



Topic: **Reservoir Committee Agenda Item 2-4** **2018 June 21**

Subject: **U.S. Department of Energy Technical Assistance Grant**

Requested Action:

Discussion and possible direction to staff regarding the submittal of a technical assistance grant application from U.S. Department of Energy for pumped-storage hydropower (PSH) projects.

Consider authorizing staff to submit this application by July 12, 2018 and to obtain letters of support from participants and other stakeholders.

Detailed Description/Background:

Staff is preparing an application for a Technical Assistance Grant from the U.S. Department of Energy’s Energy Efficiency and Renewable Energy’s office to perform a “Techno-Economic Studies of Pumped-Storage Hydropower”. This effort would provide project-specific analysis related to the cost-benefit, power market, financial, and valuation.

The grant will provide \$1.5 million of funding for up to 2 projects. The submission deadline for the optional Letter of Intent was June 12, 2018, with the final application deadline of July 12, 2018.

Prior Reservoir Committee Action:

None.

Fiscal Impact/Funding Source:

None.

Staff Contact:

Jim Watson

Attachments:

Attachment 2-4A: Department of Energy Technical Assistance Grant - Overview

DE-FOA-0001838: Notice of Opportunity for Technical Assistance for Techno-Economic Studies of Pumped-Storage Hydropower

Water Power Technologies Office Hydropower Program

Key Dates	
Notice of Opportunity for Technical Assistance Issue Date	April 27, 2018
Informational Webinar (Optional)	May 24, 2018 at 1 p.m. ET
Submission Deadline for Letters of Intent (Optional)	Letters of Intent are due at 5 p.m. ET on June 12, 2018.
Submission Deadline for Applications	Applications are due at 5 p.m. ET on July 12, 2018.
Expected Date for EERE Selection Notifications	All selections are expected to be made by September 2018.
Summary Information	
Means of Submission	Applications must be submitted through EERE Exchange at https://eere-exchange.energy.gov , EERE's online application portal. EERE will not review or consider applications submitted through other means.
Total Value of Technical Assistance to be Provided	Total Technical Assistance is valued at \$3,000,000. DOE will provide the funding to the team that will provide the Technical Assistance for the selected projects. There is no direct financial assistance available under this NOTA.
Anticipated Number of Project Selections	2
Value of Technical Assistance Provided Per Project	EERE anticipates providing approximately \$1,500,000 per selected project in the form of Technical Assistance.
Period of Performance	Period of Performance will be up to 18 months.
Eligible Entities	For-profit and non-profit companies or entities, and State, local, and tribal government are eligible to apply. Federal agencies and federally-funded research and development centers (FFRDCs) are not eligible.
Cost Share Requirement	Not required
Submission of Multiple Applications	Applicants may submit more than one application, provided that each application describes a unique site.
Questions	Questions may be directed to WPTONOTA@ee.doe.gov .

OVERVIEW AND DESCRIPTION OF TECHNICAL ASSISTANCE

A. SUMMARY

As an energy storage technology, pumped storage hydropower (PSH) plays a key role in supporting the ongoing evolution of the electric power system. In addition to enabling higher penetration of wind and solar generation, PSH also provides a large amount of flexible dispatchable capacity that helps provide for a safe, reliable, and economical operation of the power grid. Nevertheless, the challenge to accurately evaluate the different value streams that PSH projects provide to the grid has been and remains a major issue for the hydropower industry, generation planners, and system operators.

The purpose of this Notice of Opportunity for Technical Assistance (NOTA) is to perform techno-economic studies—including cost-benefit analyses, power market analyses, financial analyses, and a valuation analysis—to evaluate the long-term value of two selected PSH projects. These studies will provide PSH developers the capability to estimate the value of a proposed PSH project, including: value of bulk power/storage capacity; energy arbitrage; value of ancillary services; power system stability; and transmission benefits. The studies will also investigate and compare PSH financial revenue streams under current market structures relative to the economic value of PSH to the grid.

The techno-economic studies will be carried out by a Technical Assistance team comprising subject matter experts from the following DOE national laboratories: Argonne National Laboratory (ANL), Idaho National Laboratory (INL), National Renewable Energy Laboratory (NREL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL). As part of the Technical Assistance, the Technical Assistance team has developed draft guidance for methodologies and approaches to PSH valuation. Through these studies, the team will test and refine the valuation guidance, after which the guidance and valuation tools will be transferred to the industry and made publicly available.

B. OBJECTIVES

In Fiscal Year (FY) 2017, Congress directed the Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE), Water Power Technologies Office (WPTO) to produce “a thorough techno-economic analysis of the value of PSH at two sites with high-levels of intermittent renewable energy generation in the United States.”¹ In addition to serving as the mechanism for selecting both sites, WPTO is issuing this NOTA to achieve the following objectives:

- Assess services and contributions that PSH projects provide to the grid and estimate the value of those services, including revenue streams over time;
- Quantify the economic value provided by new PSH projects based on the market, location, and plant characteristics;
- Compare design configurations for new PSH projects based on cost and value;
- Test and refine a comprehensive, replicable, and transparent PSH valuation guidance to enable consistent assessments and comparisons of new PSH projects and design options; and
- Support a larger multi-year research strategy to define PSH capabilities and estimate the value that hydropower and PSH resources contribute to reliability, resiliency, and other benefits under a set of plausible future electric power system conditions.

¹ See Explanatory Statement for the Consolidated Appropriations Act, 2017, Congressional Record – House, 115th Cong., First Session, Vol. 163, No. 76-Book II, p. H3751 (May 3, 2017).

These objectives will assure that the NOTA outcomes benefit not only those directly receiving technical assistance but the broader hydropower industry and electricity stakeholders.

C. BACKGROUND

PSH is a type of hydropower facility where energy can be stored and generated by moving water between two reservoirs of differing elevations. As an energy storage technology, PSH supports many aspects of power grid operations and spans all major power grid components, including electricity generation, delivery, and demand sub-systems. Historically, most PSH plants in the United States were built to complement and provide backup capacity to large baseload coal and nuclear plants, which operate at a steady rate. PSH plants would generate power during the daily peak electrical demand, and pump water to the upper reservoir late at night during periods when energy demand was low. This practice is known as energy arbitrage. The penetration of variable renewable generation from wind and solar resources is now one of the key factors for the renewed interest in PSH as there is an increasing need for flexibility in power system operations. In addition to providing 97% of the total utility-scale storage in the United States, PSH plants can respond quickly and flexibly to both grid generation and load needs to accommodate variable generation. This dual mode of operation contributes toward greater resiliency and reliability of the power grid.

While the services provided by PSH are increasingly valuable, almost no new facilities have been built in the United States in the last several decades. PSH plants require high initial capital costs and long lead times to complete the construction process. Further, it is difficult to assess and quantify the full value of PSH contributions to the grid. The value of flexibility, for example, is less predictable than day-night energy arbitrage. The inability to estimate the full value of PSH, especially system-wide contributions, makes it difficult to assess the total benefits of a PSH project to the system.

In FY17, WPTO established a multi-laboratory research effort to develop an advanced valuation guidance for PSH. The valuation guidance is a step-by-step methodology that can be used by PSH developers, plant owners and operators, and other stakeholders to assess the economic value of existing or planned PSH projects. The valuation guidance is general in nature such that it can be applied to different types and sizes of PSH plants operating in different market environments, while also being detailed enough to account for the various services that specific plants provide to the grid. The methodology will be applied at the two sites selected through this NOTA, allowing recipients to evaluate and demonstrate the potential economic and financial value of the proposed projects. Utilizing the valuation guidance at the two selected sites will help validate and refine the guidance itself, which will be made publicly available after the studies are complete.

D. SCOPE OF ACTIVITIES

DOE anticipates providing tailored Technical Assistance to two (2) entities selected under this NOTA through the use of a specifically-assembled Technical Assistance team comprised of subject matter experts from DOE national laboratories. Cost-benefit analyses, power market analyses, financial analyses, and a valuation analysis will be conducted to help recipients assess and estimate the value of the various services and contributions that each selected PSH project provides to the grid based on the project's design, equipment, operational characteristics, location, market landscape, and other project-specific characteristics. The techno-economic studies will compare project investment costs to assessed grid benefits and revenue streams.

During the period of duration of this NOTA, the Technical Assistance team will perform the following tasks:

Task 1. Cost-Benefit Analyses

The Technical Assistance team will perform a number of analyses to estimate the benefits and costs of each selected PSH project, including:

- Bulk power capacity and energy value over PSH lifetime (value of energy arbitrage and PSH capacity);
- Value of PSH ancillary services: regulation service (secondary frequency control), contingency reserves (tertiary frequency control), flexibility reserves, and black start service;
- Power system stability services: inertial response, governor response (primary frequency control), transients and small signal stability, and voltage support;
- PSH impacts on reducing system cycling and ramping costs (value of reducing cycling and ramping of other units in the system);
- Other system-wide (portfolio) effects of PSH operations (e.g., PSH impacts on decreasing overall power system production costs, benefits for integration of variable energy resources, and impacts on power system emissions);
- Transmission benefits of PSH (transmission congestion relief, transmission investments deferral); and
- Non-energy services of PSH (e.g., water management services, socioeconomic benefits, and environmental impacts).

Given that PSH projects typically have long lifetimes, the studies will be performed in the context of plausible future scenarios of the power system where the projects are located (e.g., generation mix, demand growth and load projects, potential impacts of the transportation and other sectors on electricity demand) to estimate and project their costs and benefits over time. Sensitivity analyses on key factors that may influence the costs and benefits of the selected projects will also be performed.

The cost-benefit analyses will provide NOTA recipients with detailed information and estimates of potential values of various services and contributions that their projects could provide to the grid. This information will help NOTA recipients better understand the potential role and value of their projects in the power system and help them identify relative values of different PSH services and contributions. As these studies progress and evolve, other PSH benefits may also be incorporated into the analyses.

Task 2. Power Market Analysis

The Technical Assistance team will perform an analysis of the market rules and potential revenues for the electricity market in which each selected PSH project will be located. The analysis will include historical energy prices, capacity prices, and ancillary services prices. An analysis of new market trends and potential new market products will also be conducted.

The results of the market analysis will provide NOTA recipients with the estimated value and potential revenue streams that can be achieved in the electricity markets in which their projects will be located. The market analysis results will also provide NOTA recipients with necessary inputs for the financial analysis to determine financial feasibility of their projects.

Task 3. Financial Analysis (Optional)

At the recipient's discretion, pro forma financial analyses can also be performed for the two selected PSH projects to calculate appropriate financial ratios and parameters using the relevant financial value streams. Sensitivity studies will be performed to identify key cost factors and value streams that influence PSH feasibility.

The results of the financial analysis will help NOTA recipients determine the financial feasibility of their project.

Task 4. Valuation Analysis

An advanced valuation guidance developed by the Technical Assistance team will be used to perform a valuation analysis of each selected PSH project. Results of Tasks 1 and 2 will serve as inputs to provide specific values of various services and contributions provided by each selected PSH project. The valuation analysis will account for the types of products and associated revenue streams that each project may expect within their market landscape and participation levels. In addition to established revenue streams, the economic valuation analysis will account for the assessed value of other grid services provided by the project, including those that are not monetized. A co-optimization analysis will be performed to determine which PSH services and contributions can be performed at the same time or in parallel, and which are mutually exclusive.

The results of the valuation analysis will provide NOTA recipients with an objective assessment of the economic value of their projects. A detailed cost-benefit analysis will be performed by the Technical Assistance team to calculate the net present value (NPV), benefit-cost ratio, and other economic indicators of the value of their project. NOTA recipients will benefit from this information, which, together with the financial analysis, is crucial for sound decision-making in regard to project development and investments.

Task 5. Reporting

At the end of the period of performance, each recipient will receive a detailed final report documenting the results of the techno-economic studies. A report summarizing the results will be published by WPTO.

The Technical Assistance team will utilize the results and lessons learned during this study to refine the PSH valuation guidance. A revised version of the guidance will be made publicly available for use by PSH developers, plant owners and operators, policy makers, and other stakeholders.