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Real-time and Autonomous Hydropower Water Quality Monitoring System

Project span:

January 2019 – December 2020

PNNL capabilities:

- *Environmental monitoring & risk assessment for hydropower*
- *Sensor & transmitter development*
- *Flow characterizations in complex environments*
- *A2LA accredited facility for underwater acoustic testing*
- *Aquatic Research Lab for studying fish behavior related to hydropower*
- *Experienced teams for field testing in river environments & at hydroelectric dams*

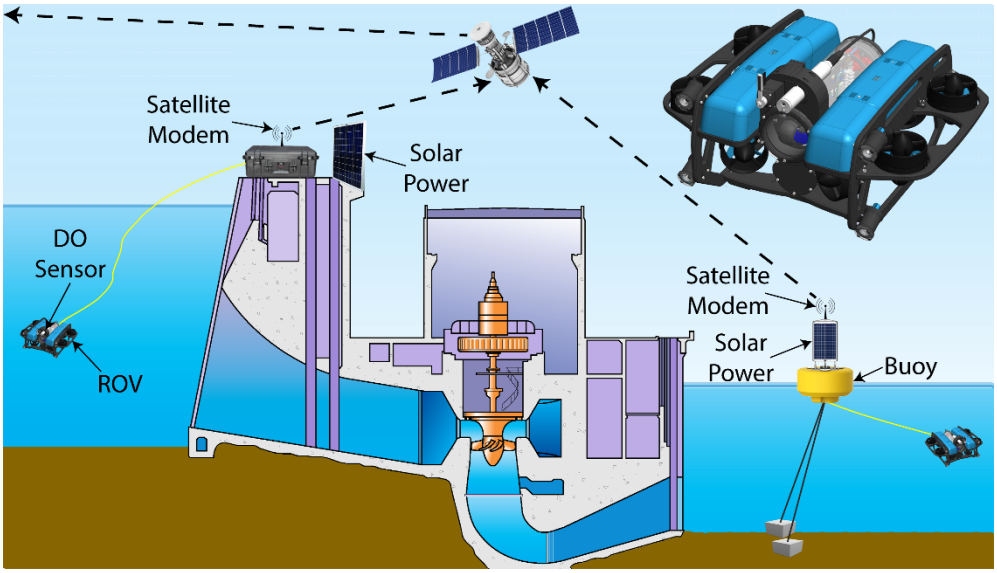

Figure 1. A visualization of the real-time and autonomous water quality monitoring system in operation.

With funding from the U.S. Department of Energy's Water Power Technologies Office and in partnership with Southern Company, Cube Hydro Partners, and Sapere Consulting, Pacific Northwest National Laboratory (PNNL) is developing an autonomous mobile sensor platform that can operate in dangerous water environments near hydropower facilities (intake and tailrace, etc.) for water sampling at multiple locations.

The goal is to enable safe, timely, and comprehensive water-quality data collection to guide hydropower operations. This technology will maximize power generation revenue with the improved operation control and reduce Federal Energy Regulatory Commission (FERC) and state water quality monitoring costs for compliance.

Existing water quality monitoring capabilities near hydropower facilities are limited by the lack of mobility of the sensors' carrier platform. Most use a buoy, a mounting fixture attached to a solid structure, or a human worker which significantly limits the selection of the sampling sites and poses safety risks during data collection and equipment maintenance.

The mobile sensor platform will transform the way water quality data is collected. It will facilitate data collection and water quality monitoring at U.S. hydropower facilities and around the world. It will also provide critical data to support development of more accurate predictive, real-time modeling for dissolved oxygen to optimize dam/river operations.

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The system is based on a remotely operated vehicle (ROV). It includes a software interface for the user to access read-time and historical sensor reading remotely. Two different deployment schemes (as shown in Figure 1) are used to accommodate flow condition differences upstream and downstream of a hydroelectric dam. Both are solar-powered.

Dam structure-based deployment: The ROV will be tethered from a station positioned at the top of the dam—without using a buoy— and will locations and depths along the face of the dam near the intake.

Buoy-based deployment: The ROV will use a buoy as a docking station at a downstream location— at or very near the tailrace— and will be able to take measurements at any location that is not limited by the length of the ROV's tether and the local flow conditions.

System Features and Functions

Autonomous	*Takes pre-programed or real-time measurements at multiple locations*
Self-powered	*Harvests solar energy to support autonomous operation*
Wireless real-time communication	*Transmits measurement and maintenance data to an on-or-offsite computer*
Modular and expandable	*Carries various combinations of sensors (DO, TDG, temperature, etc.) via a modular mount configuration*
Remote monitoring of sensor	*Monitors onboard sensors through real-time video images to detect biofouling or other potential issues*
Ease of servicing	*Travels to shore--away from the dangerous water environment where it is deployed-- for maintenance*

Expected Outcomes

- We will develop and demonstrate working prototypes of the mobile sensor platform suitable for both upstream and downstream locations near a hydroelectric dam.

This platform aims to enhance the flexibility and data accuracy of water quality sampling and meet the practical monitoring needs of dam owners and operators.

Partnerships are welcome. Contact us and let us know your specific use cases and monitoring needs!

Current industry partners:

- *Southern Company*
- *Cube Hydro Partners*
- *Sapere Consulting*

Contact:

Daniel Deng

Tel: 509.372.6120

Email: zhiqun.deng@pnnl.gov