Request for Information: Testing Capabilities and Facilities to Validate Hydropower Technology Innovations

DATE: August 24, 2021
SUBJECT: Request for Information (RFI) DE-FOA-0002561

Description

The U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Water Power Technologies Office (WPTO), seeks comments on the testing facilities and capabilities for use by technology developers, manufacturers, designers, construction contractors, owners, regulators, researchers, and other stakeholders to validate and advance emerging and future hydropower technology (including pumped-storage technology) innovations, improved technical procedures, and advanced best practices.

An appropriate definition of testing in this context is *activities that validate the health and safety protections, quality, performance, reliability, resilience, or environmental interactions of technology, technical procedures, and best practices.* The focus of this RFI is testing for the purpose of validating *innovative* hydropower technology, improved technical procedures, and advanced best practices—those that have yet to be put into widespread use or practice in the U.S. This includes design innovations, pre-commercial prototypes, initial production versions of innovative technology, and innovative fabrication, construction, operations, and maintenance procedures. However, if there are other needs for testing of commercialized technology in the U.S. that would enable hydropower growth or capability enhancements, WPTO welcomes responses that address those unmet needs.

Testing for other purposes—typical validation of conventional site-specific designs, routine assessment of functional degradation of commercialized and installed products after normal wear and tear or testing to assess loss of function after a catastrophic event— while important activities within hydropower asset operations and maintenance, are not the focus of this RFI.

WPTO seeks input in four specific topics and one general topic: (1) emerging and future hydropower *technology innovations, improved technical procedures, advanced best practices, new operating scenarios* that will need validation through testing; (2) the current and future *availability* of and access to testing facilities and capabilities to meet the needs of emerging and future technology validation; (3) the potential and challenges of *federal water infrastructure* being re-purposed or co-purposed as testing facilities for emerging and future technology; (4) the appropriate *priorities, roles, and business models* of federally-funded hydropower test facilities; and (5) general responses.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

In the context of this RFI, *federal water infrastructure* means federally owned and operated water control facilities and their encompassing hydrologic and hydraulic context that have a primary purpose (flood reduction, navigation, water supply, irrigation, or hydropower production) other than testing and research. It does not include federal laboratories and experimental facilities with a primary mission of research support. WPTO is undertaking a separate effort from this RFI to catalog the hydropower-relevant validation capabilities of laboratory and test facilities operated by DOE, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and other federal agencies.

Background

A hydropower facility is a complex integration of systems and sub-systems, requiring an interdisciplinary and hierarchical treatment to understand how its many parts function and can be tested. Two primary dimensions of hydropower technology and testing are: (1) physical equipment hierarchy (the arrangement of structures, conveyances, powertrains, instrumentation and controls, electrical interconnections, and other equipment); and (2) design objectives, which may be categorized as (i) health and safety; (ii) reliability, resilience, and maintainability; (iii) efficiency, capacity, and flexibility; and (iv) environmental interactions. The footprint of a technological innovation across these dimensions influences the types of facilities, equipment, resources, and methods required to yield useful testing results—results that validate a technological innovation as meeting its stated design objectives. Other factors may also influence the design of testing facilities and procedures. These include system completeness (how much of the equipment hierarchy is being tested), water condition (dry, submerged, or flow-through), scale (partial or full), ambient conditions (steady-state or time-varying), and response characterization (static, dynamic, or monitored and trended).

Purpose

The purpose of this RFI is to solicit feedback from industry, academia, research laboratories, government agencies, and other stakeholders on issues related to testing in support of research and development of hydropower technology. WPTO is specifically interested in information on unmet needs for hydropower testing capability within the U.S. and challenges that technology developers face in accessing testing capabilities. WPTO is also soliciting insights into how federal water infrastructure can be repurposed, refurbished, upgraded, or enhanced to provide testing capability that is needed and does not already exist. The need for testing and validation was highlighted in the DOE Hydropower Vision Report (2015):

> New technologies represent risks to first adopters, making it difficult for equipment manufacturers to bring nascent technologies to market. Those risks can be reduced through validation activities, such as fleet benchmarking and the development of testing

> facilities, to confirm performance and reliability. Testing and validation of emerging technologies can ensure that biological, physical, and environmental requirements are met. Validation can also increase confidence on the part of investors and decision makers, which, in turn, helps accelerate deployment of new hydropower and [pumped storage] technologies.

Congress encouraged DOE to undertake scoping activities to investigate establishing a hydropower test facility in the FY2020 Energy and Water Appropriations Report. H.R. 116-449, which accompanies the Fiscal Year 2021 Consolidated Appropriations Act (Public Law 116-260), which demonstrates continued support of scoping a test facility.

This is solely a request for information and not a Funding Opportunity Announcement (FOA). DOE is not accepting applications.

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI; however, EERE may also elect not to issue a FOA. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that EERE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind EERE to any further actions related to this topic.

Confidential Business Information

Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via two well-marked copies: one copy of the document marked “confidential” including all the information believed to be confidential, and one copy of the document marked “non-confidential” with the information believed to be confidential deleted. Submit these documents via email. DOE will

make its own determination about the confidential status of the information and treat it according to its determination.

Evaluation and Administration by Federal and Non-Federal Personnel

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to EERE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

Request for Information Categories and Questions

Respondents are encouraged to consider their responses to this RFI into with respect to the five topic areas that follow, using the questions in each topic as prompts**. *It is not necessary to answer all questions, but it will be helpful if each response identifies the question to which a response applies.***

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

WPTO requests that respondents identify hydropower (including pumped storage) technology innovations, advanced technical procedures, advanced best practices, and new operating scenarios that need testing, as well as the testing capabilities and testing procedures that are needed. The question prompts included below are provided as a guide to respondents.

> **Important:** *It is NOT necessary for respondents to answer all questions. Respondents need only identify their response as pertaining to Topic 1, answering only those questions they choose.*

The scope of Topic 1 includes technologies representing a range of Technology Readiness Levels[1] (TRL), as well as conventional designs proposed for service in new operating regimes (increased start/stop and ramping, for example) and new ambient conditions (increased water temperatures and grey water conduits, for example). Testing of materials, parts, components, sub-systems, complete units, or even major portions of hydropower facilities are in scope for

[1] Technology Readiness Level is a rubric for assessing the maturity level of a technological innovation, see https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-04-admchg1.

this RFI. Hybrid systems as such as hydropower with battery, pumps as turbines, and wind and pump storage technologies may also be considered.

Topic 1 also focuses on identifying and clarifying testing needs, including the capabilities that do and do not exist for validating technological innovations against design objectives. Examples of heretofore untested innovations and configurations include multi-pump-turbine arrangements in pumped-storage designs, variable speed pump and generator testing, and advanced power electronics for grid interconnection.

Question 1.1: What are the dimensions and factors affecting the technical specifications for testing of hydropower innovations? Examples include specific design objectives (performance, reliability, and environmental effects), wet/dry conditions, geometric scale, control of ambient conditions, and characterization of response.

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?

Question 1.3: Are there new operating regimes or new technology combinations (hybrid hydropower-battery designs, for example) that require new testing capabilities or facilities?

Question 1.4: What testing needs exist for testing and validating effective grid interconnection and the provision of services to the grid by hydropower assets? What are the challenges of doing so?

Topic 2: Availability of Hydropower Testing Facilities and Capabilities

WPTO requests that respondents comment on the *availability* of existing hydropower testing facilities and capabilities to address the technology testing needs scoped in Topic 1. The question prompts included below are provided as a guide to respondents.

> **Important:** *It is NOT necessary for respondents to answer all questions. Respondents need only identify their response as pertaining to Topic 2, answering only those questions they choose.*

Facilities in this case include those hosted and operated by commercial providers, academic institutions, DOE laboratories, and other federal agency laboratories. Note that testing possible at federal water infrastructure (having a primary purpose other than testing and experimentation) is addressed in Topic 3. WPTO is interested in the challenges that those with testing needs face when searching for and engaging with these facilities. Challenges may include funding of testing expenses, contracting, scheduling of short- and long-term testing amidst multiple clients, and confidentiality of test articles and results. Flow through testing

facilities must contend with water availability constraints that include abundant and predictable water supply, sufficient hydraulic head, flexibility to vary upstream and downstream water levels for testing, and the ability to accommodate a range of fluctuating and varied power inputs and outputs for testing. WPTO is also interested in the comparative value and difficulty of testing technology at a single integrated facility versus a network of facilities with different, but complementary, testing capabilities.

Question 2.1: What is your experience with hydropower technology testing? Please identify the testing facilities you have accessed and the test outcomes you obtained. What challenges did you face in accessing these facilities and achieving outcomes?

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?

Question 2.3: Considering the hydropower technology landscape introduced in Topic 1, what gaps in testing availability are limiting your progress or industry progress?

Question 2.4: How adaptable are existing facilities to future hydropower needs (for example, solar-wind-hydropower hybrid technology, pumped-storage technology, hydropower-battery hybrid technology, turbine aeration, or fish passage technology)?

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

The third topic of this RFI is the potential re-purposing or co-purposing of federal water infrastructure for testing hydropower technologies. In this context, federal water infrastructure is defined as engineered facilities having a primary purpose other than testing and experimentation—dams (powered and non-powered), navigation locks, irrigation systems, and other federal water control facilities. Using federal water infrastructure for testing would leverage prior federal funding for development and operation facilities and may be less expensive than capital investments required for a new federal testing facility for hydropower technology. The question prompts included below are provided as a guide to respondents.

> **Important:** *It is NOT necessary for respondents to answer all questions. Respondents need only identify their response as pertaining to Topic 3, answering only those questions they choose.*

The compatibility of such facilities will need evaluation to ensure existing mission objectives continue to be accomplished or, in the case of decommissioned facilities, ensuring that they can be restored to service with appropriate testing capabilities. Such re-purposing or co-purposing of federal infrastructure would be a federal action and require environmental assessment and

public input compliant with National Environmental Policy Act (NEPA) regulations. Ownership, control, liability, and regulatory jurisdictions for infrastructure, testing equipment, test articles, and operations are issues that will require further study (Topic 4 addresses business models for hydropower technology testing facilities).

Desirable features of federal water infrastructure for hydropower technology testing include abundant and predictable water availability, sufficient hydraulic head, flexibility to vary upstream and downstream water levels for testing, and the ability to accommodate a range of fluctuating and varied power inputs and outputs for testing. Infrastructure that has previously not been interconnected for power generation will require assessment for proximity to power systems for upgraded interconnection. The addition of hydropower generation to existing U.S. Army Corps of Engineers (USACE) navigation and fishway facilities may provide insight into how new mission objectives associated with hydropower technology testing can be combined with existing operations at federal facilities.

Question 3.1: Are you aware of federal water infrastructure that may be useful in testing hydropower technology? If so, please describe the facility and its desirable and unique features.

Question 3.2 What factors should WPTO consider (for example, necessary modifications or upgrades, interconnections, water management, environmental assessment, regulatory jurisdiction) in selecting, conceptualizing, designing, and implementing hydropower technology testing at a federal water infrastructure facility?

Question 3.3: How would scheduling and testing needs best be coordinated between the primary mission and the testing mission of the infrastructure/facility?

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?

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

The business model for a hydropower test facility, or a network of facilities, must describe the rationale, in terms of use cases, costs, and benefits, for creating and operating the facility to deliver value to stakeholders and the public. Use cases for a new test facility must be consistent with prioritized unmet needs for hydropower technology testing (i.e. those parts of the technology-objective matrix for which testing capabilities or access to capabilities are insufficient). Consistent with these defined use cases, the business model must address public and commercial benefits of the facility; costs of development, operation, and maintenance of the facility; estimation of the initial and ongoing demand for testing services; estimation of

capital and financial income to the facility from public and commercial sources; and timelines and lifetime for the facility. The question prompts included below are provided as a guide to respondents.

> **Important:** *It is NOT necessary for respondents to answer all questions. Respondents need only identify their response as pertaining to Topic 4, answering only those questions they choose.*

Institutional roles for ownership, control, operation, outreach, and technical support will influence the business model for the test facility, as will the river system, power system, and regulatory contexts for the facility. In particular, WPTO must discern and define its role within the hydropower test facility activities, which may include selecting users and enabling user access, assessing and ensuring efficacy of testing through best practices and standards development, coordinating testing at the facility with testing external to the facility, and providing technical support and subject matter expertise to the facility.

Question 4.1: What metrics and rubrics should DOE use to prioritize testing needs that are unmet by existing testing facilities and capabilities?

Question 4.2: What factors (value proposition) do technology developers consider in decisions to engage a facility to test their hydropower technology?

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

Question 4.4: How should DOE sequence the development of a test facility (e.g. specification, site selection, conceptual design, environmental assessment, engineering design, construction/installation, commissioning, operation, decommissioning) to maximize the value of a public investment in hydropower technology testing facilities?

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?

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to WPTORFI@ee.doe.gov no later than 5:00pm (ET) on December 7, 2021. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (.docx)

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.

attachment to the email, in 12-point font, and 1-inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if applicable. Respondents may answer as many or as few questions as they wish.

EERE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.