Hydrokinetic Energy in Alaska

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Alaska Hydrokinetic Energy Research Center (AHERC)

UAF Institute of Northern Engineering
Alaska Center for Energy and Power
Information, Research & Technology Resource
Hydrokinetic Energy Technology

- Hydrokinetic devices convert kinetic energy of wave, tidal or river currents into electrical power
  - Turbines are placed in areas of strong currents
  - Wave absorbers placed in high energy wave environments
- Dams not required
- MHK technologies are pre-commercial -- “emerging technology”
- Niche technology with great potential for Alaska
Hydrokinetic Turbines

Pulse tidal* hydrofoil

New Energy Encurrent*

Marine Current Turbine*

ORPC*

VIVACE*: vortex induced vibration

Light bulb powered by cylinder

*Turbine images used with permission
Wave Energy Converters

Oscillating Wave Surge Converter

Oscillating water column

Courtesy: Dresser-Rand, Inc./Ocean Energy, LTD.

Courtesy: Resolute Marine, Inc.
Alaska has:
90% of U.S. tidal current energy
40% of U.S. river current energy
40% of U.S. wave energy
Opportunity
Wave Energy

- West Coast: 250 TWh/year
- East Coast: 160 TWh/year
- Gulf of Mexico: 60 TWh/year
- Hawaii: 80 TWh/year
- Puerto Rico: 20 TWh/year
- Alaska: 620 TWh/year
Demonstration projects (PAST & IN PROGRESS OR PLANNED)

- Ruby – Yukon River (YRITWC, 2010)
- Oceana, Inc. – UAF’s TRTS (UAF, UAA, AEA, 2014, 2015)
- BRI, Kvichak (AEA, 2014)
- Tanana River at Nenana (ORPC, DC, resource assessment)
- Whitestone (Delta Junction, design)
- False Pass (AEA, APICDA, ORPC, tidal, planning)
- Kvichak (DOE, IVC, ORPC, UAF ongoing)
- UAF TRTS (2016)
- Yakutat (CBY, AEA, DOE, UAF, wave resource assessment)
Challenges: Debris

Disrupts operations, and creates maintenance and safety issues.

Examples:

- Ruby 5 kW turbine demonstration
- Eagle 25 kW AP&T Demonstration
- Fort Simpson 25 kW New Energy demonstration
Enabling technologies developed by AHERC
Debris Video (Debris Diversion)
Turbine Test at the Tanana River Test Site (2014 & 2015)

Turbine Test Platform and RDDP

Oceana Turbine Testing
Fisheries Sampling

Gone Fishing
Is hydrokinetic energy generation in Alaska feasible?

YES: will not solve rural Alaska’s energy crisis (there is not a single solution)

- Lots of promise for small scale, seasonal operation (MINING)
- ABS Alaska and others are developing/selling commercial systems

Village/micro grid scale: need to advance quickly and systematically to avoid predictable missteps

- Long term testing needed
- Gather economic, O&M, efficiency, fisheries and further environmental data during testing
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Works Cited


AHERC: applied research organization focused on rapid results

1. Systematically identify challenges faced by hydrokinetic generation (e.g., debris, grid integration, fisheries, icing)
2. Identify and RAPIDLY develop solutions to challenges
3. Assemble team to address challenges
   - J. Kasper (AHERC Director, Physical Oceanographer)
   - J. Johnson (Geophysicist)
   - P. Duvoy (ACEP Res. Eng.)
   - N. Konefal (ACEP Res. Eng.)
   - A. Seitz (UAF-SFOS, Fisheries Oceanographer)
   - S. Jump (Fisheries Undergraduate)
   - M. Mueller Stoffels (ACEP, Power systems Integration)
   - A. Kulchitsky (UAF-INE, Computer Scientist)
   - J. McGlynn, Energy Solutions for Developing Nations
   - J. Holmgren (Jon’s Machine Shop)

http://acep.uaf.edu/programs/alaska-hydrokinetic-energy-research-center.aspx
Hydrokinetic Power

The Power per unit of cross-sectional area:

\[ P_{sp} = \frac{1}{2} d_w V^3 \]

- \( P_{sp} \) - specific power (W/m\(^2\))
- \( d_w \) - density of water (kg/m\(^3\))
- \( V \) - current velocity (m/s)

[Graph showing power output versus water current for a 10' twin turbine]
Challenges: Ice

Winter River Measurements

Maximum measured winter velocities
0.5-0.8 m/s
Challenges: Ice

Winter Current Velocity
Solution?

Floating Fiber Optical Cable: Kvichack River