

Hydropower Track 1: Grid Reliability and Resilience, New Technology and Modernization

Technology R&D for Low-Impact Hydro Growth

Hydropower Program

Wednesday October 9, 2019

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Water Power Technologies Office

Hydropower Program Strategic Priorities

Environmental R&D and Hydrologic Systems Science

Big-Data Access and Management

Technology R&D for
Low-Impact
Hydropower Growth

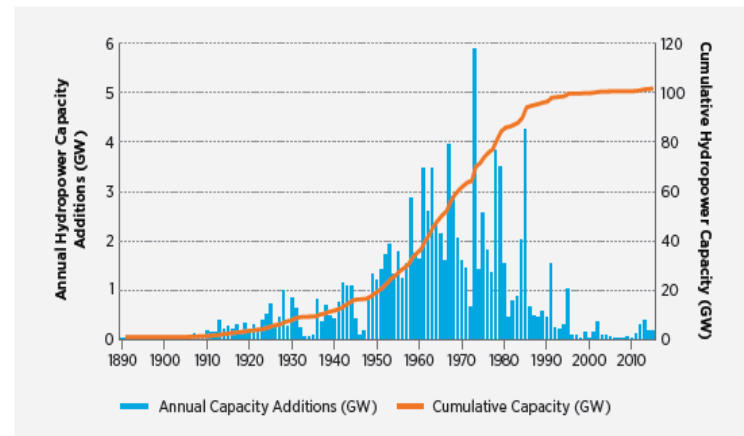
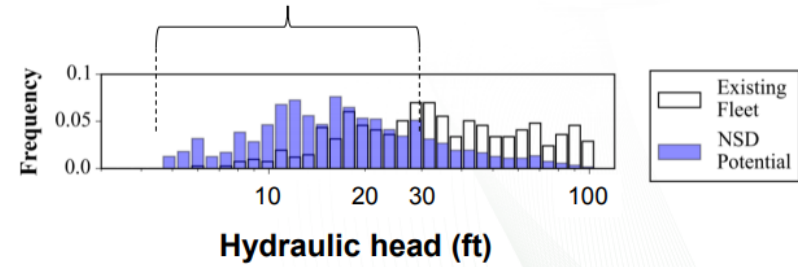
R&D to Support
Modernization,
Upgrades and Security
for Existing Hydropower
Fleet

Understand, Enable,
and Improve
Hydropower's
Contributions to Grid
Reliability, Resilience,
and Integration

Challenges

- Remaining new hydropower resources (including non-powered dams and new stream-reaches) are **smaller, lower-head, more diverse and distributed**, and require new technologies to be **cost-competitive**.
- Conventional hydropower designs/systems can have **significant environmental impacts** that are often uncertain, complex, and require difficult and expensive mitigation measures.
- There is a **lack of infrastructure and capabilities** to test and validate new technologies and designs.

Majority of NSD sites are **low-head** (< 30ft) compared to existing fleet



Technology R&D for Low-Impact Hydropower Growth

- Enable the design and development of new technologies for both existing water infrastructure and new stream-reach development. This new approach to systems design for hydropower projects incorporates ecological and social objectives for river systems earlier in design processes.
- Leverage new advancements in manufacturing and materials to dramatically lower costs of SMH components and systems designs.
- Support development of necessary testing infrastructure for new technologies.



New Stream Reaches



Conduits and Canals



Non-Powered Dams

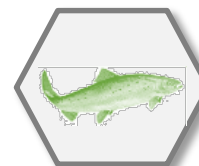
Technology R&D for Low-Impact Hydropower Growth

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Standard Modular Hydropower: ORNL-led multi-year effort to establish *standardization, modularity, and environmental compatibility* as the three enabling principles of a low-cost, environmentally sustainable hydropower growth strategy.



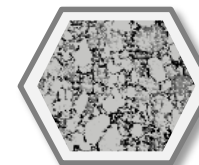
**Recreation
Passage**



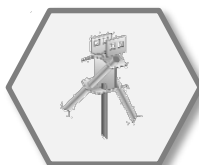
**Fish
Passage**



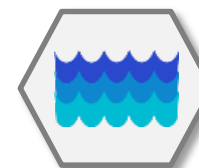
Generation



**Sediment
Passage**



Foundation



**Water
Passage**

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- Potential enhancements enabled by advanced manufacturing include:
 - ❖ Simplified assemblies with fewer bolted connections
 - ❖ Reduced manufacturing labor costs
 - ❖ Increased strength-to-weight ratios
 - ❖ Improved durability
 - ❖ Complex shapes and flow passages
 - ❖ Lower operational and maintenance costs
 - ❖ Embedded sensors to monitor machine condition and aquatic system health

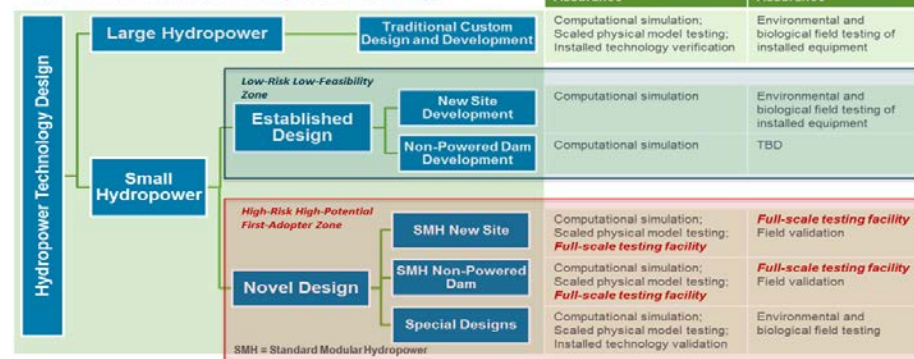
RFI forthcoming!



Technology R&D for Low-Impact Hydropower Growth

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The testing and validation needs for hydropower technology depend on the scale and maturity of the technology.

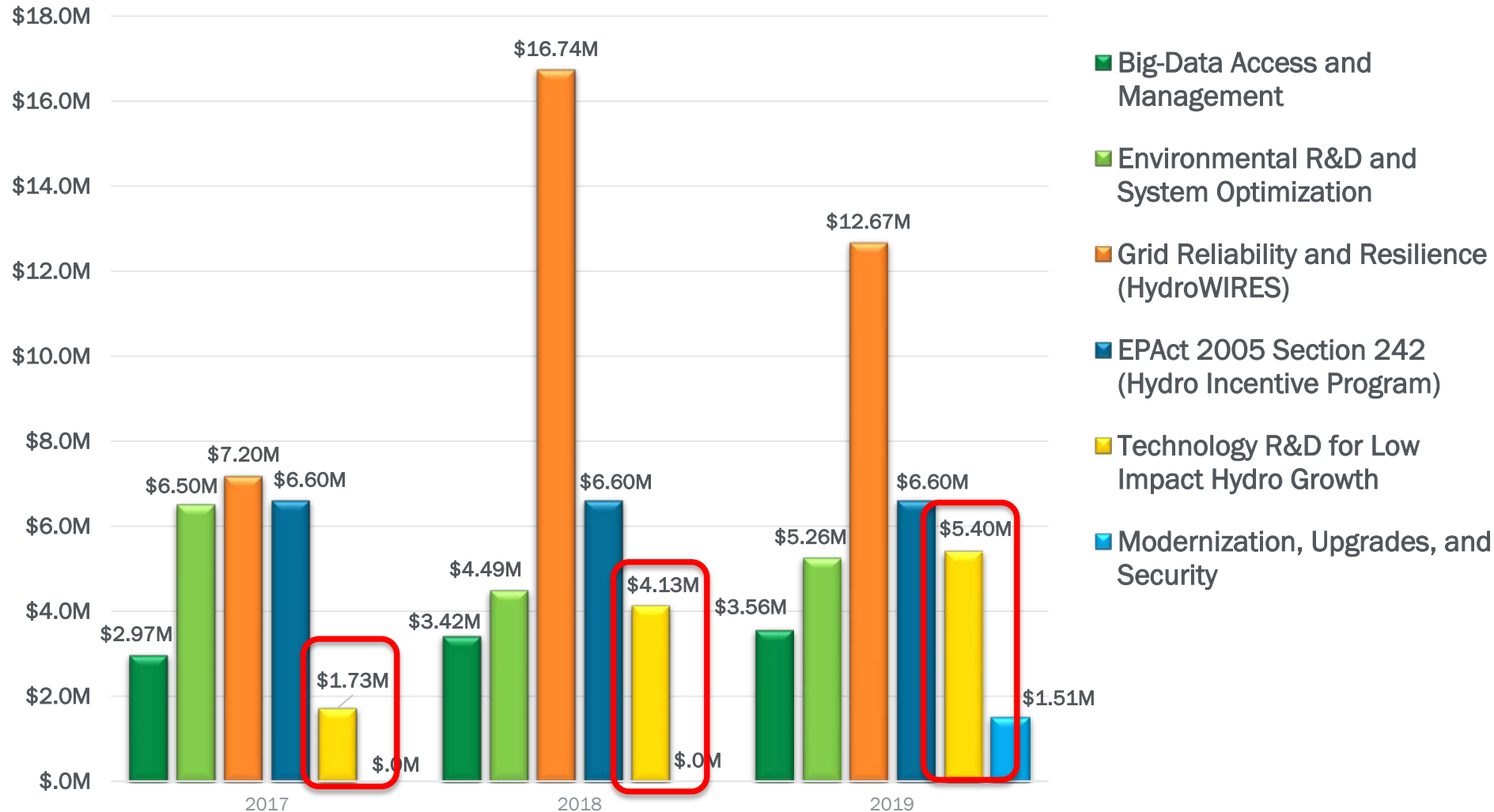


2016 ORNL Report: A Full-scale Testing Capability for Innovative Small Hydropower Technology



FY20 House Mark: “Not less than \$1M is provided to explore using existing government assets, including infrastructure operated by the U.S. Army Corps of Engineers and any necessary agreements that would be required to **establish a hydropower research and development test facility.**”

Program Management Approach



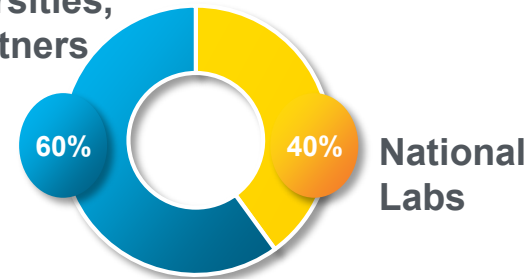
National Laboratories

- Foundational research, national resource assessments, data gathering and dissemination, high-performance computational modeling and simulation, and testing capabilities

Industry and University Partners

- Technology innovation, application of foundational concepts, and tests/demonstrations

Industry, Universities,
and Other Partners



Technical Assistance

- Provides industry partners with access to DOE's national laboratories, helping them tap resources to overcome critical technology challenges



2014

Water Power Manufacturing

- Eaton Corporation
- Pennsylvania State University

2015

Innovative Technologies for Low-Impact Hydro

- Littoral Power Systems
- Percheron Power
- Composite Technology Development

2016

Innovative Technologies to Advance Non-Powered Dam Development

- Natel Energy

Facility Design Concepts for Standard Modular Hydropower Development at New Stream Reaches

Standard Modular Hydropower Development at Low-Head Non-Powered Dams

Foundational Research at ORNL:

- Module Design Specification
- Site Classification Tool
- Baseline Engineering Design and Costs

\$2M

Advanced Manufacturing for Development of New Standard Modules

\$5M

2016

2017

2018

2019

2020

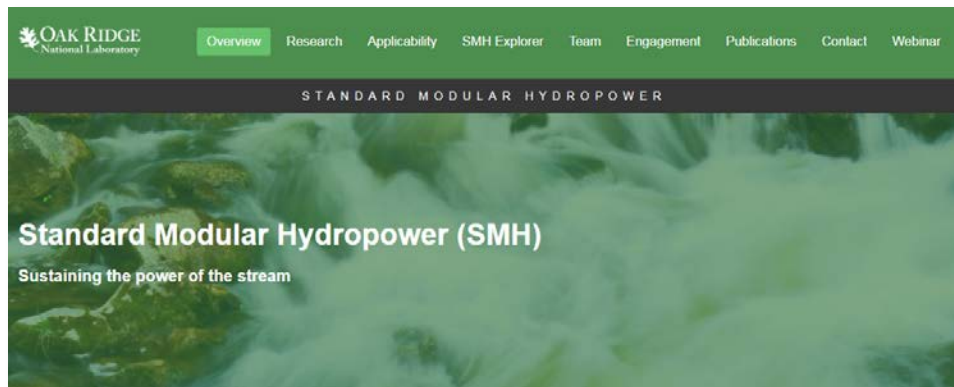
- **Planning, hosting, and facilitation of workshops and summits:**
 - Hydropower Executive Summit (FY18, FY19)
- **Participating in industry groups:**
 - NHA Small Hydro Council
 - NHA Hydraulic Power Committee
 - NHA Water Innovation Council
 - CEATI Hydraulic Plant Life Interest Group
 - CEATI Hydropower Operations and Planning Interest Group
 - IEA Annex XVI Hidden Hydro
- **Other:**
 - Conference presentations (e.g., HydroVision, Water Power Week, CEATI Annual Conference)
 - NHA Webinar Series

Stakeholder Engagement, Outreach, and Dissemination



hydrosource.ornl.gov

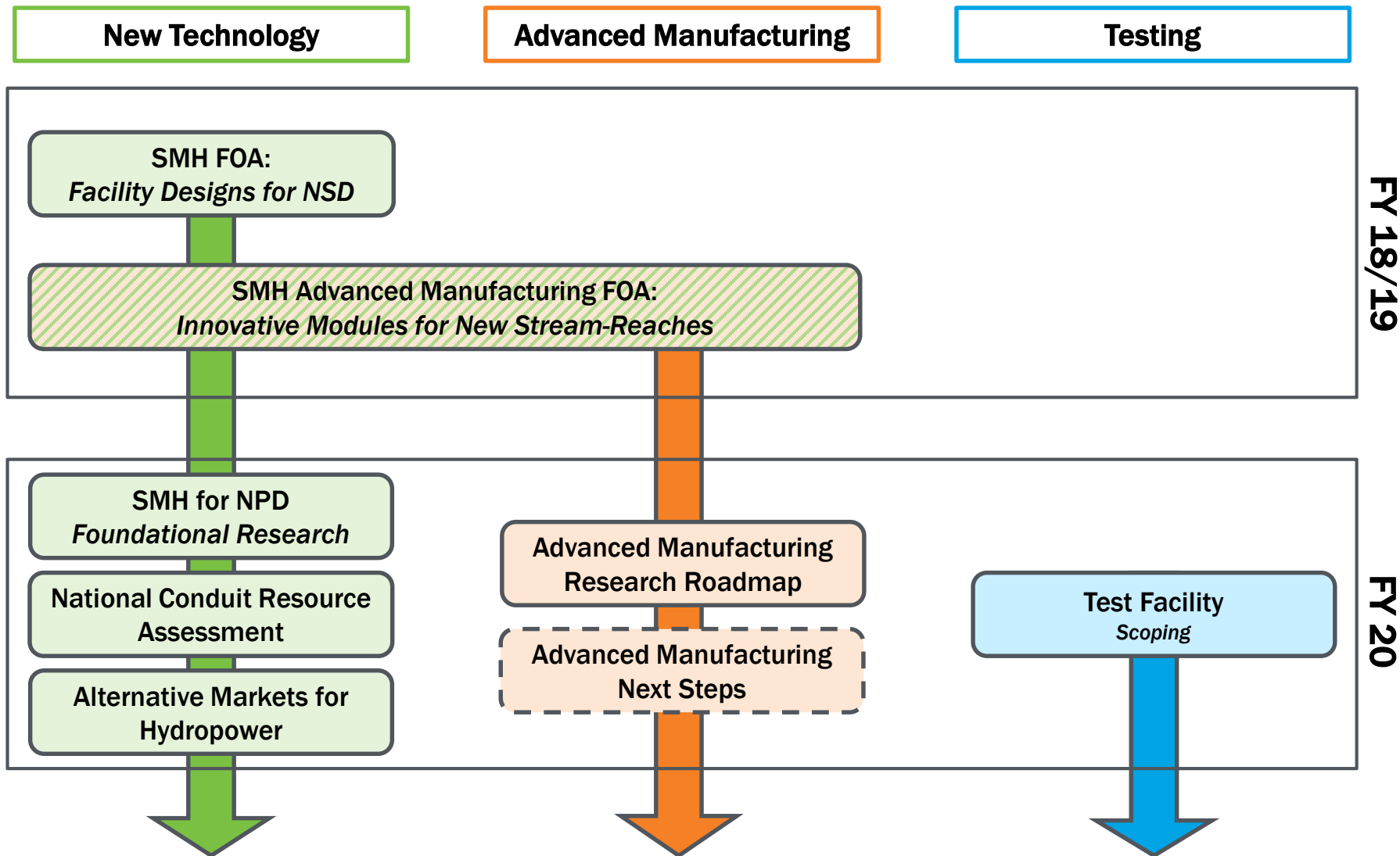
- Resource Assessments for New Stream Reaches and Non-Powered Dams



smh.ornl.gov

- Publications
- Tools (Design Envelope, Site Classification)

Demos every HydroVision at the DOE Booth!



Track 1: Wednesday, October 9th

Start	End	Agenda Session	Presenter	Affiliation	Track
1:15 PM	1:35 PM	Overview of Technology R&D for Low-Impact Hydro Growth	Marisol Bonnet	WPTO	New Tech+Mod
1:35 PM	1:45 PM	Introduce FOAs 1006, 1286, 1455	Marisol Bonnet	WPTO	New Tech+Mod
1:45 PM	2:15 PM	Modular Roots-Based Rotor Turbine-Generator System for Small Hydro	David Yee	Eaton Corporation	New Tech+Mod
2:15 PM	2:45 PM	Rapidly Deployable Advanced Integrated Low Head Hydropower Turbine Prototype	Arnie Fontaine	Pennsylvania State University	New Tech+Mod
2:45 PM	2:55 PM	Coffee Break			
2:55 PM	3:25 PM	Optimized Composite Prototype for Archimedes Turbine Manufacture	Marisol Bonnet (on behalf of Percheron)	Percheron Power, LLC	New Tech+Mod
3:25 PM	3:55 PM	The Design and Development of a Composite Hydropower Turbine Runner	Paul Fabian	Composite Technology Development, Inc.	New Tech+Mod
3:55 PM	4:25 PM	A Cost-Disruptive, Low-Impact, Modular Form Factor Low-Head Hydropower System	David Duquette	Littoral Power Systems, Inc.	New Tech+Mod
4:25 PM	4:55 PM	Efficient, Modular Low-Head Linear Pelton Turbine with Simple, Low-Cost Civil Works	Abe Schneider	Natel Energy	New Tech+Mod
4:55 PM	5:40 PM	Standard Modular Hydropower Technology Acceleration	Brennan Smith	ORNL	New Tech+Mod
5:40 PM	6:00 PM	End of Session Networking Activity	All recent presenters	All recent presenters	New Tech+Mod

Track 1: Thursday, October 10th

Start	End	Agenda Session	Presenter	Affiliation	Track	Room
10:20 AM	10:30 AM	Introduce Laboratory Projects	Tim Welch	WPTO	New Tech+Mod	Washington /Jefferson
10:30 AM	11:00 AM	An Assessment of Conduit Hydropower Potential at Public Drinking Water Systems—Pilot Study	Shih-Chieh Kao	ORNL	New Tech+Mod	Washington /Jefferson
11:00 AM	11:30 AM	Solid State Processing for Improved Performance of Current and Next-Generation Hydropower Components	Ken Ross	PNNL	New Tech+Mod	Washington /Jefferson
11:30 AM	11:50 AM	End-of-Session Networking Activity	All recent presenters	All recent presenters	New Tech+Mod	Washington /Jefferson
11:50 AM	12:25 PM	Hydro New Tech + Mod Peer Reviewer Only Meeting				Madison
12:25 PM	1:15 PM	Lunch				

New Technology and Modernization Peer Review Panel

- Greg D. Lewis, Duke Energy (Hydro Review Chair/Panel Lead)
- David Hanson, Retired (formerly Sacramento Municipal Utility District)
- David Sinclair, Advanced Hydro Solutions
- Steve Lewis, Sapere Consulting



THANK YOU, REVIEWERS!

- Project presentations will be kept to a strict 20 minutes, with 10 minutes of Q&A following, unless otherwise stated on the agenda.
- A yellow card will be flashed at the last 5 minutes, and then a red card will be held when time is up.
- Please respect your fellow presenters by keeping within your allotted time.
- The Review Panel Lead will kick off the Q&A, then allow questions from the other reviewers, and then the audience, time permitting.
- Any questions left unanswered due to time limitations can be addressed during the End-of-session Networking Activity.

