

**Department of Energy (DOE)  
Office of Energy Efficiency and Renewable Energy (EERE)**

**Water Power Technologies Office 2019 Research Funding  
Opportunity**

**Funding Opportunity Announcement (FOA) Number: DE-FOA-0002080**

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<b>FOA Issue Date:</b>	4/01/2019
<b>Informational Webinar:</b>	4/11/2019
<b>Submission Deadline for Concept Papers:</b>	5/13/2019 5:00pm ET
<b>Submission Deadline for Full Applications:</b>	7/09/2019 5:00pm ET
<b>Expected Submission Deadline for Replies to Reviewer Comments:</b>	8/21/2019 5:00pm ET
<b>Expected Date for EERE Selection Notifications:</b>	September 2019
<b>Expected Timeframe for Award Negotiations:</b>	September – December 2019

- Applicants must submit a Concept Paper by 5:00pm ET the due date listed above to be eligible to submit a Full Application.
- To apply to this FOA, applicants must register with and submit application materials through EERE Exchange at <https://eere-Exchange.energy.gov>, EERE's online application portal.
- Applicants must designate primary and backup points-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the applicant/selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the Selection.

# Modifications

All modifications to the FOA are [HIGHLIGHTED] in the body of the FOA.

Mod. No.	Date	Description of Modification
0001	4/12/2019	To remove the last four bullets from AOI 4 Specific Technical Volume Requirements (page 77) and add them to AOI 3 Specific Technical Volume Requirements (page 76).
0002	4/15/2019	<p><u>Section I.B AOI3 (page 41):</u></p> <p><u>Original FOA language:</u> Device designs must be capable of delivering a minimum of 440,000 kW-h/year to the grid when deployed in the PacWave-South test site resource, corresponding to a 50-kW average electrical power output.</p> <p><u>Mod 0002 changes:</u> Device designs must be capable of delivering a minimum of 220,000 kW-h/year to the grid when deployed in the PacWave-South test site resource, corresponding to a 25-kW annual average electrical power output. Device designs should not exceed 880,000 kW-h/year to the grid when deployed in the PacWave-South test site resource, corresponding to a 100-kW average annual electrical power output.</p>

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# I. Funding Opportunity Description

## A. Background and Context

### i. Background and Purpose

The Office of Energy Efficiency and Renewable Energy (EERE) is issuing, on behalf of the Water Power Technologies Office (WPTO), a Funding Opportunity Announcement (FOA) titled “Water Power Technologies Office 2019 Research Funding Opportunity.” This FOA addresses priorities in the following areas: hydropower operational flexibility, low-head hydropower and in-stream hydrokinetic technologies, advancing wave energy device design, and research infrastructure upgrades at the National Marine Renewable Energy Centers (NMRECs).

Hydropower and Marine and Hydrokinetic (MHK) energy technologies are renewable sources of electricity that support EERE goals of increasing energy affordability, domestic economic prosperity, and energy security while enhancing the reliability and resiliency of the U.S. power grid. The priorities of this FOA also align with long-term targets for performance improvements and cost reductions of these technologies established to meet requirements of the Government Performance and Results Act (GPRA) of 1993 and the GPRA Modernization Act of 2010.<sup>1</sup>

The goals of this FOA also align with other DOE priorities:

- EERE’s Beyond Batteries initiative in the President’s FY19 budget request and Department-wide storage initiatives, which focus on improving the capabilities of technologies to deliver value to the grid such as temporal flexibility and resiliency; and
- Strengthening U.S. manufacturing and increasing manufacturing competitiveness.

Hydropower has provided the U.S. with sustainable, reliable, and affordable power for over 100 years, and there are still many promising untapped opportunities. In addition to the economic benefits of providing cost-competitive and clean electricity, the flexible nature of hydropower makes it among the most valuable forms of generation, capable of providing the full range of flexibility and essential reliability services required by the electrical bulk-power system. The flexibility and storage capacity of hydroelectric power plants make them efficient and economical in supporting the integration of variable sources of renewable energy, such as wind or solar photovoltaics. Pumped storage hydropower (PSH) can additionally be used to store excess variable generation, further contributing to grid reliability, reducing the curtailment of other generation sources, and supporting the integration of a larger share of variable generation resources. While improved understanding and utilization of the flexible capabilities of hydropower can enable greater grid reliability and resilience, another focus of this FOA is

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<sup>1</sup> Water Power Technologies Office GPRA Goals as identified in the Department of Energy FY 2019 Congressional Budget Request: <https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf#page=30>

adding additional new hydropower capacity by supporting innovative technology development. Low-head hydropower resources are widespread, but will require a number of technology innovations and new design philosophies in order to be cost-effectively and sustainably developed. Investments made in this FOA in hydropower technology research and development (R&D) for innovative standardized and modular approaches to low-head hydropower development will lead to lower overall project costs versus traditional, custom-designed projects at greenfield sites; and increasing the flexibility of hydropower and pumped storage can lead to a stronger, more resilient grid and reduced system-wide costs to ensuring reliability.

MHK technologies convert the energy of waves, tides, and river and ocean currents into electricity and have the potential to provide millions of Americans with locally sourced, clean, and reliable energy. MHK resources are predictable and forecastable with a generation profile complementary to other renewable energy resources such as onshore wind and solar, which can enhance its contributions to grid resilience and reliability. To advance the state of MHK technologies, additional research, development, and testing infrastructure are needed to support long-term objectives for harnessing the power of the Nation's oceans and rivers. Advancements of in-stream hydrokinetic technologies provide more options for developing the diverse set of riverine resources in the U.S.; river MHK applications of particular interest are devices that would function well in remote communities dependent on costly diesel fuel for power. A number of wave energy device designs will also be advanced to the point where they would be ready to move forward with fabrication and open-water ocean testing at grid-connected wave energy test sites, and research and testing infrastructure will be improved at the nation's National Marine Renewable Energy Centers. The investments made through this FOA will increase energy affordability by achieving improvements in design, prototyping, and testing in wave, tidal, ocean and in-river current technologies, ultimately leading to reduced costs and increased competitiveness of marine energy devices.

## **ii. Technology Space and Strategic Goals**

The Water Power Technologies Office 2019 Research Funding Opportunity covers priorities in both the Hydropower Subprogram and Marine and Hydrokinetics Subprogram.

### Area of Interest 1 - Hydropower Operational Flexibility

Hydropower has significant capabilities for flexible operation, making it well-positioned to contribute to system reliability and resilience in an evolving electricity system. Many hydroelectric plants are dispatchable, can alter generation output on demand, provide a range of ancillary services as well as capacity (in the form of stored water and unit headroom) over various time horizons, and stabilize the grid to maintain reliable and cost-effective electric service. DOE efforts such as the Hydropower Vision Report<sup>2</sup> show that hydropower already

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<sup>2</sup> DOE's 2016 Hydropower Vision Report: <https://www.energy.gov/eere/water/downloads/hydropower-vision-report-full-report>



delivers flexibility services in many regions, but much less data exists about the full extent of *potential* flexibility services that hydropower plants could provide. The complexity of multi-use constraints affecting many hydropower plants, together with the wide variability in plant configurations across the fleet, make understanding the fleet’s potential for flexibility a formidable challenge. Specifically, there is a lack of comprehensive understanding among hydropower owners and operators of the breadth of hydropower components that can enable flexible capabilities (broadly including machines, water flows, and cascading system attributes) as well as how these separate components can provide specific flexibility services.

To address these challenges, Area of Interest (AOI) *1a, Quantify Hydropower Capabilities for Operational Flexibility*, seeks a comprehensive framework to catalog and account for the different types of flexibility that hydropower plants can provide. This framework would then be applied to individual hydropower plants in order to build up a “benchmark” of the available flexibility potential present in the U.S. hydropower fleet. Concurrent with the development and application of the framework, *AOI 1b, Operational Strategies for Increasing Hydropower Flexibility*, seeks research and development of operational strategies that enable enhanced provision of flexibility services at individual hydropower plants or combinations of plants within the fleet. Operational strategies could include innovative application of commercial or near-commercial sensors and controls, as well as machine learning or other data-driven analytics to unlock new flexible capabilities. To develop such a framework and identify operational strategies, the hydropower community must be an active partner. AOI 1 of this funding opportunity is therefore designed to (1) solicit industry-led research to comprehensively understand and assess the flexibility within the fleet, and (2) solicit innovative industry-led techniques to increase flexibility present in the existing fleet.

AOI 1 builds on substantial foundational work by WPTO on understanding hydropower’s capabilities to support grid reliability and resilience. Congressional appropriations language has also specifically requested work on PSH technologies and techno-economic valuations, both of which require deep understanding of flexible plant capabilities. Responses to WPTO’s Request for Information (RFI) on “Expanding Hydropower and Pumped Storage’s Contribution to Grid Resiliency and Reliability,” received in April 2018, showed strong industry interest in enabling new, more flexible roles for hydropower that support a rapidly changing electricity system. The RFI submissions offered examples of hydropower plants that have changed their operations to cycle more frequently in recent years, underscoring the need for WPTO to understand and support advancement of the fleet’s flexible capabilities. WPTO is advancing several research projects within its national laboratories to build understanding of flexible capabilities. This includes a Hydropower Value Study<sup>3</sup> surveying hydropower operations, costs, and possible future system states, which will include categorization of machine and water characteristics, as

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<sup>3</sup> Report forthcoming in 2019.

well as illuminating case studies of flexible operation that can inform efforts under AOI 1. WPTO also supports the Hydropower Fleet Intelligence effort to organize and draw insight from hydropower asset condition, cost, and availability data, including impacts of more flexible operations.<sup>4</sup> AOI 1 of this funding opportunity will also draw from and inform DOE-wide efforts such as Beyond Levelized Cost of Energy (LCOE)<sup>5</sup>, which seeks to develop new metrics and frameworks to understand flexibility and other system values that various generation resources can provide.

#### Area of Interest 2 – Low-Head Hydropower and In-Stream Hydrokinetic Technologies<sup>6</sup>

Low-head hydropower and hydrokinetic river current energy converter (CEC) technologies have the potential to generate a significant amount of electricity from the Nation’s rivers and to support the resiliency of the U.S. electricity system. A 2012 DOE supported study<sup>7</sup> calculated that theoretical river hydrokinetic resources (i.e. the energy contained in the natural flow of a river) were roughly 1,381 TWh/year, while the 2016 Hydropower Vision Report identified that approximately 17 GW of new stream-reach hydropower capacity development could be possible if technologies that balance efficiency, economics, and environmental sustainability were developed.

Riverine resources, which can be developed with either hydropower or hydrokinetic technologies, are very functionally and geographically diverse. Low-head hydropower and hydrokinetic technologies are fundamentally different approaches to generating energy from the same resources, but are best-suited to different types of locations based on a number of physical attributes of rivers (namely “head” which is the elevation change within a river, amounts and speeds of river flow, and depth). For example, based on the prior studies identified above, four hydrologic regions with significant hydrokinetic potential included the lower Mississippi, Alaska, the Pacific Northwest, and the Ohio River, while five regions with

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<sup>4</sup> Reports forthcoming in 2019.

<sup>5</sup> Beyond Levelized Cost of Energy (LCOE) is a multi-national laboratory project initiated in FY2019, co-sponsored by EERE, Office of Electricity, Office of Fossil Energy, and Office of Nuclear Energy with the National Renewable Energy Laboratory as a lead. The objective of this project is to develop and apply a framework that enables DOE and electricity sector stakeholders to compare the system value of grid services provided by generation and storage technologies necessary for reliable and resilient grid operations, on a more comprehensive and consistent “apples-to-apples” basis than previously possible using only the LCOE metric; and reflect other potentially high impact grid services, and their system value for specific technologies, that are not otherwise currently valued in organized markets (e.g., inertia, voltage support).

<sup>6</sup> In Fiscal Year 2019, WPTO was congressionally directed to release a “competitive funding opportunity for industry-led research, development, and deployment of cross-cutting energy converter technologies for run-of-river and tailrace applications to better utilize underdeveloped low-head and other hydropower resources.” This AOI is specifically designed to meet Congressional direction on both hydropower and MHK, due to the direction provided for funds for specific MHK and hydro subprograms.

<sup>7</sup> Assessment and Mapping of the Riverine Hydrokinetic Resource in the Continental United States. Available at <https://www.energy.gov/eere/water/downloads/assessment-and-mapping-riverine-hydrokinetic-resource-continental- united-stat-0>

particularly significant hydropower resources<sup>8</sup> included the Pacific Northwest, Missouri, California, Arkansas-White-Red, and Ohio River basins.

To most effectively make use of these diverse river resources, WPTO is supporting the development of two types of technologies – standard modular hydropower (SMH) and current energy converters (CEC). CEC technologies extract kinetic energy from rivers without the need for a dam or diversion, whereas SMH technologies use structures to create hydraulic head and generate power through a turbine. CEC technologies potentially have multiple market applications, including electricity generation for remote communities or other areas where installation of larger civil works is difficult or prohibitively costly. SMH can deliver the benefits of hydropower at lower cost and with greater environmental benefits by leveraging standardized and modular component designs that are more easily and cheaply manufactured. In tandem, SMH shifts the design philosophy from custom-designing every facility to extract the greatest amount of energy possible and then mitigating impacts, to focus on first sustaining the important hydrologic, hydraulic, geomorphic, physiochemical, and ecologic processes that occur in streams and watersheds. SMH technologies can also be leveraged to provide additional co-benefits beyond energy generation, such as water quality enhancement, invasive species control, hydrologic restoration, and recreation opportunities.

SMH and CEC technologies are still in the preliminary stages of development and must be developed further for their potential to provide power from the Nation's rivers to be fully realized. Recent trends reflect the steep challenges to the conventional new stream-reach hydropower development approach: over the past ten years, hydropower capacity increases have come predominantly from upgrades to existing facilities, powering of non-powered dams, and energy recovery in conduit facilities, while only five small new stream-reach hydropower projects were completed, none of which involved construction of a large impoundment dam.<sup>9</sup> And to date, no commercial, grid-tied CEC projects have come online in the United States.<sup>10</sup>

To capture these resources, both through CEC and hydropower technologies, innovation is needed to reduce the costs of these systems and further demonstrate their value to the grid. For MHK, this includes building upon previous work on CEC rotor and generation technologies, including via the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs<sup>11</sup>; for hydropower, R&D and testing is needed to advance existing SMH technologies and develop new innovative technologies (based on previously developed design criteria by ORNL), that can efficiently and responsibly generate electricity from new stream-reach resources.

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<sup>8</sup> Regions are as defined by the U.S. Geologic Survey: <https://water.usgs.gov/GIS/regions.html> Geographic ranking based on Potential Capacity (MW) is from ORNL New Stream-reach Development Resource Assessment (NSD) project: <https://hydrosourc.ornl.gov/hydropower-potential/new-stream-reach-development-resource-assessment>

<sup>9</sup> 2017 Hydropower Market Report, <https://www.energy.gov/sites/prod/files/2018/04/f51/Hydropower%20Market%20Report.pdf>

<sup>10</sup> <https://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/hydrokinetics-projects.pdf>

<sup>11</sup> <https://www.energy.gov/eere/water/small-business-innovation-research-and-small-business-technology-transfer-programs>

AOI 2 builds on previous component level R&D and will support the development of full systems that utilize advanced manufacturing techniques and modular designs that help CEC and SMH technologies achieve performance and cost reduction targets. Further, to ensure that AOI 2 significantly advances the state of the CEC and SMH industries, projects are required to not only design and fabricate prototype devices, but also that these devices be tested in a realistic operating environment.

*AOI 2a, Modular Technologies for Low-Head Hydropower Applications*, will focus on the design and testing of entirely new standardized, modular hydropower technologies for low-head, new stream-reach (i.e., greenfield) sites, including designs for generation, fish passage, sediment passage, recreational passage, water passage, and foundation modules. New stream-reach sites are characterized by low heads, varying flows, and valued river functions and attributes that must be protected and preserved. The 2016 Hydropower Vision Report predicted that no new stream-reach projects will be deployed without the emergence of innovative—even transformational—advances in technologies that address these challenges. This is what Oak Ridge National Laboratory’s (ORNL) SMH Technology Acceleration project, which has been focused on developing functional requirements and design envelopes for SMH technologies, has been working to achieve.

SMH is a new design paradigm that places the functionalities of a stream that must be preserved at the forefront of the design process, while also utilizing standardization and modularity principles to reduce site specificity and project costs. Historically, hydropower projects have been custom-designed and built with the objectives of maximizing the potential generation that facilities could produce, and then designs or mitigations are adjusted to deal with potential impacts. With SMH, component and project design first consider how opportunities for energy generation fit into the other multi-functional needs and uses of a river, and then project cost reductions are achieved by utilizing standard technologies and solutions that scale widely across many sites and reduce the reliance on site-specific and custom-designed equipment and structures. Construction costs are further reduced by envisioning facilities as a combination of individual modules that are easily manufactured, transported, and assembled on site. This presents a challenging undertaking, as new modular technologies need to account for many different site characteristics in the design criteria in order to be broadly applicable. In fiscal years 2016 and 2017, ORNL conducted the necessary foundational research and produced the SMH Exemplary Design Envelope Specification (EDES, or the Design Envelope), a document outlining the objectives, requirements, constraints, and performance of standard hydropower modules.

In 2018, WPTO took the first step towards engaging the private sector in the practical engineering application of the Design Envelope and SMH principles by releasing funding opportunity DE-FOA-0001836 titled *Facility Design Concepts for Standard Modular Hydropower Development* to adapt existing modular technologies into the design of small, low-head hydropower facilities. In this FOA’s *AOI 2a*, WPTO is soliciting entirely new modular hydropower

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technologies, with a focus on those that utilize advanced manufacturing techniques. In future years, WPTO and ORNL plan to advance the SMH principles beyond new-stream reach development and apply them to non-powered dam facility design.

The projects supported in this area of interest will focus on the design and testing of new standardized, modular hydropower technologies for low-head applications (30 feet or less). Applications must include innovative designs for generation, fish passage, sediment passage, recreation passage, water passage, or foundation modules that leverage advanced manufacturing techniques and materials. The purpose of the awards is to bring technology concepts through validation of the concept through simulation and partial- or full-scale testing in a laboratory or relevant environment.

*AOI 2b, Modular Technologies for River Current Energy Converter Applications*, will support efforts to develop CEC technologies that can responsibly and cost-effectively harness the Nation's riverine resources, leading to improved resiliency and diversity of the Nation's energy generation system. CEC technologies may ultimately be easier and more cost effective to deploy in the many regions of the United States, especially in remote locations, that lack robust port infrastructure and vessel availability. But there are many technical challenges remaining before these potential opportunities can be realized. The DOE Reference Model Report<sup>12</sup> identifies deployment (moorings, power cables, and device installation), operations, and maintenance as the most important cost drivers for CECs, while suggesting that improving other components, such as rotors and drivetrains, does not provide as much cost savings potential. WPTO has previously supported R&D projects that have developed and tested components, control strategies, and generator technologies, and one CEC system prototype project. However, today's CEC systems still require potentially complicated installation, operation, and maintenance (IO&M) strategies.

To address the capability gaps in today's river CEC technologies, *AOI 2b, Modular Technologies for River Current Energy Converter Applications* focuses on developing and testing CEC systems that can be efficiently deployed and retrieved without the need for significant port or on-site infrastructure and specialized vessels. Successful projects will expand the number and geographic diversity of locations where CEC technologies are commercially viable, while simultaneously advancing the state of CEC technologies. Further, *AOI 2b* requires the development and use of modular system designs, enabling CEC projects to be easily optimized for a wide range of deployment locations and electricity load needs. *AOI 2b* projects will design, fabricate, and open-water test modular CEC river system that incorporate and advance IO&M techniques which require only limited use of port and vessel infrastructure.

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<sup>12</sup> [Neary, et.al \(2014\) Methodology for Design and Economic Analysis of Marine Energy Conversion \(MEC\) Technologies. Sandia Report, SAND2014-9040.](#)

### Area of Interest 3 - Advancing Wave Energy Device Design<sup>13</sup>

Wave energy converter (WEC) technologies are still in the early stages of development, and the nascent industry has yet to deploy and test cost competitive utility-scale WEC technologies. Given the current state of the industry, WPTO's portfolio contains a broad spectrum of foundational R&D activities aimed at advancing the industry on all fronts towards commercialization. Over the last decade, WPTO has supported work on numerical modeling, tank and laboratory testing of scaled models, materials development and characterization, component design optimization, integrated control systems engineering, and some limited full-scale systems testing. Through this work, significant advances in wave energy device designs have been realized and WPTO is beginning to focus on open-water testing of larger systems in order to advance WEC technologies. These efforts are in direct support of expanding and diversifying the Nation's energy portfolio and are a critical step on the way to developing both grid-scale and distributed power generation WEC systems. WPTO investment in R&D allows the domestic wave energy industry to advance and achieve cost competitiveness with local hurdle rates in high-cost markets, while working towards the long-term goal of cost competitiveness at the utility scale. This will be accomplished by focusing on early-stage R&D that has potential to increase energy capture and annual energy production of devices, improve reliability and availability, and reduce capital and operating/maintenance costs if further developed and deployed by industry.

To enable the critical testing needed to further advance early-stage WEC technologies, the WPTO recently made a significant investment in the PacWave-South wave energy test facility that is being constructed off the coast of Newport, Oregon. This facility will provide the wave energy industry with access to a pre-permitted, fully-energetic, and grid connected deep water testing facility that enables full scale system performance testing, thus helping to accelerate the development and improvement of wave energy technologies. The facility will play a critical role in demonstrating wave energy systems in the ocean environment and will help improve the efficiency and reliability of utility scale wave energy devices. The PacWave-South test site is currently scheduled to be operational in 2022-23 and will provide the ability to simultaneously test up to twenty wave energy devices while providing access to the technical expertise and infrastructure support required by the wave energy industry.

Projects funded under AOI 3 will be the first step in WPTO's efforts to support designing, building, and testing WEC systems in the fully energetic wave environment similar to PacWave-South conditions. This type of full-scale testing in the open ocean is required to accurately access device performance due to limitations inherent in laboratory testing at reduced scales and in simulated wave environments. Lessons learned and data collected during PacWave-South tests will be used to inform the next generation device designs to expeditiously advance

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<sup>13</sup> In FY 2019, WPTO was congressionally directed to provide "\$30,000,000 for a balanced portfolio of competitive solicitations to support industry- and university-led research, development, and deployment of marine and hydrokinetic technologies."



wave energy technologies. However, before devices can be tested at PacWave-South, robust system designs that satisfy rigorous engineering requirements and technical standards must be developed to ensure reliable device operation in highly energetic wave climates. The wave energy at the PacWave-South test site is on average four times more energetic than the Wave Energy Test Site (WETS) in Kaneohe, Hawaii, and will provide the forceful conditions necessary to rigorously test the resiliency of devices.

This AOI will generate new designs based on previous WEC projects funded by the WPTO. These previous projects have enabled the MHK industry to progressively test new designs for both WEC components and systems to enable the performance and reliability improvements required for cost reductions. The WPTO wave energy portfolio has evolved from the FY13 and FY15 System Performance Advancement (SPA) FOAs that focused specifically on component level advancements in controls, structures and power takeoffs (PTOs), to the FY17 and FY18 FOAs that are focused primarily on innovation and design improvements at the system level. This iterative and systematic design process is necessary to achieve the program goals for continuous improvements in LCOE.

Designing WEC systems that meet rigorous MHK design standards is the explicit goal of AOI 3 and is also a critical step on the path to grid-scale WEC technology commercialization. The system designs will be verified through rigorous design reviews performed by WPTO and national laboratories so that, at the completion of AOI 3 projects, system designs will be developed to the point where they could be fabricated, deployed, and tested at a test site like PacWave-South. Applicants must propose detailed work plans to develop WEC designs that are capable of two years of continuous testing and operations at PacWave-South test site utilizing the physical characteristics and wave climate at that location. The designs must incorporate the International Electrotechnical Commission (IEC) Technical Specifications (TS) and the Institute of Electrical and Electronics Engineers (IEEE) standards to ensure that designs are final and fully ready to utilize for future shipyard fabrication and open-water testing via future funding opportunities. The development of international standards is critical to increase investor and stakeholder confidence, and reduce project insurance costs, by incorporating best practices developed in related marine industries that have proven designs and operations.

Some of requirements for the final design report include engineer approved design drawings with supporting load calculations and power performance estimates with supporting tank testing results. The complete list of final report requirements is contained within the body of the specific Advancing Wave Energy Device Design AOI 3 section of this FOA.

Though the WEC device must be designed to operate reliably within the expected sea states for the PacWave-South test site, the developer is not required to design a device that is optimized for power production within the PacWave-South wave environment. As part of this project, the developer is required to prepare a commercialization plan that describes the intended market

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for the WEC device and the differences in the device dimensions, power rating, and other relevant characteristics for this market.

#### Area of Interest 4 - Marine Energy Centers Research Infrastructure Upgrades<sup>14</sup>

As the marine renewable energy industry continues to advance technologies towards commercialization, there is an ongoing need for testing at all levels of technological development. Testing MHK technologies is inherently more complex and time consuming than for land-based energy generation technologies. The already slow pace of design and in-water testing cycles is further exacerbated by the limited availability of testing infrastructure at various scales, complex and time consuming permitting processes, and expensive environmental monitoring. These challenges have to-date severely limited the ability of technology developers to quickly assess the performance of devices and components, innovate solutions where necessary, and deploy the next generation of devices. Due to the complex physics of the ocean wave and current environments, MHK prototypes must be tested in real-world environments to fully characterize their performance and reliability. These challenges associated with testing, deploying, and optimizing technologies in a time and cost-effective manner must be overcome in order to accelerate the pace of MHK technology development.

At the direction of Congress, WPTO originally partnered with five universities to create three distinct National Marine Renewable Energy Centers (NMRECs) to incubate advanced MHK technologies. These three centers – Pacific Marine Energy Center (PMEC) formerly known as the Northwest National Marine Renewable Energy Center (NNMREC), operated jointly by Oregon State University, the University of Washington, and the University of Alaska Fairbanks; Hawaii National Marine Renewable Energy Center (HINMREC), operated by the University of Hawaii; and Southeast National Marine Renewable Energy Center (SNMREC), operated by Florida Atlantic University – were competitively selected and launched at U.S. universities, each with unique research and testing capabilities to address the most pressing questions for new marine energy technology development. WPTO investments in the test centers have helped address the broad spectrum of R&D needs of the MHK industry to include the design and fabrication of an ocean buoy to support open water systems testing at PMEC, ocean instrumentation at HINMREC in support of WETS operations, and development of open ocean current testing infrastructure at SNMREC.

At this time, open water testing capabilities are limited for all variations of MHK technologies (wave, ocean current, tidal, river current). Gaps also exist in smaller scale wave tank testing and power take-off (PTO) testing. The principal goal of this AOI is to address some of these testing needs and focus on MHK industry associated device testing. In some cases, a new capability is

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<sup>14</sup> In FY2019, Congress directed WPTO to provide “not less than \$5,000,000 to prioritize infrastructure needs at the marine and hydrokinetic technology testing sites operated by the NMRECs”.



required, and in other cases, upgrades to existing facilities or equipment are required to enable higher fidelity testing in support of industry needs.

This AOI will support efforts to upgrade infrastructure at the NMRECS in order to help reduce technical barriers for further MHK technology research. Providing industry with access to an economical, world-class infrastructure at Marine Renewable Energy Centers is an important part of WPTO’s long-term MHK strategy. There is a distinct inefficiency associated with developers independently investing in either their own or separate testing facilities, and through strategic investments, AOI 4 will enhance and enable broader industry usage of testing facilities while reducing costs to both developers and to the WPTO.

## B. Areas of Interest (AOI)

**TABLE 1: Summary of FOA Areas of Interest and Funding**

Area of Interest	DOE Funding	Cost Share	# of Awards
<b>1 - Hydropower Operational Flexibility:</b> To quantify the flexible capabilities of hydropower and advance solutions to increase utilization and availability of that flexibility to meet the demands of an evolving grid.			
<b>1a Quantify Hydropower Capabilities for Operational Flexibility</b> To develop a comprehensive, transparent analytical framework to quantify the potential flexibility available within hydropower plants and systems of plants.	\$1,500,000	20%	Up to 1
<b>1b Operational Strategies for Increasing Hydropower Flexibility</b> To develop novel operational strategies that enable greater provision of flexibility from hydropower plants or systems of plants.	\$2,750,000	20%	Up to 3
<b>2 - Low-Head Hydropower and In-Stream Hydrokinetic Technologies:</b> To support new, low-cost designs for power generation from the nation’s geographically diverse river systems.			
<b>2a Modular Technologies for Low-Head Hydropower Applications</b> To design and produce entirely new standardized, modular hydropower technologies for low-head applications (30 feet or less).	\$5,000,000	20%	Up to 5
<b>2b Modular Technologies for River Current Energy Converter Applications</b> To advance the state of the art for current energy converters that capture hydrokinetic river energy in low-flow environments.	\$4,600,000	20%	Up to 3
<b>3 - Advancing Wave Energy Device Design:</b> To advance the design of MHK systems and devices capable of being tested at an open-water testing facility.	\$7,200,000	20%	Up to 4
<b>4 - Marine Energy Centers Research Infrastructure Upgrades:</b> To provide infrastructure upgrades to National Marine Renewable Energy Centers to help reduce technical barriers for further MHK technology development.	\$5,000,000	20%	Up to 3

All work under EERE funding agreements must be performed in the United States. See [Section IV.J.iii.](#) and [Appendix C.](#)

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For Applications Specifically Not of Interest for each of the FOA's Areas of Interest, see [Section I.C.](#)

## 1 Hydropower Operational Flexibility

Recent DOE national-scale studies have illustrated the evolving utilization of the U.S. hydropower fleet<sup>15</sup> over the past decade in response to power system needs for load-following, intra-hour ramping, and integration of high penetrations of variable renewable resources such as wind and solar PV.<sup>16</sup> These studies demonstrate that hydropower is an important flexibility asset, currently contributing significant services to support grid reliability and resilience. Furthermore, many projections point to a future power system that could include significantly higher penetrations of variable and/or distributed resources.<sup>17</sup> To maintain grid reliability, the evolving power system will in many cases require additional provision of flexible capabilities from dispatchable generation resources such as hydropower.

As a whole, the technical attributes of the U.S. hydropower fleet make it well-suited to provide flexible capabilities and thus to contribute to grid reliability and resilience in a range of possible future scenarios. Most hydropower plants have the technical capability to provide flexible generation. Hydropower can generate electricity in a flexible manner (i.e., ramping both up and down) by modulating water inflows, turbine power output, and other variables. Hydropower also has the capability to respond quickly to dispatch signals, and to hold water in reserve in anticipation of future needs. This inherent flexibility is due to hydropower plant design and component attributes. Turbines can be designed to operate over a wide range of water flows, or made to withstand a certain amount of start/stops per year. Multiple units in a facility can be coordinated to better support grid needs. Reservoirs and spillways offer a control buffer to manage flow levels and power generation.

DOE research has extensively documented examples of flexible operation of hydropower plants. For example, [Figure AOI 1](#) below shows monthly generation profiles in three water years for two hydropower plants in Washington State. This is one illustration of hydropower flexibility over multiple temporal scales provided by varying generation over hours, days, months and seasons to meet market opportunities and local demands, managed in concert with water availability.<sup>18</sup> Other research has identified examples of hydropower providing capacity and reserves, as well as shorter-term flexibility services such as inertia and frequency regulation.

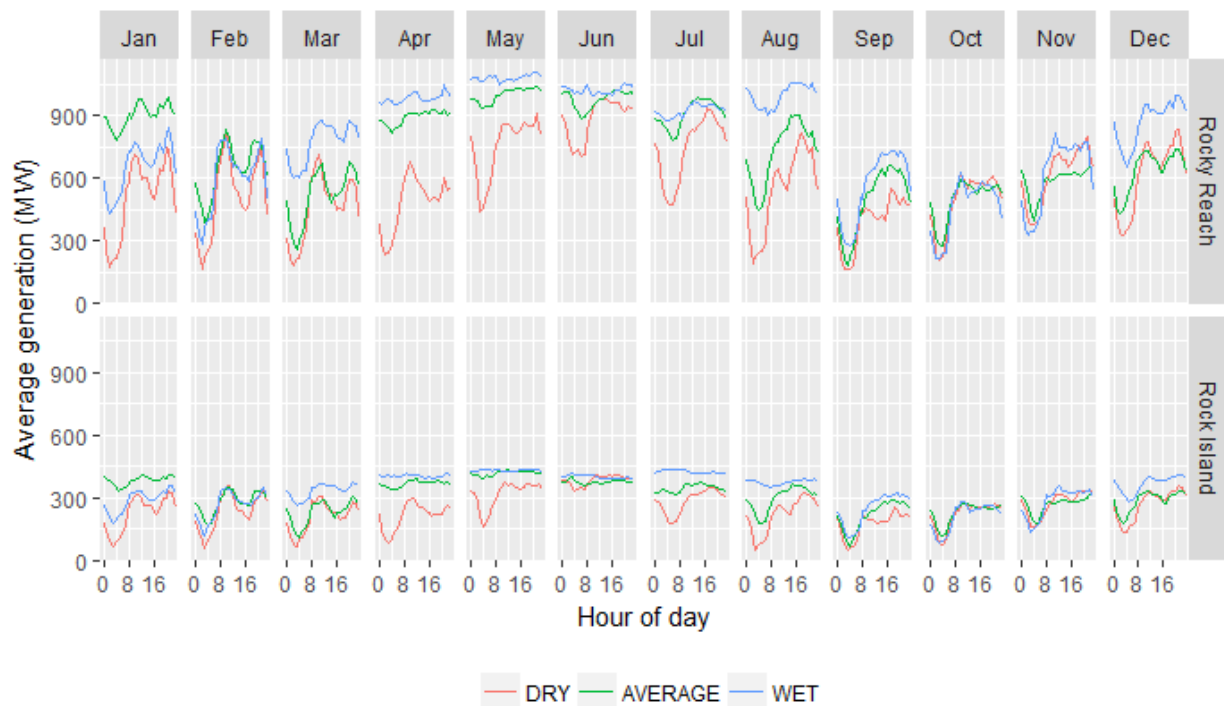
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<sup>15</sup> Throughout AOI 1, "hydropower" includes pumped storage hydropower (PSH) unless noted otherwise.

<sup>16</sup> Hydropower Market Report 2017.

<sup>17</sup> EIA AEO projections.

<sup>18</sup> Voisin, Nathalie, G. Carrington, S. Turner, W. Fields, "Hydropower Value – Chelan PUD Case Study." Forthcoming publication from Pacific Northwest National Laboratory in collaboration with Chelan County Public Utility District #1, Wenatchee, WA.



**Figure AOI 1. Average generation for each hour of the day across all months of operation at Rocky Reach and Rock Island, two hydropower plants in Washington State. Generation profiles for representative dry, average, and wet years are shown.**

Most existing work on hydropower flexibility, however, focuses on the historical *utilization* of hydropower rather than the full hypothetical *potential* of hydropower capabilities for flexibility. The full potential of individual hydropower plants and the U.S. hydropower fleet to provide flexibility is unknown. Moreover, responses to a recent WPTO Request for Information (RFI) on “Expanding Hydropower and Pumped Storage’s Contribution to Grid Resiliency and Reliability,” released in February 2018, showed broad interest from owners and operators in better understanding and enabling capabilities for flexible operation. As hydropower operations shift to accommodate changing market structures, generation mixes, load shapes, and reliability paradigms, it has become increasingly important to develop a detailed and quantitative understanding of the actual flexibility potential of hydropower resources.

While many hydropower plants have flexible capabilities, plants may also face constraints on their operations. Some of these constraints arise from equipment (maximum and minimum generation, turbine attributes, vibrations) while others arise from external sources (requirements surrounding water supply, water temperature, water quality). Hydropower relies on water as fuel, and thus supply of water can impose an operational constraint. Moreover, many large hydropower plants are components of multi-use water projects, which can include required purposes of flood control, navigation, recreation, environmental flows, and water supply in addition to hydropower generation. These additional constraints can restrict

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hydropower plants from exercising their full technical capabilities for flexible operation. Detailed accounting of constraints as well as technical capabilities is therefore required to understand the full potential flexibility of the hydropower fleet.

An added complexity is the vast diversity of hydropower plants in the U.S. fleet; plants vary greatly by size, equipment, configuration, hydrologic context, and multi-use constraints. Flexible capabilities of a given hydropower plant can depend on all of these factors individually and in combination. Building up an understanding of flexible capabilities of the U.S. hydropower fleet must therefore account for a wide range of plant attributes.

Despite these challenges, there is likely to be significant opportunity for targeted improvements to operational strategies that can enable increased flexibility in the existing hydropower fleet. About 95% of the existing U.S. fleet was designed and built before 1995, with about 50% of plants built prior to 1965.<sup>19</sup> When these hydropower plants were originally built, modern technologies and methods – including modeling and computing capabilities, software, controls, and other digital and data-driven solutions – were not yet available. Neither were these modern tools available when many large hydropower plant owners and operators developed and institutionalized methods for managing multi-use constraints. The cumulative effect of the age of the hydropower fleet and the complexity of its multiple management objectives should leave ample room for innovative strategies to unlock new flexible capabilities in the existing fleet.

This area of interest is considered part of DOE’s Grid Modernization Initiative (GMI), which seeks to develop the concepts, tools, and technologies needed to measure, analyze, predict, protect, and control the grid of the future.<sup>20</sup>

## **1a: Quantify Hydropower Capabilities for Operational Flexibility**

*\$1.5M in Federal funds, 20% Cost Share requirement*

*Up to 1 award, up to \$1.5M in DOE funds per award, 36-month anticipated award duration*

The objective of AOI 1a is to develop a comprehensive framework to rigorously catalog, characterize, and quantify the full potential of hydropower’s flexible capabilities at the level of individual hydropower plants. The framework will be transparent and broadly applicable to the U.S. hydropower fleet. WPTO anticipates that, to achieve these objectives, the framework will need to account for detailed machine attributes, control of water flows and reservoirs, multi-use constraints, and cascading reservoir systems. Crucially, the framework will also need to account for the interrelationships among these plant and multi-plant components. As part of the work to be performed under AOI 1a, the framework as developed would be applied to a set

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<sup>19</sup> Hydropower Vision Report, p.170 Section 2.5.5. Existing Equipment Optimization.

<sup>20</sup> For more information on the Grid Modernization Initiative, visit <https://www.energy.gov/grid-modernization-initiative>

of hydropower plant case studies to provide a detailed accounting of the full range of their potential capabilities for flexibility. Following successful development and application of the framework in several case studies under AOI 1a, longer-term WPTO objectives could include application of the framework to build up a fleet-wide flexibility assessment of hydropower in the U.S.

Benefits of the flexibility framework will be at least twofold. First, the long-term goal for AOI 1a is to provide the hydropower industry with the tools to catalog its own hydropower flexible capabilities and limitations, and to do so with replicable, comprehensive, and broadly accepted methods. This quantification is essential for the hydropower industry to demonstrate the competitive capabilities of hydropower, to effectively invest in and maintain hydropower assets, to support long-term tradeoff decisions, and to access the full value of hydropower resources into the future.<sup>21</sup> System operators, public utility commissions, and other decision makers could also find benefit in an accurate and transparent accounting of hydropower's flexible capabilities in order to make well-informed decisions about resource planning and operation.

Second, accurately quantifying the operational flexibility of existing hydropower assets is essential for future research in WPTO and the broader community. In essence, how can “flexibility” be accurately understood when we consider a single hydropower plant, a connected system of plants, and the entire hydropower fleet? Identification of untapped opportunities, possible synergies, targeted technology R&D, and efforts to address other research gaps could benefit greatly from a rigorous accounting of the current state of flexible potential in the hydropower fleet and a way to measure progress and improvement.

These objectives connect to ongoing DOE work in a number of ways. The Hydropower Value Study surveys hydropower operations, costs, and possible future system states, which will provide illuminating case studies of flexible operation among hydropower operators. The Hydropower Fleet Intelligence (HFI) project seeks to develop data and understand tradeoffs among component cost, component condition, and plant availability. Relevant questions for HFI include the implications of flexible operation on cost, condition, and availability. The flexibility framework proposed in this FOA would seek to identify the full range of hydropower flexible capabilities, and this information could be used as an input to the HFI effort to understand implications of flexible operations.

### ***AOI 1a Scope and Technical Requirements***

Successful applications will develop an industry-recognized framework and methodologies, demonstrate the validity of those approaches and the viability of comprehensive application across the fleet, and establish a platform for future flexibility assessments.

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<sup>21</sup> “Maximizing the market value of flexible hydro resource requires a review of the constraints that a plant faces with respect to operations, market design, market rules, and transmission congestion.” (p. 14, Conclusions. *Maximizing the Market Value of Flexible Hydro Generation*, March 29 2018, The Brattle Group).

As illustrated in [Table AOI 1a](#), the task of quantifying the operational flexibility of hydropower plants relies on three elements: a systematic and detailed understanding of hydropower plants’ actual technical and physical capabilities to provide flexible generation; an accounting of the constraints that limit full utilization of those capabilities; and an organizing framework to characterize the various types of flexible operations and services that could potentially be provided given physical capabilities and constraints. Successful applications should address flexibility from sources at multiple scales, including at the levels of unit/machine, plant, and cascading system of plants.

While interconnection and interaction with the broader power system is an important consideration, the scope of the framework can be limited to the plant- and cascading-system-of-plants-level. The scope should span from the water (incorporating water-specific constraints) through to the transformer. It need not include markets, bulk transmission constraints, load profiles, or other system-level capabilities and constraints.

**Table AOI 1a. Elements of Quantifying Operational Flexibility of Hydropower Fleet**

Element	Description (Examples)
Capabilities assessment	General, comprehensive hydropower plant attributes and physical components that enable flexibility, together with supporting data requirements and methodological requirements to calculate their relationship to flexibility.
Constraints assessment	Practical site-based limitations of hydropower capabilities, such as those related to water or environmental management, that affect provision of flexibility, together with supporting data and methodological requirements to calculate their relationship to flexibility.
Flexibility framework	Comprehensive organization of flexibility services from hydropower, including responsiveness, rate of change, sustained response, and reserves, over durations ranging from instantaneous to seasonal flexibility. Services should be generic and defined by quantitative technical parameters, and should not be a replication of region- or market-specific products and ancillary services. The framework links the relationship of capabilities and constraints to flexibility services.

Successful applications should convene a team with the expertise, resources, connections, and project management acumen to achieve not only the development of the flexibility framework, but also the application of this framework to quantify flexibility in several real hydropower plants. The team should also be well-positioned to facilitate application of a successful framework to quantify flexibility more broadly across the U.S. fleet. Partnering with and securing strong commitments for participation from utilities, original equipment manufacturers, and other entities with the necessary expertise is strongly encouraged.

In general, applicants should propose work consistent with the following general principles:

- **Comprehensive.** The framework should include all relevant sources of flexibility in a hydropower plant or system of plants so that a comprehensive understanding can be built up. Many aspects of the framework may not apply to any given plant, and some aspects

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may have greater uncertainty in their quantification, but all potential sources of flexibility should be represented.

- **Applicability.** There is a hydropower plant in almost every state in the United States. The hydropower sector claims most of the oldest continuously operating plants. Scales of generation range from watts to gigawatts. Despite this complexity, methods, data inputs, and associated practices must be appropriate for a large set of the fleet.
- **Innovation.** Applicants should ensure that the framework can handle complex capabilities and constraints that are out of reach of casual research, such as areas with low-quality or low-availability data, or where fleet diversity is particularly difficult for methodological uniformity. Opportunities for flexibility that are “hidden” or not widely utilized are of particular interest.
- **Quantitative/Quantifiable.** The framework must enable quantitative understanding of flexible capabilities. Anecdotes and qualitative information may inform its development, but quantitative rigor is required for broad applicability.
- **Transparent.** The framework and its application must be able to illustrate clearly the capabilities for flexible operation that hydropower can provide, starting from the most granular level of plant attributes.
- **Team.** Meeting AOI 1a objectives will require significant industry and/or utility partnership and engagement throughout the development of work products.
- **Dissemination.** Applications should propose mechanisms under the award to engage industry and apply the framework broadly, ultimately to gain understanding of the entire U.S. fleet. Applicants are encouraged to go beyond one-way dissemination toward lasting practices, such as connections with technical standards, partnerships with data warehouses, working groups, and integration with business systems.
- **Data.** Applications should describe in some detail their plans for developing comprehensive data sets, unifying disparate data sets, conditioning data, and ensuring data access to relevant audiences to achieve the objectives of AOI 1a.

WPTO intends to manage any award under this AOI as an integrated part of the WPTO portfolio, both in the selection process and during the period of performance. The portfolio of projects may include work being/to be performed at the National Labs and other entities.

### ***AOI 1a Anticipated Work to Be Performed***

In Budget Period 1, the primary product (Flexibility Framework) will organize the range of potential flexible generation services from hydropower resources. The framework additionally links these elements to hydropower components and capabilities at the unit, plant, and cascading system of plants level (Capabilities Assessment) and integrates the relationship of constraints on capabilities (Constraints Assessment). WPTO anticipates support from and coordination with DOE’s National Laboratories to be available to an awardee as part of this work. These products will be presented as detailed written reports, together with any relevant

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databases, software tools, modeling, or data analytics. There will be a go/no-go decision at the end of Budget Period 1.

If the project advances to Budget Period 2, the focus will be on validating and applying the flexibility framework to a set of representative real hydropower plants. A feedback loop to revise and improve the framework based on the results will be established. Products will be presented as detailed written reports, together with relevant databases, software tools, modeling, or data analysis. In addition, a platform and methodology for collecting and organizing necessary data sources to support the framework will be developed.

### **AOI 1a Intellectual Property**

If development of software is proposed in the application, this software is not required to be open-source in order to be eligible for award. However, applications should describe in detail how they will meet AOI 1 objectives of impact (that at the conclusion of the work, the outcome will be used and useful) and availability (that the outcome is accessible to users without excessive cost). If applicable, applicants must describe a software licensing and dissemination strategy.

### **AOI 1a Teaming Partner Mechanism (Optional)**

WPTO encourages collaboration across sectors to ensure broad impact of work performed on hydropower operational flexibility. WPTO will compile a Teaming Partner List that can be used by potential applicants or entities interested in partnering with applicants who want to find partners. The Teaming Partner List is a tool to facilitate the formation of new project teams. Participation is not a requirement of AOI 1a and is completely voluntary and has no impact on the evaluation and selection process of applications.

Any organization that would like to be included on this list should submit the following information to [WPTOFOA@ee.doe.gov](mailto:WPTOFOA@ee.doe.gov) with the subject line "Teaming Partner Information": FOA AOI (1a or 1b), Organization Name, Contact Name, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities. By submitting the above Teaming Partner Information, you consent to the publication of the above-referenced information as part of the Teaming Partner List.

The Teaming Partner List will be made available on EERE Exchange at <https://eere-Exchange.energy.gov> under DE-FOA-0002080. The Teaming Partner List will be updated periodically until the close of the Full Application period to reflect new Teaming Partners who have provided their information. By facilitating this Teaming Partner List, EERE does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List. EERE will not pay for the provision of any information, nor will it compensate any respondents for the development of such information.

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**AOI 1a Specific Technical Review Criteria for Full Applications**

- Criterion 1: Technical Merit, Innovation, and Impact (40%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (30%)

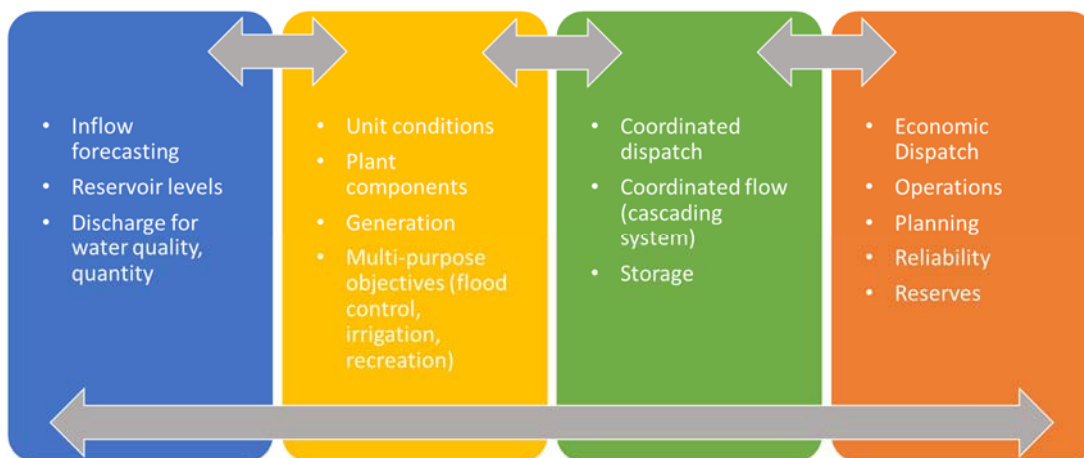
Full Application Technical Review Criteria are detailed in [Section V.A.ii.](#)

**1b: Operational Strategies for Increasing Hydropower Flexibility**

*\$2.75M in Federal funds, 20% Cost Share requirement*

*Up to 3 awards, up to \$1M in DOE funds per award, 36-month anticipated award duration*

The objective of AOI 1b is to increase the utilization of flexible capabilities of existing hydropower plants through innovative operational strategies. Many hydropower plants must simultaneously manage multiple competing constraints across several domains (water, machines, cascading reservoirs, power system) to assure that all objectives, stakeholders, and requirements are satisfied ([Figure AOI 1b](#)). These constraints include upstream requirements, downstream requirements, local demand, transmission, and electricity dispatch decisions. Innovative operational strategies under AOI 1b may allow coordination and optimization that meets these constraints while additionally enabling new flexible capabilities. Strategies of interest may include innovative use and/or integration of commercialized or near-commercialized sensors and controls, or innovative application of operational modeling and data-driven analytics to unit, plant, or system-of-plant operations.



**Figure AOI 1b. Operational Strategies for Increasing Hydropower Flexibility.**

Through work performed under AOI 1b, WPTO intends to engage the hydropower community on novel operational strategies that can add value to their systems in terms of additional or previously unknown flexible capabilities. From a system perspective, enabling provision of additional flexibility services from the existing hydropower fleet will also support grid reliability and resilience, particularly as the grid evolves to include more variable renewable resources.

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While the focus of the sub-topic is on the existing fleet, it is anticipated that innovative strategies to increase flexibility could find ready application in new hydropower development as well.

A further intended benefit will be to foster cross-disciplinary collaborations within the community. To develop truly innovative operational solutions across a diverse sector and including diverse areas of work, the broad hydropower community – operators, original equipment manufacturers, researchers, regulators, and other stakeholders – must be a part of the conversation. Current business units within utilities, for example, may separate hydropower resource and plant operations from system dispatch and front-office marketing. Work performed under AOI 1b may be able to facilitate greater institutional alignment for hydropower innovation to enhance flexibility and unlock additional value.

### ***AOI 1b Scope and Technical Requirements***

Successful applications will propose the use of operational strategies that enable significant increases in one or more sources of hydropower operational flexibility.

Operational strategies of interest include, broadly, innovative approaches to managing unit/machine components, plant operations (including water as a fuel source and other water-related constraints), and/or cascading systems of plants in a way that enables additional flexibility services to be provided to the grid. Alternatively, operational strategies of interest could involve removing or alleviating constraints on flexible operation that would otherwise be present. Operational strategies may involve integration across multiple components, or across multiple aspects of plant operations ([Figure AOI1 b](#)). Applicability of the proposed operational strategies must be feasible in a significant subset<sup>22</sup> of the existing U.S. hydropower fleet. Transformative and far-reaching operational strategies with potential for large impact on fleet-wide provision of flexibility are preferred over incremental approaches.

Successful applications must propose to clearly and quantifiably enhance the flexibility of hydropower plants. Applicants should demonstrate this impact with a clear justification and quantitative basis for asserting an improved flexibility outcome. Applicants must also clearly articulate the anticipated character of the flexibility enhancement to the grid (e.g., coordinated generation) not just to a plant (e.g., reservoir level mobility). While providing specific valued market products in identified markets need not be a focus of responsive applications, the flexible capabilities provided should have some conceivable value to the grid, and applicants should demonstrate awareness of the broader grid and market context in which the hydropower plant(s) are operating.

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<sup>22</sup> Evaluation of applicability across the fleet could include factors such as total capacity of target plants, increase in total flexible capacity at target plants, geographic or market area diversity of target plants, or ramp rate improvements and other flexibility services enabled.

In addition, responsive applications should clearly articulate both the nature and magnitude of any challenges or barriers that the operational strategy would overcome, and the applicability of the proposed solution across the existing fleet. Applicants must describe the constraint on provision of flexibility including the underlying rationale (environmental, multiple-use objectives) for the constraint. Applicants can demonstrate applicability through providing supporting analysis, assessment, and other reference material in the body of the application.

Specific operational strategies of interest fall into several categories:

1. Innovative application of existing or near-commercial tools such as sensors, real-time control systems, or a combination of the two, to enhance flexibility. Sensors are defined broadly to include those measuring characteristics of machines, water, geospatial data, and any other relevant aspects of units, plants, or systems of plants. Real-time controllers or control systems governing plant operations are also of interest, provided that the primary purpose of the innovation is to enable more flexible operation of the plant. Strategies could include addition of a sensor to enable a new capability, or improved control schemes to optimize operations.
2. Physics-based component modeling, water modeling, integrated operational modeling, and related modeling techniques that identify new opportunities for flexible operation. Strategies for operation would need to be based on real systems, and have clear pathways for translation to actual plant operations.
3. Application of data-driven techniques such as artificial intelligence, machine learning, and other advanced analytics to machine component data, plant operations, water forecasting, cascading reservoir management, remote sensing, or other applications that can enable new flexible capabilities. Such techniques depend on training data of sufficient quantity and quality, and applications would need to address these requirements. As with (2), strategies for operation would need to be based on real systems, and have clear pathways for translation to actual plant operations.
4. Operational strategies that consider coordinated water operation and/or energy or other grid service dispatch among two or more plants, either located on linked cascading reservoirs or in separate hydrologic systems.
5. Any relevant combinations of (1), (2), (3), and (4). New software tools to support flexible operation, including decision-support tools for operators, are also in scope.

In general, successful applications will demonstrate the quantified and clearly explained impact of the proposed operational strategy, the innovation of the work proposed, and the applicability and relevance to the U.S. hydropower fleet. WPTO anticipates that responsive applications will result in demonstrated and replicable improvements for hydropower flexibility, achieve new degrees of advancement and state-of-the-art within hydropower plants, and

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create new techniques for more optimal use of hydropower fleets across various market and operational footprints.

The overall objectives for AOI 1b include broad impact on provision of flexibility across the U.S. hydropower fleet. While incremental improvements are generally available in the commercial hydropower sector, the transformative strategies sought in this subtopic will likely require new ways of combining disciplines and industry innovations. Applicants are encouraged to engage partners in fulfillment of the award and recruit letters of support. Applicants are also encouraged to engage multiple business units within hydropower-owning utilities.

In general, AOI 1b applicants should propose work consistent with the following general principles:

- **Innovation.** Applicants should propose operational strategies that enable new flexible capabilities beyond incremental advances. Opportunities for flexibility that are “hidden” or not widely utilized are of particular interest.
- **Applicability.** There is a hydropower plant in almost every state in the United States. The hydropower sector claims most of the oldest continuously operating plants. Scales of generation range from watts to gigawatts. Despite this complexity, the proposed work must be appropriate for a significant subset of the fleet.
- **Quantitative.** Rigorous quantification of the improved capability is essential. Anecdotes and qualitative information may be provided as background, but quantitative rigor is required for broad applicability.
- **Dissemination.** Applications should thoughtfully describe the intention and pathway(s) to disseminate and encourage adoption of the results. Proposals should be clear about the intended further advancement regarding the optimization innovation beyond the term of the award and demonstrate a plan to share or otherwise advance findings and outcomes (e.g., publication in the open literature, licensing strategy, such as open-source or commercial).
- **Data.** Applications should describe in some detail their plans for developing comprehensive data sets, unifying disparate data sets, conditioning data, and ensuring data access to relevant audiences to achieve the objectives of AOI 1b.

WPTO intends to manage any award under this AOI as an integrated part of the WPTO portfolio, both in the selection process and during the period of performance. The portfolio of projects may include work being/to be performed at the National Labs and other entities.

### **AOI 1b National Laboratory Technical Assistance**

Where advanced computation or another advanced tool is required to test or validate an innovative operational strategy, applicants may indicate a request for national laboratory support in their applications. Requests should be specific to the need, not to the laboratory or the facility. WPTO will consider independent support for High Performance Computing (HPC) or other leveraged research assets. However, the innovation’s usefulness and ultimate success

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cannot be predicated on tools or systems that are not widely present or available in the sector. If applicants make a request for national lab support, a possible mechanism to provide it could be a Cooperative Research and Development Agreement (CRADA) with the national laboratory, with the detailed collaborative work scope to be established during the award negotiation period in the event that an application is selected.

*Note that National Laboratory staff cannot be consulted in relation to this AOI prior to the announcement of selection decision(s) under this FOA.*

### **AOI 1b Anticipated Work to Be Performed**

In Budget Period 1, AOI 1b awardees will produce a detailed technical report on the operational strategy and its potential for broad applicability. The report should describe the practical effect of the operational strategy, including a full, quantitative characterization of the flexibility provided, a description of the possible value to the grid, and an analysis of the extent of applicability across the fleet. The results should include all relevant engineering design, modeling, and supporting data. There will be a go/no-go decision at the end of Budget Period 1.

If the project advances to Budget Period 2, awardees should demonstrate or otherwise validate the applicability of the operational strategy to real hydropower plants. Field validation is of greatest interest, but other methods of simulation or validation are also acceptable, provided they use real hydropower plants under real or demonstrably realistic operations scenarios. Reports on this work should include a detailed description of facilities and current operations management, design intention, installation, integration, and validated effects of the operational strategy. In addition, a platform and methodology for collecting and organizing necessary data sources to support the framework will be developed.

### **AOI 1b Intellectual Property**

If development of software is proposed in the application, this software is not required to be open-source in order to be eligible for award. However, applications should describe in detail how they will meet AOI 1 objectives of impact (that at the conclusion of the work, the outcome will be used and useful) and availability (that the outcome is accessible to users without excessive cost). If applicable, applicants must describe a software licensing and dissemination strategy.

### **AOI 1b Specific Technical Review Criteria for Full Applications**

- Criterion 1: Technical Merit, Innovation, and Impact (50%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (20%)

Full Application Technical Review Criteria are detailed in [Section V.A.ii.](#)

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### ***AOI 1b Teaming Partner Mechanism (Optional)***

WPTO encourages collaboration across sectors to ensure broad impact of work performed on hydropower operational flexibility. WPTO will compile a Teaming Partner List that can be used by potential applicants or entities interested in partnering with applicants who want to find partners. The Teaming Partner List is a tool to facilitate the formation of new project teams. Participation is not a requirement of this FOA and is completely voluntary. Participation or nonparticipation will have no impact on the evaluation and selection process.

Any organization that would like to be included on this list should submit the following information to [WPTOFOA@ee.doe.gov](mailto:WPTOFOA@ee.doe.gov) with the subject line “Teaming Partner Information”: FOA AOI (1a or 1b), Organization Name, Contact Name, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities. By submitting the above Teaming Partner Information, you consent to the publication of the above-referenced information as part of the Teaming Partner List.

The Teaming Partner List will be available on EERE Exchange at <https://eere-Exchange.energy.gov> under DE-FOA-0002080. The Teaming Partner List will be updated periodically until the close of the Full Application period to reflect new Teaming Partners who have provided their information. By facilitating this Teaming Partner List, EERE does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List. EERE will not pay for the provision of any information, nor will it compensate any respondents for the development of such information.

## **2 Low-Head Hydropower and In-Stream Hydrokinetic Technologies**

Hydropower and hydrokinetic technologies generate renewable electricity that supports domestic economic prosperity and energy security while enhancing the reliability and resiliency of the U.S. power grid. New development at these sites requires the balancing of project costs with the protection and preservation of important river functions and attributes. To address these challenges, WPTO has identified standardization, modularity, and environmental compatibility as three enabling principles of a low-cost, environmentally sustainable strategy for growth at riverine resources. This area of interest will consider applications that employ these principles into the design of both hydropower and in-stream hydrokinetic technologies. Applicants are encouraged to use advanced manufacturing techniques to achieve performance and cost reduction targets. Awardees will design, manufacture, and test their technologies in a lab or field environment at the appropriate scale.

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## 2a: Modular Technologies for Low-Head Hydropower Applications

*\$5M in Federal funds, 20% Cost Share requirement*

*Up to 5 awards, up to \$1M in DOE funds per award, 24-month anticipated award duration*

Projects under AOI 2a will focus on the design and testing of new standardized, modular hydropower technologies for low-head applications (30 feet or less). Applications must include innovative designs for generation, fish passage, sediment passage, recreation passage, water passage, or foundation modules that leverage advanced manufacturing techniques and materials.

New stream-reach development sites—defined as stream segments without hydroelectric facilities or other hydraulic structures—comprise the majority of the technical hydropower resource potential in the United States.<sup>23</sup> These sites are characterized by low heads, varying flows, and highly valued river functions and attributes that must be maintained, including fish migration, sediment transport, recreational usage, physiochemical regulation, and sustenance of aquatic habitat. The 2016 Hydropower Vision Report analysis used a comprehensive electric sector expansion model to identify approximately 17 GW of economically feasible hydropower growth that could be developed at new stream-reach sites by 2050.<sup>24</sup> However, the Hydropower Vision Report also noted that these growth levels can only be achieved with the emergence of innovative—even transformational—advances in technologies and designs that reduce costs and meet environmental performance objectives. Recent trends reflect the steep challenges to the conventional new stream-reach hydropower development approach: over the past ten years, hydropower capacity increases have come predominantly from upgrades to existing facilities, powering of non-powered dams, and energy recovery in conduit facilities, while only five small new stream-reach hydropower projects were completed, none of which involved construction of a large impoundment dam.<sup>25</sup> Such development presents a complex and challenging undertaking because of the risks, costs, and uncertainty associated with project development, with design, construction, equipment selection, and environmental impact mitigation strategies driven by site-specific considerations.

In 2016, Oak Ridge National Laboratory (ORNL) initiated a DOE-funded multi-year research and development effort titled Standard Modular Hydropower (SMH) Technology Acceleration to define standardization, modularity, and environmental compatibility as the three enabling

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<sup>23</sup> Kao et al. 2014. New Stream-Reach Development: A Comprehensive Assessment of Hydropower Energy Potential in the United States. [https://hydrosourc.ornl.gov/sites/default/files/ORNL\\_NSD\\_FY14\\_Final\\_Report.pdf](https://hydrosourc.ornl.gov/sites/default/files/ORNL_NSD_FY14_Final_Report.pdf).

<sup>24</sup> 2016 Hydropower Vision Report, <https://www.energy.gov/eere/water/downloads/hydropower-vision-report-full-report>. These findings are based on a credible modeled scenario in which technology advancement lowers capital and operating costs, innovative market mechanisms increase revenue and lower financing costs, and a combination of environmental considerations are taken into account.

<sup>25</sup> 2017 Hydropower Market Report, <https://www.energy.gov/sites/prod/files/2018/04/f51/Hydropower%20Market%20Report.pdf>

principles of a low-cost, environmentally sustainable hydropower growth strategy.<sup>26</sup> These principles have been defined as follows:

- **Standardization:** Guidelines, rules, and specifications (i.e., standards) to maximize compatibility, acceptance, interoperability, quality, safety, and repeatability while minimizing environmental disturbance. In a hydropower context, standardization of design, review, regulation, manufacturing, operations, maintenance, and other features is intended to reduce site specificity and project costs.
- **Modularity:** The physical or virtual organization of a hydropower facility into discrete functional units, known as modules. In SMH, the entire facility is envisioned as a modular structure, with generation, passage, and foundation modules assembled in a flexible manner to deliver energy and environmental benefits at many different sites.
- **Environmental Compatibility:** Siting and developing hydropower facilities with an understanding that streams have important environmental attributes that must be maintained. SMH development must embody an understanding of how coupled stream-hydropower systems can minimize disturbances to landscape features, water quantity, connectivity, geomorphology, water quality, and biota.

As part of the SMH Technology Acceleration project, ORNL produced the SMH Exemplary Design Envelope Specification (EDES, or the Design Envelope),<sup>27</sup> a set of guidelines for technology-neutral design of modular hydropower technology. It documents the functionalities that are necessary for successful module operation, independent of how these functionalities are accomplished. As illustrated in [Figure AOI 2a](#), a standard hydropower module is an independently operable unit with dedicated functionality from which an SMH facility can be constructed. The Design Envelope identifies the objectives, requirements, constraints, and measures of performance of exemplary generation, passage, and foundation modules. Further, it identifies functional relationships between the aquatic environment and module performance attributes needed to minimize disruptions of the river continuum.

While the Design Envelope was established to focus hydropower technology developers on design solutions that balance performance and environmental sustainability, cost reductions that broaden applicability to and feasibility of new stream-reach development opportunities nationwide will require innovation. One innovation pathway is advanced manufacturing, or the application of innovative technologies, processes, and materials to hydropower module design, manufacturing, and assembly. Examples of advanced manufacturing include, but are not limited to, additive manufacturing (the three-dimensional printing of physical components in layers), composite manufacturing, use of new high-strength low-weight materials, automated construction and assembly, and embedded sensors to monitor machine condition and aquatic system health. The potential enhancements enabled by advanced manufacturing include simplified assemblies with fewer bolted connections; reduced manufacturing labor costs;

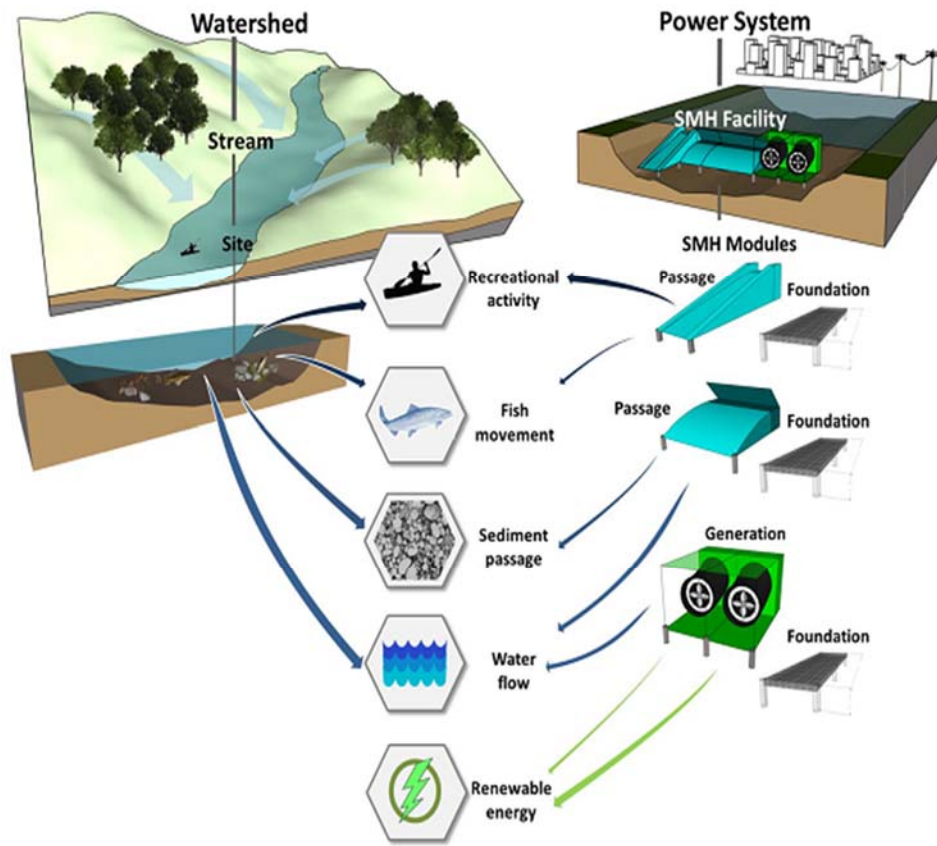
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<sup>26</sup> For more information on the SMH project visit <https://hydropower.ornl.gov/smh/>

<sup>27</sup> Full document available at <https://hydropower.ornl.gov/smh/docs/ORNL-SMH-Exemplary-Design-Envelope-Specification.pdf>



increased strength-to-weight ratios; improved durability; complex shapes and flow passages; lower operational and maintenance costs; and new insights into modular and facility performance. While similar enhancements have ushered in cost reductions for mass-produced components in other industrial sectors, their potential for advancing hydropower design and development remains largely unexplored.



**Figure AOI 2a. Conceptual schematic of a standard modular facility where the basic building blocks are individual modules with a dedicated functionality. Modules shown are not intended to convey an actual or preferred design.**

Building on the SMH Technology Acceleration project, WPTO seeks to engage the private sector in the practical engineering application of SMH principles. As part of 2018 Funding Opportunity Announcement DE-FOA-0001836, WPTO released a topic area titled *Facility Design Concepts for Standard Modular Hydropower Development* with the objective of adapting existing modular technologies into the design of small, low-head hydropower facilities.<sup>28</sup> Through this FOA’s AOI 2a, WPTO is now soliciting *new and innovative* modular hydropower technologies that utilize advanced manufacturing techniques.

<sup>28</sup> <https://eere-exchange.energy.gov/FileContent.aspx?FileID=0023b8fa-43d5-4631-a02b-2ce854c8b367>

### *AOI 2a Application Expectations*

*AOI 2a, Modular Technologies for Low-Head Hydropower Applications* seeks to develop new, innovative, transformative, modular hydropower technologies that balance performance, economics, and environmental sustainability. Proposed technologies must leverage advanced manufacturing techniques to lower the cost, increase performance, and/or facilitate rapid deployment of these technologies. Applicants must propose innovations in one of the following modules:

- **Generation Module:** The objective of the generation module is to generate hydroelectric power from flowing water under pressure. The generation module is envisioned as a complete hydroelectric generation machine containing all equipment and systems for safe and reliable water power generation, including an intake, flow conveyance, electro-mechanical equipment, and an outflow passage. It is pre-engineered to accommodate a host of potential sites, the internal component configuration is predictable and scalable, performance characteristics meet preconceived expectations, and can be relied upon to produce a regular supply of hydropower.
- **Fish Passage Module:** The objective of the fish passage module is to allow the unimpeded and safe passage of fish through a hydropower facility, upstream and downstream. To succeed in this objective, the fish passage module must attract fish to the module inlet, allow safe and timely passage through the module, and allow fish to exit safely into the river. The module must possess favorable geometry and create hydraulic conditions such that fish are encouraged to cross the hydropower facility in a safe manner by minimizing fish fatigue, disorientation, and injury.
- **Sediment Passage Module:** The objective of the sediment passage module is to ensure sediment from upstream of the facility is effectively transported downstream. The sediment passage module must ensure sediment is supplied to the module inlet, transported through the module, and passed downstream while minimizing river geomorphic change upstream and downstream of the facility.
- **Recreation Passage Module:** The objective of the recreation passage module is to allow the passage of small recreational watercraft (e.g., canoes, kayaks) consistently and safely through a facility when so desired. The module should provide a safe and visible entrance, exhibit consistent passage hydraulics appropriate for the recreational craft, provide a safe exit downstream, and include provisions for emergency rescue personnel and apparatus.
- **Water Passage Module:** The objective of the water passage module is to allow the conveyance of non-generating water through a hydropower facility. The module must safely pass flows not usable by other modules while supporting entrance hydraulics for generation and passage modules.
- **Foundation Module:** The objective of the foundation module is to securely anchor passage and generation modules to the streambed and banks. The module must provide structural resistance against imposed loads, ensure stability of the modular facility, and minimize the mechanical impacts of moving water and sediment on the streambed.

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Modules are further defined in the SMH Design Envelope, which includes detailed module-specific requirements, design constraints, functional relationships, and measures of performance.

*Only one type of module may be proposed per application.* An entity may submit more than one application to this area of interest, provided that each application describes unique, scientifically-distinct technology. Note that an eligible Concept Paper must be submitted for each Full Application per [Section III.F.](#)

An ideal applicant would have a technology concept formulated with supporting information to demonstrate its feasibility ([TRL 2](#)). Through this award, the awardees will validate the concept through simulation and partial- or full-scale testing in a laboratory or relevant environment ([TRL 4-7](#)). In addition to testing, the project should be structured to demonstrate the proposed innovation's potential to meet the performance targets laid out in this document. Applicants need not have previous hydropower technology development experience, but should have some experience and familiarity with physical structures that effectively function in riverine and/or aquatic environments.

### ***AOI 2a Performance Targets***

AOI 2a seeks modules that can meet the following characteristics:

- Operated at hydraulic heads of up to 30 feet
- Independently arranged, configured, and delivered
- Independently deployed across a set of distributed sites
- Swapped in and out without compromising facility performance
- Transported individually to a site
- Easily matched to compatible sites
- Quantified and parameterized measures of performance within the categories defined in the Design Envelope

Proposed technologies must also leverage advanced manufacturing and/or materials to achieve one or more of the following metrics compared to the state-of-the-art:

- Cost reduction
- Performance improvement
- Increased energy capture
- Replicability
- Rapid deployment
- Broad and site-independent deployability

### ***AOI 2a Technical Assistance***

In addition to the financial assistance provided under this award, WPTO will directly fund ORNL to provide technical assistance to each awardee. Technical assistance includes access to the Department of Energy's first Manufacturing Demonstration Facility, established at ORNL,

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offering world-leading capabilities in innovative materials and manufacturing technologies. During the award negotiation period, awardees should be prepared to discuss with WPTO and ORNL the proposed concepts, design constraints, functionality, material requirements, fabrication methods, and laboratory testing. Within four weeks of the award start date, awardees must provide ORNL with a preliminary design package for their module. ORNL technical staff will review the design package and schedule a four-hour design review meeting to discuss the extent to which the awardee's planned uses of new technology are feasible and take full advantage of the design and performance opportunities that advanced materials and manufacturing may admit. ORNL will enter into necessary and appropriate non-disclosure agreements with awardees to ensure that awardee business sensitive data are protected.

ORNL may also provide technical assistance to each awardee in the following activities:

- Design and modeling support
- Cost analysis
- Aquatic ecology expertise

If such assistance is desired, applicants must indicate their intent and plan for using ORNL technical assistance within proposed tasks. Using this input and the results of the aforementioned design review meeting, ORNL and the awardee will prepare a detailed plan for integration of ORNL facility and technical support into the awardee's workplan. WPTO, ORNL, and the awardee will tailor the ORNL scope of work (hours of effort), not to exceed 20% of the scope of work to be performed by the awardee. An awardee that has requested this assistance in their application should anticipate entering into a Cooperative Research and Development Agreement (CRADA) with ORNL, with the detailed collaborative work scope to be established during the award negotiation period and finalized thereafter when the CRADA is executed.

*Note that ORNL staff cannot be consulted in relation to this AOI prior to the announcement of selection decision(s) under this FOA.*

#### ***AOI 2a Specific Technical Volume Requirements [\(Details in Section IV.D.ii\)](#)***

- Clear description of the state-of-the-art for the particular module being proposed—including cost and performance baselines—and how the proposed module will advance it;
- Demonstration that the Design Envelope was used to:
  - Establish the design objectives and performance targets for modules;
  - Understand module boundaries and interfaces;
  - Establish quantitative performance requirements from list of desired module performance.
- Substantiated responses to the following questions:
  - What is the expected performance for this module?
  - How well can the module be applied at a variety of sites?
  - What is the expected cost to manufacture, deliver, and install the module?

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- Does the module size make it amenable to standard transportation methods and facilitate installation?
- What is the expected service life of the module?
- Description of advanced manufacturing techniques that will be used to fabricate or construct the module;
- Identification and prioritization of technical assistance from ORNL, if so desired;
- The qualifications, relevant expertise, and time commitment of the individuals on the team;
- Description of facilities and resources that will be used to validate performance. In case of partial-scale testing, rationale must be provided for scaling up results to demonstrate confidence of eventual commercial success.

#### **AOI 2a Specific Technical Review Criteria for Full Applications**

- Criterion 1: Technical Merit, Innovation, and Impact (50%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (20%)

Full Application Technical Review Criteria are detailed in [Section V.A.ii.](#)

## **2b: Modular Technologies for River Current Energy Converter Applications**

*\$4.6M in Federal funds, 20% Cost Share requirement*

*Up to 3 awards, up to \$3.9M in DOE funds per award, 36-month anticipated award duration*

Successful applications under this AOI will submit a proposal that includes engineering design and analysis, numerical modeling, and relevant model-scale testing to support project objectives, to satisfy the International Electrotechnical Commission (IEC) Technical Specifications (TS) ([described below](#)) and design reviews. Applicants should propose the design basis for their device size and load conditions based on the expected depth and flow velocities at their desired open water test site. The CEC shall be designed with a minimum electrical output power of 10 kW per module at 2.0 m/sec inflow speed, with a minimum of two modules connected to a common support structure module. A system that can provide a total electrical output power of 30 kW or more at 2.0 m/sec inflow speed, although not required, is desirable. The individual CEC optimal performance should lie between an inflow speed of 0.5 m/sec and 2.0 m/sec to maximize availability at low flow sites.

Applications should focus on improving deployment and retrieval techniques and reducing operations and maintenance costs. Projects under this area of interest will establish deployment, retrieval and operation (DRO) costs based on comprehensive data and clearly identify cost reduction pathways to inform the Original Equipment Manufacturer (OEM), MHK industry and WPTO. Testing will include gathering inflow current speed data in order to validate/update Annual Energy Production (AEP) calculation and mechanical/structural load

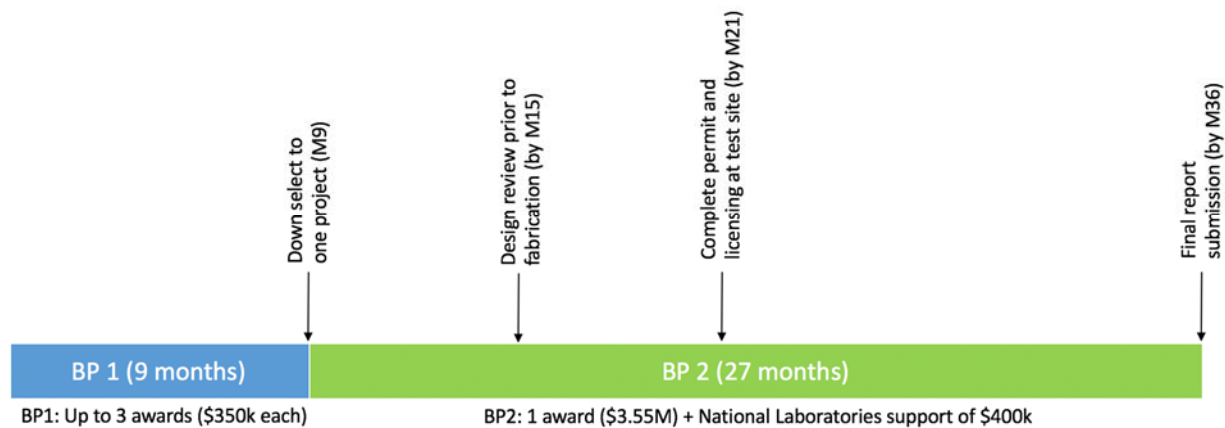
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data in order to validate/update structural models to verify the design and related manufacturing costs.

### AOI 2b Timeline

The total duration of the project is 36 months and the total DOE budget is \$4.6M administered in two budget periods (see [Figure AOI2b](#)). WPTO anticipates selecting up to 3 applications at \$350k each for Budget Period (BP) 1 lasting for nine (9) months for initial design. A down-select process will occur at the end of BP1, down-selecting projects to one award to continue to BP2 for final design, fabrication, and testing. Anticipated duration of BP2 is twenty-seven (27) months.



**Figure AOI 2b. Expected AOI 2b project timeline**

### AOI 2b International Electrotechnical Commission (IEC) Technical Specifications (TS)

In order to develop resilient designs capable of at least six months of continuous testing and operations, applicants are expected to submit a proposal that incorporate IEC TS into their CEC design. To enable this, applicants must consider the hydrodynamic characteristics at the proposed test site when developing their prototype design. WPTO, National Renewable Energy Laboratory (NREL), and Sandia National Laboratories (SNL) will review the design against applicable IEC TS, such as the suitability of the load cases selected for designing the CEC and numerical models used for predicting load and performance.

Specifically, Awardees are required to develop designs that follow IEC TS 62600-2 standard (latest revisions at the time of the award) to the degree practical through consultation with NREL, SNL and WPTO:

- **IEC TS 62600-2 Design Requirements for Marine Energy Systems<sup>29</sup>:** Provides the essential design requirements to ensure the engineering integrity of wave, tidal and

<sup>29</sup> <https://webstore.iec.ch/publication/25634>



other water current energy converters, referred to as marine energy converters (MECs), for a specified design life.

Additionally, awardees will be required to develop their system design in consideration of the following IEC Technical Specifications standards, when published, to the degree determined practical through consultation with NREL, SNL and WPTO:

- **IEC TS 62600-10 Assessment of Mooring System<sup>30</sup>**: provides uniform methodologies for the design and assessment of mooring systems for floating MECs.
- **IEC TS 62600-30 Electrical Power Quality<sup>31</sup>**: Definition and specification of the quantities to be determined for characterizing the power quality of a marine energy (wave, tidal and other water current) converter unit; measurement procedures for quantifying the characteristics of a marine energy (wave, tidal and other water current) converter.
- **IEC TS 62600-300 Electricity Producing River Energy Converters<sup>32</sup>: Power performance Assessment**: Provides a method for assessing the electrical power production performance of a Current Energy Converter (CEC), based on the performance at a testing site.
- **IEC TS 62600-301 River Energy Resource Assessment<sup>33</sup>**: Provides a method for estimating resource, to enable calculation of Annual Energy Production (AEP) for River Energy Converter.

#### **AOI 2b CEC Device Performance Metrics**

Awardees must provide estimates of the metrics listed below 45 days prior to the BP1 down select and then provide updates to the metrics for the BP2 design review and the end of BP2. The metrics should estimate for this project at the testing site and for the intended commercialization site. The baseline will be set for Capital expenditures (CapEx), Operational expenditures (OpEx) and Annual Energy Production (AEP) by each developer for their proposed system, before incorporating the upgrades associated with this award, at their specific test location. The goals of this AOI are to improve the OpEx value over the baseline by twenty percent, the CapEx by ten percent, and AEP by five percent.

- **Capital Expenditures (CapEx)** calculated as all expenditures associated with the planning, design, manufacturing, initial deployment, and project management of the WEC deployment.
- **Operations and maintenance costs (OpEx) and schedule.** Costs and schedule should include all routine and planned maintenance, operations to include deployment and retrieval for maintenance, and monitoring activities.

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<sup>30</sup> <https://webstore.iec.ch/publication/22012>

<sup>31</sup> <https://webstore.iec.ch/publication/28781>

<sup>32</sup> Not yet available, still in ED

<sup>33</sup> Not yet available, still in ED

- **Annual energy production (AEP)** describing the average annual energy delivered to the grid interconnect point after accounting for device or array availability.
- **Power versus current speed** calculated in accordance with IEC TS 62600-300 Electricity Producing River Energy Converters, including a scatter plot of performance (electrical power output and mechanical power output) data using the method of bins showing the mean power, maximum power, minimum power and the standard deviation as function of current speed for the flow conditions experienced during testing. Show a comparison between the measured power versus current speed and the modeled power versus current speed for the full design operating range of the prototype. Note that this metric may be estimated for BP1 work but must be measured during BP2 testing and reported in the final report.
- **Probability distribution of current speed and turbulence characteristics** calculated in accordance with IEC TS 62600-301 River Energy Resource Assessment. Awardees will be specifically required to provide plots of the velocity distribution (probability of exceedance, i.e. probability distribution curve, versus current speed) and turbulence distributions at the test site. Measurements used to develop these plots must be a minimum of two diameters upstream of the device under test. Similar downstream measurements would also be desirable but not required. Note that this metric may be estimated for BP1 work but must be measured during BP2 testing and reported in the final report.

#### **AOI 2b National Laboratory Technical Assistance**

Applicant selected to continue to BP2 will be eligible to request up to \$400K in technical support from NREL and/or SNL as part of BP2 scope. The \$400K will not be part of the BP2 funding provided to BP2 awardee, and instead will be funded directly by DOE to the National Laboratory. Final determination of the specific laboratory support will be made during award negotiations based on input from developer, laboratories, and DOE. If such assistance is desired, applicants must indicate their intent and plan for using National Laboratory technical assistance within proposed tasks. An awardee that has requested this assistance in their application should anticipate entering into a Cooperative Research and Development Agreement (CRADA) with the National Laboratory, with the detailed collaborative work scope to be established during the award negotiation period and finalized thereafter when the CRADA is executed. This technical assistance may include the following activities:

- Hydrodynamic resource modeling for estimating AEP, CapEx and OpEx at the selected testing and market sites. Low to high fidelity models, as well as high performance computing (HPC) support are available;
- Hydrodynamic, fluid-structure interaction and finite element analysis modeling for the CEC, for estimating performance, loads, bed erosion, etc. Low to high fidelity models, as well as high performance computing (HPC) support are available;
- Laboratory testing support in the area of power-take-off testing, structural testing, and component testing;
- Design support and verification testing support for composite blades and structures;

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- Field testing and instrumentation support. Sensor and instrumentations available include Acoustic Doppler Current Profilers (ADCP), Acoustic Doppler Velocimeters (ADV), remote control survey boat with GPS and echo sounder, load sensors, fiber optic strain sensors, etc.;
- Current, bathymetry and site data analysis;
- Performance metrics analysis;
- Support designing to IEC Technical Specifications;
- Development of risk management plans;
- Technology Performance Level assessment;
- Flume/open channel/laboratory testing support;
- Planning for risk reduction;
- Extreme event modeling;
- Cost modeling;
- Composite structure design and testing.

*Note that National Laboratory staff cannot be consulted in relation to this AOI prior to the announcement of selection decision(s) under this FOA.*

#### **AOI 2b BP1, Initial Design: REQUIRED TASKS**

- Develop preliminary design;
- Develop innovative approaches, which can include innovative design of infrastructure, balance of systems (BOS) and/or foundation and mooring system, as well as a more efficient deployment/retrieval system and procedure, to reduce the cost of the deployment, and retrieval operation for maintenance;
- Design a CEC system that includes a deployment and retrieval system and strategy for open water testing. The design must include the use of instrumentation and sensors, not only for validating performance and AEP, but also for measuring loads on critical components. The load measurements that will be conducted during the open water testing in BP2 will be used to validate models and update the cost of the CEC system over its design life period;
- Develop plans to incorporate IEC and IEEE standards into the device design as defined in [AOI 2b International Electrotechnical Commission Technical Specifications and Standards](#) section;
- Perform calculations and simulations to determine device performance and loads;
- Initiate permitting actions for open water testing;
- Develop Deployment and Operations Plan – Describes preliminary work to develop innovative approaches that reduce the cost of IO&M. Outlines the IO&M strategy and includes a cost analysis that quantifies targets for reduction in CapEX, reduction in OpEx and an increase in availability;
- Perform preliminary calculations and simulations to estimate device performance and loads, including the effects of turbulence;

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- Perform preliminary calculations and simulations to estimate AEP, CapEx and OpEx for the intended commercialization site(s);
- Develop manufacturing plan and estimate system fabrication, deployment, operations, and maintenance costs for a minimum of 6 months deployment at the proposed test site;
- Develop preliminary risk register and risk management plan;
- Submit a final design report summarizing the work performed during the entire project
- Participate in the preliminary design review/down-select meeting and give presentation to DOE, NREL, and SNL on the project and device design status;
- Submit BP1 final report and all deliverables identified in section labeled [AOI 2b BP1, Initial Design: ANTICIPATED DELIVERABLES](#).

### ***AOI 2b BP1, Initial Design: ANTICIPATED DELIVERABLES***

#### **1. BP1 report**

- CAD design drawings of the CEC system;
- Performance estimates for the full operational range of the device (power curve);
- Preliminary estimates of velocity duration curve, power duration curve, and AEP for the intended commercialization site(s);
- CapEx, OpEx and AEP estimates;
- Design loads estimates;
- Manufacturing and commercialization plans, including a description of any advanced manufacturing techniques that will be used for fabrication;
- Installation, operation, and maintenance (IO&M) concept;
- Conformity of the design with IEC TS 62600-2;
- Preliminary estimates for the metrics identified in the [AOI 2b CEC Device Performance Metrics](#) section;
- Appropriate consideration of the IEC-10, IEC-30, IEC-300, IEC-301;
- Unresolved open design issues and resolution plans with cost estimates;
- Risk Management Plan and Risk Register Complete development of the risk management plan and risk register following the “Marine and Hydrokinetic Technology Development Risk” risk register template - <https://www.nrel.gov/docs/fy15osti/63258.pdf>. The risk management plan and risk register must consider risks that could be encountered during a potential device manufacturing, deployment, and testing project;
- Permitting Plan;
- Attend the design review meeting and give presentation to DOE, NREL, and SNL on the project and design status;
- Lab support request for BP2 detailed under [AOI2b National Laboratory Technical Assistance section](#).

## 2. A BP1 commercialization plan

- How the project will advance the technology towards commercial viability;
- The target dimensions, power rating, and other relevant characteristics of the device for commercialization (note any differences with the design being developed as part of this award);
- The intended market for the CEC device;
- How the device will be deployed commercially (e.g., individually or in arrays);
- The anticipated size of the target market;
- Relevant project data and project metrics data uploaded to the MHK-DR (<https://mhkdr.openei.org>) using the appropriate content models (<https://mhkdr.openei.org/models/>).

### **AOI 2b BP1 to BP2 DOWN SELECTION PROCESS AND CRITERIA**

For AOI 2b only, WPTO intends to conduct a competitive project review (down-selection process) upon the completion of BP1 initial design. AOI 2b recipients will present their projects to WPTO individually (not to other recipients). Subject matter experts from academia, national laboratories, and industry may be used as reviewers, subject to conflict of interest and non-disclosure considerations. WPTO will down select to one project to proceed into BP2 to complete the design, build and testing of a prototype in open water. Forty-five (45) days before the completion of BP1, all BP1 awardees will submit BP1 required deliverables to WPTO Project Officer. These reports will be used by WPTO team to conduct a project review against the criteria listed below. Approximately thirty (30) days before the completion of BP1, BP1 awardees will give a presentation to WPTO team.

Projects will be evaluated based on the following criteria:

1. Technical performance and progress towards stated project objectives.
2. Level of innovation and potential impact of modular design and IO&M techniques to reduce Capex and OpEx and increase AEP.
3. Likelihood of project success; as indicated by the technical risk analysis, open water test plans, feasibility of permitting plan, progress made on permitting activities, and feasibility of the data collection plan.

Upon completion of the competitive project review (down-selection process), WPTO will select which AOI 2b project will receive federal funding beyond BP1. Due to the availability of funding and program considerations, only one (1) recipient will be selected to receive funding for project continuation into BP2. As a result of this down-select process, certain projects will not receive federal funding beyond BP1 even if the project is meeting the pre-defined metrics. Details in [Section IV.C.](#)

### **AOI 2b BP2, Final Design, Fabrication, and Testing: REQUIRED TASKS**

In addition to the award funding, the awardee selected to continue to BP2 will receive up to \$400K in technical support from NREL and/or SNL, which will be funded directly by WPTO. The

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final allocation of funding to the laboratories will be determined by WPTO based on developer's request and funding available. Technical assistance from the National Laboratories is further discussed below under [AOI 1b National Laboratory Technical Assistance](#) subsection.

In Budget Period 2 (BP2), the AOI 2b awardee will be required to have one final design review (detailed below under BP2 [anticipated deliverables](#)) with WPTO and National Laboratories prior to fabrication.

Currently anticipated tasks include:

- Finalize manufacturing plan and estimate system fabrication, deployment, operations, and estimates for CapEx and OpEx for the open water testing to be conducted in BP2;
- Participate in design review;
- Complete any permitting and licensing needed at the testing site;
- Complete risk analysis using the Risk Management Framework, "Marine and Hydrokinetic Technology Development Risk" risk register template - <https://www.nrel.gov/docs/fy15osti/63258.pdf>, or equivalent method for the open water testing. Mitigate these risks and monitor progress over the course of the project;
- Plan to perform testing in the open water with a minimum of 6 months system operation;
- Demonstrate that the [IEC Technical Standards](#) identified in this document have been satisfied;
- Submit a final design report summarizing the work performed during the entire project, including lesson learned, numerical modeling results, and any tank or component testing results;
- Submit all [BP2 required deliverables](#).

*AOI 2b BP2 Additional Design and Testing Constraints:*

- Any numerical design calculations and tools used in the design process must be verified and validated through tank testing and/or laboratory testing data or based on scientifically sound rationale;
- Deployment at a site with a large blockage ratio, i.e. > 10%, shall be avoided. Awardees should report blockage ratio in final test report;
- The test site selected for open water testing should have as wide a range of current speeds as practical to enable testing the prototype device over as much of its intended operating range as possible. The test site must experience periods of time where the current speed is at, or near, the maximum design current speed for the design;
- Site with significant bathymetry changes over time shall be avoided, because this may affect the quality of power performance assessment and become a safety issue;
- Electrical power output, voltage and current measurements are required;

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- Mechanical power (torque and rotational speed), and if feasible thrust loads and blade roots bending moment should be measured on at least one rotor unit. These measurements can help provide insight on the turbine's performance and loading;
- Turbulence measurements upstream and in the wake of the device are desirable.

### AOI 2b BP2, Final Design, Fabrication, and Testing: ANTICIPATED DELIVERABLES

In support of design review a Final Design Report will be provided to WPTO that includes all items mentioned under BP1 report and their updates, and these additional items:

- Detailed manufacturing/fabrication plan, including cost estimates;
- Detailed installation, deployment, operation and decommissioning plan;
- Detailed permitting plan to accomplish all permitting activities.
- Detailed commercialization plan.

Final report at end of project:

1. Final report that includes all items mentioned under BP1/ BP2 report and their updates based on the result from the open water testing, and the additional items below:
  - Results and lessons learned from open water testing;
  - Comparison between measurement and numerical model results, to determine the accuracy of the numerical models used during the design stage;
  - Final AEP, CapEx ad OpEx for the test location and intended market, based on open water testing result;
  - Power versus current speed calculated in accordance with IEC TS 62600-300 Electricity Producing River Energy Converters;
  - Probability of current speed and turbulence characteristics calculated in accordance with IEC TS 62600-301 River Energy Resource Assessment;
  - Final power and thrust curves obtained from testing data and a comparison of the measured loads with the loads used for design;
  - Lessons learned from IEC TS implementation.
2. A final commercialization plan that includes all items mentioned under BP1 commercialization plan and their updates based on the result from the open water testing;
3. Relevant project data and project metrics data uploaded to the MHKDR (<https://mhkdr.openei.org>) using the appropriate content models (<https://mhkdr.openei.org/models/>).

DOE labs will review the draft of the final project report, including reviewing the degree of appropriateness of data analysis, event reporting, lessons learned, etc. and provide input with a goal to improve the final report.

Further details of information that applicants should provide with their application to AOI 2b are provided in AOI 2b National Laboratory Technical Assistance. DOE National laboratories are

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not eligible to be prime or sub applicants to AOI 2b and national laboratory participation in AOI 2b awards is described further in [Section III.E](#).

***AOI 2b Specific Technical Volume Requirements (Details in Section IV.D.ii)***

- Description of the device concept with sketch and anticipated dimensions;
- Description of proposed test site as well as the intended commercialization site, if different from the test site;
- Description of work plan to meet project objectives and complete deliverables identified section labeled AOI 2b BP1, Initial Design: ANTICIPATED DELIVERABLES;
- Preliminary estimates of velocity and power duration/exceedance curves at the intended test and commercialization site is desired;
- Previous flume testing completed on similar designs, if any;
- Description of the plan for how to incorporate IEC standards to satisfy FOA requirements;
- Plan for how to develop a design that can be tested for a minimum of six months at the proposed site;
- Description of technical merit, innovation, and overall R&D value to MHK industry;
- Description of technical risks and the risk mitigation strategy;
- Description of numerical models and design methodologies that will be used to develop the device design;
- Description of how design tools and methodologies have been or will be validated using previous gathered experimental testing data; or a description of what work will be performed during the period of performance to verify and validate the design tools and methodologies that will be used;
- A matrix that defines roles and responsibilities of the team members and anticipated subcontractors;
- A discussion of the CEC design and testing experience of the team members and anticipated subcontractors;
- Description of the intended market(s) of the CEC device and any associated requirements;
- Description of any advanced manufacturing techniques that will be used in fabrication;
- A proposal for how the applicant would like NREL and/or SNL to provide technical assistance based on the lab technical capabilities described in AOI 2b National Laboratory Technical Assistance;
- Description of how the FOA metrics identified in [AOI 2b CEC Device Performance Metrics](#) section will be estimated during the period of performance;
- Baseline and target values for FOA metrics identified in AOI 2b CEC Device Performance Metrics section that will be achieved during the project period-of-performance;
- How the project will advance the state of the CEC technology towards commercial viability, the intended market for the CEC device, how the device will be deployed

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commercially (e.g., individually or in arrays), and the anticipated size of the target market;

- A plan to accomplish permitting activities to obtain all permits required in support of open water testing to include identification of all permits required for test site;
- Data dissemination plan;
- Relevant project data and project metrics data uploaded to the MHKDR (<https://mhkdr.openei.org>) using the appropriate content models (<https://mhkdr.openei.org/models/>).

#### **AOI 2b Specific Technical Review Criteria for Full Applications**

- Criterion 1: Technical Merit, Innovation, and Impact (40%)
- Criterion 2: Project Research and Market Transformation Plan (40%)
- Criterion 3: Team and Resources (20%)

Full Application Technical Review Criteria are detailed in [Section V.A.ii.](#)

### **3 Advancing Wave Energy Device Design**

*\$7.2M in Federal funds, 20% Cost Share requirement*

*Up to 4 awards, up to \$1.8M in DOE funds per award, 20% cost share, 18-month award duration, with one budget period.*

The goal of projects funded under Area of Interest 3 (AOI 3) will be to develop wave energy converter (WEC) system designs that are ready for fabrication, deployment, and prototype testing at the DOE-funded PacWave-South test site. Full-scale testing in the open ocean is required to accurately assess device performance because of limitations inherent in laboratory testing at reduced scale and artificially generated wave patterns. Lessons learned and data collected from the testing will be used to inform next generation device designs to expeditiously advance wave energy technologies. These projects will develop wave energy converter system designs that satisfy rigorous engineering requirements to ensure wave energy devices can operate reliably in highly energetic wave energy resources of 40 kW/m or more that are representative of future deployment sites for utility scale power generation.

Applications to AOI 3 must propose detailed work plans to develop resilient WEC designs that are capable of two years of continuous testing and operations at PacWave-South test site. WEC designs must incorporate the IEC and the Institute of Electrical and Electronics Engineers (IEEE) standards as described in AOI 3 Technical Specifications and Standards section below. Device designs must be capable of delivering a minimum of 220,000 kW-h/year to the grid when deployed in the PacWave-South test site resource, corresponding to a 25-kW annual average electrical power output. Device designs should not exceed 880,000 kW-h/year to the grid when deployed in the PacWave-South test site resource, corresponding to a 100-kW average annual electrical power output.

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Accordingly, awardees must consider the physical characteristics and wave climate at the PacWave-South test site when developing their prototype designs. [Appendix D](#) provides further information on the PacWave-South test site.

### **AOI 3 Timeline**

The project duration for AOI 3 awards is 18 months and projects will have a single budget period. The maximum value of AOI 3 awards is \$1.8M in DOE funds per award and awardees are required to provide minimum of 20% cost share. WPTO anticipates making up to four AOI 3 awards.

### **AOI 3 Technical Specifications and Standards**

Awardees are required to develop designs that follow IEC TS 62600-2 and IEC TS 62600-10 standards (latest revisions at the time of the award) to the degree practical through consultation with NREL, SNL and DOE. Details on these two standards are given below:

- **IEC TS 62600-2 Design Requirements for Marine Energy Systems<sup>34</sup>**: Provides the essential design requirements to ensure the engineering integrity of wave, tidal and other water current energy converters, referred to as marine energy converters (MECs), for a specified design life.
- **IEC TS 62600-10 Assessment of Mooring System<sup>35</sup>**: provides uniform methodologies for the design and assessment of mooring systems for floating MECs.

Additionally, awardees will be required to develop their system designs in consideration of the following IEC Technical Specifications and IEEE standards, when published, to the degree determined practical through consultation with NREL, SNL and WPTO:

- **IEC TS 62600-30 Electrical Power Quality<sup>36</sup>**: Definition and specification of the quantities to be determined for characterizing the power quality of a marine energy (wave, tidal and other water current) converter unit; measurement procedures for quantifying the characteristics of a marine energy (wave, tidal and other water current) converter.
- **IEC TS 62600-40 Acoustic Characterization<sup>37</sup>**: Provides methods and specifications for collecting and assessing acoustic information generated by marine energy devices.
- **IEC TS 62600-100 Wave Energy Power Performance<sup>38</sup>**: Provides a method for assessing the electrical power production performance of a Wave Energy Converter (WEC), based on the performance at a testing site.

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<sup>34</sup> <https://webstore.iec.ch/publication/25634>

<sup>35</sup> <https://webstore.iec.ch/publication/22012>

<sup>36</sup> <https://webstore.iec.ch/publication/28781>

<sup>37</sup> Not yet available. This standard will only be part of AOI 3 work scope if it is published before the preliminary design review is conducted.

<sup>38</sup> <https://webstore.iec.ch/publication/7241>

- **IEC TS 62600-103 Best Practices for the Testing of Pre-Prototype Devices<sup>39</sup>**: This standard is concerned with the sub-prototype scale development of wave energy converters.
- **IEEE 1547 Grid Interconnection Requirements<sup>40</sup>**: The technical specifications for, and testing of, the interconnection and interoperability between utility electric power systems (EPSs) and distributed energy resources (DERs) are the focus of this standard.

WPTO is requiring that these standards are considered so that if the design is eventually fabricated, deployed, and tested at PacWave-South there will be a high level of confidence that the design is robust and compatible with the PacWave-South wave resource and testing requirements.

### **AOI 3 WEC Device Performance Metrics**

Awardees must provide estimates and supporting calculations for the following metrics at the intended deployment resource and for the PacWave-South resource during the preliminary and final design reviews. In addition, in their AOI 3 proposals, applicants must identify targets for the metrics that will be achieved during the AOI 3 period-of-performance.

**Levelized cost of energy (LCOE)** calculated using the NREL System Advisory Model (SAM) (<https://sam.nrel.gov/>). If the SAM tool is not capable of modeling marine energy systems by the time AOI 3 awards are finalized, awardees should calculate LCOE using the DOE LCOE reporting guidance methodology (<https://openei.org/community/document/mhk-lcoe-reporting-guidance-draft>).

**Peak-to-average mechanical power** as a function of significant wave height and peak period, where the peak absorbed power is the peak of mechanical power absorbed before conversion to electrical power.

$$\text{Peak to average power} = \frac{\text{peak absorbed power [kW]}}{\text{average absorbed power [kW]}}$$

Note that this can be the statistical measure of the peak power, fitted to a distribution rather than the absolute peak measured in testing. Average absorbed power is average mechanical power absorbed before conversion to electrical power.

**Capture width ratio** as a function of significant wave height and peak period. Capture width ratio should be calculated as the average width of wave front captured by the device as a given sea state divided by the characteristic dimension (e.g., diameter) of the device multiplied by the average wave energy flux at the given sea state.

$$\text{Capture width ratio} = \frac{\text{capture width [m]}}{\text{characteristic dimension of the device [m]}}$$

<sup>39</sup> <https://webstore.iec.ch/publication/32966>

<sup>40</sup> <https://standards.ieee.org/standard/1547-2018.html>

$$\text{Capture width} = \frac{\text{absorbed wave power [kW]}}{\text{wave resource } \left[\frac{\text{kW}}{\text{m}}\right]}$$

### **AOI 3 National Laboratory Technical Assistance**

WPTO will provide all AOI 3 awardees with up to \$400K of combined technical, engineering, and testing expertise from NREL and/or SNL. The \$400K will not be part of the \$1.8M in funding provided to awardees, and instead NREL and SNL will be funded directly by DOE. In their applications, awardees should propose work scope for NREL and/or SNL support. The final determination of the specific laboratory support will be made during award negotiations based on input from developer, NREL, SNL, and WPTO. If such assistance is desired, applicants must indicate their intent and plan for using National Laboratory technical assistance within proposed tasks. An awardee that has requested this assistance in their application should anticipate entering into a Cooperative Research and Development Agreement (CRADA) with the National Laboratory, with the detailed collaborative work scope to be established during the award negotiation period and finalized thereafter when the CRADA is executed. This technical assistance may include the following activities:

- Wave modeling and site wave characterization;
- Wave and site data analysis;
- Performance metrics analysis;
- Support designing to IEC Technical Specifications;
- Development of risk management plans;
- Test and instrumentation planning in support of future ocean testing;
- Tank testing support;
- Laboratory testing support in the area of power-take-off testing, structural testing, and component testing;
- Planning for risk reduction;
- Power performance modeling;
- Operational modeling;
- Extreme event modeling;
- Composite structure design and testing;
- High fidelity modeling using computational fluid dynamics (CFD) and finite element analysis (FEA) modeling;
- LCOE modeling;
- Control Systems engineering consultation.

*Note that National Laboratory staff cannot be consulted in relation to this AOI prior to the announcement of selection decision(s) under this FOA.*

### **AOI 3 Scope and Technical Requirements**

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The work scope for AOI 3 projects must include engineering design and analysis, numerical modeling, and any tank and laboratory testing that is needed to complete the scope and deliverables. In order to provide a high level of confidence that designs will perform as expected at PacWave-South test site, during the period-of-performance, awardees must either (1) demonstrate that the design tools and methodologies being used have been previously verified and validated or (2) perform tank or laboratory testing to verify and validate the design tools and methodologies being used.

Successful completion of AOI 3 work scope and deliverables will be verified during a preliminary design review performed during month 6 of the project and a final design review performed during month 18. WPTO, the NREL, and Sandia National Laboratories (SNL) will work with awardees to perform these design reviews. In addition to the DOE funding provided to AOI 3 awardees, it is anticipated that each awardee will be provided with \$400K in combined technical support from NREL and/or SNL. National laboratories are not eligible to be prime- or sub-applicants to AOI 3. More details on national laboratory capabilities and participation in AOI 3 projects is described in [AOI 3 National Laboratory Technical Assistance](#) section.

### **AOI 3 REQUIRED TASKS**

Months 1-6 of the period-of-performance:

- Develop the preliminary WEC design;
- Perform preliminary calculations and simulations to estimate device performance and loads;
- Demonstrate that design tools and methodologies that are being used are validated or develop a plan for how to validate the design tools and methodologies during the remainder of the period-of-performance;
- Develop plans to incorporate IEC and IEEE standards into the device design as defined in AOI 3 Technical Specifications and Standards section;
- Submit all deliverables identified in AOI 3 DELIVERABLES section;
- Develop a preliminary commercialization plan that identifies the intended market and describes how the AOI 3 project is moving the technology towards commercial viability
- Complete preliminary estimates for the project metrics identified in AOI 3 WEC Device Performance Metrics section and describe how achieving the metrics goals is a step towards realizing the commercialization plan;
- Submit a preliminary design report summarizing the work performed;
- Participate in preliminary design review performed by DOE, NREL, and SNL.

Note: During the preliminary design review, DOE, NREL and SNL will work with AOI 3 awardees to evaluate progress towards meeting project objectives and to refine and/or modify the remainder of the project work plan to help ensure project objectives are met.

Months 7-18 of the period-of-performance:

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- Develop the final WEC design;
- Perform calculations and simulations to determine device performance and loads;
- Complete final estimates for the project metrics identified in AOI 3 WEC Device Performance Metrics section;
- Develop a final commercialization plan;
- Complete any necessary tank testing or component testing and use the data to validate the design tools and methodologies that were used to design the WEC system;
- Incorporate IEC and IEEE standards into the device design as defined in AOI 3 Technical Specifications and Standards section;
- Develop manufacturing plan and estimate system fabrication, deployment, operations, and maintenance costs for a 2-year deployment at PacWave-South test site;
- Submit all deliverables identified in [AOI 3 DELIVERABLES](#) section;
- Submit a final design report summarizing the work performed during the entire project;
- Work with a third-party engineering firm to perform a manufacturing feasibility study prior to the final design review;
- Participate in the final design review meeting and give presentation to DOE, NREL and SNL on the project and device design status.

### **AOI 3 DELIVERABLES**

Months 1-6 of the period-of-performance:

1. A preliminary design report that includes preliminary:
  - CAD Design drawings;
  - Power performance estimates and load estimates for the intended commercial deployment resource and the PacWave-South resource;
  - Design weight estimate;
  - LCOE estimate following the guidance contained in AOI 3 WEC Device Performance Metrics section;
  - Installation, operation, and maintenance (IO&M) concept;
  - Unresolved open design issues and resolution plans with cost estimates;
  - Complete development of the risk management plan and risk register following the “Marine and Hydrokinetic Technology Development Risk” risk register template - <https://www.nrel.gov/docs/fy15osti/63258.pdf>. The risk management plan and risk register must consider risks that could be encountered during a potential device manufacturing, deployment, and testing project;
  - Preliminary estimates for the metrics identified in AOI 3 WEC Device Performance Metrics section;
  - Plan for how to design for IEC and IEEE standards as defined in AOI 3 Technical Specifications and Standards section;
  - Demonstration that design calculations have been validated by laboratory testing or plans and budget for any remaining laboratory testing in months 7-18.
2. A preliminary commercialization plan that provides the following information:

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- The intended market for the WEC device;
- The anticipated size of the target market;
- How the device will be deployed commercially (e.g., individually or in arrays);
- How this project will advance the technology towards commercial viability;
- The device target dimensions, power rating, and other relevant characteristics of the device for commercialization (note any differences with the design being developed as part of this award);
- Relevant project data and project metrics data uploaded to the MHKDR (<https://mhkdr.openei.org>) using the appropriate content models (<https://mhkdr.openei.org/models/>).

Months 7-18 of the period-of-performance:

1. Hold the design review meeting.
2. A design report that includes final:
  - CAD Design drawings;
  - Power performance estimates and load estimates for the device in the intended commercial deployment resource and at in the PacWave-South test site resource;
  - Design loads calculations;
  - Design weight calculation;
  - Fabrication costs estimate;
  - Installation, Operation, and Maintenance (IO&M) plan and cost estimate;
  - Complete development of the risk management plan and risk register following the “Marine and Hydrokinetic Technology Development Risk” risk register template - <https://www.nrel.gov/docs/fy15osti/63258.pdf>. The risk management plan and risk register must consider risks that could be encountered during a potential device manufacturing, deployment, and testing project;
  - Final calculations of the metrics identified in AOI 3 WEC Device Performance Metrics section to include LCOE;
  - Unresolved open design issues and resolution plans;
  - Design, fabrication and operation plans to ensure that device can operate at PacWave-South test site for a duration of at least 2 years;
  - Demonstration of conformity to IEC and IEEE standards as defined in AOI 3 Technical Specifications and Standards section;
  - Lessons learned from IEC TS implementation.
  - Demonstration that design tools and methodologies have been validated;
  - Report on tank and/or laboratory testing.
3. A final commercialization plan that provides the following information:
  - The intended market for the WEC device;
  - The anticipated size of the target market;
  - How the device will be deployed commercially (e.g., individually or in arrays);
  - How this project will advance the technology towards commercial viability;

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- The device target dimensions, power rating, and other relevant characteristics of the device for commercialization (note any differences with the design being developed as part of this award);
- Relevant project data and project metrics data uploaded to the MHKDR (<https://mhkdr.openei.org>) using the appropriate content models (<https://mhkdr.openei.org/models/>).

#### **AOI 3 Specific Concept Paper Requirements**

- Description of the device concept with sketch and anticipated dimensions.
- Description of work plan to meet project objectives and complete deliverables identified under AOI 3 DELIVERABLES section.
- Description of anticipated technical risks and a preliminary risk mitigation strategy.
- Matrix that defines roles and responsibilities of project partners and anticipated subcontractors.

#### **AOI 3 Specific Technical Volume Requirements (Details in Section IV.D.ii)**

- Description of the device concept with sketch and dimensions;
- Detailed work plan to meet project objectives and meet deliverables identified in AOI 3 DELIVERABLES section;
- Description of the plan for how to incorporate IEC and IEEE standards, identified in in AOI 3 Technical Specifications and Standards section, into the device design;
- Plan for how to develop a design that can be tested for 2-years of sustained operation at PacWave-South test site;
- Description of technical merit, innovation, and overall R&D value to MHK industry;
- Description of technical risks and the risk mitigation strategy;
- Description of numerical models and design methodologies that will be used to develop the device design;
- Description of how design tools and methodologies have been or will be validated using previously gathered experimental testing data; or a description of what work will be performed during the period of performance to verify and validate the design tools and methodologies that will be used;
- A matrix that defines roles and responsibilities of the team members and anticipated subcontractors;
- A discussion of the WEC design experience of the team members and anticipated subcontractors;
- Description of the intended market(s) of the WEC device and any associated requirements;
- A proposal for how the applicant would like NREL and/or SNL to provide technical assistance based on the lab technical capabilities described in AOI 3 National Laboratory Technical Assistance;
- Description of how the FOA metrics identified in AOI 3 WEC Device Performance Metrics section will be estimated during the period of performance;

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- Targets values for FOA metrics identified in AOI 3 WEC Device Performance Metrics section that will be achieved during the project period of performance;
- How the project will advance the state of the WEC technology towards commercial viability, the target dimensions and power rating of the device for commercialization, the intended market for the WEC device, how the device will be deployed commercially (e.g., individually or in arrays), and the anticipated size of the target market.

#### ***AOI 3 Specific Technical Review Criteria for Full Applications***

Criterion 1: Technical Merit, Innovation, and Impact (30%)

Criterion 2: Project Research and Market Transformation Plan (50%)

Criterion 3: Team and Resources (20%)

Full Application Technical Review Criteria are detailed in [Section V.A.ii.](#)

## **4 Marine Energy Centers Research Infrastructure Upgrades**

*\$5M in Federal funds, 20% Cost Share requirement*

*Up to 3 awards, range of \$1M-\$5M in DOE funds per award, 20% cost share, 18-month award duration, with one budget period.*

The National Marine Renewable Energy Centers (NMREC) provide testing infrastructure that directly accelerates development and deployment of MHK technologies as they progress towards commercialization by reducing technical and financial risks, reducing the cost of testing for the industry, and reducing the time-to-market for new MHK systems.

Each NMREC has unique research and testing capabilities to address the most pressing challenges for new marine energy technology development. There are three National Marine Renewable Energy Centers:

- [Pacific Marine Energy Center \(PMEC\) formerly known as the Northwest National Marine Renewable Energy Center \(NNMREC\)](#), operated jointly by Oregon State University, the University of Washington, and the University of Alaska Fairbanks, facilitates the development of wave, tidal, and in-river energy converters through research, education, outreach, and environmental characterization, design, and operation of testing sites.
- [Hawaii National Marine Renewable Energy Center \(HINMREC\)](#), operated by the University of Hawaii, emphasizes wave energy and ocean thermal energy conversion and boasts a collaborative wave energy test site with the U.S. Navy.
- [Southeast National Marine Renewable Energy Center \(SNMREC\)](#), operated by Florida Atlantic University, focuses on ocean currents and ocean thermal energy conversion and specializes in environmental baseline observation systems.

Advancing MHK technologies beyond concepts and small-scale prototypes requires fundamental, early stage research to simulate performance and improve the design of components and

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integrated systems. In-water testing of performance and reliability, especially in difficult ocean environments, is required to validate models and iterate design improvements.

As the MHK industry has matured over the last decade, additional testing needs have been identified that require upgrades at NMREC sites to support the maturation of MHK systems. The Fiscal Year 2019 Conference Report directs WPTO to allocate “not less than \$5,000,000 to prioritize infrastructure needs at the marine and hydrokinetic technology testing sites operated by the Marine Renewable Energy Centers.”<sup>41</sup> In line with congressional direction and WPTO’s MHK strategy, Applications in this AOI have the following restrictions:

- Only the three (3) National Marine Renewable Energy Centers are eligible as Prime applicants
- Each NMREC can submit one (1) Concept Paper per unique concept
- Each NMREC can submit one (1) Full Application as a Prime Applicant
- The federal award floor is \$1M per award
- If the prime NMREC partners with at least one (1) other NMREC, the federal award ceiling is \$5M per award.
- If the prime NMREC does not partner with one of the two other Marine Centers, the federal award ceiling is \$2M per award.

Successful applications under this area of interest should sufficiently justify how the test infrastructure proposal fills a need and/or gap in testing capabilities and benefits the MHK industry. In addition, applicants should clearly describe why their specific proposal offers the best value-added project to advance the testing infrastructure, clearly demonstrate technological and financial value of the proposal, and quantify the anticipated impact the project will have across the industry.

#### **AOI 4 Specific Concept Paper Requirements**

- The proposed infrastructure upgrades, including basic operating principles and how the upgrades will enhance the testing site;
- The current state of testing infrastructure in the relevant field and application, including key shortcomings, limitations, and challenges;
- How the proposed infrastructure upgrades will overcome the shortcomings, limitations, and challenges in the relevant field and application;
- The potential impact that the proposed project would have on the relevant field and application;
- The key technical risks/issues associated with the proposed infrastructure development plan;
- The impact that EERE funding would have on the proposed project.

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<sup>41</sup> H.R. REP. No. 5895, at 34 (2018) (Conf. Rep.).

**AOI 4 Specific Technical Volume Requirements (Details in Section IV.D.ii)**

- Project Goal: The applicant should explicitly identify the targeted improvements to the baseline infrastructure and the critical success factors in achieving that goal.
- Relevance and Outcomes: The applicant should provide a detailed description of the infrastructure upgrades, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project.
- Innovation and Impacts: The applicant should describe the current state of testing infrastructure in the applicable field, the specific innovation of the proposed upgrades, the advantages of proposed upgrades over current and emerging infrastructure, and the overall impact on advancing the state of testing infrastructure if the project is successful.

**AOI 4 Specific Technical Review Criteria for Full Applications**

- Criterion 1: Technical Merit, Innovation, and Impact (50%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (20%)

Full Application Technical Review Criteria are detailed in [Section V.A.ii](#).

**C. Applications Specifically Not of Interest**

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (See Section III.D. of the FOA):

**TABLE 2: Applications Specifically NOT of Interest**

All AOIs	<ul style="list-style-type: none"> <li>• Applications that fall outside the technical parameters specified in Section I.A and I.B of the FOA;</li> <li>• Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).</li> </ul>
AOI 1a	<ul style="list-style-type: none"> <li>• Applications proposing technology R&amp;D;</li> <li>• Applications principally focused on monetization of flexible capabilities, bidding strategies, or market design.</li> </ul>
AOI 1b	<ul style="list-style-type: none"> <li>• Applications proposing technology R&amp;D;</li> <li>• Applications proposing incremental advancement of an operational strategy that is already well-established and adopted by the hydropower sector;</li> <li>• Applications that propose an operational strategy applicable only to a single site;</li> <li>• Applications principally focused on market acceleration or market conditioning activities.</li> </ul>
AOI 2a	<ul style="list-style-type: none"> <li>• Applications for technologies that are only applicable to locations with existing hydraulic infrastructure, such as non-powered dams, canals, and conduits;</li> <li>• Applications for marine or in-river hydrokinetic technologies.</li> </ul>

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AOI 2b	<ul style="list-style-type: none"> <li>Applications that utilize CEC technologies designed to extract energy from ocean current, tidal currents or flow in a closed conduit, (e.g., clean water distribution pipe);</li> <li>Applications that utilize CEC technologies that require a dam or structure that diverts water, either partially or fully, to create head.</li> </ul>
AOI 3	<ul style="list-style-type: none"> <li>Applications that do not include grid connection requirements in their proposed design;</li> <li>Open water testing activities cannot be funded under AOI 3;</li> <li>Applications that propose to design devices that are not intended for testing and grid connection at PacWave-South test site.</li> </ul>
AOI 4	<ul style="list-style-type: none"> <li>Per Congressional Direction, only the three (3) National Marine Renewable Energy Centers are eligible as Prime applicants, all other Applications are not of interest.</li> </ul>

## D. Authorizing Statutes

The programmatic authorizing statute is the Energy Policy Act of 2005, Public Law 109-58 (Section 931(a) (2) (D)). The programmatic authorizing statute is the Energy Policy Act of 2005, section 931(a)(2)(E)(i) and the Energy Independence and Security Act of 2007 (EISA), Section 633-Marine and Hydrokinetic Renewable Energy Research and Development, Public Law 110-140 (Dec. 19, 2007).

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (CFR) Part 200 as amended by 2 CFR Part 910.

## II. Award Information

### A. Award Overview

#### i. Estimated Funding

EERE expects to make a total of approximately \$27M of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 22 awards under this FOA. EERE may issue one, multiple, or no awards. EERE may issue awards in one, multiple, or none of the following AOIs:

Areas of Interest	AOI Details (funding is approximate)
1a Quantify Hydropower Capabilities for Operational Flexibility	Up to \$1.5M total Up to \$1.5M per award
1b Operational Strategies for Increasing Hydropower Flexibility	Up to \$2.75M total Up to \$1M per award
2a Modular Technologies for Low-Head Hydropower Applications	Up to \$5M total Up to \$1M per award
2b Modular Technologies for River Current Energy Converter Applications	Up to \$4.6M total

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	Up to \$350k BP1 per award; up to \$3.55M for BP2 and subject to down-select
3 Advancing Wave Energy Device Design	Up to \$7.2M total Up to \$1.8 per award
4 Marine Energy Infrastructure Upgrades	Up to \$5M total Up to \$1M-5M range per award

EERE may establish more than one budget period for each award and fund only the initial budget period(s). Funding for all budget periods, including the initial budget period, is not guaranteed. Before the expiration of the initial budget period(s), EERE may perform a down-select among different recipients and provide additional funding only to a subset of recipients.

**ii. Period of Performance**

EERE anticipates making awards that will run up to 18-36 months in length, comprised of one or more budget periods. Project continuation will be contingent upon satisfactory performance and Go/No-Go decision review or down-select, depending on the AOI.

Areas of Interest	Est. Period of Performance (months)	Budget Period Guidance
1a Quantify Hydropower Capabilities for Operational Flexibility	Up to 36 months	Go/No-Go decisions per individual award negotiations, two (2) Budget Periods anticipated
1b Operational Strategies for Increasing Hydropower Flexibility	Up to 36 months	Go/No-Go decisions per individual award negotiations, two (2) Budget Periods anticipated
2a Modular Technologies for Low-Head Hydropower Applications	Up to 24 months	Go/No-Go decisions per individual award negotiations, two (2) Budget Periods anticipated
2b Modular Technologies for River Current Energy Converter Applications	Up to 36 months BP1: 9 months BP2: 27 months and subject to Down-Select	Down-Select process will be used. For details see <a href="#">AOI2b Down Select section</a>
3 Advancing Wave Energy Device Design	Up to 18 months	Go/No-Go decisions not anticipated, one (1) Budget Period anticipated
4 Marine Energy Infrastructure Upgrades	Up to 18 months	Go/No-Go decisions per individual award negotiations, two (2) Budget Periods anticipated

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At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE will make a determination to continue to fund the project, recommend re-direction of work under the project, place a hold on federal funding for the project, or discontinue funding the project.

**iii. New Applications Only**

EERE will accept only new applications under this FOA. EERE will not consider applications for renewals of existing EERE-funded awards through this FOA.

**B. EERE Funding Agreements**

Through Cooperative Agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the United States Government.

**i. Cooperative Agreements**

EERE generally uses Cooperative Agreements to provide financial and other support to prime recipients.

Through Cooperative Agreements, EERE provides financial or other support to accomplish a public purpose of support or stimulation authorized by federal statute. Under Cooperative Agreements, the Government and prime recipients share responsibility for the direction of projects.

EERE has substantial involvement in all projects funded via Cooperative Agreement. See Section VI.B.ix of the FOA for more information on what substantial involvement may involve.

**ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)**

In most cases, FFRDCs are funded independently of the remainder of the Project Team. The FFRDC then executes an agreement with any non-FFRDC Project Team members to arrange work structure, project execution, and any other matters. Regardless of these arrangements, the entity that applied as the prime recipient for the project will remain the prime recipient for the project.

### III. Eligibility Information

To be considered for substantive evaluation, an applicant’s submission must meet the criteria set forth below. If the application does not meet these eligibility requirements, it will be considered ineligible and removed from further evaluation.

#### A. Eligible Applicants

##### i. Individuals

U.S. citizens and lawful permanent residents are eligible to apply for funding as a prime recipient or subrecipient.

##### ii. Domestic Entities

For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular State or territory of the United States and have a physical location for business operations in the United States are eligible to apply for funding as a prime recipient or subrecipient. Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995, are not eligible to apply for funding.

State, local, and tribal government entities are eligible to apply for funding as a prime recipient or subrecipient.

DOE/NNSA FFRDCs are eligible to apply for funding per table below.

**TABLE 3: DOE/NNSA FFRDCs Eligibility Restrictions Summary per AOI**

Areas of Interest	DOE/NNSA FFRDCs work
1a Assess and Quantify Hydroelectric Flexibility	DOE/NNSA FFRDCs are not eligible to apply as either a prime recipient or subrecipient.
1b Enhance Industry Utilization of Flexibility	DOE/NNSA FFRDCs are not eligible to apply as either a prime recipient or subrecipient.
2a Modular Technologies for Low-Head Hydropower Applications	Oak Ridge National Laboratory is not eligible to apply as either prime recipient or sub-recipient. Other DOE/NNSA FFRDCs are eligible to apply as a subrecipient, but are not eligible to apply as a prime recipient.
2b Modular Technologies for River Current Energy Converter Applications	DOE/NNSA FFRDCs are not eligible to apply as either a prime recipient or subrecipient.
3 Advancing Wave Energy Device Design	DOE/NNSA FFRDCs are not eligible to apply as either a prime recipient or subrecipient.

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4 Marine Energy Infrastructure Upgrades	Restricted to the National Marine Renewable Energy Centers (NMRECs), per Congressional direction. Only NMRECs are eligible to apply as prime recipients. DOE/NNSA FFRDCs are not eligible to apply as either a prime recipient or subrecipient.
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Non-DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

**iii. Foreign Entities**

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA. Other than as provided in the “Individuals” or “Domestic Entities” sections above, all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States and have a physical location for business operations in the United States. If a foreign entity applies for funding as a prime recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a State or territory of the United States to be the prime recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

Foreign entities may request a waiver of the requirement to designate a subsidiary in the United States as the prime recipient in the Full Application (i.e., a foreign entity may request that it remains the prime recipient on an award). To do so, the applicant must submit an explicit written waiver request in the Full Application. [Appendix C](#) lists the necessary information that must be included in a request to waive this requirement. The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

In the waiver request, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the prime recipient. EERE may require additional information before considering the waiver request.

A foreign entity may receive funding as a subrecipient.

**iv. Incorporated Consortia**

Incorporated consortia, which may include domestic and/or foreign entities, are eligible to apply for funding as a prime recipient or subrecipient. For consortia incorporated (or otherwise formed) under the laws of a State or territory of the United States, please refer to “Domestic Entities” above. For consortia incorporated in foreign countries, please refer to the requirements in “Foreign Entities” above.

Each incorporated consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the EERE Contracting Officer.

**v. Unincorporated Consortia**

Unincorporated Consortia, which may include domestic and foreign entities, must designate one member of the consortium to serve as the prime recipient/consortium representative. The prime recipient/consortium representative must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. The eligibility of the consortium will be determined by the eligibility of the prime recipient/consortium representative under Section III.A. of the FOA.

Upon request, unincorporated consortia must provide the EERE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortium’s:

- Management structure;
- Method of making payments to consortium members;
- Means of ensuring and overseeing members’ efforts on the project;
- Provisions for members’ cost sharing contributions; and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

**B. Cost Sharing**

The cost share must be at least 20% of the total allowable costs for research and development projects (i.e., the sum of the Government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-federal sources unless otherwise allowed by law. (See 2 CFR 200.306 and 2 CFR 910.130 for the applicable cost sharing requirements.)

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**PLEASE NOTE:** Section 108, “Short-Term Cost-Share Pilot Program” of the recently enacted Department of Energy Research and Innovation Act (RIA), Pub. L. 115-246 removes the minimum statutory cost share requirement for Institutions of Higher Education and Non-Profit Organizations for research and development for a two year pilot period. Nevertheless, RIA does not automatically change the cost share requirements as set forth in 2 CFR 910.130 of DOE’s financial assistance regulation without first amending the regulation. Therefore, until the regulation is updated and aligned with RIA or a cost share waiver is issued, DOE programs and Contracting Officers must adhere to the cost share requirements as set forth in 2 CFR 910.130 and the FOA.

To assist applicants in calculating proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation as Appendices A and B to this FOA.

**i. Legal Responsibility**

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the prime recipient, the prime recipient is legally responsible for paying the entire cost share. If the funding agreement is terminated prior to the end of the project period, the prime recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The prime recipient is solely responsible for managing cost share contributions by the project team and enforcing cost share obligation assumed by project team members in subawards or related agreements.

**ii. Cost Share Allocation**

Each project team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual project team members may vary, as long as the cost share requirement for the project as a whole is met.

**iii. Cost Share Types and Allowability**

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.J.1 of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

Project teams may provide cost share in the form of cash or in-kind contributions. Cost share may be provided by the prime recipient, subrecipients, or third parties (entities that do not have a role in performing the scope of

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work). Vendors/contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

Cash contributions include, but are not limited to: personnel costs, fringe costs, supply and equipment costs, indirect costs and other direct costs.

In-kind contributions are those where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. Allowable in-kind contributions include, but are not limited to: the donation of volunteer time or the donation of space or use of equipment.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding was not provided to the state or local government by the federal government.

The prime recipient may not use the following sources to meet its cost share obligations including, but not limited to:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;
- Federal funding or property (e.g., federal grants, equipment owned by the federal government); or
- Expenditures that were reimbursed under a separate federal program.

Project teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the prime recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same federal regulations as federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 2 CFR 200.306 as amended by 2 CFR 910.130 for additional guidance on cost sharing.

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**iv. Cost Share Contributions by FFRDCs**

Because FFRDCs are funded by the federal government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or another non-federal source.

**v. Cost Share Verification**

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to [Appendix A](#) of the FOA.

**vi. Cost Share Payment**

EERE requires prime recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the prime recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated). As FFRDC funding will be provided directly to the FFRDC(s) by DOE, prime recipients will be required to provide project cost share at a percentage commensurate with the FFRDC costs, on a budget period basis, resulting in a higher interim invoicing cost share ratio than the total award ratio.

In limited circumstances, and where it is in the government's interest, the EERE Contracting Officer may approve a request by the prime recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the prime recipient must be up-to-date on cost share at each interval. Such requests must be sent to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the prime recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they go into effect.

## **C. Compliance Criteria**

**Concept Papers, Full Applications and Replies to Reviewer Comments must meet all compliance criteria listed below or they will be considered noncompliant. EERE will**

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**not review or consider noncompliant submissions**, including Concept Papers, Full Applications, and Replies to Reviewer Comments that were: submitted through means other than EERE Exchange; submitted after the applicable deadline; and/or submitted incomplete. EERE will not extend the submission deadline for applicants that fail to submit required information due to server/connection congestion.

## **i. Compliance Criteria**

### *Concept Papers*

Concept Papers are deemed compliant if:

- The Concept Paper complies with the content and form requirements in Section IV.C. of the FOA; and
- The applicant successfully uploaded all required documents and clicked the “Submit” button in EERE Exchange by the deadline stated in this FOA.

### *Full Applications*

Full Applications are deemed compliant if:

- The applicant submitted a compliant Concept Paper;
- The Full Application complies with the content and form requirements in Section IV.D. of the FOA; and
- The applicant successfully uploaded all required documents and clicked the “Submit” button in EERE Exchange by the deadline stated in the FOA.

### *Replies to Reviewer Comments*

Replies to Reviewer Comments are deemed compliant if:

- The Reply to Reviewer Comments complies with the content and form requirements in Section IV.E. of the FOA; and
- The applicant successfully uploaded all required documents to EERE Exchange by the deadline stated in the FOA.

## **D. Responsiveness Criteria**

All “Applications Specifically Not of Interest,” as described in Section I.C. of the FOA, are deemed nonresponsive and are not reviewed or considered.

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## E. Other Eligibility Requirements

### i. Requirements for DOE/NNSA and non-DOE/NNSA Federally Funded Research and Development Centers Included as a Subrecipient

DOE/NNSA (for AOI 2a only) and non-DOE/NNSA FFRDCs may be proposed as a subrecipient on another entity's application subject to the following guidelines:

#### *Authorization for non-DOE/NNSA FFRDCs*

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

#### *Authorization for DOE/NNSA FFRDCs*

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

Authorization is granted for the Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.

#### *Value/Funding*

The value of and funding for the FFRDC portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal (WP) system and non-DOE/NNSA FFRDC through an interagency agreement with the sponsoring agency.

#### *Cost Share*

Although the FFRDC portion of the work is usually excluded from the award to a successful applicant, the applicant's cost share requirement will be based on the total cost of the project, including the applicant's, the subrecipient's, and the FFRDC's portions of the project.

#### *Responsibility*

The prime recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues

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including, but not limited to disputes and claims arising out of any agreement between the prime recipient and the FFRDC contractor.

*Limit on FFRDC Effort*

The scope of work to be performed by the FFRDC may not be more significant than the scope of work to be performed by the applicant.

**F. Limitation on Number of Concept Papers and Full Applications Eligible for Review**

Areas of Interest	Limitation re: number of application submittals
1a Assess and Quantify Hydroelectric Flexibility	An entity may submit more than one Concept Paper and Full Application to this area of interest, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.
1b Enhance Industry Utilization of Flexibility	An entity may submit more than one Concept Paper and Full Application to this area of interest, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.
2a Modular Technologies for Low-Head Hydropower Applications	An entity may submit more than one Concept Paper and Full Application to this area of interest, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.
2b Modular Technologies for River Current Energy Converter Applications	An entity may submit more than one Concept Paper and Full Application to this area of interest, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.
3 Advancing Wave Energy Device Design	An entity may only submit one Concept Paper and one Full Application to this area of interest.**
4 Marine Energy Infrastructure Upgrades	Only the three (3) National Marine Renewable Energy Centers (NMRECs) are eligible to submit Concept Papers and Full Applications to this area of interest.  An NMREC may submit more than one Concept Paper but is restricted to submit only one Full Application provided that each Concept Paper describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for the Full Application.

\*\*If an entity submits more than one Concept Paper and Full Application area of interest 3, EERE will request a determination from the applicant’s authorizing representative as to which application should be reviewed. Any other submissions received listing the same entity as the applicant will not be eligible for further consideration. This limitation does not prohibit an applicant from collaborating on other applications (e.g., as a potential

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subrecipient or partner) so long as the entity is only listed as the applicant on one Concept Paper and one Full Application submitted under this area of interest.

## G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

## IV. Application and Submission Information

### A. Application Process

The application process will include two phases: a Concept Paper phase and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application.** At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via EERE Exchange at <https://eere-exchange.energy.gov/>, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE Exchange, submissions submitted after the applicable deadline, or incomplete submissions.** EERE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion.

A **Control Number** will be issued when an applicant begins the EERE Exchange application process. This control number must be included with all application documents, as described below.

The Concept Paper, Full Application, and Reply to Reviewer Comments must conform to the following requirements:

- Each must be submitted in Adobe PDF format unless stated otherwise;
- Each must be written in English;
- All pages must be formatted to fit on 8.5 x 11 inch paper with margins not less than one inch on every side. Use Times New Roman typeface, a black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10 point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement;

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- The Control Number must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page; and
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages.

Applicants are responsible for meeting each submission deadline. **Applicants are strongly encouraged to submit their Concept Papers and Full Applications at least 48 hours in advance of the submission deadline.** Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), applicants should allow at least 1 hour to submit a Concept Paper, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application, or Reply to Reviewer Comments is submitted in EERE Exchange, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made to any of these documents, the applicant must resubmit the Concept Paper, Full Application, or Reply to Reviewer Comments before the applicable deadline.

EERE urges applicants to carefully review their Concept Papers, and Full Applications and to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V.A.ii. of the FOA.

**i. Additional Information on EERE Exchange**

EERE Exchange is designed to enforce the deadlines specified in this FOA. The “Apply” and “Submit” buttons will automatically disable at the defined submission deadlines. Should applicants experience problems with EERE Exchange, the following information may be helpful.

Applicants that experience issues with submission PRIOR to the FOA deadline: In the event that an applicant experiences technical difficulties with a submission, the applicant should contact the EERE Exchange helpdesk for assistance ([EERE-ExchangeSupport@hq.doe.gov](mailto:EERE-ExchangeSupport@hq.doe.gov)). The EERE Exchange helpdesk and/or the EERE Exchange system administrators will assist applicants in resolving issues.

Applicants that experience issues with submissions that result in late submissions: In the event that an applicant experiences technical difficulties so severe that they are unable to submit their application by the deadline, the applicant should contact the EERE Exchange helpdesk for assistance ([EERE-ExchangeSupport@hq.doe.gov](mailto:EERE-ExchangeSupport@hq.doe.gov)). The EERE Exchange helpdesk and/or the EERE

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Exchange system administrators will assist the applicant in resolving all issues (including finalizing submission on behalf of and with the applicant’s concurrence). Please note, network traffic is at its heaviest during the final hours and minutes prior to submittal deadline. Applicants who experience this during the final hours or minutes and are unsuccessful in uploading documents will not be able to use this process.

## B. Application Forms

The application forms and instructions are available on EERE Exchange. To access these materials, go to <https://eere-Exchange.energy.gov> and select the appropriate funding opportunity number.

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:

**ControlNumber\_LeadOrganization\_Project\_Part\_1**  
**ControlNumber\_LeadOrganization\_Project\_Part\_2**

## C. Content and Form of the Concept Paper

To be eligible to submit a Full Application, applicants must submit a Concept Paper by the specified due date and time.

### i. Concept Paper Content Requirements

EERE will not review or consider ineligible Concept Papers (see Section III of the FOA).

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

The Concept Paper must conform to the following content requirements:

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page should include the project title, the specific FOA Areas of Interest being addressed, roles, responsibilities, and organization matrix (including the technical and business points of contact along with all other key team members), and any statements regarding confidentiality.

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<p><b>Technical Description and Impacts</b></p>	<p>4 pages maximum</p>	<p>Applicants are required to describe succinctly:</p> <ul style="list-style-type: none"> <li>• The proposed work, including its basic operating principles and how it is unique and innovative;</li> <li>• The proposed work’s target level of performance (applicants should provide technical data or other support to show how the proposed target could be met);</li> <li>• The current state-of-the-art in the relevant field and application, including key shortcomings, limitations, and challenges;</li> <li>• How the proposed work will overcome the shortcomings, limitations, and challenges in the relevant field and application;</li> <li>• The potential impact that the proposed project would have on the relevant field and application;</li> <li>• The key technical risks/issues associated with the development plan; and</li> <li>• The impact that EERE funding would have on the proposed project.</li> </ul>
<p><b>Addendum</b></p>	<p>2 pages maximum</p>	<p>Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed Project Team, including:</p> <ul style="list-style-type: none"> <li>• Whether the Principal Investigator (PI) and Project Team have the skill and expertise needed to successfully execute the project plan;</li> <li>• Whether the applicant has prior experience which demonstrates an ability to perform tasks of similar risk and complexity;</li> <li>• Whether the applicant has worked together with its teaming partners on prior projects or programs; and</li> <li>• Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how it intends to obtain access to the necessary equipment and facilities.</li> </ul> <p>Applicants may provide graphs, charts, or other data to supplement their Technical Description and Impacts.</p>
<p><b>AOI Specific Concept Paper Requirements</b></p>		
<p><b>AOI 2a Specific Concept Paper Requirements</b></p> <ul style="list-style-type: none"> <li>• In addition to the above requirements, applicants must clearly identify the module being proposed, as listed in Section AOI 2a Application Expectations and consistent with the SMH Design Envelope.</li> </ul> <p><b>AOI 2b Specific Concept Paper Requirements</b></p> <ul style="list-style-type: none"> <li>• Description of the device concept with sketch and anticipated dimensions.</li> </ul>		

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**AOI 3 Specific Concept Paper Requirements**

- Description of the device concept with sketch and anticipated dimensions.
- Description of work plan to meet project objectives and complete deliverables identified under AOI 3 DELIVERABLES section.
- Description of anticipated technical risks and a preliminary risk mitigation strategy.
- Matrix that defines roles and responsibilities of project partners and anticipated subcontractors.

**AOI 4 Specific Concept Paper Requirements**

- The proposed infrastructure upgrades, including basic operating principles and how the upgrades will enhance the testing site;
- The current state of testing infrastructure in the relevant field and application, including key shortcomings, limitations, and challenges;
- How the proposed infrastructure upgrades will overcome the shortcomings, limitations, and challenges in the relevant field and application;
- The potential impact that the proposed project would have on the relevant field and application;
- The key technical risks/issues associated with the proposed infrastructure development plan; and
- The impact that EERE funding would have on the proposed project.

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.i. of the FOA. EERE will encourage a subset of applicants to submit Full Applications. Other applicants will be discouraged from submitting a Full Application. An applicant who receives a “discouraged” notification may still submit a Full Application. EERE will review all eligible Full Applications. However, by discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project in an effort to save the applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

EERE may include general comments provided from reviewers on an applicant’s Concept Paper in the encourage/discourage notification posted on EERE Exchange at the close of that phase.

## **D. Content and Form of the Full Application**

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. Applicants must complete the following application forms found on the EERE Exchange website at <https://eere-exchange.energy.gov/>, in accordance with the instructions.

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification on EERE Exchange to prepare and submit a Full Application. Regardless of the date the applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.

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All Full Application documents must be marked with the Control Number issued to the applicant. Applicants will receive a control number upon clicking the “Create Concept Paper” button in EERE Exchange, and should include that control number in the file name of their Full Application submission (i.e., *Control number\_Applicant Name\_Full Application*).

**i. Full Application Content Requirements**

EERE will not review or consider ineligible Full Applications (see Section III. of the FOA).

Each Full Application shall be limited to a single concept or technology. Unrelated concepts and technologies shall not be consolidated in a single Full Application. Full Applications must be submitted in PDF format unless stated otherwise, and conform to the following requirements:

AOIs	Components	File Name
All	Technical Volume (PDF format. See Chart in Section IV.D.ii.)	ControlNumber_LeadOrganization_TechnicalVolume
All	Statement of Project Objectives (SOPO) (Microsoft Word format. 10 page limit)	ControlNumber_LeadOrganization_SOPO
All	SF-424 Application for Federal Assistance (PDF format)	ControlNumber_LeadOrganization_App424
All	Budget Justification (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Budget_Justification
All	Summary for Public Release (PDF format. 1 page limit)	ControlNumber_LeadOrganization_Summary
All	Summary Slide (Microsoft PowerPoint format. 1 page limit)	ControlNumber_LeadOrganization_Slide
All	Subrecipient Budget Justification, if applicable (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
AOI 2a only if applicable	DOE WP for FFRDC, if applicable (PDF format. See <a href="#">DOE O 412.1A, Attachment 3</a> )	ControlNumber_LeadOrganization_WP
AOI 2a only if applicable	Authorization from cognizant Contracting Officer for FFRDC, if applicable (PDF format)	ControlNumber_LeadOrganization_FFRDCAuth
All	SF-LLL Disclosure of Lobbying Activities (PDF format)	ControlNumber_LeadOrganization_SF-LLL
All	Foreign Entity and Performance of Work in the United States waiver requests, if applicable (PDF format)	ControlNumber_LeadOrganization_Waiver

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AOI 1, 2, 3	U.S. Manufacturing Plan (PDF format)	ControlNumber_LeadOrganization_USMP
AOI 1, 2, 3	Data Management Plan (Microsoft Word format)	ControlNumber_LeadOrganization_DMP

**Note:** The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:

**ControlNumber\_LeadOrganization\_TechnicalVolume\_Part\_1**  
**ControlNumber\_LeadOrganization\_TechnicalVolume\_Part\_2**

**EERE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.**

EERE provides detailed guidance on the content and form of each component below.

**ii. Technical Volume**

The Technical Volume must be submitted in Adobe PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. This volume must address the Merit Review Criteria as discussed in Section V.A.ii. of the FOA. Save the Technical Volume in a single PDF file using the following convention for the title: “ControlNumber\_LeadOrganization\_TechnicalVolume”.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. However, EERE and reviewers are under no obligation to review cited sources.

The Technical Volume to the Full Application may not be more than 30 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation criteria (see Section V.A.ii of the FOA) when preparing the Technical Volume.

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The Technical Volume should clearly describe and expand upon information provided in the Concept Paper. The Technical Volume must conform to the following content requirements:

SECTION/PAGE LIMIT	DESCRIPTION
<p><b>Cover Page</b></p>	<p>The cover page should include the project title, the specific FOA Area of Interest being addressed, both the technical and business points of contact, names of all team member organizations, description of the device concept with sketch and anticipated dimensions (if applicable) and any statements regarding confidentiality.</p>
<p><b>Project Overview</b> (This section should constitute approximately 10% of the Technical Volume)</p>	<p>The Project Overview should contain the following information:</p> <ul style="list-style-type: none"> <li>• <b>Background:</b> The applicant should discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application.</li> <li>• <b>Project Goal:</b> The applicant should explicitly identify the targeted improvements to the baseline and the critical success factors in achieving that goal.</li> <li>• <b>DOE Impact:</b> The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives.</li> </ul>
<p><b>Technical Description, Innovation, and Impact</b> (This section should constitute approximately 30% of the Technical Volume)</p>	<p>The Technical Description should contain the following information:</p> <ul style="list-style-type: none"> <li>• <b>Relevance and Outcomes:</b> The applicant should provide a detailed description of the proposed work, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project.</li> <li>• <b>Feasibility (not applicable to AOI 4):</b> The applicant should demonstrate the technical feasibility of the proposed work and capability of achieving the anticipated performance targets, including a description of previous work done and prior results.</li> <li>• <b>Innovation and Impacts:</b> The applicant should describe the current state of the art (testing infrastructure for AOI 4) in the applicable field, the specific innovation of the proposed work, the advantages of proposed work (testing infrastructure AOI 4) over the state of the art (upgrades AOI 4), and the overall impact on advancing the state of the art/technical baseline if the project is successful.</li> </ul>

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<p><b>Workplan and Market Transformation Plan</b> (This section should constitute approximately 40% of the Technical Volume)</p>	<p>The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is separately requested. The Workplan should contain the following information:</p> <ul style="list-style-type: none"> <li>• <b>Project Objectives:</b> The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes.</li> <li>• <b>Technical Scope Summary:</b> The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period.</li> <li>• <b>WBS and Task Description Summary:</b> The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard WBS for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is unacceptable). It is the applicant’s responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks.</li> <li>• <b>Milestone Summary:</b> The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a SMART technical milestone. SMART milestones should be <b>S</b>pecific, <b>M</b>easurable, <b>A</b>chievable, <b>R</b>elevant, and <b>T</b>imely, and must demonstrate a technical achievement rather than simply completing a task. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one milestone per quarter for the duration of the project with at least one SMART technical milestone per year (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The applicant should also provide the means by which the milestone will be verified. The summary provided should be consistent with the Milestone Summary Table in the SOPO.</li> <li>• <b>Go/No-Go Decision Points (not applicable to AOI 3):</b> The applicant should provide a summary of project-wide Go/No-Go decision points at appropriate points in the Workplan. A Go/No-Go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is</li> </ul>
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	<p>definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one project-wide Go/No-Go decision point for each budget period (12 to 18-month period) of the project. The applicant should also provide the specific technical criteria to be used to make the Go/No-Go decision. The summary provided should be consistent with the SOPO. Go/No-Go decision points are considered “SMART” and can fulfill the requirement for an annual SMART milestone.</p> <ul style="list-style-type: none"> <li>• End of Project Goal: The applicant should provide a summary of the end of project goal(s). Unless otherwise specified in the FOA, the minimum requirement is that each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO.</li> <li>• Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and Go/No-Go decision points.</li> <li>• Project Management: The applicant should discuss the team’s proposed management plan, including the following:             <ul style="list-style-type: none"> <li>○ The overall approach to and organization for managing the work</li> <li>○ The roles of each Project Team member</li> <li>○ Any critical handoffs/interdependencies among Project Team members</li> <li>○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices</li> <li>○ The approach to project risk management</li> <li>○ A description of how project changes will be handled</li> <li>○ If applicable, the approach to Quality Assurance/Control</li> <li>○ How communications will be maintained among Project Team members</li> </ul> </li> <li>• Market Transformation Plan (Not applicable to AOI 4): The applicant should provide a market transformation plan, including the following:             <ul style="list-style-type: none"> <li>○ Identification of target market, competitors, and distribution channels for proposed work along with known or perceived barriers to market penetration, including a mitigation plan</li> <li>○ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan, and product distribution.</li> </ul> </li> </ul>
<p><b>Technical Qualifications and Resources</b> (Approximately</p>	<p>The Technical Qualifications and Resources should contain the following information:</p> <ul style="list-style-type: none"> <li>• Describe the Project Team’s unique qualifications and expertise, including those of key subrecipients.</li> </ul>

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20% of the Technical Volume)	<ul style="list-style-type: none"> <li>• Describe the Project Team’s existing equipment and facilities that will enable/facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project.</li> <li>• This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives.</li> <li>• Describe the time commitment of the key team members to support the project.</li> <li>• Attach one-page resumes for key participating team members as an appendix. Resumes do not count towards the page limit. Multi-page resumes are not allowed.</li> <li>• Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable.</li> <li>• Attach letters of commitment from all subrecipient/third party cost share providers as an appendix. Letters of commitment do not count towards the page limit.</li> <li>• Attach any letters of commitment from partners/end users as an appendix (1 page maximum per letter). Letters of commitment do not count towards the page limit.</li> <li>• For multi-organizational or multi-investigator projects, describe succinctly:             <ul style="list-style-type: none"> <li>○ The roles and the work to be performed by each PI and Key Participant;</li> <li>○ Business agreements between the applicant and each PI and Key Participant;</li> <li>○ How the various efforts will be integrated and managed;</li> <li>○ Process for making decisions on scientific/technical direction;</li> <li>○ Publication arrangements;</li> <li>○ Intellectual Property issues; and</li> <li>○ Communication plans</li> </ul> </li> </ul>
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**AOI Specific Technical Volume Requirements**

**AOI 2a Specific Technical Volume Requirements**

- Clear description of the state-of-the-art for the particular module being proposed—including cost and performance baselines—and how the proposed module will advance it;
- Demonstration that the Exemplary Design Envelope Specification was used to:
  - Establish the design objectives and performance targets for modules;
  - Understand module boundaries and interfaces;
  - Establish quantitative performance requirements from list of desired module performance.
- Substantiated responses to the following questions:
  - What is the expected performance for this module?
  - How well can the module be applied at a variety of sites?
  - What is the expected cost to manufacture, deliver, and install the module?
  - Does the module size make it amenable to standard transportation methods and facilitate installation?
  - What is the expected service life of the module?

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- Description of advanced manufacturing techniques that will be used to fabricate or construct the module;
- Identification and prioritization of technical assistance from ORNL, if so desired;
- The qualifications, relevant expertise, and time commitment of the individuals on the team;
- Description of facilities and resources that will be used to validate performance. In case of partial-scale testing, rationale must be provided for scaling up results to demonstrate confidence of eventual commercial success.

#### **AOI 2b Specific Technical Volume Requirements**

- Description of the device concept with sketch and anticipated dimensions;
- Description of proposed test site as well as the intended commercialization site, if different from the test site;
- Description of work plan to meet project objectives and complete deliverables identified section labeled AOI 2b BP1, Initial Design: ANTICIPATED DELIVERABLES;
- Preliminary estimates of velocity and power duration/exceedance curves at the intended test and commercialization site is desired;
- Previous flume testing completed on similar designs, if any;
- Description of the plan for how to incorporate IEC standards to satisfy FOA requirements;
- Plan for how to develop a design that can be tested for a minimum of six months at the proposed site;
- Description of technical merit, innovation, and overall R&D value to MHK industry;
- Description of technical risks and the risk mitigation strategy;
- Description of numerical models and design methodologies that will be used to develop the device design;
- Description of how design tools and methodologies have been or will be validated using previous gathered experimental testing data; or a description of what work will be performed during the period of performance to verify and validate the design tools and methodologies that will be used;
- A matrix that defines roles and responsibilities of the team members and anticipated subcontractors;
- A discussion of the CEC design and testing experience of the team members and anticipated subcontractors;
- Description of the intended market(s) of the CEC device and any associated requirements;
- Description of any advanced manufacturing techniques that will be used in fabrication;
- A proposal for how the applicant would like NREL and/or SNL to provide technical assistance based on the lab technical capabilities described in AOI 2b National Laboratory Technical Assistance;
- Description of how the FOA metrics identified in AOI 2b CEC Device Performance Metrics section will be estimated during the period of performance;
- Baseline and target values for FOA metrics identified in AOI 2b CEC Device Performance Metrics section that will be achieved during the project period-of-performance; FOA goal is to achieve 20% improvement in OpEx and AEP, and 10% in CapEx.
- How the project will advance the state of the CEC technology towards commercial viability, the intended market for the CEC device, how the device will be deployed commercially (e.g., individually or in arrays), and the anticipated size of the target market;

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- A plan to accomplish permitting activities to obtain all permits required in support of open water testing to include identification of all permits required for test site;
- Data management plan.

#### **AOI 3 Specific Technical Volume Requirements**

- Description of the device concept with sketch and dimensions;
- Detailed work plan to meet project objectives and meet deliverables identified in AOI 3 DELIVERABLES section;
- Description of the plan for how to incorporate IEC and IEEE standards, identified in in AOI 3 Technical Specifications and Standards section, into the device design;
- Plan for how to develop a design that can be tested for 2-years of sustained operation at PacWave-South test site;
- Description of technical merit, innovation, and overall R&D value to MHK industry;
- Description of technical risks and the risk mitigation strategy;
- Description of numerical models and design methodologies that will be used to develop the device design;
- Description of how design tools and methodologies have been or will be validated using previous gathered experimental testing data; or a description of what work will be performed during the period of performance to verify and validate the design tools and methodologies that will be used;
- A matrix that defines roles and responsibilities of the team members and anticipated subcontractors;
- A discussion of the WEC design experience of the team members and anticipated subcontractors;
- Description of the intended market(s) of the WEC device and any associated requirements;
- A proposal for how the applicant would like NREL and/or SNL to provide technical assistance based on the lab technical capabilities described in AOI 3 National Laboratory Technical Assistance;
- Description of how the FOA metrics identified in AOI 3 WEC Device Performance Metrics section will be estimated during the period of performance.
- Targets values for FOA metrics identified in AOI 3 WEC Device Performance Metrics section that will be achieved during the project period of performance.
- How the project will advance the state of the WEC technology towards commercial viability, the target dimensions and power rating of the device for commercialization, the intended market for the WEC device, how the device will be deployed commercially (e.g., individually or in arrays), and the anticipated size of the target market.

#### **AOI 4 Specific Technical Volume Requirements**

- Project Goal: The applicant should explicitly identify the targeted improvements to the baseline infrastructure and the critical success factors in achieving that goal.
- Relevance and Outcomes: The applicant should provide a detailed description of the infrastructure upgrades, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project.

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- Innovation and Impacts: The applicant should describe the current state of testing infrastructure in the applicable field, the specific innovation of the proposed upgrades, the advantages of proposed upgrades over current and emerging infrastructure, and the overall impact on advancing the state of testing infrastructure if the project is successful.
- A proposal for how the applicant would like NREL and/or SNL to provide technical assistance based on the lab technical capabilities described in AOI 3 National Laboratory Technical Assistance;
- Description of how the FOA metrics identified in AOI 3 WEC Device Performance Metrics section will be estimated during the period of performance.
- Targets values for FOA metrics identified in AOI 3 WEC Device Performance Metrics section that will be achieved during the project period of performance.
- How the project will advance the state of the WEC technology towards commercial viability, the target dimensions and power rating of the device for commercialization, the intended market for the WEC device, how the device will be deployed commercially (e.g., individually or in arrays), and the anticipated size of the target market.

### iii. Statement of Project Objectives (SOPO)

Applicants are required to complete a SOPO. A SOPO template is available on EERE Exchange at <https://eere-Exchange.energy.gov/>. The SOPO, including the Milestone Table, must not exceed 10 pages when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 12 point. Save the SOPO in a single Microsoft Word file using the following convention for the title "ControlNumber\_LeadOrganization\_SOPO".

### iv. SF-424: Application for Federal Assistance

Complete all required fields in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at <http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms>, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period. Save the SF-424 in a single PDF file using the following convention for the title "ControlNumber\_LeadOrganization\_App424".

### v. Budget Justification Workbook

- Applicants are required to complete the Budget Justification Workbook. This form is available on EERE Exchange at <https://eere-Exchange.energy.gov/>.
- Prime recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the prime recipient and its subrecipients and contractors.

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- Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The “Instructions and Summary” included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook.
- Applicants must carefully read the “Instructions and Summary” tab provided within the Budget Justification Workbook.
- Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title “ControlNumber\_LeadOrganization\_Budget\_Justification”.

**vi. Summary/Abstract for Public Release**

Applicants are required to submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as DOE may make it available to the public after selections are made. The project summary must not exceed 1 page when printed using standard 8.5 x 11 paper with 1” margins (top, bottom, left, and right) with font not smaller than 12 point. Save the Summary for Public Release in a single PDF file using the following convention for the title “ControlNumber\_LeadOrganization\_Summary”.

**vii. Summary Slide**

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format. This slide is used during the evaluation process. Save the Summary Slide in a single file using the following convention for the title “ControlNumber\_LeadOrganization\_Slide”.

The Summary Slide template requires the following information:

- A summary of proposed work;
- A description of the proposed work’s impact;
- Proposed project goals;
- Any key graphics (illustrations, charts and/or tables);
- The project’s key idea/takeaway;
- Project title, prime recipient, Principal Investigator, and Key Participant information; and

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- Requested EERE funds and proposed applicant cost share.

**viii. Subrecipient Budget Justification (if applicable)**

Applicants must provide a separate budget justification for each subrecipient that is expected to perform work estimated to be more than \$250,000 or 25 percent of the total work effort (whichever is less). The budget justification must include the same justification information described in the “Budget Justification” section above. Save each subrecipient budget justification in a Microsoft Excel file using the following convention for the title

“ControlNumber\_LeadOrganization\_Subrecipient\_Budget\_Justification”.

**ix. Budget for DOE/NNSA FFRDC (if applicable)**

If a DOE/NNSA FFRDC contractor is to perform a portion of the work, the applicant must provide a DOE WP in accordance with the requirements in DOE Order 412.1A, Work Authorization System, Attachment 3, available at:

<https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a/@@images/file>. Save the WP in a single PDF file using the following convention for the title “ControlNumber\_LeadOrganization\_WP”.

**x. Authorization for non-DOE/NNSA or DOE/NNSA FFRDCs (if applicable)**

The federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor’s authority under its award. Save the Authorization in a single PDF file using the following convention for the title

“ControlNumber\_LeadOrganization\_FFRDCAuth”.

**xi. SF-LLL: Disclosure of Lobbying Activities (required)**

Prime recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Prime recipients and subrecipients are required to complete and submit SF-LLL, “Disclosure of Lobbying Activities”

(<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

- An officer or employee of any federal agency;
- A Member of Congress;
- An officer or employee of Congress; or

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- An employee of a Member of Congress.

Save the SF-LLL in a single PDF file using the following convention for the title “ControlNumber\_LeadOrganization\_SF-LLL”.

## **xii. Waiver Requests: Foreign Entities and Performance of Work in the United States (if applicable)**

### **1. Foreign Entity Participation:**

As set forth in Section III.A.iii., all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application.

[Appendix C](#) lists the necessary information that must be included in a request to waive this requirement.

### **2. Performance of Work in the United States**

As set forth in Section IV.J.iii., all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. [Appendix C](#) lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

Save the Waivers in a single PDF file using the following convention for the title “ControlNumber\_LeadOrganization\_Waiver”.

## **xiii. U.S. Manufacturing Commitments**

Pursuant to the DOE Determination of Exceptional Circumstances (DEC) dated September 9, 2013, each applicant is required to submit a U.S. Manufacturing Plan as part of its application. The U.S. Manufacturing Plan represents the applicant's measurable commitment to support U.S. manufacturing as a result of its award.

Each U.S. Manufacturing Plan must include a commitment that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States, unless the applicant can show to the satisfaction of DOE that it is not commercially feasible to do so (referred to hereinafter as “the U.S. Competitiveness Provision”). The applicant further agrees to make the U.S. Competitiveness Provision binding on

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any subawardee and any assignee or licensee or any entity otherwise acquiring rights to any subject invention, including subsequent assignees or licensees. A subject invention is any invention conceived of or first actually reduced to practice under an award.

Due to the lower technology readiness levels of this FOA, DOE does not expect the U.S. Manufacturing Plans to be tied to a specific product or technology. However, in lieu of the U.S. Competitiveness Provision, an applicant may propose a U.S. Manufacturing Plan with more specific commitments that would be beneficial to the U.S. economy and competitiveness. For example, an applicant may commit specific products to be manufactured in the U.S., commit to a specific investment in a new or existing U.S. manufacturing facility, keep certain activities based in the U.S. or support a certain number of jobs in the U.S. related to the technology. An applicant which is likely to license the technology to others, especially universities for which licensing may be the exclusive means of commercialization the technology, the U.S. Manufacturing Plan may indicate the applicant's plan and commitment to use a specific licensing strategy that would likely support U.S. manufacturing.

If DOE determines, at its sole discretion, that the more specific commitments would provide a sufficient benefit to the U.S. economy and industrial competitiveness, the specific commitments will be part of the terms and conditions of the award. For all other awards, the U.S. Competitiveness Provision shall be incorporated as part of the terms and conditions of the award as the U.S. Manufacturing Plan for that award.

The U.S. Competitiveness Provision is also a requirement for the Class Patent Waiver that applies to domestic large business under this FOA (see Section VIII.K. Title to Subject Inventions).

Please note that the requirement for this U.S. Manufacturing Plan is distinct from the requirements for manufacturing and commercialization plans discussed elsewhere in Section I.

Save the U.S. Manufacturing Plan in a single PDF file using the following convention for the title "ControlNumber\_LeadOrganization\_USMP".

**xiv. Data Management Plan (DMP)**

Applicants are required to submit a DMP with their Full Application.

An applicant may select one of the template Data Management Plans (DMP) listed below. Alternatively, instead of selecting one of the template Data

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Management Plans below, an applicant may submit another DMP provided that the DMP, at a minimum, (1) describes how data sharing and preservation will enable validation of the results from the proposed work, how the results could be validated if data are not shared or preserved and (2) has a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications. DOE Public Access Plan dated July 24, 2014 provides additional guidance and information on Data Management Plans.

Option 1 (when protected data is allowed): For the deliverables under the award, the recipient does not plan on making the underlying research data supporting the findings in the deliverables publicly-available for up to 5 years after the data were first produced because such data will be considered protected under the award. The results from the DOE deliverables can be validated by DOE who will have access, upon request, to the research data. Other than providing deliverables as specified in the award, the recipient does not intend to publish the results from the project. However, in an instance where a publication includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Option 2: For any publication that includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Please note that this requirement for a Data Management Plan is distinct from requirements for data dissemination plans discussed elsewhere in Section I.

Save the DMP in a single Microsoft Word file using the following convention for the title "ControlNumber\_LeadOrganization\_DMP".

**xv. FFRDCs**

DOE FFRDCs are subject to the U.S. Manufacturing requirements set forth in their M&O Contracts. All other FFRDCs are subject to the U.S. Manufacturing requirements as set forth above, based on their size and for-profit status.

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## E. Content and Form of Replies to Reviewer Comments

EERE will provide applicants with reviewer comments following evaluation of all eligible Full Applications. Applicants will have a brief opportunity to review the comments and to prepare a short Reply to Reviewer Comments responding to comments however they desire or supplementing their Full Application. The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments. EERE will post the Reviewer Comments in EERE Exchange. The expected submission deadline is on the cover page of the FOA; however, it is the applicant’s responsibility to monitor EERE Exchange in the event that the expected date changes. The deadline will not be extended for applicants who are unable to timely submit their reply due to failure to check EERE Exchange or relying on the expected date alone. Applicants should anticipate having approximately three (3) business days to submit Replies to Reviewer Comments.

EERE will not review or consider ineligible Replies to Reviewer Comments (see Section III of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three pages in length, EERE will review only the first three (3) pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
<b>Text</b>	2 pages max	Applicants may respond to one or more reviewer comments or supplement their Full Application.
<b>Optional</b>	1 page max	Applicants may use this page however they wish; text, graphs, charts, or other data to respond to reviewer comments or supplement their Full Application are acceptable.

## F. Post Selection Information Requests

If selected for award, EERE reserves the right to request additional or clarifying information regarding the following (non-exhaustive list):

- Indirect cost information;
- Other budget information;
- Commitment Letters from Third Parties Contributing to Cost Share, if applicable;
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5);

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- Representation of Limited Rights Data and Restricted Software, if applicable; and
- Environmental Questionnaire.

## **G. Dun and Bradstreet Universal Numbering System (DUNS) Number and System for Award Management (SAM)**

Each applicant (unless the applicant is an individual or federal awarding agency that is excepted from those requirements under 2 CFR §25.110(b) or (c), or has an exception approved by the federal awarding agency under 2 CFR §25.110(d)) is required to: (1) Be registered in the SAM at <https://www.sam.gov> before submitting its application; (2) provide a valid DUNS number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the DOE will determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

## **H. Submission Dates and Times**

Concept Papers, Full Applications, and Replies to Reviewer Comments must be submitted in EERE Exchange no later than 5 p.m. Eastern Time on the dates provided on the cover page of this FOA.

## **I. Intergovernmental Review**

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

## **J. Funding Restrictions**

### **i. Allowable Costs**

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable federal cost principles.

Refer to the following applicable federal cost principles for more information:

- Federal Acquisition Regulation (FAR) Part 31 for For-Profit entities; and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

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## ii. **Pre-Award Costs**

Selectees must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the federal award directly pursuant to the negotiation and in anticipation of the federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the federal award and **only** with the written approval of the federal awarding agency, through the Contracting Officer assigned to the award.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis. Pre-award costs can only be incurred if such costs would be reimbursable under the agreement if incurred after award.

Pre-award expenditures are made at the Selectee's risk. EERE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the Selectee anticipated.

### 1. **Pre-Award Costs Related to National Environmental Policy Act (NEPA) Requirements**

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse costs where the prime recipient incurred the costs prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share. Likewise, if an application is selected for negotiation of award, and the prime recipient elects to undertake activities that are not authorized for federal funding by the Contracting Officer in advance of EERE completing a NEPA review, the prime recipient is doing so at risk of not receiving federal funding and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override these NEPA

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requirements to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives.

### **iii. Performance of Work in the United States**

#### **1. Requirement**

All work performed under EERE awards must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment; however, the prime recipient should make every effort to purchase supplies and equipment within the United States. The prime recipient must flow down this requirement to its subrecipients.

#### **2. Failure to Comply**

If the prime recipient fails to comply with the Performance of Work in the United States requirement, EERE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable recipient cost share. The prime recipient is responsible should any work under this award be performed outside the United States, absent a waiver, regardless of if the work is performed by the prime recipient, subrecipients, contractors or other project partners.

#### **3. Waiver**

There may be limited circumstances where it is in the interest of the Project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit a written waiver request to EERE. [Appendix C](#) lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

The applicant must demonstrate to the satisfaction of EERE that a waiver would further the purposes of the FOA and is in the economic interests of the United States. EERE may require additional information before considering a waiver request. Save the waiver request(s) in a single PDF file titled "ControlNumber\_LeadOrganization\_Waiver". The applicant does not have the right to appeal EERE's decision concerning a waiver request.

### **iv. Construction**

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

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**v. Foreign Travel**

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 USC 40118), commonly referred to as the “Fly America Act,” and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. flag carrier, if service is available. Foreign travel costs are allowable only with the written prior approval of the Contracting Officer assigned to the award.

**vi. Equipment and Supplies**

To the greatest extent practicable, all equipment and products purchased with funds made available under this FOA should be American-made. This requirement does not apply to used or leased equipment.

Property disposition will be required at the end of a project if the current fair market value of property exceeds \$5,000. The rules for property disposition are set forth in 2 CFR 200.310 – 200.316 as amended by 2 CFR 910.360.

**vii. Lobbying**

Recipients and subrecipients may not use any federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and subrecipients are required to complete and submit SF-LLL, “Disclosure of Lobbying Activities” (<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the application:

- An officer or employee of any federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

**viii. Risk Assessment**

Prior to making a federal award, the DOE is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 to review information available through any Office of Management

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and Budget (OMB)-designated repositories of government-wide eligibility qualification or financial integrity information, such as SAM Exclusions and “Do Not Pay.”

In addition, DOE evaluates the risk(s) posed by applicants before they receive federal awards. This evaluation may consider: results of the evaluation of the applicant's eligibility; the quality of the application; financial stability; quality of management systems and ability to meet the management standards prescribed in this part; history of performance; reports and findings from audits; and the applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-federal entities.

In addition to this review, DOE must comply with the guidelines on government-wide suspension and debarment in 2 CFR 180, and must require non-federal entities to comply with these provisions. These provisions restrict federal awards, subawards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in federal programs or activities.

**ix. Invoice Review and Approval**

DOE employs a risk-based approach to determine the level of supporting documentation required for approving invoice payments. Recipients may be required to provide some or all of the following items with their requests for reimbursement:

- Summary of costs by cost categories;
- Timesheets or personnel hours report;
- Invoices/receipts for all travel, equipment, supplies, contractual, and other costs;
- UCC filing proof for equipment acquired with project funds by for-profit recipients and subrecipients;
- Explanation of cost share for invoicing period;
- Analogous information for some subrecipients; and
- Other items as required by DOE.

## **V. Application Review Information**

### **A. Technical Review Criteria**

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## i. Concept Papers

Concept Papers are evaluated based on consideration of the following factors. All sub-criteria are of equal weight.

### **Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)**

This criterion involves consideration of the following factors:

- The applicant clearly describes the proposed work<sup>42</sup>, describes how the proposed work is unique and innovative, and how the proposed work will advance the current state-of-the-art;
- The applicant has identified risks and challenges, including possible mitigation strategies, and has shown the impact that EERE funding and the proposed project would have on the relevant field and application;
- The applicant has the qualifications, experience, capabilities and other resources necessary to complete the proposed project; and
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the FOA.

## ii. Full Applications

### *AOI 1a Specific Technical Review Criteria for Full Applications*

- Criterion 1: Technical Merit, Innovation, and Impact (40%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (30%)

### *AOI 1b, 2a, & 4 Specific Technical Review Criteria for Full Applications*

- Criterion 1: Technical Merit, Innovation, and Impact (50%)
- Criterion 2: Project Research and Market Transformation Plan (30%)
- Criterion 3: Team and Resources (20%)

### *AOI 2b Specific Technical Review Criteria for Full Applications*

- Criterion 1: Technical Merit, Innovation, and Impact (40%)
- Criterion 2: Project Research and Market Transformation Plan (40%)
- Criterion 3: Team and Resources (20%)

### *AOI 3 Specific Technical Review Criteria for Full Applications*

- Criterion 1: Technical Merit, Innovation, and Impact (30%)
- Criterion 2: Project Research and Market Transformation Plan (50%)

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<sup>42</sup> For this FOA, “proposed work” may refer generally to a technology, testing infrastructure upgrade, process, framework, modeling effort, analysis, or optimization strategy, as indicated in the description of each AOI.

- Criterion 3: Team and Resources (20%)

While weight of the specific Technical Review Criteria for Full Applications is different for different AOIs, details are the same and detailed below. Applications under all AOIs will be evaluated against the merit review criteria shown below. All sub-criteria are of equal weight.

### **Criterion 1: Technical Merit, Innovation, and Impact**

This criterion involves consideration of the following factors:

#### Technical Merit and Innovation

- Extent to which the application responds to requirements established in the respective AOI;
- Extent to which the proposed work<sup>43</sup> is innovative;
- Degree to which the current state of the art and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state-of-the-art to the proposed advancement; and
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work.

#### Impact of Advancement

- How the project supports individual area of interest objectives and target specifications and metrics; and
- The potential impact of the project on advancing the state-of-the-art.

### **Criterion 2: Project Research and Market Transformation Plan**

This criterion involves consideration of the following factors:

#### Research Approach, Workplan and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered; and
- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed workplan and SOPO will succeed in meeting the project goals.

#### Identification of Technical Risks

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<sup>43</sup> For this FOA, “proposed work” may refer generally to a technology, testing infrastructure upgrade, process, framework, modeling effort, analysis, or optimization strategy, as indicated in the description of each AOI.



- Discussion and demonstrated understanding of the key technical risk areas involved in the proposed work and the quality of the mitigation strategies to address them.

#### Baseline, Metrics, and Deliverables

- The level of clarity in the definition of the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

#### Market Transformation Plan

- Identification of target market, competitors, and distribution channels for proposed work along with known or perceived barriers to market penetration, including mitigation plan; and
- Comprehensiveness of market transformation plan including but not limited to product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, and product distribution.

### **Criterion 3: Team and Resources**

This criterion involves consideration of the following factors:

- The capability of the Principal Investigator(s) and the proposed team to address all aspects of the proposed work with a high probability of success. The qualifications, relevant expertise, and time commitment of the individuals on the team;
- The sufficiency of the facilities to support the work;
- The degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed work;
- The level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the workplan; and
- The reasonableness of the budget and spend plan for the proposed project and objectives.

### **iii. Criteria for Replies to Reviewer Comments**

EERE has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are attached to the original applications and evaluated as an extension of the Full Application.

## **B. Standards for Application Evaluation**

Applications that are determined to be eligible will be evaluated in accordance with this FOA, by the standards set forth in EERE's Notice of Objective Merit Review

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Procedure (76 Fed. Reg. 17846, March 31, 2011) and the guidance provided in the “DOE Merit Review Guide for Financial Assistance,” effective April 14, 2017, which is available at: <https://energy.gov/management/downloads/merit-review-guide-financial-assistance-and-unsolicited-proposals-current>.

## C. Other Selection Factors

### i. Program Policy Factors

In addition to the above criteria, the Selection Official may consider the following program policy factors in determining which Full Applications to select for award negotiations:

- The degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA;
- The degree to which the proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives;
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers;
- The degree to which the proposed project is likely to lead to increased employment and manufacturing in the United States;
- The degree to which the proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty; and
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications).
- The degree to which the proposed project enables new and expanding market segments.

## D. Evaluation and Selection Process

### i. Overview

The evaluation process consists of multiple phases; each includes an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

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**ii. Pre-Selection Interviews**

As part of the evaluation and selection process, EERE may invite one or more applicants to participate in Pre-Selection Interviews. Pre-Selection Interviews are distinct from and more formal than pre-selection clarifications (See Section V.D.iii of the FOA). The invited applicant(s) will meet with EERE representatives to provide clarification on the contents of the Full Applications and to provide EERE an opportunity to ask questions regarding the proposed project. The information provided by applicants to EERE through Pre-Selection Interviews contributes to EERE's selection decisions.

EERE will arrange to meet with the invited applicants in person at EERE's offices or a mutually agreed upon location. EERE may also arrange site visits at certain applicants' facilities. In the alternative, EERE may invite certain applicants to participate in a one-on-one conference with EERE via webinar, videoconference, or conference call.

EERE will not reimburse applicants for travel and other expenses relating to the Pre-Selection Interviews, nor will these costs be eligible for reimbursement as pre-award costs.

EERE may obtain additional information through Pre-Selection Interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without Pre-Selection Interviews. Participation in Pre-Selection Interviews with EERE does not signify that applicants have been selected for award negotiations.

**iii. Pre-Selection Clarification**

EERE may determine that pre-selection clarifications are necessary from one or more applicants. Pre-selection clarifications are distinct from and less formal than pre-selection interviews. These pre-selection clarifications will solely be for the purposes of clarifying the application, and will be limited to information already provided in the application documentation. The pre-selection clarifications may occur before, during or after the merit review evaluation process. Information provided by an applicant that is not necessary to address the pre-selection clarification question will not be reviewed or considered. Typically, a pre-selection clarification will be carried out through either written responses to EERE's written clarification questions or video or conference calls with EERE representatives.

The information provided by applicants to EERE through pre-selection clarifications is incorporated in their applications and contributes to the merit review evaluation and EERE's selection decisions. If EERE contacts an applicant for pre-selection clarification purposes, it does not signify that the applicant has been selected for negotiation of award or that the applicant is among the top ranked applications.

EERE will not reimburse applicants for expenses relating to the pre-selection clarifications, nor will these costs be eligible for reimbursement as pre-award costs.

**iv. Recipient Integrity and Performance Matters**

DOE, prior to making a federal award with a total amount of federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313).

The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under federal awards when completing the review of risk posed by applicants as described in 2 C.F.R. § 200.205.

**v. Selection**

The Selection Official may consider the technical merit, the Federal Consensus Board's recommendations, program policy factors, and the amount of funds available in arriving at selections for this FOA.

**E. Anticipated Notice of Selection and Award Negotiation Dates**

EERE anticipates notifying applicants selected for negotiation of award and negotiating awards by the dates provided on the cover page of this FOA.

## VI. Award Administration Information

### A. Award Notices

#### i. Ineligible Submissions

Ineligible Concept Papers and Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will state the basis upon which the Concept Paper or the Full Application is ineligible and not considered for further review.

#### ii. Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application. EERE will post these notifications to EERE Exchange.

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. The purpose of the Concept Paper phase is to save applicants the considerable time and expense of preparing a Full Application that is unlikely to be selected for award negotiations.

A notification encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project. Please refer to Section IV.J.ii. of the FOA for guidance on pre-award costs.

#### iii. Full Application Notifications

EERE will notify applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, EERE may notify one or more applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds or other factors.

**iv. Successful Applicants**

Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by EERE to issue an award. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the prime recipient in FedConnect.

The award negotiation process will take approximately 60 days. Applicants must designate a primary and a backup point-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. The applicant must be responsive during award negotiations (i.e., provide requested documentation) and meet the negotiation deadlines. If the applicant fails to do so or if award negotiations are otherwise unsuccessful, EERE will cancel the award negotiations and rescind the Selection. EERE reserves the right to terminate award negotiations at any time for any reason.

Please refer to Section IV.J.ii. of the FOA for guidance on pre-award costs.

**v. Alternate Selection Determinations**

In some instances, an applicant may receive a notification that its application was not selected for award and EERE designated the application to be an alternate. As an alternate, EERE may consider the Full Application for federal funding in the future. A notification letter stating the Full Application is designated as an alternate does not authorize the applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

**vi. Unsuccessful Applicants**

EERE shall promptly notify in writing each applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds.

## **B. Administrative and National Policy Requirements**

**i. Registration Requirements**

There are several one-time actions before submitting an application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

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**1. EERE Exchange**

Register and create an account on EERE Exchange at <https://eere-Exchange.energy.gov>.

This account will then allow the user to register for any open EERE FOAs that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Applicants should also designate backup points of contact so they may be easily contacted if deemed necessary.

**This step is required to apply to this FOA.**

The EERE Exchange registration does not have a delay; however, **the remaining registration requirements below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA.**

**2. DUNS Number**

Obtain a DUNS number (including the plus 4 extension, if applicable) at <http://fedgov.dnb.com/webform>.

**3. System for Award Management**

Register with the SAM at <https://www.sam.gov>. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called a Marketing Partner ID Number (MPIN) are important steps in SAM registration. Please update your SAM registration annually.

**4. FedConnect**

Register in FedConnect at <https://www.fedconnect.net>. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at [https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect\\_Ready\\_Set\\_Go.pdf](https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf).

**5. Grants.gov**

Register in Grants.gov (<http://www.grants.gov>) to receive automatic updates when Amendments to this FOA are posted. However, please note that Concept Papers and Full Applications will not be accepted through Grants.gov.

**6. Electronic Authorization of Applications and Award Documents**

Submission of an application and supplemental information under this FOA through electronic systems used by the DOE, including EERE Exchange and FedConnect.net, constitutes the authorized representative's approval and electronic signature.

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**ii. Award Administrative Requirements**

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR Part 200 as amended by 2 CFR Part 910.

**iii. Foreign National Access to DOE Sites**

All applicants that ultimately enter into an award resulting from this FOA will be subject to the following requirement concerning foreign national involvement. Upon DOE's request, prime recipients must provide information to facilitate DOE's responsibilities associated with foreign national access to DOE sites, information, technologies, and equipment. A foreign national is defined as any person who was born outside the jurisdiction of the United States, is a citizen of a foreign government, and has not been naturalized under U.S. law. If the prime recipient or subrecipients, contractors or vendors under the award, anticipate utilizing a foreign national person in the performance of an award, the prime recipient is responsible for providing to the Contracting Officer specific information of the foreign national(s) to satisfy compliance with all of the requirements for access approval.

**iv. Subaward and Executive Reporting**

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier subrecipients. Prime recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

**v. National Policy Requirements**

The National Policy Assurances that are incorporated as a term and condition of award are located at: <http://www.nsf.gov/awards/managing/rtc.jsp>.

**vi. Environmental Review in Accordance with National Environmental Policy Act (NEPA)**

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA (42 USC 4321, *et seq.*). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at <http://nepa.energy.gov/>.

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While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the costs to prepare the necessary records may be included as part of the project costs.

## **vii. Applicant Representations and Certifications**

### **1. Lobbying Restrictions**

By accepting funds under this award, the prime recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. §1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

### **2. Corporate Felony Conviction and Federal Tax Liability Representations**

In submitting an application in response to this FOA, the applicant represents that:

- a.** It is **not** a corporation that has been convicted of a felony criminal violation under any federal law within the preceding 24 months, and
- b.** It is **not** a corporation that has any unpaid federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these FOA representations the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

### **3. Nondisclosure and Confidentiality Agreements Representations**

In submitting an application in response to this FOA the applicant represents that:

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- a. It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a federal department or agency authorized to receive such information.
  
- b. It **does not and will not** use any federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:
  - (1) *“These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.”*
  
  - (2) The limitation above shall not contravene requirements applicable to Standard Form 312 Classified Information Nondisclosure Agreement (<https://fas.org/sgp/othergov/sf312.pdf>), Form 4414 Sensitive Compartmented Information Disclosure Agreement (<https://fas.org/sgp/othergov/intel/sf4414.pdf>), or any other form issued by a federal department or agency governing the nondisclosure of classified information.
  
  - (3) Notwithstanding the provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an

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authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

**viii. Statement of Federal Stewardship**

EERE will exercise normal federal stewardship in overseeing the project activities performed under EERE awards. Stewardship Activities include, but are not limited to, conducting site visits; reviewing performance and financial reports; providing assistance and/or temporary intervention in unusual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

**ix. Statement of Substantial Involvement**

EERE has substantial involvement in work performed under awards made as a result of this FOA. EERE does not limit its involvement to the administrative requirements of the award. Instead, EERE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes, but is not limited to, the following:

1. EERE shares responsibility with the recipient for the management, control, direction, and performance of the project.
2. EERE may intervene in the conduct or performance of work under this award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.
3. EERE may redirect or discontinue funding the project based on the outcome of EERE's evaluation of the project at the Go/No-Go decision point(s).
4. EERE participates in major project decision-making processes.

**x. Subject Invention Utilization Reporting**

In order to ensure that prime recipients and subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE may require that each prime recipient holding title to a subject invention submit annual reports for 10 years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by prime recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the prime recipient, and such other data and information as EERE may specify.

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**xi. Intellectual Property Provisions**

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at <http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards>.

**xii. Reporting**

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement. This helpful EERE checklist can be accessed at <https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms>. See Attachment 2 Federal Assistance Reporting Checklist, after clicking on "Model Cooperative Agreement" under the Award Package section.

For AOIs 2b and 3, all the data collected as well as key deliverables will be uploaded to the DOE Marine and Hydrokinetic Data Repository at: <https://mhkdr.openei.org>. Data produced under this Award will be treated according to the Intellectual Property Provisions.

**xiii. Go/No-Go Review**

Each project selected under this FOA (except for AOI 3) will be subject to a periodic project evaluation referred to as a Go/No-Go Review. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the EERE program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient's technical progress compared to the Milestone Summary Table stated in Attachment 1 of the award; (4) recipient's submittal of required reports; (5) recipient's compliance with the terms and conditions of the award; (6) EERE's Go/No-Go decision; (7) the recipient's submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

As a result of the Go/No-Go Review, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the

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project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, EERE may take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

**xiv. Conference Spending**

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States Government would otherwise exceed \$20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

**xv. Uniform Commercial Code (UCC) Financing Statements**

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than \$1,000,000, the recipient or subrecipient must:

Properly record, and consent to the Department's ability to properly record if the recipient fails to do so, UCC financing statement(s) for all equipment in excess of \$5,000 purchased with project funds. These financing statement(s) must be approved in writing by the Contracting Officer prior to the recording, and they shall provide notice that the recipient's title to all equipment (not real property) purchased with federal funds under the financial assistance agreement is conditional pursuant to the terms of this section, and that the Government retains an undivided reversionary interest in the equipment. The UCC financing statement(s) must be filed before the Contracting Officer may reimburse the recipient for the federal share of the equipment unless otherwise provided for in the relevant financial assistance agreement. The recipient shall further make any amendments to the financing statements or additional recordings, including appropriate continuation statements, as necessary or as the Contracting Officer may direct.

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## C. Program Down-Select

For [AOI 2b](#) only, WPTO intends to conduct a competitive project review (down-selection process) upon the completion of BP1 initial design. AOI 2b recipients will present their projects to WPTO individually (not to other recipients). Subject matter experts from academia, national laboratories, and industry may be used as reviewers, subject to conflict of interest and non-disclosure considerations. WPTO will down select to one project to proceed into BP2 to complete the design, build and testing of a prototype in open water. Forty-five (45) days before the completion of BP1, all BP1 awardees will submit BP1 required deliverables to WPTO Project Officer. These reports will be used by WPTO team to conduct a project review against the criteria listed below. Approximately thirty (30) days before the completion of BP1, BP1 awardees will give a presentation to WPTO team.

Projects will be evaluated based on the following criteria:

1. Technical performance and progress towards stated project objectives.
2. Level of innovation and potential impact of modular design and IO&M techniques to reduce Capex and OpEx and increase AEP.
3. Likelihood of project success; as indicated by the technical risk analysis, open water test plans, feasibility of permitting plan, progress made on permitting activities, and feasibility of the data collection plan.

Upon completion of the competitive project review (down-selection process), WPTO will select which AOI 2b project will receive federal funding beyond BP1. Due to the availability of funding and program considerations, only one (1) recipient will be selected to receive funding for project continuation into BP2. As a result of this down-select process, certain projects will not receive federal funding beyond BP1 even if the project is meeting the pre-defined metrics.

## VII. Questions/Agency Contacts

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and answer process as described below. Specifically, questions regarding the content of this FOA must be submitted to: [WPTOFOA@ee.doe.gov](mailto:WPTOFOA@ee.doe.gov). Questions must be submitted not later than 3 business days prior to the application due date and time. Please note, feedback on individual concepts will not be provided through Q&A.

All questions and answers related to this FOA will be posted on EERE Exchange at: <https://eere-exchange.energy.gov>. **Please note that you must first select this specific FOA Number in order to view the questions and answers specific to this FOA.** EERE will

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attempt to respond to a question within 3 business days, unless a similar question and answer has already been posted on the website.

Questions related to the registration process and use of the EERE Exchange website should be submitted to: [EERE-ExchangeSupport@hq.doe.gov](mailto:EERE-ExchangeSupport@hq.doe.gov).

## **VIII. Other Information**

### **A. FOA Modifications**

Amendments to this FOA will be posted on the EERE Exchange website and the Grants.gov system. However, you will only receive an email when an amendment or a FOA is posted on these sites if you register for email notifications for this FOA in Grants.gov. EERE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.

### **B. Government Right to Reject or Negotiate**

EERE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

### **C. Commitment of Public Funds**

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

### **D. Treatment of Application Information**

In general, EERE will only use data and other information contained in applications for evaluation purposes, unless such information is generally available to the public or is already the property of the Government.

Applicants should not include trade secrets or commercial or financial information that is privileged or confidential in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the FOA.

The use of protective markings such as “Do Not Publicly Release – Trade Secret” or “Do Not Publicly Release – Confidential Business Information” is encouraged. However, applicants should be aware that the use of protective markings is not dispositive as to whether information will be publicly released pursuant to the Freedom of Information Act, 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L.

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No. 110-175. (See Section I of this document, “Notice of Potential Disclosure Under the Freedom of Information Act (FOIA)” for additional information regarding the public release of information under FOIA.

Applicants are encouraged to employ protective markings in the following manner:

The cover sheet of the application must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential, and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains trade secrets or commercial or financial information that is privileged must be marked as follows: “May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure.”

In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in brackets.

## **E. Evaluation and Administration by Non-Federal Personnel**

In conducting the merit review evaluation, the Go/No-Go Review and Peer Review, the Government may seek the advice of qualified non-federal personnel as reviewers. The Government may also use non-federal personnel to conduct routine, nondiscretionary administrative activities, including EERE contractors. The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

## **F. Notice Regarding Eligible/Ineligible Activities**

Eligible activities under this FOA include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not

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those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

### **G. Notice of Right to Conduct a Review of Financial Capability**

EERE reserves the right to conduct an independent third party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

### **H. Notice of Potential Disclosure Under Freedom of Information Act (FOIA)**

Under the FOIA, 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175, any information received from the applicant is considered to be an agency record, and as such, subject to public release under FOIA. The purpose of the FOIA is to afford the public the right to request and receive agency records unless those agency records are protected from disclosure under one or more of the nine FOIA exemptions. Decisions to disclose or withhold information received from the applicant are based upon the applicability of one or more of the nine FOIA exemptions, not on the existence or nonexistence of protective markings or designations. Only the agency's designated FOIA Officer may determine if information received from the applicant may be withheld pursuant to one of the nine FOIA exemptions. All FOIA requests received by DOE are processed in accordance with 10 C.F.R. Part 1004.

### **I. Requirement for Full and Complete Disclosure**

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

### **J. Retention of Submissions**

EERE expects to retain copies of all Concept Papers, Full Applications, Replies to Reviewer Comments, and other submissions. No submissions will be returned. By applying to EERE for funding, applicants consent to EERE's retention of their submissions.

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## K. Title to Subject Inventions

Ownership of subject inventions is governed pursuant to the authorities listed below:

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42 U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (see below); Class Patent Waiver: Under 42 U.S.C. § 5908, title to subject inventions vests in the U.S. Government and large businesses and foreign entities do not have the automatic right to elect to retain title to subject inventions. However, EERE may issue “class patent waivers” under which large businesses and foreign entities that meet certain stated requirements may elect to retain title to their subject inventions.
- Advance and Identified Waivers: Applicants may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award’s intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.
- DEC: Each applicant is required to submit a U.S. Manufacturing Plan as part of its application. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. Any Bayh-Dole entity

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(domestic small business or nonprofit organization) affected by this DEC has the right to appeal it.

## **L. Government Rights in Subject Inventions**

Where prime recipients and subrecipients retain title to subject inventions, the U.S. Government retains certain rights.

### **1. Government Use License**

The U.S. Government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the Government.

### **2. March-In Rights**

The U.S. Government retains march-in rights with respect to all subject inventions. Through “march-in rights,” the Government may require a prime recipient or subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the Government may grant licenses for use of the subject invention when a prime recipient, subrecipient, or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by federal statutes in a reasonably satisfied manner; or
- The U.S. Manufacturing requirement has not been met.

Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

## **M. Rights in Technical Data**

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

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“Limited Rights Data”: The U.S. Government will not normally require delivery of confidential or trade secret-type technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

Government Rights in Technical Data Produced Under Awards: The U.S. Government normally retains unlimited rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under EERE awards may be protected from public disclosure for up to five years after the data is generated (“Protected Data”). For awards permitting Protected Data, the protected data must be marked as set forth in the awards intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

## N. Copyright

The prime recipient and subrecipients may assert copyright in copyrightable works, such as software, first produced under the award without EERE approval. When copyright is asserted, the Government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the Government.

## O. Personally Identifiable Information (PII)

All information provided by the applicant must to the greatest extent possible exclude PII. The term “PII” refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, mother’s maiden name. (See OMB Memorandum M-07-16 dated May 22, 2007, found at: <https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2007/m07-16.pdf>)

By way of example, applicants must screen resumes to ensure that they do not contain PII such as personal addresses, personal landline/cell phone numbers, and personal emails. **Under no circumstances should Social Security Numbers (SSNs) be included in the application.** Federal Agencies are prohibited from the collecting, using, and displaying unnecessary SSNs. (See, the Federal Information Security Modernization Act of 2014 (Pub. L. No. 113-283, Dec 18, 2014; 44 U.S.C. §3551).

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## **P. Annual Independent Audits**

If a for-profit entity is a prime recipient and has expended \$750,000 or more of DOE awards during the entity's fiscal year, an annual compliance audit performed by an independent auditor is required. For additional information, please refer to 2 C.F.R. § 910.501 and Subpart F.

If an educational institution, non-profit organization, or state/local government is a prime recipient or subrecipient and has expended \$750,000 or more of federal awards during the non-federal entity's fiscal year, then a Single or Program-Specific Audit is required. For additional information, please refer to 2 C.F.R. § 200.501 and Subpart F.

Applicants and subrecipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. EERE will share in the cost of the audit at its applicable cost share ratio.

## **Q. Informational Webinar**

EERE will conduct one informational webinar during the FOA process. It will be held after the initial FOA release but before the due date for Concept Papers.

Attendance is not mandatory and will not positively or negatively impact the overall review of any applicant submissions. As the webinar will be open to all applicants who wish to participate, applicants should refrain from asking questions or communicating information that would reveal confidential and/or proprietary information specific to their project. Specific dates for the webinar can be found on the cover page of the FOA.



## APPENDIX A – COST SHARE INFORMATION

### Cost Sharing or Cost Matching

The terms “cost sharing” and “cost matching” are often used synonymously. Even the DOE Financial Assistance Regulations, 2 CFR 200.306, use both of the terms in the titles specific to regulations applicable to cost sharing. EERE almost always uses the term “cost sharing,” as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here “cost matching” for the non-federal share is calculated as a percentage of the federal funds only, rather than the Total Project Cost.

### How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. The following is an example of how to calculate cost sharing amounts for a project with \$1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: Federal share (\$) divided by federal share (%) = Total Project Cost  
Example: \$1,000,000 divided by 80% = \$1,250,000
- Formula: Total Project Cost (\$) minus federal share (\$) = Non-federal share (\$)  
Example: \$1,250,000 minus \$1,000,000 = \$250,000
- Formula: Non-federal share (\$) divided by Total Project Cost (\$) = Non-federal share (%)  
Example: \$250,000 divided by \$1,250,000 = 20%

### What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under an EERE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the federal Government under another award unless authorized by federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

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- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, EERE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, EERE generally does not allow pre-award costs prior to the signing of the Selection Statement by the EERE Selection Official.

### **General Cost Sharing Rules on a DOE Award**

- 1. Cash Cost Share** - encompasses all contributions to the project made by the recipient or subrecipient(s), for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project.
- 2. In-Kind Cost Share** - encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In-Kind cost share items include volunteer personnel hours, donated existing equipment, donated existing supplies. The cash value and calculations thereof for all In-Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out the In-Kind cost share section of the Budget Justification.
- 3. Funds from other federal sources MAY NOT be counted as cost share.** This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.
- 4. Fee or profit, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award.** The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

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## DOE Financial Assistance Rules 2 CFR Part 200 as amended by 2 CFR Part 910

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

**(A)** Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the prime recipient's cost sharing if such contributions meet all of the following criteria:

- (1)** They are verifiable from the recipient's records.
- (2)** They are not included as contributions for any other federally-assisted project or program.
- (3)** They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.
- (4)** They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:
  - a.** For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A-122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the FAR, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations; and
  - b.** Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.
- (5)** They are not paid by the federal government under another award unless authorized by federal statute to be used for cost sharing or matching.
- (6)** They are provided for in the approved budget.

**(B)** Valuing and documenting contributions

- (1)** Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of

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the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

- a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
  - b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.
- (2)** Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.
- (3)** Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.
- (4)** Valuing property donated by third parties.
  - a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.
  - b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:
    - i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of

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comparable space and facilities in a privately-owned building in the same locality.

- ii. The value of loaned equipment must not exceed its fair rental value.

**(5) Documentation.** The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

- a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.
- b. The basis for determining the valuation for personal services and property must be documented.

## APPENDIX B – SAMPLE COST SHARE CALCULATION FOR BLENDED COST SHARE PERCENTAGE

The following example shows the math for calculating required cost share for a project with \$2,000,000 in federal funds with four tasks requiring different non-federal cost share percentages:

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	\$1,000,000	80%	20%
Task 2 (R&D)	\$500,000	80%	20%
Task 3 (Demonstration)	\$400,000	50%	50%
Task 4 (Outreach)	\$100,000	100%	0%

Federal share (\$) divided by federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1

\$1,000,000 divided by 80% = \$1,250,000 (Task 1 Cost)

Task 1 Cost minus federal share = Non-federal share

\$1,250,000 - \$1,000,000 = \$250,000 (Non-federal share)

Task 2

\$500,000 divided 80% = \$625,000 (Task 2 Cost)

Task 2 Cost minus federal share = Non-federal share

\$625,000 - \$500,000 = \$125,000 (Non-federal share)

Task 3

\$400,000 / 50% = \$800,000 (Task 3 Cost)

Task 3 Cost minus federal share = Non-federal share

\$800,000 - \$400,000 = \$400,000 (Non-federal share)

Task 4

Federal share = \$100,000

Non-federal cost share is not mandated for outreach = \$0 (Non-federal share)

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The calculation may then be completed as follows:

Tasks	\$ Federal Share	% Federal Share	\$ Non-Federal Share	% Non-Federal Share	Total Project Cost
Task 1	\$1,000,000	80%	\$250,000	20%	\$1,250,000
Task 2	\$500,000	80%	\$125,000	20%	\$625,000
Task 3	\$400,000	50%	\$400,000	50%	\$800,000
Task 4	\$100,000	100%	\$0	0%	\$100,000
Totals	\$2,000,000		\$775,000		\$2,775,000

Blended Cost Share %

Non-federal share (\$775,000) divided by Total Project Cost (\$2,775,000) = 27.9% (non-federal)

Federal share (\$2,000,000) divided by Total Project Cost (\$2,775,000) = 72.1% (federal)

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## **APPENDIX C – WAIVER REQUESTS AND APPROVAL PROCESSES: 1. FOREIGN ENTITY PARTICIPATION AS THE PRIME RECIPIENT; AND 2. PERFORMANCE OF WORK IN THE UNITED STATES (FOREIGN WORK WAIVER)**

### **1. Waiver for Foreign Entity Participation as the Prime Recipient**

As set forth in Section III.A.iii., all prime recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States and have a physical location for business operations in the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Overall, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the prime recipient. A request to waive the *Foreign Entity Participation as the prime recipient* requirement must include the following:

- Entity name;
- The rationale for proposing a foreign entity to serve as the prime recipient;
- Country of incorporation;
- A description of the project’s anticipated contributions to the US economy;
- How the project will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the project will promote domestic American manufacturing of products and/or services;
- A description of how the foreign entity’s participation as the prime recipient is essential to the project;
- A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP; and
- Countries where the work will be performed (Note: if any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request for waiver of the Performance of Work in the United States requirement).

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

### **2. Waiver for Performance of Work in the United States (Foreign Work Waiver)**

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As set forth in Section IV.J.iii., all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the prime recipient should make every effort to purchase supplies and equipment within the United States. There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to perform work outside of the United States. A request to waive the *Performance of Work in the United States* requirement must include the following:

- The rationale for performing the work outside the U.S. (“foreign work”);
- A description of the work proposed to be performed outside the U.S.;
- An explanation as to how the foreign work is essential to the project;
- A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the US economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
- The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

## APPENDIX D – SUMMARY OF THE PACWAVE-SOUTH WAVE RESOURCE

NOTE: This appendix is applicable only to AOI3 Applications.

All devices must be designed for testing in the PacWave-South resource and test site that is summarized in Table AOI 3.

Table **AOI3**. Summary of the PacWave-South test site.

Site Specifications		Environment	
Number of berths	4	Environmental site characterization data	Meteorological data
Area of test site	6 nautical miles off the coast of Newport, OR	<b>Technical Capability</b>	
Depth of site	65-78 meters MLLW		
Site coordinates	NW: 44° 35' 00.00"N 124° 14' 30.00"W NE: 44° 35' 02.75"N 124° 13' 06.17"W SE: 44° 33' 02.75"N 124° 12' 58.51"W SW: 44° 33' 00.00"N 124° 14' 22.41"W	Data Acquisition Rated export capacity of berths: 20MW Connection Voltage: 12.47kV to CLPUD, berths configurable up to 30kV	
Nature of seabed	Soft, sandy bottom	<b>Infrastructure &amp; Support Facilities</b>	
Wave data facilities	Waverider buoys, or similar		
Mean annual wave power density	40 kW/m, varies with year and location	Site access, nearest ports	Via boat, Newport ( <a href="http://www.portofnewport.com">www.portofnewport.com</a> ) Toledo ( <a href="http://www.portoftoledo.org">www.portoftoledo.org</a> )
Wave Periods	5-17s		
Prevailing Wave Direction	WNW	Support facilities	Berthing & working areas, office facilities, boatyard
Sea States	The majority of sea states are within the range of $1\text{m} < H_{m0} < 3.5\text{m}$ and $7\text{s} < T_e < 11\text{s}$ , including extreme sea states caused by severe storms where $H_{m0}$ exceeded 7.5m.	Grid connection	Metered at point of connection to the Central Lincoln People's Utility District (CLPUD)

Sandia National Laboratories has performed a resource characterization study of the PacWave-South test site following the International Electrotechnical Commission Technical Specification (IEC 62600-101 TS) on Wave Energy Characterization. The discussion of the PacWave-South resource is available in the Sandia report posted on OpenEI at

[https://openei.org/wiki/Characterization\\_of\\_U.S.\\_Wave\\_Energy\\_Converter\\_\(WEC\)\\_Test\\_Sites](https://openei.org/wiki/Characterization_of_U.S._Wave_Energy_Converter_(WEC)_Test_Sites).

Applicants are encouraged to use the data describing the PacWave-South test site that is described in Part 2 of the report on pages 141-158 when developing their application if a detailed description of the wave resource is needed. Applicants may use other characterizations of the PacWave-South resource to which they have access but should justify why alternative resource characterization data is used.

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## APPENDIX E – GLOSSARY

Applicant – The lead organization submitting an application under the FOA.

Continuation application – A non-competitive application for an additional budget period within a previously approved project period. At least ninety (90) days before the end of each budget period, the Recipient must submit to EERE its continuation application, which includes the following information:

1. A report on the Recipient’s progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.
2. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.
3. A description of any planned changes from the negotiated Statement of Project Objectives and/or Milestone Summary Table.

Cooperative Research and Development Agreement (CRADA) – a contractual agreement between a national laboratory contractor and a private company or university to work together on research and development. For more information, see <https://www.energy.gov/gc/downloads/doe-cooperative-research-and-development-agreements>

Federally Funded Research and Development Centers (FFRDC) - FFRDCs are public-private partnerships which conduct research for the United States Government. A listing of FFRDCs can be found at <http://www.nsf.gov/statistics/ffrdclist/>.

Go/No-Go Decision Points: – A decision point at the end of a budget period that defines the overall objectives, milestones and deliverables to be achieved by the recipient in that budget period. As a result of EERE’s review, EERE may take one of the following actions: 1) authorize federal funding for the next budget period; 2) recommend redirection of work; 3) discontinue providing federal funding beyond the current budget period; or 4) place a hold on federal funding pending further supporting data.

Project – The entire scope of the cooperative agreement which is contained in the recipient’s Statement of Project Objectives.

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Recipient or “Prime Recipient” – A non-Federal entity that receives a Federal award directly from a Federal awarding agency to carry out an activity under a Federal program. The term recipient does not include subrecipients.

Subrecipient – A non-Federal entity that receives a subaward from a pass-through entity to carry out part of a Federal program; but does not include an individual that is a beneficiary of such program. A subrecipient may also be a recipient of other Federal awards directly from a Federal awarding agency. Also, a DOE/NNSA and non-DOE/NNSA FFRDC may be proposed as a subrecipient on another entity’s application. See section III.E.ii.

## APPENDIX F – DEFINITION OF TECHNOLOGY READINESS LEVELS

TRL 1:	Basic principles observed and reported
TRL 2:	Technology concept and/or application formulated
TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept
TRL 4:	Component and/or breadboard validation in a laboratory environment
TRL 5:	Component and/or breadboard validation in a relevant environment
TRL 6:	System/subsystem model or prototype demonstration in a relevant environment
TRL 7:	System prototype demonstration in an operational environment
TRL 8:	Actual system completed and qualified through test and demonstrated
TRL 9:	Actual system proven through successful mission operations

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## APPENDIX G – LIST OF ACRONYMS

AOI	Area of Interest
AEP	Annual Energy Production
CapEx and OpEx	Capital and Operational expenditures
CEC	Current Energy Converter
COI	Conflict of Interest
DEC	Determination of Exceptional Circumstances
DMP	Data Management Plan
DOE	Department of Energy
DOI	Digital Object Identifier
DRO	Deployment, Retrieval and Operation
EDES	Exemplary Design Envelope Specification, or the Design Envelope
EERE	Energy Efficiency and Renewable Energy
FAR	Federal Acquisition Regulation
FFATA	Federal Funding and Transparency Act of 2006
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FFRDC	Federally Funded Research and Development Center
GAAP	Generally Accepted Accounting Principles
IEC TS	International Electrotechnical Standard Technical Specifications
IEEE	Institute of Electrical and Electronics Engineers
IOM	Installation, Operations, and Maintenance
IPMP	Intellectual Property Management Plan
M&O	Management and Operating
MPIN	Marketing Partner ID Number
MEC	Marine Energy Converter
MHK	Marine and Hydrokinetic
MYPP	Multi-Year Program Plan
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Agency
NREL	National Renewable Energy Laboratory
OMB	Office of Management and Budget
ORNL	Oak Ridge National Laboratory
OSTI	Office of Scientific and Technical Information
PII	Personal Identifiable Information
PSH	Pumped Storage Hydropower
R&D	Research and Development
RFI	Request for Information
RFP	Request for Proposal

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SAM	System for Award Management
SOPO	Statement of Project Objectives
SMH	Standard Modular Hydropower
SNL	Sandia National Laboratories
SPOC	Single Point of Contact
TIA	Technology Investment Agreement
TRL	Technology Readiness Level
UCC	Uniform Commercial Code
WBS	Work Breakdown Structure
WP	Work Proposal

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<sup>i</sup> Conference Report, S. Rep, NO. XX-XXX, At pg (YEAR)

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