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U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Water Power Technology Office

Subject: Request for Information: DE-FOA-0002561: Testing Capabilities and Facilities to Validate Hydropower Technology Innovations.

Submitted via electronic mail to: WPTORFI@ee.doe.gov

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The National Hydropower Association (NHA)¹ appreciates the opportunity to respond to the Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Water Power Technology Office's (WPTO) recent request for information (RFI), and to provide the industry's perspectives and insights on testing hydropower technology innovations. NHA commends DOE's consideration of a federal test facility geared toward finding innovative solutions to issues currently faced by the hydropower industry. In recent years, the industry has increased testing with many operators taking on the risk of testing new technologies. Industry has worked together, as well as with federal and non-federal labs to test technology. However, the testing of innovation considered to be of great risk, including technology that may impact environmental compliance and federal licensing, preclude the testing of certain technologies within the non-federal fleet. A federal test facility with the ability to test at full scale as well as environmental improvements will deliver the greatest value. NHA has reviewed the comments provided by the Hydropower Foundation and fully endorses its recommendations. NHA offers the following recommendations.

¹ National Hydropower Association (NHA) is a national non-profit trade association dedicated exclusively to representing the U.S. hydropower industry. NHA's membership consists of over 250 organizations, including consumer-owned utilities, investor-owned utilities, independent power producers, equipment manufacturers, environmental and engineering firms, and attorneys.



Topic 1: Innovative Hydropower Technology, Technical Procedures, and Best Practices In Need of Testing

Question 1.2: What are new and emerging technologies in need of testing? What is the footprint of these technologies and testing needs across the hydropower technology landscape of Figure 1? Are the necessary testing capabilities (i) non-existent or (ii) existent but unavailable?

Product developers, laboratories and academia may be very well equipped to test a variety of technologies through hydraulic modeling. It will be important to determine whether additional advancements in methodologies will satisfy the need. If advancement in methodologies will not suffice, it will be important to determine under which circumstances operators are unable to test the technology and a federal testing facility is necessary. The below concepts speak to emerging technologies in need of testing and technologies that will benefit from further development.

- Field validation of proof of concept in modular unit installation related to both civil and mechanical designs. For example, turbine testing on a larger scale accommodating multiple “site specific” conditions with varying flow, head, geometry, environment, etc.
- Designs in aquatic habitat improvement, including fish passage, total dissolved gas, dissolved oxygen, water temperature, aerating runners, and surface water pumps
- Adaptive management in operations to meet environmental, aquatic environments or other functions
- Testing and proof of concept for new approaches in the application of digital technology with respect to monitoring the health of dam structures
- Valve designs have been tested historically via Computational Fluid Dynamic (CFD) and Finite Element Analysis (FEA) modeling and some lab facility small-scale testing. For example, testing of a new gate (25ft by 40 ft) or valve that is subject to very high pressures could be confirmed in a testing facility
- Validation of CFD and FEA for components through full scale data collection for site specific variables
- Full scale testing of modeling results, acceptance of new equipment designs by regulatory agencies and non-governmental organizations (NGO) could be enhanced
- Innovations in other industries that may be easily transferred to hydropower, for example sensors, advanced manufacturing, material science, etc.
- Pumped storage and conventional hydropower powertrain testing technologies



- Potential use of a coordinator to encourage innovation within the engineering industry, specific innovative ideas could be presented to these firms in civil works – structural water conveyance
- High performance environmentally acceptable lubricants (EALs) for hydropower require testing in full scale operating conditions. New EALs are biobased, biodegradable, non-toxic, and non-bioaccumulating, and they can outperform existing hydropower lubricants while mitigating the risk of environmental damage
- Operators have expressed high interest in these environmentally friendly options; however, the cost and risk associated with an unplanned outage, particularly for regulated utilities, is so great that operators will not adopt EALs without seeing test results under full scale operating conditions. The desire to see “in-service” data and lifetimes also extends across the various turbine types and generator configurations.
- Testing of equipment that utilize air or water in lieu of petroleum or vegetable-based lubricants, essentially an oil-free turbine hub.

Topic 2: Availability of Hydropower Testing Facilities and Capabilities

Question 2.2: Are centralized multi-capable facilities a necessity for your development pathway or can dispersed testing facilities generally meet your requirements/expectations? How can facilities be coordinated efficiently to facilitate access to and cooperation among hydropower technology developers and stakeholders?

NHA sees the benefit of both a centralized multi-capable facility and dispersed testing facilities. A facility designated as a test station would be valuable particularly if it were to contain multiple turbine types, generator configurations, and governor systems (HP/LP). Given the need to maintain baseload and consistent power supply, the industry would be well served by utilizing facilities with expired FERC licenses or facilities that are not under the same regulatory requirements as the non-federal fleet.

A centralized multi-capable facility would allow for the testing of several technologies at one point and could include testing of pumped storage technologies. For testing of fish impacts, the facility should exhibit many of the attributes of existing hydropower facilities such as head, flow and tailwater conditions. A centralized facility with the ability to holistically test modular hydropower units and innovations in civil structure design would be optimal.

Dispersed testing facilities may allow for the testing of technologies subject to a variety of environmental conditions and necessities. For example, the differences in fish species and



water environments. The Pacific Northwest, Northeast and Southeast have varying water conditions and regulations. Multiple test sites would also allow for testing equipment under various operating heads (small to large).

NHA inquires as to how the knowledge gained from the deployment of technologies at test facilities will be shared with the hydropower industry, the broader group of stakeholders and the public.

Topic 3: Suitability and Availability of Federal Water Infrastructure to Support Hydropower Technology Testing

Question 3.4: Considering that most federal dams are owned and operated by the Corps of Engineers, Bureau of Reclamation, or Tennessee Valley Authority, what could or should be the role of those agencies in developing and operating test facilities within infrastructure that they own?

NHA believes the development and operation of test facilities within federal agencies, such as the Corps of Engineers, Bureau of Reclamation and Tennessee Valley Authority infrastructure, would be of benefit to the industry. The designation of just one unit in one or more of these federal facilities to test innovations for a period of time will lend to innovative solutions the industry finds challenging to test due to certain constraints. High risk and potential environmental compliance issues are often the key issues that deter owners within the non-federal fleet from testing new technologies.

Testing in large structures, as appropriate, has the potential to provide tremendous value to the industry in understanding the impacts these larger scale technologies may have on operations. The testing of new lubricants, environmental improvements and mitigation, and elements to increase hydropower flexibility would be of most value to industry with regard to government demonstrations. Strong partnership between DOE and industry will be necessary to maximize the potential and enable small companies to access available opportunities.

NHA suggests test facilities within the federal fleet be established with consideration for diversity of environmental factors, taking into account the varying regional conditions.

A small demonstration hydropower unit could also help support an adaptive management requirement where a hydropower unit is not present today.



Topic 4: Priorities, Roles, Business Models, and Access for DOE-Sponsored Hydropower Test Facilities

Question 4.3: How can DOE ensure that hydropower technology testing facilities are available to many different users for many different needs?

With respect to a business model for a hydropower test facility or network of facilities, NHA recommends a setup similar to Testing & Expertise for Marine Energy (TEAMER). TEAMER acts as a coordinator for marine energy test facilities under the WPTO and has proven successful in coordinating testing for marine energy technology developers.

NHA encourages inclusion of willing institutions within the private sector be taken into account when considering this model, such as operators, non-federal laboratories, academia and manufacturers. Certain non-federal laboratories, academia and manufacturers are capable of testing innovative solutions close to full-scale capacity.

Topic 5: General Comments

Question 5.1: What other information about testing of innovations in hydropower technology, advanced technical procedures, new best practices and new operating scenarios do you see as important for DOE to know in planning and implementing hydropower research and development?

For innovation to scale, risk is necessary. However, often industry is not able to take on risks in its operations with respect to environmental or regulatory compliance.

NHA recently held a workshop focused on the challenges in deployment of new technologies and innovation. Within the workshop, the risk of implementation of experimental technology with respect to the operating license was identified as a key challenge in the application of a new technology to an existing facility. Operating within one's license has stymied innovation and adaptation of new technology. NHA suggests DOE work closely with FERC and other relevant federal and state environmental agencies with respect to environmental compliance parameters of a DOE facility.

In addition to exploring testing at federal facilities, NHA recommends that WPTO consider funding opportunities to entice owners and operators to allow testing at their facility. These funding opportunities may cover the costs and potential risk associated with facilitating the testing of new technologies. Additionally, the coordination of tours of these volunteer facilities will provide the ability for other operators to view the new technology at work, gain an in-person perspective, and ask questions of technology developers and facility operators. This



approach may also further the exchange of information between the WPTO, labs and industry, thus increasing industry engagement to ensure the research is relevant and adaptable.

An increase in volunteer testing facilities may also provide a greater variety of testing environments conducive to specific testing needs. For example, specific dam characteristics such as height, location, flow and environment are necessary.

DOE could first consider a TEAMER-like program consisting of willing operators within the federal fleet, non-federal fleet, academia, federal and non-federal laboratories, and manufacturers with capabilities of testing innovation. Implementing this concept first may provide a baseline for identifying gaps in testing facility needs.

Within NHA's recently held workshop, participants mentioned the need to understand what technologies and research is available to industry. NHA recommends that WPTO submit research to its recently released Waterpower Research Portal (WaRP), a repository of current and ongoing research in conventional hydropower, pumped storage, small hydro, and marine energy.

Once again, NHA appreciates the opportunity to respond to this RFI. DOE has been invaluable in helping the industry better understand and address its challenges, while being a steward for natural resources and facilitating access to affordable and reliable energy. NHA hopes the feedback provided within this response is valuable as the department considers next steps in testing innovative technologies for the hydropower industry. We look forward to future discussions.