

U.S. DEPARTMENT OF ENERGY WATER POWER TECHNOLOGIES OFFICE

DE-EE0008778 – Prefabricated standard modular hydropower installations for low-cost small hydropower



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Project Overview

Project Summary

The project lowers the time, cost and risk of small hydropower development. Sites will deliver benefit to the economic, environmental and community health by shifting small hydropower from the traditional site-specific design framework to the selection and installation of an engineered product: The standard modular hydropower (SMH) facility design supports selection and configuration of modules for generation, water passage, sediment passage, fish passage, and recreation. The project included development of the modules, configuration tools, environmental analysis and economic analysis. These analyses are now integrated into a standard process for application at future sites.

Intended Outcomes

- Innovations in technology, product, and process will lower the time, cost and risk of small hydropower development. Specific outcomes will include the following:
 - Identify suitable sites for the application of the SMH Technology
 - Design of modules and system of plans, specifications, work instructions and installation modules
 - Configure site and develop plans and specifications for reference sites
 - Memorialize and streamline the plans, specifications and tools
 - Environmental analysis of the project to ensure applicability, sound mitigation of environmental risks and net community benefit from the station

Project Information

Principal Investigator(s)

- **David Duquette** (LPS)
- Ryan Cook (LPS)

Project Partners/Subs

- Kootznoowoo, Inc.
- Electric Power Research Institute
- Oak Ridge National Lab
- Alden Research Laboratory
- Rickly Hydrological
- GZA GeoEnvironmental
- Avista
- McMillen Jacobs

Project Status

Complete, pending final report

Project Duration

- Project Start Date: Sept. 5, 2019
- Project End Date: June 30, 2022

Total Costed (FY19-FY21)

\$700.427

Project Objectives: Relevance

Relevance to Program Goals: LPS's SMH project supports the following WPTO goals



Approach:

- The approach is to use prefabricated, standard modules that are configured to fit a variety of sites.
- Modularity is not new to hydropower. The criteria for modularity to bring value is:
 - The integration brings real value;
 - Costs are truly lowered not eliminated;
 - There is suitable flexibility to allow for some site wise development while maintaining standard designs and the resulting economies of scale;
 - There is a suitable process to ensure site fit, as custom field work goes against the standard approach.
- While most "modular" designs are traditional designs with some amount of factory manufactured staging, the LPS approach investigated in this project creates a sub-set of intrinsically integrated engineered products that are selected, configured and installed at a site.

Project Objectives: Expected Outputs and Intended Outcomes

Outputs:

- Integrated system of engineered equipment to build hydropower sites (plans, specs, manufacturing prints, routing, BOM, and cost model)
- Standard design workflow to select, configure, document and plan for installation
- Validated work instructions for installation, operation and maintenance
- Standard energy, environmental, engineering and economic reporting

Outcomes:

- Hydropower plants get built as the lower LCOE supports more plants with investable economics
- Greater, environment friendly communities
- Concurrently, economic goals of the projects are validated (it costs what we say it will and delivers the promised output)
- The community and economic benefit create a virtuous cycle

FY 2019		
Project start 9/5/19	FY 2020	FY 2021
to 168 sites Reviewed module designs with potential fabricators; obtained rough quotes	 Finalized site selection: 2 replication sites, 1 active development site Visited Thayer Creek Identified substantial cost challenges and potential path to most 	Defined site criteria Redesigned modules for cost reduction; submitted drawing set Developed facility design calculator for rapid facility
	ICC=\$3500/kW goal	concept designs Granted an extension to 6/30/22

• Project completed successfully on 6/30/22.

Project Budget

Total Project Budget – Award Information				
DOE	Cost-share	Total		
\$1,000 K	\$276 K	\$1,276 K		

FY19	FY20	FY21	Total Actual Costs FY19-FY21
Costed	Costed	Costed	Total Costed
\$21 K	\$386 K	\$294 K	\$ 701 K

This project has been a tremendous opportunity to partner with Kootznoowoo, Inc., who has supported this
project with a traditional small hydropower facility design for Thayer Creek through funding provided by the
Alaska Energy Authority, totaling \$184,698 in cost share as of 6/15/22.

End-User Engagement and Dissemination

Market Opportunity

Upgrade of existing sites (0.5 – 10 Megawatt Sites) 7 GW: The fastest opportunity is in the upgrade of existing sites. LPS products are designed to support development of these projects. We provide the equipment and then support the fleet with service contracts. The technical capabilities developed on these projects also support additional, higher growth projects. The operating Hurley Dam and Mill Pond projects are examples of this project type.

Non-powered dams (200 kw to 10 Megawatt) | 12 GW of potential, \$31.5 BN investment: Only 3% of the 80,000 dams in the US are outfitted with equipment to generate power. The US DOE estimates that there are 12 GW of economically realizable potential. There is an additional 4GW in existing conduits like municipal and industrial water systems. LPS equipment lowers the time, cost and risk of developing these assets. The ongoing Walker Mill Dam and Flannagan Projects are examples of this sort of site.

Greenfield sites

- AK opportunities for islanded communities and diesel integration
- Projects at less than \$2000/kW have suitable economics
- Avista engagement on costing and site evaluation

Current Projects



McCoy Mill, Franklin WV – 20 kW Whiskey Bay, Bella Coola BC – 15 kW J.W. Flannagan Dam, Haysi VA – 1.4 MW Little River, Troy NC – 350 kW Mill Pond, Leeds NY – 500 kW Burt Dam, Olcott NY – 1.1 MW Ward Hydro, Salt Lake City UT – 30 kW Falling Springs, Covington VA – 500 kW Walker Mill Dam, Schuyler VA – 750kW Scott's Mill Hydro, Lynchburg VA – 4.5MW Town of Carbondale CO – 40kW

End-User Engagement and Dissemination (cont.)

- Project results will be disseminated through:
 - patent applications and awarded patents that will publish
 - product offers for sale with information available on littoralpower.com, at trade shows, conferences, and
 - a public version of the final technical report that will be available at osti.gov.



WHAT WE DO

LPS addresses the problems of cost, environmental impact, and regulatory complexity in hydropower and ocean energy. We develop, manufacture and install produce that reduce that time, cost and risk of patting projects huilt.





Performance: Accomplishments and Progress

Characteristic	Metric	Status
Nameplate capacity (flow and hydraulic head)	\leq 10 MW (e.g. up to 5,000 cfs and up to 30 ft. hydraulic head)	Spokane River, Spokane WA: 7.44 MW, 19.5' head, 4500 cfs Balcony Falls, Glasgow VA: 5.95 MW, 19.5' head, 4000 cfs Remote AK: 1.1 MW, 42' head,
Modeled installed capital cost per nameplate capacity	< \$3,500/kW LPS goal < \$2,000/kW	Spokane River: \$1,928/kW Balcony Falls: \$3,798/kW (<\$3500/kW possible*) Remote AK: 30-35% less than traditional * with lower cost fixed crest water passage modules
Est. construction timeline	< 2 yr from site prep. to commissioning	Presently estimating 6 months or less
Replication – same type of modules	Multiple (2 or more) U.S. sites	Three sites use some of the same type of modules Two sites use the same modules; addition of modular recreation passage at one
Passage – water, fish, recreation craft, sediment	Safe and timely	Crest gate passes water, downstream fish, debris Knife gate passes sediment and low water Recreation passage concept defined
Water quality	No degradation	EPRI analysis confirms no degradation
Co-benefits beyond generation	At least one	Remote Site – Econ Dev for Native Village Balcony Falls – Paddler safety, head pond recreation Spokane River – Head pond recreation, irrigate golf course

Performance: Accomplishments and Progress (cont.)

• Products resulting from the project: standard specifications; submittal drawings; and installation, operation and maintenance manuals



Performance: Accomplishments and Progress (cont.)

• Products resulting from the project: sold, fabricated and installing hardware







Performance: Accomplishments and Progress (cont.)

• Products resulting from the project: sold, fabricated and installing hardware







