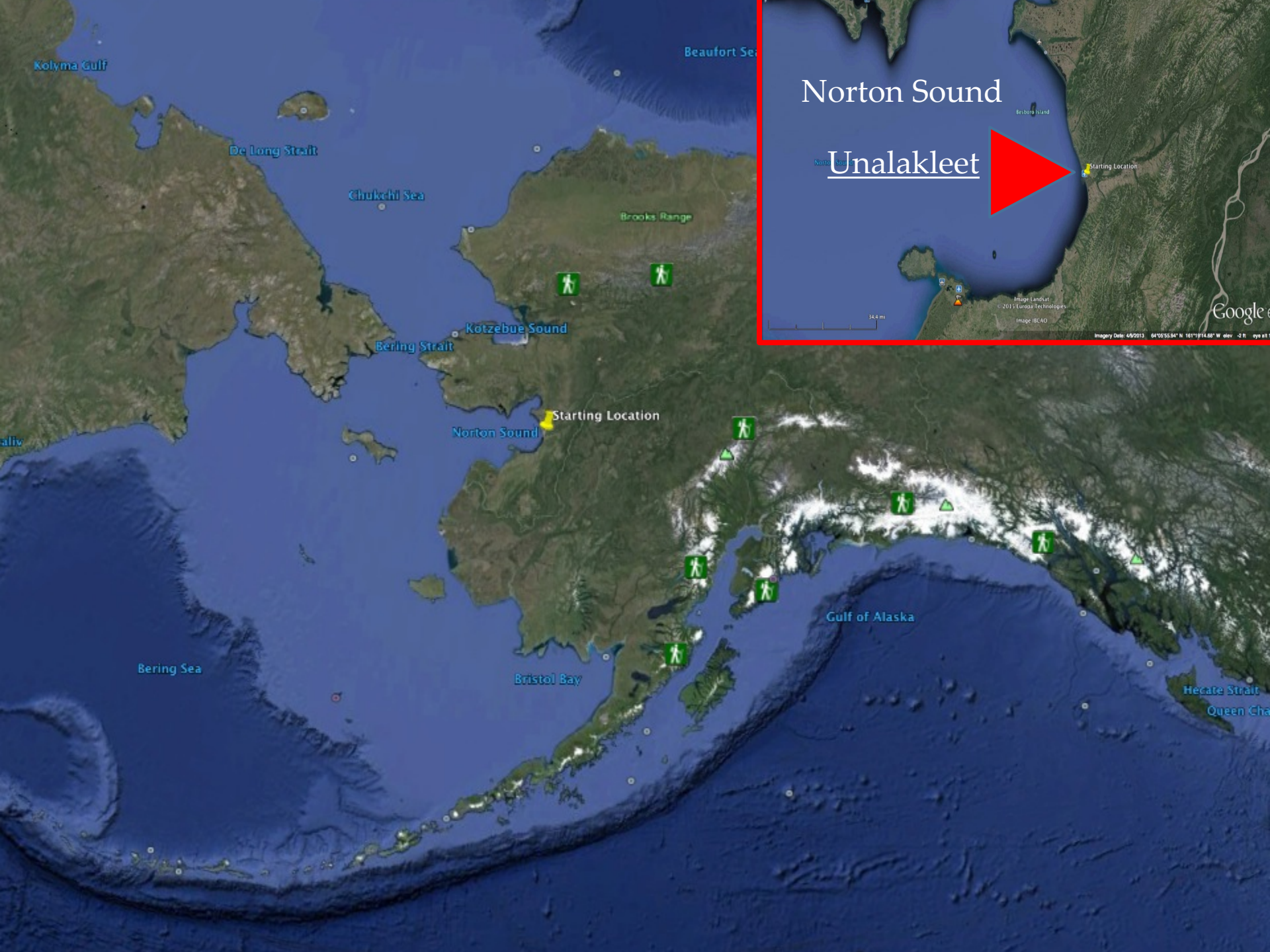
Unalakleet Microgrid Optimization

Unalakleet Native Corporation

"Where Southerly East Wind Blows"

US Department of Energy –
Office of Indian Energy
Program Review
Virtual Presentation
November 2021

UNALAKLEET VALLEY ELECTRIC COOPERATIVE
EST. 1961


Norton Sound
Unalakleet
Starting Location
Kolyma Gulf
Beaufort Sea
De Long Strait
Chukchi Sea
Brooks Range
Kotzebue Sound
Bering Strait
Starting Location
Norton Sound
Gulf of Alaska
Bering Sea
Bristol Bay
Hecate Strait

Unalakleet Demographics

- 745 Residents
- 78% AK Native
- 400 miles from road system
- 150 miles southeast of Nome
- Unalakleet Native Corporation: Land Owner
- Unalakleet Valley Electric Cooperative: Electric Service Provider

Unalakleet Native Corporation

"Where Southerly East Wind Blows"

Unalakleet Native Corporation (UNC) operates a fuel station including a heating oil delivery, grocery store, burger restaurant, and a vehicle repair garage, and in Unalakleet, Alaska.

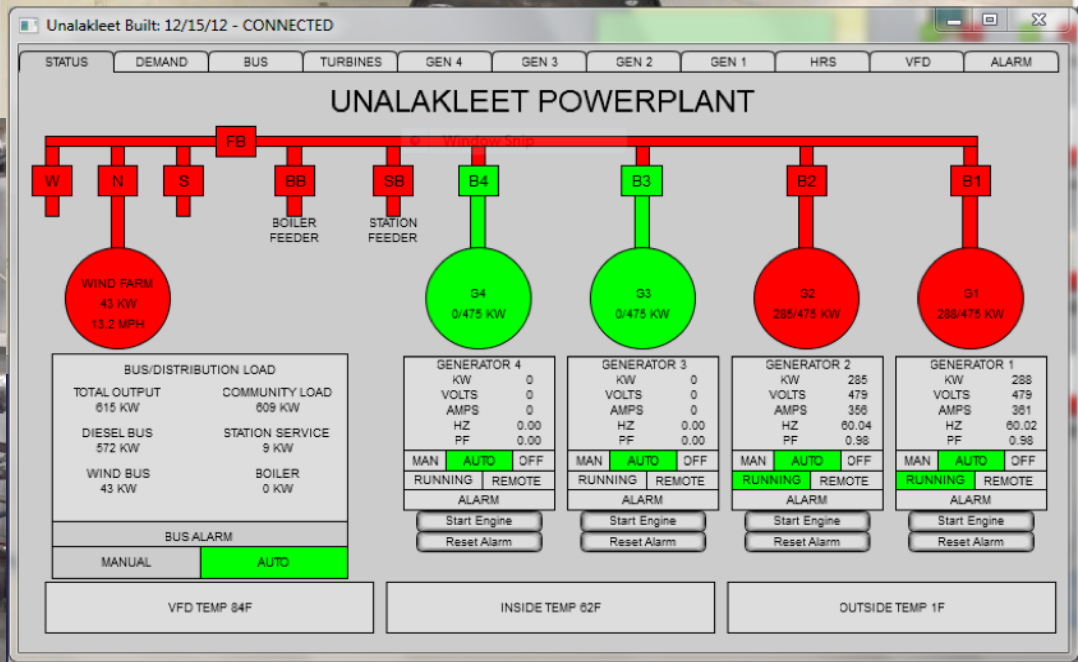
UNC leases land, residential and commercial buildings in Unalakleet, and an office building in Anchorage. Most of UNC's operating activities are concentrated in Western Alaska, but have recently expanded to government 8a Contracts in the Lower 48.

Covid Impacts: Loss of food & fuel sales, tourism, increased costs, transportation difficulties. – Main commercial airline shut from Covid

UNC as Land Owner, and UVEC as utility, and DOE-OIE joined forces to make powerplant/microgrid in Unalakleet more efficient & stable while maintaining safety & reliability.

UVEC's System

- Electric loads: 400 – 1000 kW
- Four Cat 3456 475 kW gensets.
- Six 100 kW Northern Power Systems wind turbines.
- Recovered heat system.
- 300 kW Electric boiler – secondary load.



Fuel Delivery in Unalakleet

NorthWind 100 Turbines

* 2009-Construction began with an agreement between UNC as land-owners and UVEC.
* 2010-SLC, 300 kW electric boiler, connected to Diesel Heat Recovery System: City Loop, School Loop, Baler Loop
* Rated 600 kW

- Predicted annual production: 1,500,000 kWh/year
- Actuals range from 750,0000 to 1,000,000 kWh
- Predicted annual fuel savings: 113,000 gal/year
- Actuals range from 50,0000 to 70,000 gals - improved

What is the impact of wind energy on our rates?

- UVEC would have imported 70,000 more gallons of fuel.
- Our system efficiency would drop without wind.
- The added fuel cost would add to our FUEL SURCHARGE
  - 2014 Fuel Surcharge $0.2172 (Total Res. Rate $0.50)
  - 2019 Fuel Surcharge $0.1699 (Total Res. Rate $0.45)
  - With out Wind our 2019 Surcharge would be $0.2188
    - That's 29% higher, or $0.0489 per kWh.
  - Expected higher fuel prices in future – would have even more impact

Wind production is valuable; however, we can do better, much better!

Actual wind production is ~40% LESS than Predicted, AND
High winds require UVEC to turn on a second generator for grid stability.

Invest in proven technology to get us to "one-diesel" or "diesels off" mode.

DOE OIE to the rescue…

Technical Assistance Request in Action Led to Grant Proposal & Award

UNALAKLEET VALLEY ELECTRIC COOPERATIVE EST. 1961

ALASKA NATIVE TRIBAL HEALTH CONSORTIUM
Rural Energy Initiative

ies INTELLIGENT ENERGY SYSTEMS

TDX power
a tanadgusix company

Deerstone Consulting

KAWERAK, INC.

Unalakleet Native Corporation

1847-1509

UNALAKLEET MICROGRID OPTIMIZATION
TRIBAL COMMUNITY RESILIENCE

Budget

- Federal funds: $372,011 ($669,620 – post Covid)
- Cost-share: $372,011 ($74,402 – Covid)
- Total Project Costs: $744,022

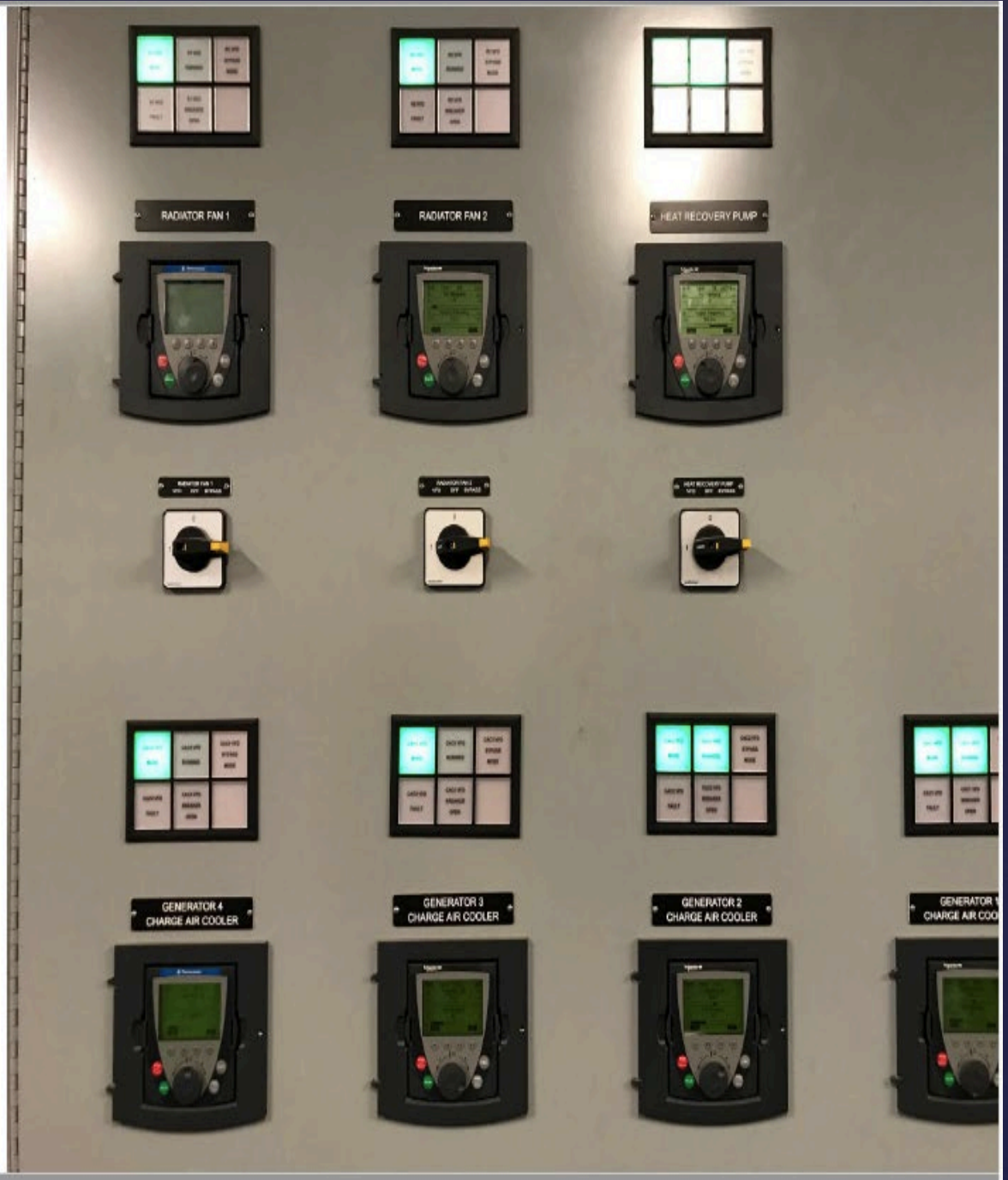
Project Outcomes

- Increase wind penetration by 63% (from 22.9% of total electric production up to 37.4%)
- Displace 43,933 gallons of diesel fuel each year equivalent to an annual savings of $131,799
- Decrease annual maintenance costs by an estimated $33,800
- Reduce annual emissions by 18 tons
- Stabilizes energy costs by further decoupling them from fluctuating fossil fuel prices.

Maximizing power generated by local, renewable resources – one step closer to energy independence.

Assessment Focus Areas

- Power Line Capacity
- Capacitor Bank
- Secondary Load Controller/Electric Boiler
- SCADA – Data Collection and Analysis



Objective

Optimize integration and performance of existing equipment in order to achieve single genset operation and pave the way for the incorporation of additional renewables and energy storage.

Known Barriers and Concerns

- Electric boiler
- Wind curtailment
- Reactive power
- Data collection/access

Power Line Capacity

Transmission line capacity constraints have led to a demand for reactive power at the wind farm. Higher turbine production often requires a second genset come online.

Findings

At a typical level of wind production (300 kW),

- Paladin analysis indicates transmission line loss > 12%.
- Voltage drop at plant > 10%.
- Power loss over time = annual power output of an entire 100 kW turbine.

Windfarm Repairs

SCADA equipment has aged and the link between the operator workstation and the plant data server has failed.

Findings

- Need to re-establish data collection and visualization.
- Need for clear sequence of how to extract data.

Unalakleet Power line Upgrade

There are two important issues considered in the line voltage upgrade:

1. Voltage Drop

The existing line voltage of 4,160 volts is constraining the efficient operation of the wind turbine output when the six (6) wind turbines are at the maximum output of 600 kW. At peak output, the voltage drop from the wind turbines to town is nearly 25%.

So, when we upgrade the line at 12,470 volts, at peak turbine output (of 600 kW), the voltage drop will be reduced to 2%.

2. Line Losses

Line losses are 28% for 4,160 volts during 500 kW of wind generation. When at 12,470 volts those line losses are only 3.73%.

RESULT: POWER LINE UPGRADE WILL ALLOW FOR MORE WIND IN THE SYSTEM, REDUCE DIESEL GEN-SET RUN TIME, SAVE FUEL

Priorities

1. <u>Upgrade power line & increase voltage</u>, starting with transformer replacement, then conductor and structural improvements as long-term solution to mitigate reactive power issues.

Increase system voltage from 4160 V to 12,470 V
* Reduces voltage drop from 25% to 2%.

- Grid stability & Reactive load brought within reasonable parameters.

- Single gen-set operation

<u>Concerns, especially since Covid:</u>

- **<u>Price escalation of transformers & other materials</u>**
- **<u>Long lead time (supply chain)</u>**
- **<u>Lost consulting Electrical Engineer</u>**
- **<u>Lost airline service to community</u>**
- **<u>Ongoing system reliability</u>**

Second-Level Priorities

2. <u>Improve SCADA and related data management systems</u>.

- New data server, extended memory.
- Re-establish data collection and visualization.
- Consolidate Wind & Diesel SCADAs.
- Update control and SCADA schematics.
- Collect data, use to conduct root cause analysis of outages.

A. Replace PLC

B. Replace generator controls

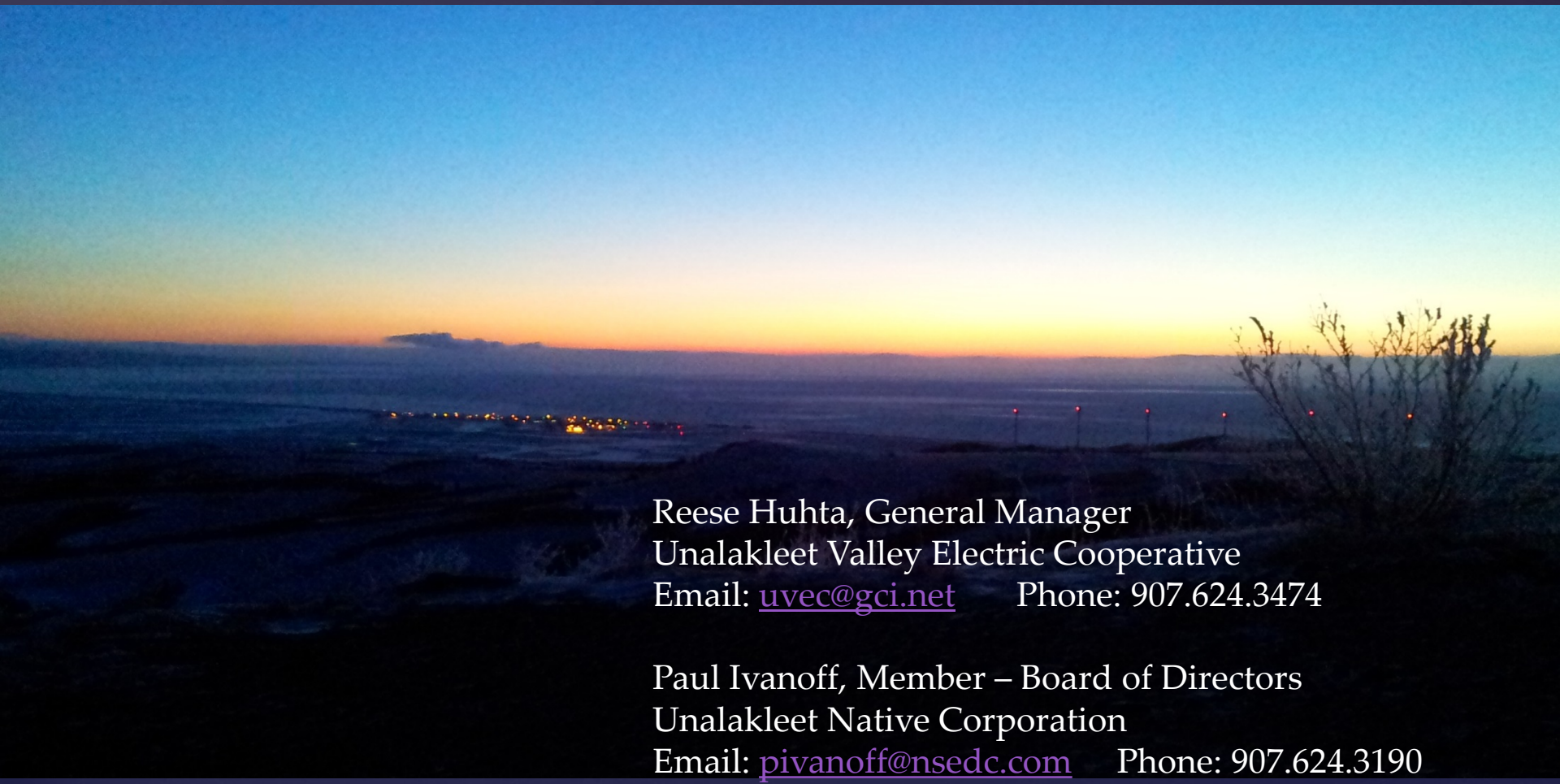
C. Expand functionality to incorporate BESS, increased renewables, electric thermal storage –> Post-DOE grant

These activities will occur after power line upgrade and first-level priorities are complete

Progress to-date & Future plans

1. Notice to Proceed. UNC to UVEC (contractor)
2. Project manager selected
3. Engineer was collecting baseline data (Gen & Dist)
4. Inventory of existing infrastrure completed
5. Financing secured
6. Engineering STOPPED in Q2 2020 – Covid & health
7. Lost Transportation outlets
8. Developed Materials & Supplies List
9. Created RFP to select new subcontractor based on new pricing and delivery challenges
10. Select new subcontractor to pick up where Engineer left off -- Board recently approved
11. Permitting needs better addressed, routing identified
12. Secure additional financing if needed

Quyana – Thank You! Questions?



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