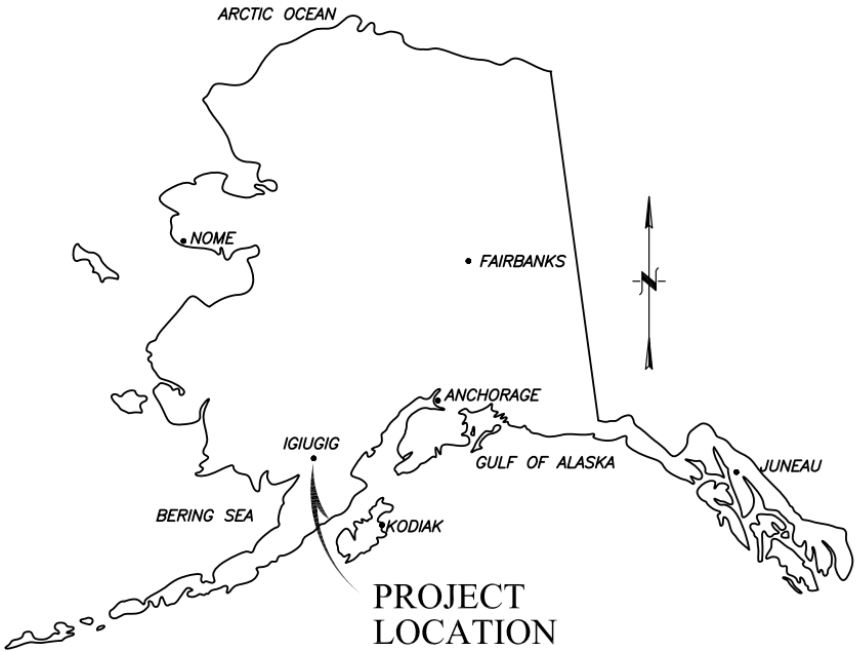
A Resilient and Autonomous Microgrid Powered by Marine Renewable Energy

November 15, 2023

Karl Hill, Igiugig Village Council

Project Location



PROJECT LOCATION MAP

Igiugig Self-Governance

Fuel and Freight Delivery

Annual Cost to Operate Igiugig Electric Co. 2022

Fuel	73.40%
Payroll Expenses	10.48
Power Plant	7.01
General Administrative	3.72
Internet	1.21
Utilities	1.12
Casual Labor	0.96
Merchant deposit fees	0.78
Miscellaneous	0.63
Equipment	0.57
Other	0.12
Total	$304,578.61

Fuel Prices in Igiugig

#1 Diesel $10.00 per gal

Gasoline $9.92 per gal

Electricity

$0.91/kWh
$0.72/kWh power cost equalization subsidy up to 750kWh

Igiugig, Alaska

Regional Detail (Alaska)

Local Detail (Iguigig, Alaska)

Project Summary

Project Need

- Igiugig has very high energy costs. Like most remote northern communities, we are not connected to a centralized electrical power grid or fuel supply pipelines
- The power plant is comprised of three diesel generators, each with 65 kW generators, which produce 325 MWh/year using a total of 24,789 gallons of diesel

Project Objective

- To acquire and install a smart microgrid and energy storage system, capable of managing high-penetration renewable energy sources that will provide power to all Igiugig homes and facilities for sustainable energy supply and resilient operations

Igiugig Hydrokinetic Project: Phase I

Technology Selection

Ensuring long-term viability through local ownership

Phase I Project Funding and Technology Partner

- Funded by the Department of Energy Water Power Technology Office
- Igiugig Village Council selected ORPC for its patented marine renewable energy technology which seemed viable for river conditions and ease of deployment

Igiugig Hydrokinetic Project

Phase I Highlights

- First tribal entity to hold a FERC hydrokinetic pilot license
- Deployed and tested Rivgen 2.0 over two Alaskan winters (-40^{o}C) and two frazil ice events
- Recorded tens of millions of sockeye salmon transiting past the device, with no observed injuries or mortalities
- During spring ice break-up, over 2 ft of lake ice flowed safely over device

Phase I Highlights

- Smolt outmigration monitoring
- Adaptive Management Meetings
- Monitoring
  - Igiugig Village Council
  - ADF&G
  - University of Alaska Fairbanks
  - Pacific Northwest National Laboratory
    - AquaAcoustics 2022

Igiugig Hydrokinetic Project: Phase II

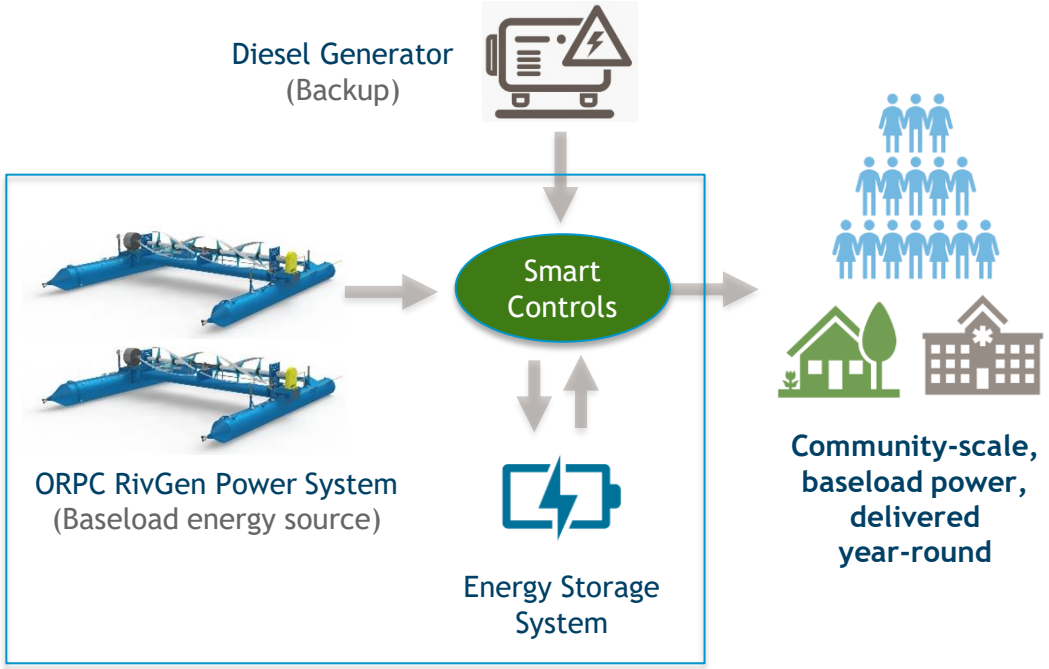
Phase II Project Funding and Technology Partners

Funded by the U.S. Department of Energy Office of Indian Energy

- ORPC, Schneider Electric, Alaska Energy Authority
- Energy Transitions Initiative Partnership Project
- National Renewable Energy Labs

A microgrid delivers baseload renewable energy from free-flowing rivers

- A RivGen-powered smart microgrid can relegate diesel generators to backup only.
- RivGen provides predictable baseload power.
- Energy storage and smart controls, coupled with RivGen baseload power, improve the value proposition of intermittent sources like wind and solar.

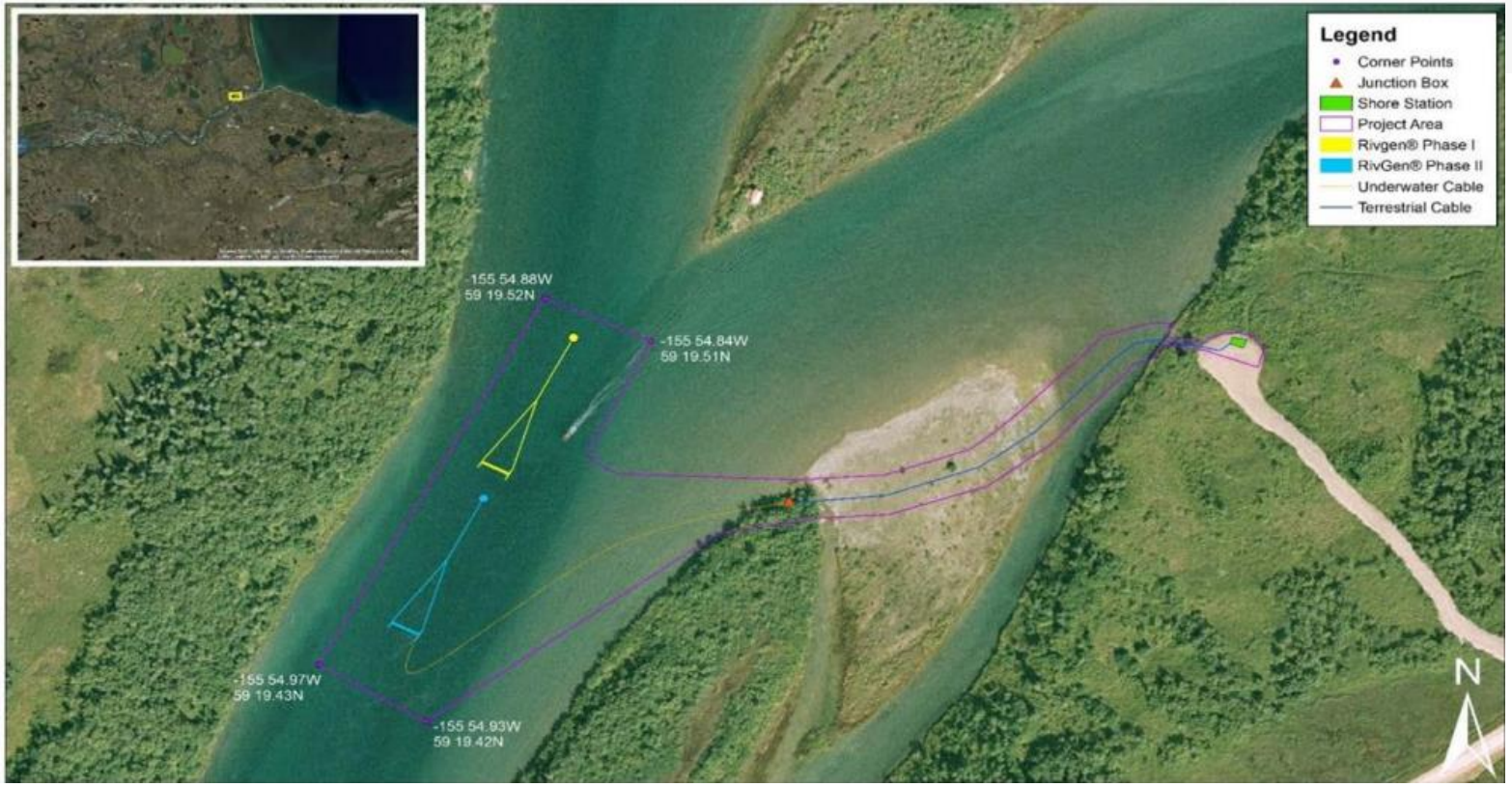


Work Completed to Date and Lessons Learned

Work Completed to Date

- Phase I: RivGen 2.0 Power System device, cabling, anchor, shore station with electronics, and interconnect to Igiugig Electric Company.
- Phase II: RivGen 2.1 Installation with similar infrastructure and connection

Work Completed to Date



Work Completed to Date

- Mooring anchor deployment

Work Completed to Date

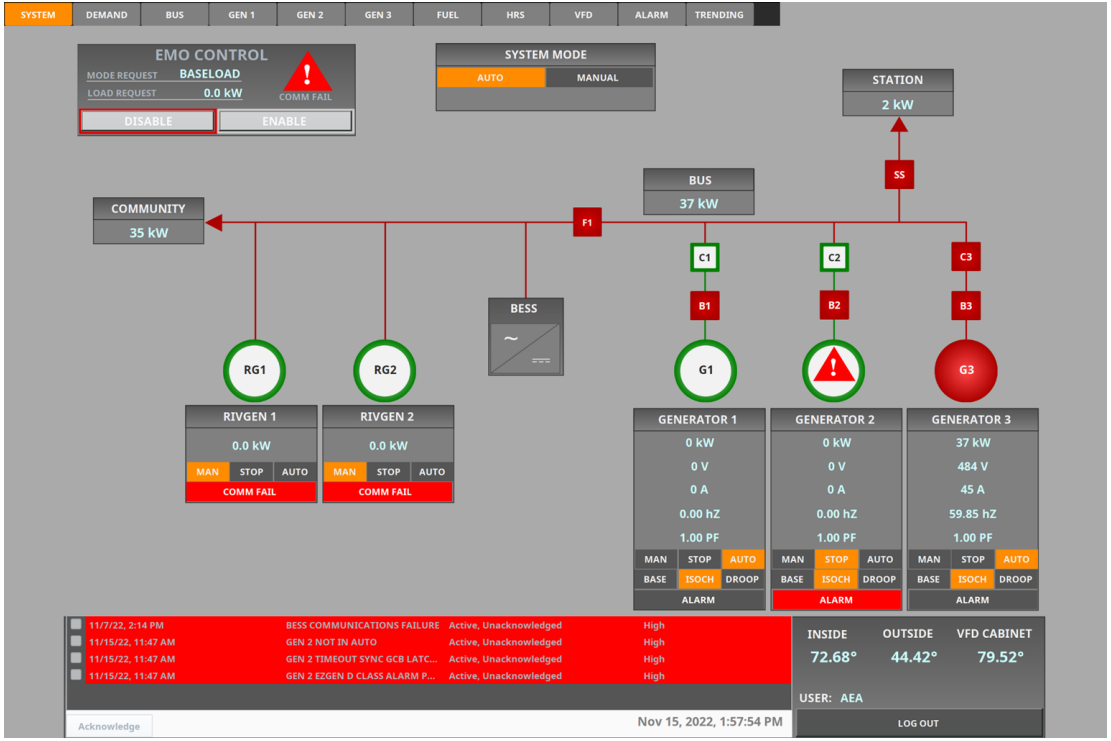
- Power and data cable deployment

Work Completed to Date: Battery Energy Storage System

- Installed fall 2021, commissioning began spring 2022…still underway
- Ability to be grid following or forming
- Rated for 253 kWh, 125kW inverter

Work Completed to Date: Generator Control Upgrades

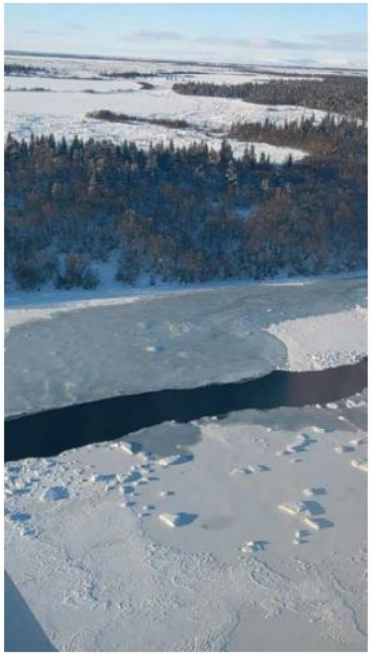
- Installed summer 2022
- Remote view
- SCADA access



Lessons Learned

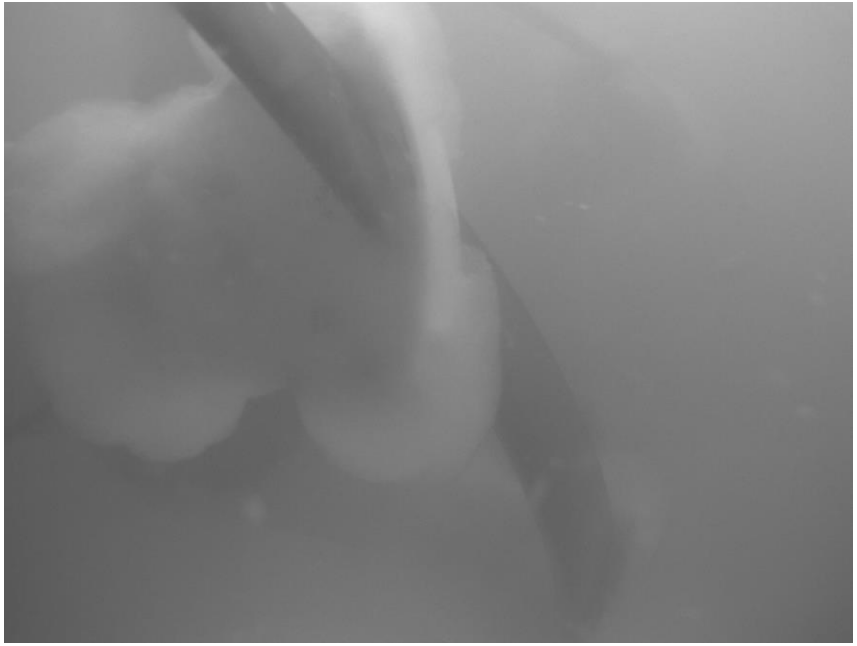
- Phase II of the project is still happening…we're continuing to learn lessons
  - Weather and seasonality can impact project timelines
  - Communication between project teams is key
  - Interconnection and commissioning will never go as planned
  - Supply chain issues continue to impact project schedule
  - Expect frazil ice conditions

Winter Operations



Frazil Event

Frazil Ice



Interconnection Short

- Several millisecond anomalies occurred
- Blackout ensued
- Safety protocols
- Adjust and keep moving forward

River Debris Increase From Storm Events

River Debris Increase From Storm Events

River Debris Increase From Storm Events

Future Activities

- Implement solution to diesel generator waste heat loop
- Complete Power Purchase Agreement/Service Agreement
- Complete commissioning Battery Energy Storage System and Microgrid
- Continue salmon smolt monitoring

RivGens 2.0 and 2.1

Thank You