Defining the SMH Project

The Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL) are laying the groundwork for a community of resource stewardship and development with a shared understanding of how small-scale, cost-optimized hydroelectric energy production can be compatible with and even enhance the existing uses and functions of natural streams. The Standard Modular Hydropower (SMH) project contemplates future hydropower facilities as integrated combinations of standard and validated modules, each with a primary objective, multiple functional requirements, and multiple design constraints.

Project Goals

This endeavor pursues scientific understanding regarding how to design, simulate, validate, and demonstrate a standard, modular facility at full scale that achieves low-cost and environmentally compatible design features. The SMH research and development further aims to

- facilitate stakeholder involvement across the hydropower development community to determine the objectives, functional requirements, and design constraints for the SMH prototype
- provide a framework to integrate stream functionality, standardization, and modularity throughout the hydropower project development life cycle
- enable increased acceptance, reduced costs, increased predictability of outcomes, and increased value to stakeholders

Project Applicability

DOE has identified roughly 12 GW of potential hydropower capacity at existing non-powered dams and 65 GW of potential hydropower capacity in un-impounded streams across the United States. SMH technology will be applicable to these resources. The SMH emphasis on preserving stream functionality with environmentally compatible, cost-optimized applications will increase the likelihood and breadth of successful development of this potential.

SMH Modules

The SMH project considers future small hydropower facilities as integrated systems of individual, standardized modules. An SMH module has dedicated functionality, and operates individually and in tandem with other modules at a site. The following are the modules and their objectives (see Figures 1 and 2):

- Passage modules. Adequately pass water, sediment, debris, aquatic life, and/or small recreational craft past an SMH facility.
- Generation modules. Generate hydroelectric power from flowing water under pressure.
- Foundation modules. Provide stability and support to SMH infrastructure by anchoring adjacent modules to the streambed and banks.

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Research Efforts

SMH research efforts are organized into four Research Pillars: Exemplary Design Envelope Specification, Simulation and Modeling Capability, Site Classification Scheme, and Testing and Validation Capability. Each pillar requires a unique dialogue with and feedback from the hydropower stakeholder community.

**Site Classification Scheme:** organizing a set of watershed, stream, and site attributes with a distinct and standardized classification scheme. The scheme will inform module design and determine which modules are needed to ensure environmentally compatible development and operation of a site.

**Exemplary Design Envelope Specification:** identifying and specifying the unique module and system functionalities, objectives, requirements, and constraints that define holistic SMH facility design.

**Simulation and Modeling Capability:** enabling improved SMH designs, performance, safety, environmental compatibility, reliability, manufacturability, and cost optimization through computational and numerical models and simulations.

**Testing and Validation Capability:** enabling module design testing and validation at partial or full scale to improve and optimize safety, performance, and reliability.

For an illustration of the SMH research efforts, see Figure 3.

Research Outcomes

Successful research and development outcomes will include a stakeholder-validated framework for site classification, exemplary design specifications, modeling tools, and testing facilities that demonstrate the benefits of using SMH technology. The framework will guide future development interests and allow DOE to partner with industry, stakeholders, and other investment partners to advance the deployment and adoption of SMH technologies.

More information on the SMH project is available at [http://hydropower.ornl.gov/smh/](http://hydropower.ornl.gov/smh/)

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Figure 2: Conceptual diagram of SMH facility and modules

Figure 3: Overview of the relationship between stakeholders, SMH Research Pillars, and desired outcomes of the SMH research effort