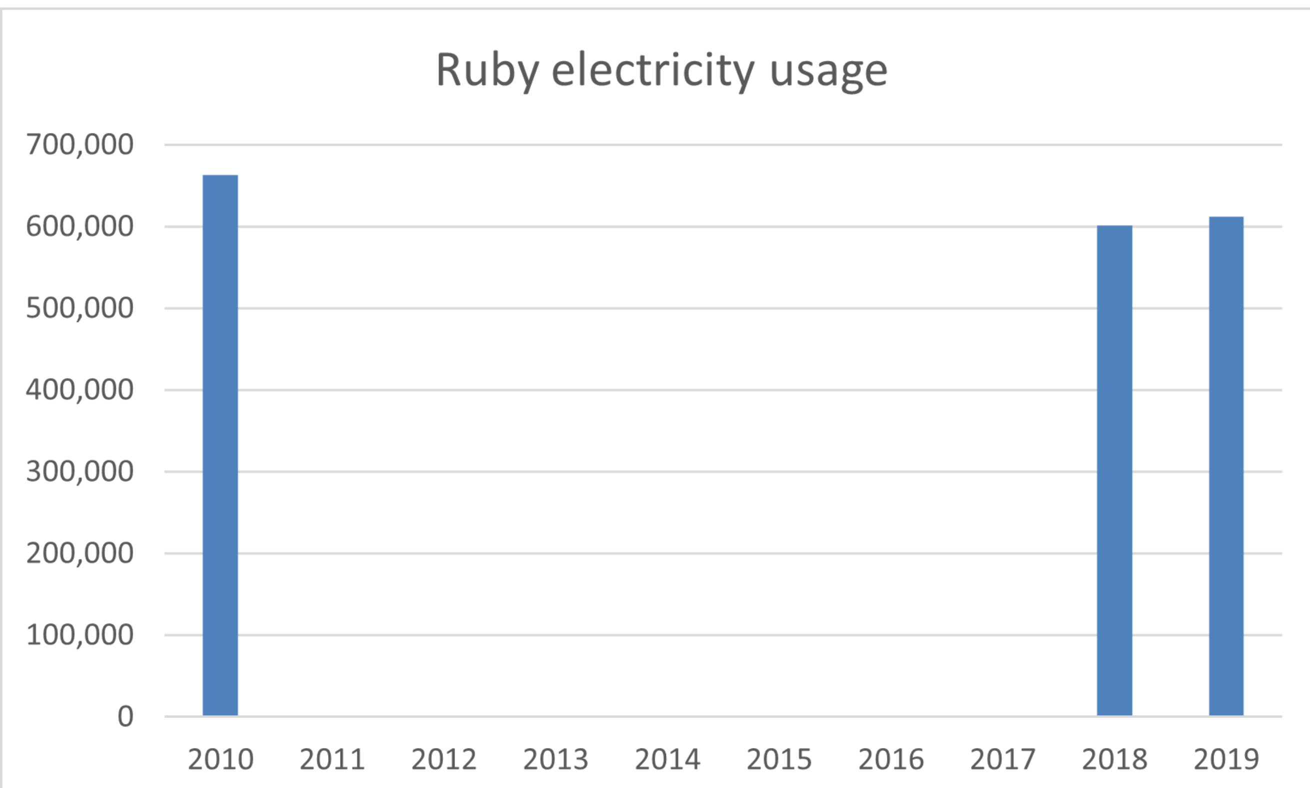


Figure 10: The annual electrical consumption of buildings in Ruby decreased over the past decade, despite and increase in the number of buildings and the population.

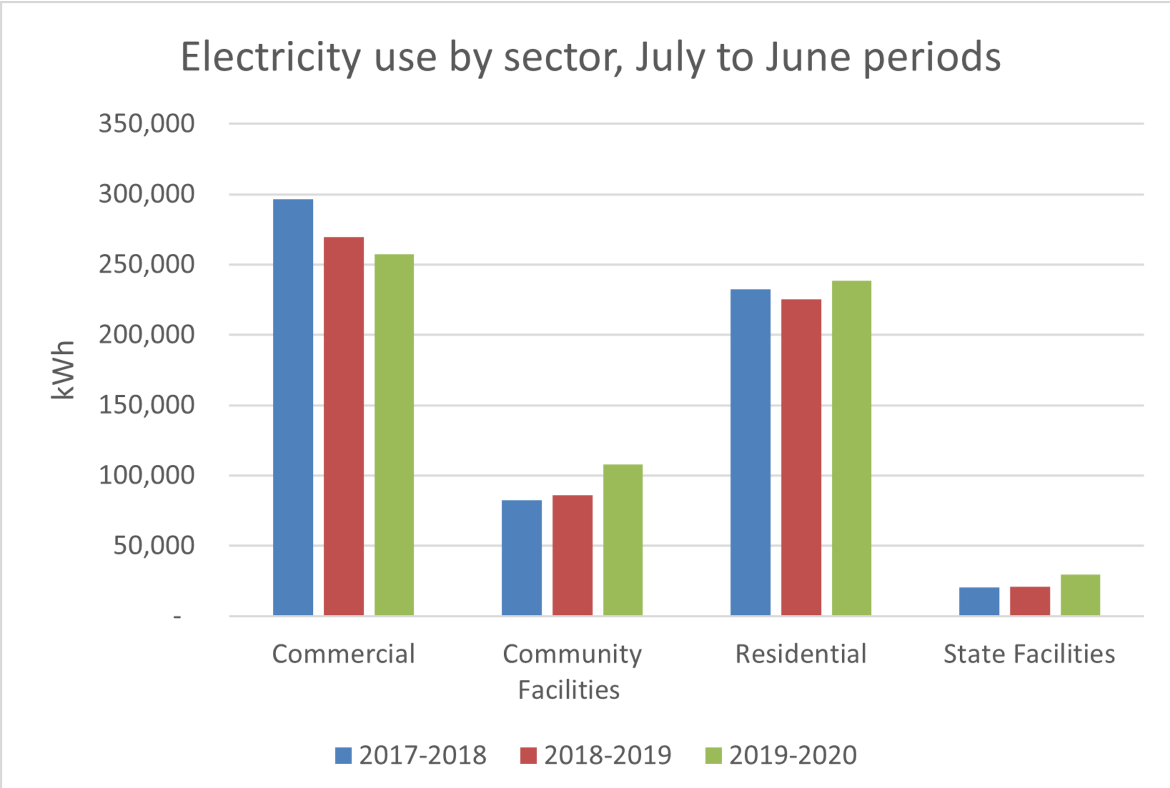


Figure 11: The annual electrical consumption of buildings in Ruby decreased over the past decade, despite and increase in the number of buildings and the population.

Conclusion

During the course of the RACEE project, the population of Ruby grew by 2%, and the overall electricity consumption during that same timeframe decreased by 4%. Fuel savings were not calculated because only incomplete data was available.This total is also not a complete representation of the energy savings due to the RACEE project tasks, because the electrical consumption decrease does not include the energy savings due to the line loss reduction activities.

Jennie Hopson, the City Administrator at Ruby said, “I could not believe how much our bill went down, more than $100/month, now it is less than $100. It has been a good learning experience for all of us here. We’re all saving quite a bit, I know I have seen it in my own home.”

The Tribal Office is also seeing an improvement in its heating costs. Ryan Madros, the technician for the building, said that when he dipped the fuel tank at the end of the 2020-2021 winter to check how much fuel was left, he was surprised to see that it was still half full, when in previous winter it would have been refilled during the winter.

The City of Ruby is also contracting with the Cold Climate Housing Research Center (CCHRC) to monitor the ground source heat pump for the course of one year, to get a more accurate picture of its performance. Additionally, CCHRC will check the connections on the solar system in order to correct the online display.

Lessons Learned

In Alaska, the construction season is short. Because it is impractical to carry on with construction projects during the winter months, projects require more time to complete. In rural Alaska, flexibility and patience are key when adapting plans to the weather, barge schedules, and flights that are more likely to be delayed. During this project, there were also obstacles imposed by the COVID-19 pandemic. David Pelunis-Messier, Rural Energy Coordinator at Tanana Chiefs Conference said, "The biggest challenge was scheduling the drilling rig for the ground source heat pump. We had to time it right with the barge going downriver; dropping it off, completing the installment, then making sure the barge picked up the drill rig on the way upriver. The difficulties associated with travel during the pandemic made the entire process more challenging."

Accurate data is also important to ensure the success of energy projects. In this project, it was difficult to gather electrical data to verify the energy savings of the retrofits in some components of the project: the streetlights are not metered so exact savings from conversion to LED bulbs is unknown, and the solar PV web dashboard was not accurately recording how much energy the system produced. In future projects, it is beneficial to collect baseline data ahead of time, and put data collection mechanisms in place alongside the energy project.

Appendix: RACEE Energy and Cost Reducations

RACEE Energy and Cost Reductions Template

RACEE Grantee:	**Ruby**	
RACEE Award Number:	**EE007855**	
Period of Performance:	**3/1/2017**	**3/31/2021**
Post-RACEE Data Start/End:	**7/1/2019**	**6/30/2020**
Project Goal(s):	**1. Reduce energy use in the community by 15% per capita 2. Showcase energy efficient technologies in a manner that can be effectively monitored and shared with other communities 3. Reduce the cost of electricity for residents.**	
Total Energy Reduction, %:	**-9.3%**	
Total Energy Cost Changes:	**-$84,683.88**	
Total RACEE Budget:	**$438,048.00**	

Overall Energy Consumption

		Overall Consumption		
	Population	**Electricity (kWh)**	**Heat (DGE)**	**Total (MMBtu)**
Baseline 2010	166	663,226		2,263.0
Post-RACEE (for dates above)	170	601,747		2,053.2
Total Change	4	-61,479		-209.8
Percent Change	2%	-9%		-9%

Per Capita Energy Consumption

		Per Capita Consumption		
	Population	**Electricity (kWh)**	**Heat (DGE)**	**Total (MMBtu)**
Baseline 2010	166	3,995		13.6
Post-RACEE (for dates above)	170	3,540		12.1
Total Change	4	-456		-1.6
Percent Change	2%	-11%		-11%

Task 2.0: Community-wide LED lighting upgrades (residences, community, and commercial buildings)
Baseline 07/2017 - 06/2018

Activated 12/2018	Total Change	Percent Change	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Residential - Ann. Electr, kWh	-21,320	-9%	225,469	246,789
Residential - ElectrCost, per kWh	-$0.09	-11%	$0.75	$0.84
Community - Ann. Electr, kWh	-2,061	-2%	85,905	87,966
Community- ElectrCost, per kWh	$0.19	54%	$0.54	$0.35
Commercial - Annual Electr, kWh	-18,448	-6%	269,736	288,184
Commercial - ElectrCost, per kWh	-$0.09	-11%	$0.75	$0.84
Annual Electricity Cost, $	-$62,373	-13%	$417,792	$480,165
Annual Energy Used, MMBtu	-142.7	-7%	1,982.8	2,125.6

Task 3.0: Streetlights conversion to LEDs
Baseline: none-- streetlights are not metered. Estimate in table is based on high pressure sodium and LEDs.

Activated 4/2018	Total Change	Percent Change	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Annual Electricity, kWh	-30,941	-80%	7,603	38,544
Electricity Cost, per kWh	$0.19	54%	$0.54	$0.35
Annual Electricity Cost, $	$9,385	-70%	$4,106	$13,490
Annual Energy Used, MMBtu	-105.6	-80%	25.9	131.5

Task 4.0: Refrigerator/freezer appliance exchange program, residential only
Baseline 07/2017 - 06/2018

Activated 01/2019	Total Change	Percent Change	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons				
Fuel Cost, per gallon				
Annual Fuel Cost, $				
Annual Electricity, kWh	-6,907	-3%	225,469	232,376
Electricity Cost, per kWh	-$0.09	-11%	$0.75	$0.84
Annual Electricity Cost, $	-$26,094.09	-13%	$169,101.75	$195,195.84
Annual Energy Used, MMBtu	-23.6	-3%	769.3	792.9

Task 5.0: Solar Photovoltaic Installation on Kendra B McCarty Tribal Building				
Baseline 11/2017 - 10/2018 because the building was only occupied in fall 2017. Baseline may not be representative				
Activated fall 2019	*Total Saved*	*Percent Change*	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons	*-162*	*-15%*	908	1,070
Fuel Cost, per gallon	*-$0.25*	*-5%*	$5.25	$5.50
Annual Fuel Cost, $	*-$1,118.26*	*-19%*	$4,766.74	$5,885.00
Annual Electricity, kWh	*1,518*	*10%*	16,403	14,885
Electricity Cost, per kWh	*-$0.21*	*-28%*	$0.54	$0.75
Annual Electricity Cost, $	*-$2,306.13*	*-21%*	$8,857.62	$11,163.75
Annual Energy Used, MMBtu	*-17.1*	*-9%*	180.7	197.8
Task: 6.0: Engineer and install heat pump system in tribal building.				
Baseline 11/2018 - 10/2019. Note: fuel numbers indicate all fuel known to be delivered to tribal buildings.				
Activated Spring 2020	*Total Change*	*Percent Change*	1 Year After RACEE	1 Year Baseline
Annual Heating Fuel, gallons	*-648*	*-72%*	252	900
Fuel Cost, per gallon	*-$0.25*	*-5%*	$5.25	$5.50
Annual Fuel Cost, $	*-$3,627.00*	*-73%*	$1,323.00	$4,950.00
Annual Electricity, kWh	*2,685*	*20%*	16,403	13,718
Electricity Cost, per kWh	*$0.00*	*0%*	$0.54	$0.54
Annual Electricity Cost, $	*$1,449.90*	*20%*	$8,857.62	$7,407.72
Annual Energy Used, MMBtu	*-79.9*	*-47%*	90.6	170.5

Assumptions etc:

The 2010 electricity use is assumed to include all entities -- residential, commercial, community facilities, and state facilities. The 2020 number includes all of these.
The LED upgrade is assumed not to change the fuel consumption in the community.
The streetlights are not metered. 22 high density sodium street lights were replaced by LEDs.
Assume that high density sodium lamps used 250W, 12 hrs a day, 30 days a month, 12 months a year, and use 250 W of electricity, compared to an LED lamp at 1/10th that : 25 watts.
Since all electricity (except for streetlights) is captured in table under task 2.0, the total energy decrease is calculated from the overall table on lines 12-16.
Alternate would be to add the electricity from task 2.0, streetlight savings from task 3.0, and heating fuel decrease due to ground source heat pump in task 5.0.
This spreadsheet does not include the line loss reduction, which further decreased the fossil fuel used in the community.

RESU

Data sheet for RESU10H type-R

LG Chem

2019.April

LG Chem

Product Specification (1/2)

2019.April

RESU10H type-R

Electrical Characteristics		
Total Energy Capacity [1]		9.8 kWh @25°C (77°F), Beginning of Life
Usable Energy Capacity [1]		9.3 kWh @25°C (77°F)
Battery Capacity		63 Ah
Voltage Range	Charge	400 to 450 V_{DC}
	Discharge	350 to 430 V_{DC}
Absolute Max. Voltage		520 V_{DC}
Max. Charge/Discharge Current		11.9A@420V / 14.3A@350V
Max. Charge/Discharge Power [2]		5kW
Peak Power (only discharging) [3]		7kW for 10 sec.
Peak Current (only discharging)		18.9A@370V for 10 sec.
Communication Interface		RS485
DC Disconnect		Circuit Breaker, 25A, 600V rating
Connection Method		Spring Type Connector
User interface		LEDs for Normal and Fault operation

Operating Conditions	
Installation Location	Indoor / Outdoor (Wall-Mounted)
Operating Temperature	14 to 113°F (-10 to 45°C)
Operating Temperature (Recommended)	59 to 86°F (15 to 30°C)
Storage Temperature	-22 to 131°F (-30 to 55°C)
Humidity	5% to 95%
Altitude	Max. 6,562ft (2,000m)
Cooling Strategy	Natural Convection
Noise Emission	< 40 dBA

Certification		
Safety	Cell	UL1642
	Battery Pack	UL1973 / CE / RCM / TUV (IEC 62619)
Emissions		FCC
Hazardous Materials Classification		Class 9
Transportation		UN38.3 (UNDOT)
Ingress Rating		IP55

※ Test Conditions - Temperature 25°C, at the beginning of life
※ Total Energy is measured under specific condition from LGC(0.3CCCV/0.3CC)

1) Value for Battery Cell Only (Depth of Discharge 95%). Actual usable energy at the AC output may vary by condition, such as the battery converter, inverter efficiency and temperature.
2) LG Chem recommends 3.3kW for maximum battery lifetime
3) Peak Current excludes repeated short duration (less than 10 sec. of current pattern).

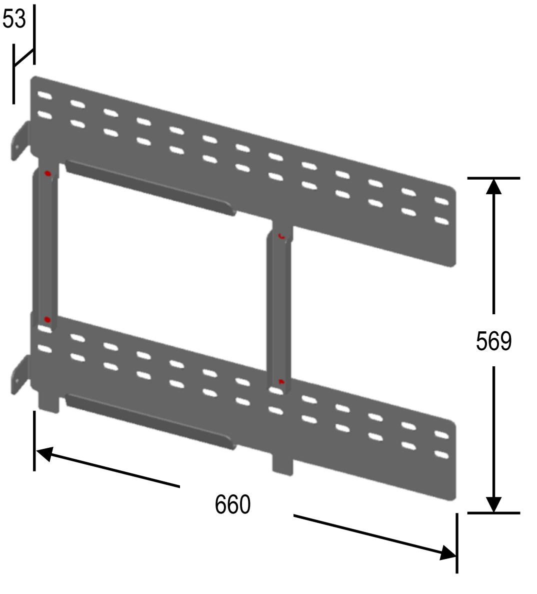
Product Specification (2/2)

2019.April

RESU10H type-R

Features

- ❑ Emergency Power Back-up
- ❑ Compact size and space saving
- ❑ Wide range of inverters available for matching
- ❑ Wall mounting installation
- ❑ Proven Safety and 10 year warranty



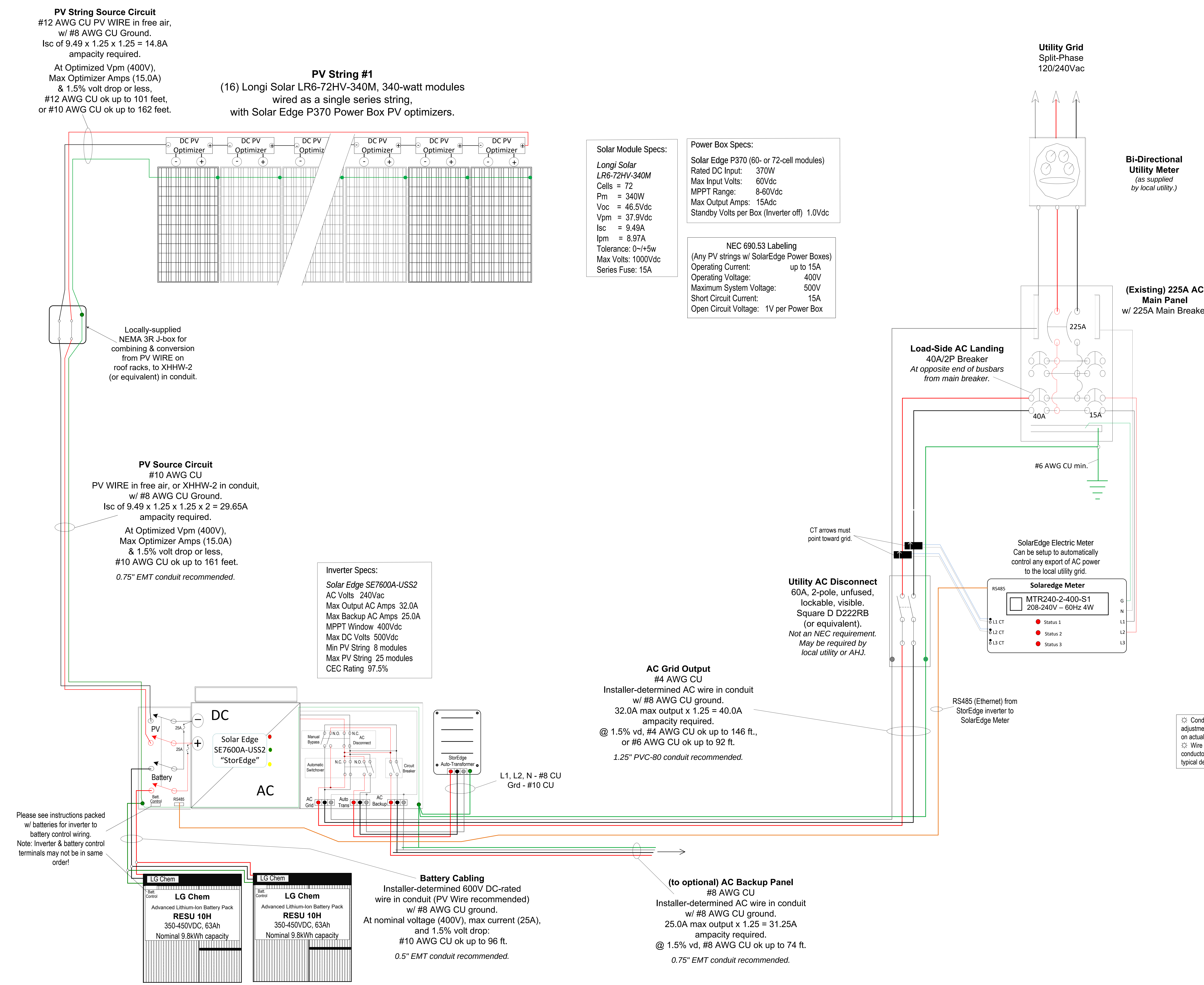
Mechanical Characteristics		
Dimensions	Width	744 mm (29.3”)
	Height	907 mm (35.7”)
	Depth	206 mm (8.1”)
Weight		97 kg (214lbs)

SolutionPartner

LG Chem
ESS Battery Division

LG Guanghwamun Building, 58, Saemunan-ro, Jongro-gu, Seoul, 03184, Korea
http://www.lgesspartner.com http://www.lgchem.com

2019.April



Project Information

Ruby Tribal Office
1 Bobby Kennedy Sr. Way
Ruby, AK 99768

Contractor

Tanana Chiefs Conference
Dave Messier
907-978-1866

AHJ Signature & Date

Revision Schedule

No.	Date	Description
1.0	08/12/2019	As Released
1.1	08/14/2019	Remove AC Backup Panel

DRAWING NAME:
16)LS340 1)SE7600A-USS2 240v Grid-Tie w/Backup LgFmt

SYSTEM TYPE:
Grid-Tied Solar Electric System w/ Battery Backup

DRAWN BY:	DP
DATE:	08/12/2019
REV. DATE:	08/14/2019
REV. #:	1.1

SHEET TITLE
Electrical Wiring Diagram

SHEET NUMBER
E-1.0

Photovoltaic System Drawings Provided By:

Solar Schematics

solarschematics.com
doug@solarschematics.com
707-380-4314

This line diagram is provided as a service and is based on our understanding of the information supplied and current requirements. Subject to revision based on actual conditions, applicable edition of the National Electrical Code, and local governmental authorities. Installing dealer has sole responsibility for the correct selection and use of all equipment and materials.

☼ Conductor size provided includes ambient temperature adjustment only. Additional derating may be needed based on actual conditions of use; conduit fill, conduit location, etc.
☼ Wire ampacity is based on NEC 2017 75°C copper conductor tables at average highest temperature (due to typical device terminal max. temperature ratings).

DUCTWORK SYMBOLS

DOUBLE LINE / SINGLE LINE

- EXISTING EQUIPMENT OR DUCTWORK TO BE REMOVED.
- EXISTING DUCTWORK TO REMAIN
- NEW DUCTWORK
- VD — MANUAL VOLUME DAMPER (MVD) MOTOR OPERATED DAMPER (MOD)
- AD — ACCESS DOOR
- RADIUS ELBOW (R=1.5)
- VANED ELBOW
- BRANCH DUCT TAKE-OFF
- D / R — RISE OR DROP DIRECTION OF AIR FLOW
- FLEXIBLE CONNECTION
- DIFFUSER (SIZE CFM/BLOW)
- CEILING RETURN/EXHAUST GRILLE (SIZE CFM)
- SD-X NUMBER, XX CFM — SUPPLY AIR DIFFUSER
- RG-X NUMBER, XX CFM — RETURN AND/OR EXHAUST AIR GRILLE
- BACKDRAFT DAMPER
- FIRE DAMPER
- MOTORIZED DAMPER
- SUPPLY AIR
- FILTER/DP SENSOR
- RETURN OR EXHAUST AIR
- COIL
- OUTSIDE AIR

PIPE LINETYPES

- DCW
- DHW
- DHWC
- VENT
- W
- W-UF
- GHS
- GHR
- GHS (E)
- GHR (E)

HVAC REFERENCE SYMBOLS

- BB-1 / B — EQUIPMENT IDENTITY (SEE EQUIPMENT ABBREVIATION LIST AND SCHEDULES)
- X' / X / 1 — EQUIPMENT NUMBER
- GPM
- LENGTH
- X — INDICATES DETAIL, PLAN, SECTION, AND/OR DIAGRAM(APPLIES ONLY WHERE INDICATED ON DRAWINGS)
- X — INDICATES DRAWING ON WHICH DETAIL APPEARS
- TYP — INDICATES TYPICAL DETAIL (APPLIES TO ALL CONTRACT DRAWINGS)
- X — INDICATES DRAWING ON WHICH DETAIL APPEARS
- X — INDICATES SECTION NUMBER
- X — INDICATES ON WHICH DRAWING SECTION APPEARS
- X — INDICATES REVISION & NUMBER
- CONNECT NEW TO EXISTING
- # — SHEET NOTE NUMBER

NOTE: SYMBOLS SHOWN IN LEGEND DO NOT NECESSARILY APPEAR ON DRAWINGS.

PIPING ELEMENTS/VALVING

- GATE VALVE
- GLOBE VALVE
- BALL VALVE
- SWING CHECK VALVE
- LIFT CHECK VALVE
- GATE VALVE, ANGLE
- GLOBE VALVE, ANGLE
- AUTOMATIC FLOW CONTROL VALVE
- CBV — CIRCUIT SETTING BALANCING VALVE
- THREE WAY CONTROL VALVE
- TWO WAY CONTROL VALVE
- S — SOLENOID VALVE
- PRESSURE REDUCING VALVE (PRV)
- TPV — TEMPERATURE/PRESSURE RELIEF VALVE
- RELIEF/SAFETY VALVE
- BACKFLOW PREVENTOR (REDUCED ZONE)
- BACKFLOW PREVENTOR (DOUBLE CHECK VALVE ASSEMBLY)
- GAS COCK
- GAS PRESSURE REGULATOR
- VALVE IN RISE OR DROP
- HOSE BIBB
- STRAINER
- STRAINER WITH BLOW OFF VALVE
- BASKET STRAINER
- AUTOMATIC AIR VENT (EXTEND DISCHARGE TO DRAIN)
- MV — MANUAL AIR VENT
- DIRECTION OF FLOW
- R / D — DIRECTION OF PITCH-RISE OR DROP
- PIPE RISING UP
- PIPE DROPPING DOWN
- UNION – SCREWED OR FLANGED
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- ELECTRICALLY TRACED PIPING
- VB — VACUUM BREAKER
- WATER HAMMER ARRESTER
- RD — ROOF DRAIN
- FD — FLOOR DRAIN
- CO — CLEANOUT
- CO — CLEANOUT (PLAN VIEW)
- PUMP
- W / H — EXPANSION LOOP (WxH)
- FLEXIBLE-CONNECTION
- A — ANCHOR
- G — GUIDE
- EJ — EXPANSION JOINT
- TT — TEMPERATURE SENSOR
- TT — SPACE TEMPERATURE SENSOR
- FG — FLAMMABLE GAS OR VAPOR SENSOR (BY OTHERS)
- TT — DUCT AVERAGING TEMPERATURE SENSOR
- PT/PS — PRESSURE SENSOR OR PRESSURE SWITCH
- THERMOMETER
- GAUGE WITH GAUGE COCK/ PRESSURE INDICATOR
- CO — WALL CLEAN OUT

WATER-TO-WATER HEAT PUMP SCHEDULE

EQP TAG	HC (MBH)	COP	KW	SOURCE FLUID	SOURCE GPM	SOURCE EST°F	SOURCE LST°F	LOAD FLUID	LOAD GPM	LOAD RISE °F	LOAD LLT°F	ELECTRICAL FLA	ELECTRICAL VOLTS	ELECTRICAL PHASE	CONNECTIONS SUPPLY	CONNECTIONS RETURN	BASIS OF DESIGN MFR	BASIS OF DESIGN MODEL
HP-1	14.5	2.5	2.8	20% METH	9	25	-	50% PG	7	6.8	115	17.9	208-230	1	1.25	1.25	ENERTECH	WS036

ELEC NOTE: SINGLE POINT OF CONNECTION.

PUMP SCHEDULE

EQP TAG	SERVICE	GPM	HEAD (FT)	FLUID	BODY	(°F)	SUCT/DISCH SIZE (IN)	ELECTRICAL HP	ELECTRICAL VOLTS	ELECTRICAL PHASE	BASIS OF DESIGN MFR	BASIS OF DESIGN MODEL	NOTES
PMP-4	GLHE	9.0	20	20% M	CI	30	1-1/4	-	120	1	-	-	1
PMP-5	HP-1 TO HS-1	7.0	10	50%PG	CI	115	1 1/4	1/25	120	1	GRUNDFOS	UPS 15-58FC SUPERBRUTE	2
PMP-6	INJECTION	9.9	10	50%PG	CI	136	1 1/4	1/25	120	1	GRUNDFOS	UPS 15-58FC SUPERBRUTE	3

NOTES: GENERAL: PMP-1, -2, -3 ARE EXISTING. REFER TO ORIGINAL 2016 DESIGN DRAWINGS BY MBA CONSULTING ENGINEERS.

1. HP-1 MANUFACTURER FLOW CENTER WITH FLUSH FITTINGS, OR EQUIVALENT SHOP-FABRICATED ASSEMBLY MATCHED TO GLHE PRESSURE DROP - BY OTHERS
2. SET INITIALLY TO SPEED 2.
3. SET INITIALLY TO SPEED 3.

ABBREVIATIONS

DCW	DOMESTIC COLD WATER
DHW	DOMESTIC HOT WATER
DHWC	DOMESTIC HOT WATER CIRC.
(E)	EXISTING
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
GHR	GLYCOL HEATING RETURN
GHS	GLYCOL HEATING SUPPLY
GLHE	GROUND LOOP HEAT EXCHANGER
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
THW	TEMPERED HOT WATER
UF	UNDER FLOOR
V	VENT
VTR	VENT THROUGH ROOF
W	WASTE

NOTE: NOT ALL ABBREVIATIONS APPEAR ON DRAWINGS.

MISCELLANEOUS EQUIPMENT SCHEDULE

EQP TAG	EQUIPMENT	LOCATION	CAPACITY	ELECTRICAL W	ELECTRICAL VOLTS	ELECTRICAL PH	BASIS OF DESIGN MFR	BASIS OF DESIGN MODEL	NOTES
AS-1	AIR SEP	MECH	30 GPM MAX	-	-	-	SPIROVENT	VDR150FT	1

NOTES

1. OVERSIZED TO MATCH EXISTING 1-1/2 SUPPLY FROM BOILER B-1 SHOWN ON ORIGINAL PLAN. FIELD VERIFY.

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SYMB	DATE	REVISION	BY

PROJECT: RUBY MULTIPURPOSE FACILITY HEATING SYSTEM UPGRADES

CITY OF RUBY, ALASKA

SHEET CONTENTS: MECHANICAL LEGEND AND SCHEDULES

DRAWN	HBR
DRAWN	HBR
CHECKED	HBR
DATE	11/22/2019

SHEET NUMBER: M1

HBR W.O. NUMBER: 1910

SPECIFICATIONS

General

A. Contractor shall furnish and install all materials, equipment, and supervision necessary for a complete installation of the mechanical system as shown on the Drawings and as herein specified.
B. Contractor shall comply with local and state governing regulations and be responsible for obtaining and paying for all licenses and permits.
C. The mechanical work shall be in conformance with the State of Alaska Building and Mechanical Codes, and all local codes and regulations. Upon completion of the project, Contractor shall provide Owner with certificates of Department of Labor, State of Alaska, local office.
D. Contractor shall receive and store equipment upon delivery to ensure good working condition. If equipment is damaged due to shipment, Contractor shall immediately take appropriate action to correct the situation at no additional cost to Owner.
E. Contractor shall submit electronic copies of product data, certificates, and warranties to Owner within 30 days of notice to proceed. Provide submittals for equipment shown in the equipment schedules on the Drawings.
F. Contractor shall install equipment in accordance with manufacturer's instructions and recommendations, and shall notify Engineer immediately when there are conflicts with the Drawings.
G. Contractor shall provide a one-year warranty on all materials and workmanship.

Electrical Wiring

A. Electrical wiring, including distribution panels, cabinets, supports, feeders, circuit wiring, motor disconnects, and related items; and electrical connections to equipment, fixtures, and devices shall be provided by the Electrical Contractor unless specifically called for by the Mechanical Contractor.
B. Electrical Contractor shall furnish and install all wiring and conduit to and from the equipment that is provided by the Mechanical Contractor.
C. All electrical wiring provided as part of the mechanical equipment shall meet the requirements of the current edition of the NEC.

Mechanical Work Close-out

A. Do not proceed with the transfer of the mechanical system to the Owner for operation until guarantees, warranties, performance certifications, maintenance agreements, and similar commitments to be signed by the Contractor and others have been executed and transmitted to the Owner.
B. After complete installation of equipment and before any test runs are carried out, Contractor shall lubricate equipment in accordance with the manufacturer's instructions and change all filters. Contractor shall provide one extra change of filters to the Owner.
C. After cleaning of the construction area is complete, the Contractor shall thoroughly clean all equipment to remove construction dust and dirt. Repair scratches or mars using paint from the manufacturer to match the equipment.
D. Contractor shall operate the entire installation for at least one week or for a period of time the Engineer deems necessary, to ensure correct operation. During this time, Contractor shall instruct Owner or his representative in the operation and maintenance of the mechanical systems.
E. Contractor shall provide operating instructions, repair parts list, equipment manuals and automatic control diagrams to the Owner.
F. During the first year of operation, make two complete inspections of the mechanical system, making any adjustments required, and provide a report to Owner describing actions taken.

Equipment

A. Mechanical equipment shall be as scheduled on Drawings, or an accepted equal meeting the scheduled specifications.
B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
C. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
E. Install equipment to allow right of way for piping installed at required slope.

Insulation – General

A. Mastics, sealants, and adhesives shall be UL listed. Insulation shall have composite flame hazard classification not exceeding Flame Spread 25, Smoke Developed 50, and Fuel Contributed 50 when tested in accordance with procedures of UL Standard 723, and shall meet requirements of ASTM-84 and NFPA 255.
B. Insulation shall not be applied until all services are free of dirt, dust, grease, frost, moisture, and other imperfections.
C. Install insulation continuously through walls and partitions. Seal penetrations. Comply with architect's accepted through-penetration fire stop systems when walls or partitions are fire-rated.
D. For below-ambient service, install a continuous unbroken vapor barrier. Seal longitudinal seams, end joints, and protrusions with a water based vapor-barrier mastic and joint sealant, suitable for indoor and outdoor use on below ambient services.

Equipment Insulation

A. Insulate equipment if/as noted on the Drawings. Equipment insulation shall be as in items C. or D. below depending on the shape of the equipment. Use 1-1/2-inch-thick mineral fiber board or mineral fiber pipe and tank insulation with factory-applied ASJ. Nominal density shall be 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F shall be 0.29 Btu x in./h x sq. ft. x deg F or less.
B. Insulation shall be applied to cover all exterior surfaces of equipment and sealed tightly to prevent leakage. Secure with insulation pins and Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
C. Insulation for rectangular equipment shall be Mineral-Fiber Board Insulation: Comply with ASTM C 612, Type IA or Type IB.
D. Insulation for round equipment shall be Mineral-Fiber, Pipe and Tank Insulation: Comply with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB.
E. Pressure test system before installing insulation.

Pipe insulation

A. Pipe insulation for colder-than-ambient service shall be flexible elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Adhesive: Comply with MIL-A-24179A, Type II, Class I.A. Pipe insulation for warmer-than-ambient service shall be Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Cover fitting insulation with one-piece PVC covers.
B. NPS 1 and smaller: insulation shall be ½ inch thick.
C. NPS 1-1/4 to 2: insulation shall be 1 inch thick.
D. NPS 2-1/2 and larger: insulation shall be 1-1/2 inches thick.
E. Pressure test piping before installing insulation.

Pipe and Fittings – General

A. Install piping free of sags and bends.
B. Install fittings for changes in direction and branch connections.
C. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.
D. Comply with architect's requirements for sealing pipe penetrations in fire-rated construction.
E. Install unions at final connection to each piece of equipment.
F. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.
G. Hanger and Pipe Attachments: Factory fabricated with galvanized coatings; nonmetallic coated for hangers in direct contact with copper tubing.
H. Powder-Actuated Fasteners: Threaded-steel stud, with pull-out and shear capacities appropriate for supported loads and building materials where used.
I. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, with pull-out and shear capacities appropriate for supported loads and building materials where used.
J. Seismic Restraints:
   1. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
   2. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
   3. Restraining Cables: Stainless-steel cables with end connections made of steel assemblies that swivel to final installation angle and use two clamping bolts for cable engagement.
K. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.
L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
M. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches thick.
N. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
O. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
P. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

Heating and Chilled Fluid, and Safety Relief Valve Piping 2 Inches and Smaller

A. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.
B. Fittings: ASME B16.22 wrought-copper, solder-joint fittings.
C. Aboveground: Hard Copper Tubing: ASTM B 88, Type L or M, water tube, drawn temper, or PEX plastic as described below and NSF 61 approved (DCW, DHW only).
D. Copper Unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
E. Underground: Soft Copper Tubing: ASTM B 88, Type K, water tube, annealed temper.
F. Underground: PE, ASTM Pipe: ASTM D 2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

Heating and Chilled Fluid, and Condensate Piping 2-1/2 and 3 Inches

A. Joining Materials: Use Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
C. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated.
D. Heat Pump, source side: use schedule 80.
E. Condensate: use schedule 40.

General Duty Valves

A. Valve Sizes: Same as upstream piping unless otherwise indicated.
B. NSF Compliance: NSF 61 for valve materials for potable-water service.
C. Valves in Insulated Piping: With 2-inch stem extensions.
D. End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for cast-iron valves and with ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.
E. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
F. Bronze, Swing Check Valves: Class 125, bronze body with nonmetallic disc and seat.
G. Use ball valves for shutoff and throttling duty.
H. Locate valves for easy access and provide separate support where necessary.
I. Install valves for each fixture and item of equipment.
J. Install three-valve bypass around each pressure-reducing valve using throttling-type valves.
K. Install valves in horizontal piping with stem at or above center of pipe.
L. Install valves in a position to allow full stem movement.
M. Install check valves for proper direction of flow in horizontal position with hinge pin level.

Controls

A. Line voltage wiring through starters and safety switches to equipment shall be provided by the Electrical Contractor. All remaining electrical work including low-voltage wiring and/or accessories required for the complete system shall be furnished by the Mechanical Contractor.Thermostats shall be mounted 5'-0" above finished floor and where shown on Drawings. Sensors S1-thru S5 shall be Tekmar or accepted equal to match controllers. Follow manufacturer's written instructions for sensor mounting to pipe. Provide 1-inch-thick pipe insulation for 1 foot on either side of each sensor. Use thermowells in steel pipe over 1-1/4" diameter, or in copper pipe of larger diameter where low fluid velocity could allow temperature stratification.
B. Controls shall perform according to their Sequence of Operations:
   1. Existing Boiler B-1, existing Water heater WH-1, new Heat Pump HP-1, and associated pumps: See Heating Schematic Diagram.

Testing, Adjusting, and Balancing

A. Ensure and record correct fluid flows at existing baseboard finned tube zone balance valves. Reference the original project drawings by MBA Consulting Engineers, Inc., 2016.
B. Performance of this work shall be in accordance with the recommendations, procedures and standards as described in the HVAC Systems Testing, Adjusting, and Balancing manual, latest edition, published by SMACNA. Report shall be made on the recommended SMACNA forms. A copy of the testing and balancing report shall be submitted to the Owner for approval.

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SYMB	DATE	REVISION	BY

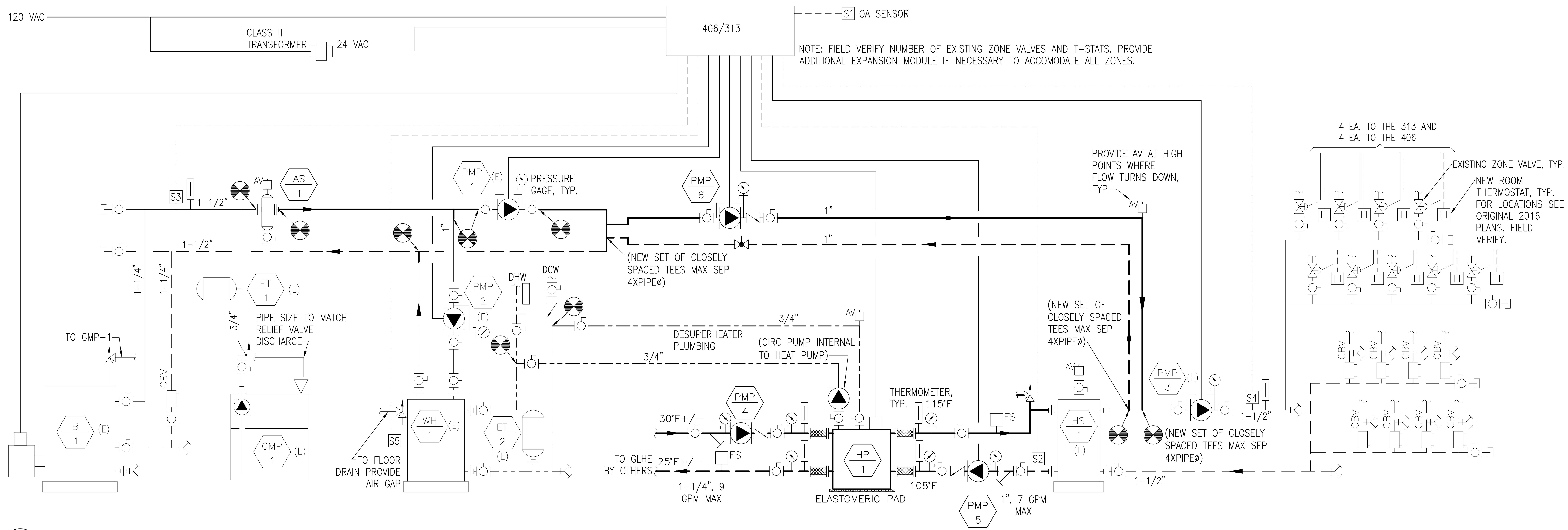
PROJECT:
RUBY MULTIPURPOSE FACILITY
HEATING SYSTEM UPGRADES
CITY OF RUBY, ALASKA

SHEET CONTENTS:
MECHANICAL SPECIFICATIONS

DRAWN		HBR
DRAWN		HBR
CHECKED		HBR
DATE		11/22/2019

SHEET NUMBER:
M2

HBR W.O. NUMBER: 1910



1 / M3 HEATING SYSTEM SCHEMATIC DIAGRAM

SCALE: NONE

SEQUENCE OF OPERATION

THE HOUSE CONTROL 406 OPERATES A SINGLE STAGE WATER SOURCE HEAT PUMP HP-1 IN HEATING MODE TO SUPPLY AN OUTDOOR RESET TEMPERATURE TO 4 ONBOARD TANK ZONES AND 4 ADDITIONAL TANK ZONES CONNECTED TO THE TANK EXPANSION TERMINALS WITH THE WIRING CENTER 313, VIA 532 T-STATS. THE 406 ALSO OPERATES AN ON/OFF BOILER B-1 TO SUPPLY BACKUP HEAT TO THE TANK LOOP USING THE VARIABLE SPEED PUMP P-6.
TO ALLOW THE HEAT PUMP HP-1 TO OPERATE FOR SOME AMOUNT OF TIME BEFORE THE VARIABLE SPEED PUMP P-6 STARTS ADDING HEAT TO THE TANK LOOP, USE THE BACKUP DELAY SETTINGS IN THE ADJUST MENU. THIS ENSURES THE HEAT PUMP IS BEING USED TO ITS FULL POTENTIAL BEFORE BACKUP IS ALLOWED. A NON-CONDENSING BOILER MAY BE USED SINCE P-6 PROVIDES BOILER RETURN PROTECTION, PREVENTING FLUE GAS CONDENSATION.

INITIALLY SET THE "BOIL MIN" SETTING, MEASURED BY S3, TO 150°F TO ENSURE BOILER RETURN TEMP ABOVE 130°F.

INITIALLY SET THE 406 TO PROVIDE SUPPLY TEMP, MEASURED BY S4, TO THE TANK ZONES USING A LINEAR CURVE AS FOLLOWS: WHEN THE OAT, MEASURED BY S1, IS 50°F OR ABOVE, THE SUPPLY TEMP IS 100°F. WHEN THE OAT IS -30°F OR BELOW, THE SUPPLY WATER TEMP IS THE ORIGINAL DESIGN TEMP OF 140°F.

SET THE HEAT PUMP RETURN MAX SETTING, MEASURED BY S2, IN ACCORDANCE WITH THE HEAT PUMP MANUFACTURER'S RECOMMENDATION TO AVOID HEAT PUMP USE AT TEMPERATURES RESULTING IN A LOW COP.

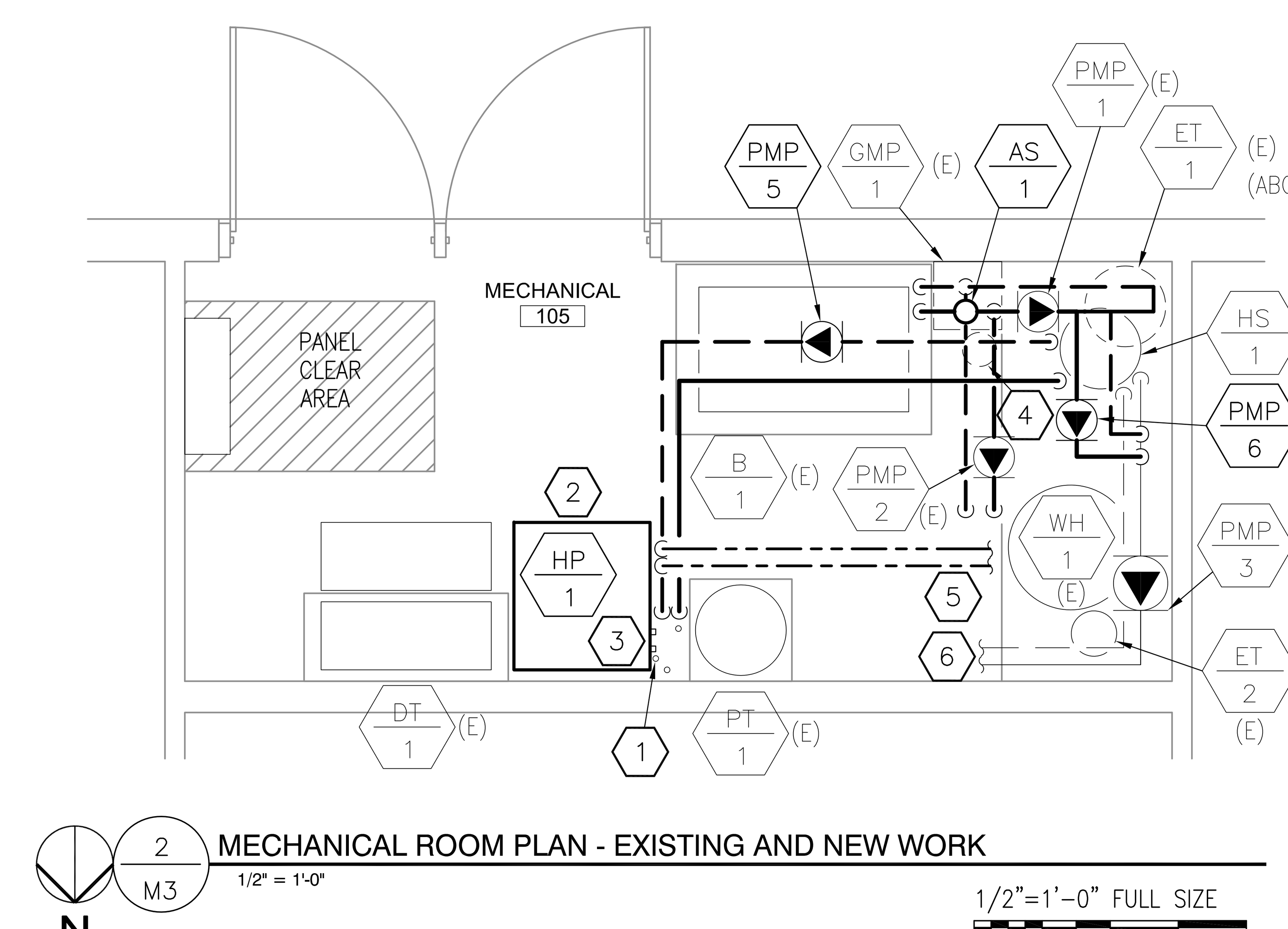
SET THE DHW CONTROL TO MODE 1, DHW IN PARALLEL, NO PRIORITY. WHEN A DHW CALL IS PRESENT, MEASURED BY S5, THE DHW PUMP IS ACTIVATED AND THE BOILER OPERATES AT THE DHW EXCHANGE SETTING, SET AT 180°F INITIALLY, PER THE WH-1 SCHEDULE INFORMATION IN THE ORIGINAL 2016 DESIGN DRAWINGS.

GENERAL NOTES

1. REFERENCE THE ORIGINAL 2016 DESIGN DRAWINGS BY MBA CONSULTING ENGINEERS.
2. FIELD VERIFY EXISTING PIPE SIZES.
3. LOCATIONS SHOWN FOR EXISTING EQUIPMENT ARE BASED ON THE ORIGINAL DRAWINGS AND PHOTOS. FIELD VERIFY.

SHEET NOTES

1. AVOID EXISTING PIPES DOWN THRU FLOOR. TYP. OF 3.
2. FIELD VERIFY BEST LOCATION FOR HP-1.
3. CMP-4 OR FLOW CENTER AND GLHE PIPING BY OTHERS NOT SHOWN FOR CLARITY.
4. COORDINATE PIPE ROUTING WITH B-1 FLUE THIS AREA.
5. HP-1 DESUPERHEATER DCW, DHW CONNECTIONS TO EXISTING WH-1 INLET PIPING, FIELD VERIFY CONNECTION POINTS.
6. EXISTING GHS/GHR PIPING TO ZONES, TO REMAIN.



2 / M3 MECHANICAL ROOM PLAN - EXISTING AND NEW WORK

1/2" = 1'-0"

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PROJECT: RUBY MULTIPURPOSE FACILITY HEATING SYSTEM UPGRADES

CITY OF RUBY, ALASKA

SHEET CONTENTS: MECHANICAL SCHEMATIC DAGRAM AND PLAN

DRAWN	HBR
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M3

HBR W.O. NUMBER: 1910