OAK RIDGE NATIONAL LABORATORY

Needs and Opportunities for **Testing of Hydropower Technology Innovations**

Changes in the global energy sector have prompted a variety of hydropower innovations to meet the demand for flexible and environmentally friendly energy solutions, such as efficient low-head turbines, variable frequency drives, advanced materials and fish passage technologies. However, adopting unvalidated technologies can be risky for stakeholders since hydropower systems are complex and provide many essential services to communities.

Testing is a key step to lower risk and prove the value of these solutions. In a new report, researchers at Oak Ridge National Laboratory identified the key U.S. hydropower testing gaps and recommended two initiatives to fill those gaps with both new and existing testing capabilities.

What's in the Report?

The goal of the report, as directed by the U.S. Department of Energy's Water Power Technologies Office, was to identify the **U.S. hydropower testing gaps** (i.e., what kinds of testing stakeholders want but cannot access). This task required several sequential steps that are reflected in the report:

Section 1—Defines testing in the context of hydropower and describes the motivations for investing in testing capabilities, particularly for small hydropower development

Section 2—Reviews the current state of practice for hydropower testing, compiling common test standards and the emerging technologies that may need testing

Section 3—Identifies the testing challenges for new innovations (four testing gap themes, as listed on the next page)

Section 4—Reviews and catalogues existing testing capabilities at labs across the United States

Section 5—Proposes two initiatives to fill in the testing gaps: a hydropower testing network and a full-scale, flow-through facility (see next page)

Section 6—Proposes building a test facility at existing federal water infrastructures



(from top to bottom) Dynamometer at the National Renewable Energy Laboratory's Flatirons Campus. Main Channel Facility at the St. Anthony Falls Laboratory of the University of Minnesota. Physical model of spillway gates at Alden Research Laboratory. MedUSA at ORNL's Manufacturing Demonstration Facility.

Scan to review the project profile

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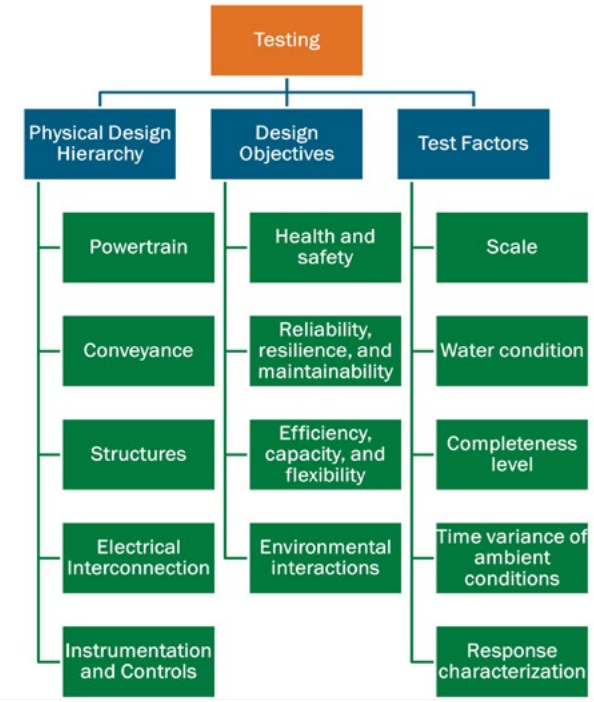
What is Testing for Hydropower?

To analyze testing gaps, it was important to define testing as it relates to hydropower. As shown on the right, ORNL categorized testing according to the following:

- Physical design hierarchy: what technology is being tested?
- Design objectives: why is it being tested?
- Test factors: how is it being tested?

This framework was applied to existing capabilities for hydropower testing at national laboratories, universities, private testing centers and federal agencies. Information on existing capabilities was captured through web searches and a public request for information that received responses from 19 stakeholder groups. Most of these capabilities can already cover several hydropower testing categories, including model-scale, flow-through testing of powertrains and conveyances for efficiency and reliability. However, few or no locations have testing technologies at full scale for high–technology readiness level innovations that involve high hydraulic capacity.



Key Testing Gaps

ORNL identified four major testing gap themes.

THEME 1. Full-scale testing is necessary to validate small hydropower innovations

THEME 2. Validation of environmental mitigation technology innovations is crucial and will benefit from a coordinated community effort

THEME 3. Hydropower technologies must be tested and validated for flexible operations over extended durations to ensure hydropower's value in the evolving grid

THEME 4. Advanced materials and manufacturing for hydropower components will require new and updated testing and validation procedures to enable innovative designs

How to learn more and get involved

Visit the ORNL Test Facility website and review the report, which can be found by scanning the QR code. If you have testing capabilities and would like to be included in a testing network or **have a hydropower technology** that you would like to test, please reach out to researcher Scott DeNeale. Finally, stayed tuned for updates from WPTO by visiting its website and subscribing to the Water Wire newsletter.

Recommended Initiatives

Hydropower Testing Network Program—The use of existing testing capabilities for early-stage innovations could be promoted by creating an online testing network platform and a grant funding model. The program could be modeled on successful industrial support mechanisms, such as the WPTO TEAMER (Testing and Expertise for Marine Energy) network for marine energy technology development.

Full-Scale Hydropower Testing Facility—New testing infrastructure could be developed to pursue designs validation at full-scale, flow-through conditions and with capabilities to monitor transient and dynamic responses for sustained durations. They should support validation of environmental metrics and unconventional material and manufacturing techniques. Constructing facilities at an existing federal structure, such as at a non-powered dam or navigation lock, DOE could reduce costs and save time.

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