



Furthering Advancements to Shorten the Time (FAST) to Commissioning for Pumped Storage Hydropower (PSH) Prize

Cooperative Research and Development Final Report

CRADA Number: CRD-19-00837

NREL Technical Contact: Tessa Greco

**NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC**

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Contract No. DE-AC36-08GO28308

Technical Report
NREL/TP-5700-79871
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NOTICE

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Cooperative Research and Development Final Report

Report Date: March 31, 2021

In accordance with requirements set forth in the terms of the CRADA agreement, this document is the final CRADA report, including a list of subject inventions, to be forwarded to the DOE Office of Scientific and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Move the Peak, LLC and Battelle Memorial Institute, Management and Operator Contractor for the Pacific Northwest National Laboratory (PNNL)

CRADA Number: CRD-19-00837 (PNNL CRD 457)

CRADA Title: Furthering Advancements to Shorten the Time (FAST) to Commissioning for Pumped Storage Hydropower (PSH) Prize

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Sponsoring DOE Program Office(s):

Office of Energy Efficiency and Renewable Energy (EERE), Water Power Technologies Office

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources a/k/a Government In-Kind
Year 1	\$7,500.00
Year 2, Modification #1	\$.00
Year 3, Modification #2	\$.00
Year 4, Modification #3	\$.00
TOTALS	\$7,500.00

Executive Summary of CRADA Work:

The National Renewable Energy Laboratory (NREL) initiated a Prize with support from Argonne National Laboratory (ANL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL), and sponsored by the U.S. Department of Energy Water Power Technologies Office (DOE WPTO) to encourage ideas to reduce the time to

commissioning for PSH projects. As a result, nine finalists have been chosen to develop their concepts in advance of the FAST Prize Pitch Contest to be held on October 7, 2019. The national labs will provide technical and business advisement to the noted FAST Prize finalists in preparation for this Pitch Contest.

Summary of Research Results:

Task 1: Technical and business support provided by the national laboratories to develop finalist concepts in advance of Pitch Day. The technical advisement includes narrowing scope of concept, light economic feasibility analysis support, light modeling support, and connecting with appropriate industry partners. Completed by October 7, 2019.

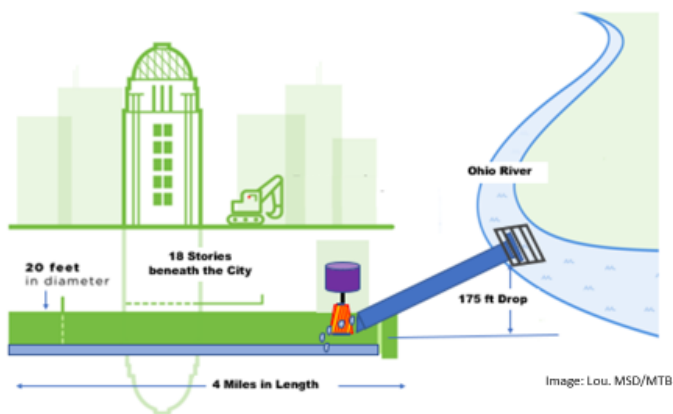
NREL and PNNL worked with Move the Peak to provide specific technical guidance on their concept for “Accelerating Pumped Storage Hydro Using Existing Infrastructure”. The existing infrastructure is combined sewer overflow tunnels. During the 3-month period prior to the Pitch Day, NREL and PNNL held regularly occurring calls with the team from Move the Peak, LLC to ensure they were prepared for the live Pitch.

Images of the developed slide deck are included below. NREL specifically advised Move the Peak, LLC on the need to address national scalability of the technology innovation, as well as clearly identifying the cost and time savings associated with implementing this innovation for PSH.

Our Benchmark Example:

Louisville Kentucky’s Waterway Protection Tunnel A 55 Million Gallon Pumped Storage Reservoir

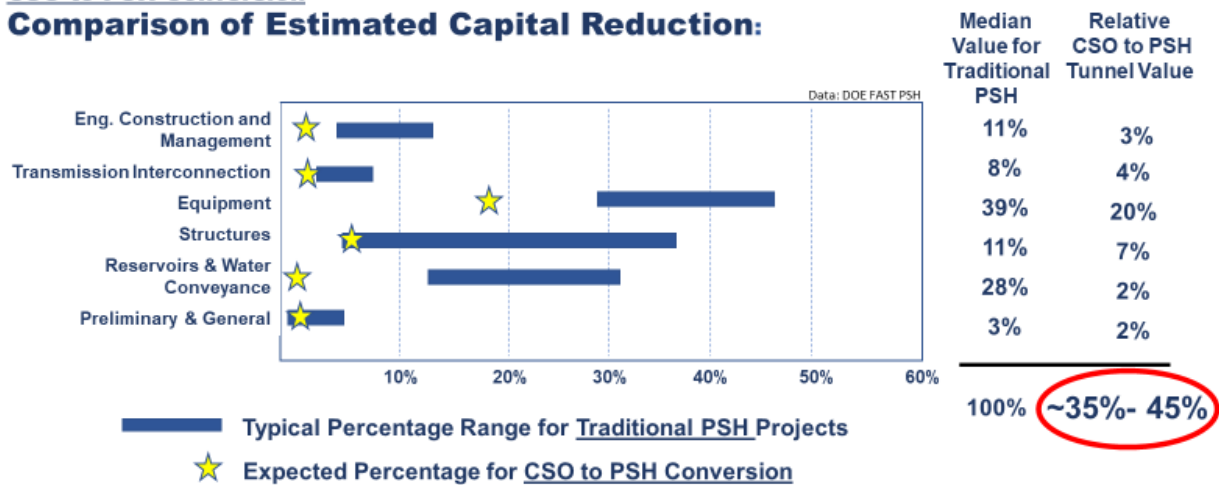
- An Existing 4 Mile-long, \$200M Low Elevation Reservoir buried 175 ft beneath the City of Louisville KY.
- Ohio River will be the Upper Reservoir.
- System is sized, designed and being constructed to:
 - ❖ Capture 55M gallons of water,
 - ❖ Treat water if needed
 - ❖ Pump the water into the Ohio River once cleaned.
- PSH Upper and Lower reservoir & Pumping Equipment are already in place.
- Tunnel CSO usage predictions indicate approximately 300 days per year of PSH availability.



55M Gallons of water falling 175ft has the potential to produce approximately 24 MWh of Energy

Figure 1: Slide 3 showing specific application of the PSH using CSO tunnels concept

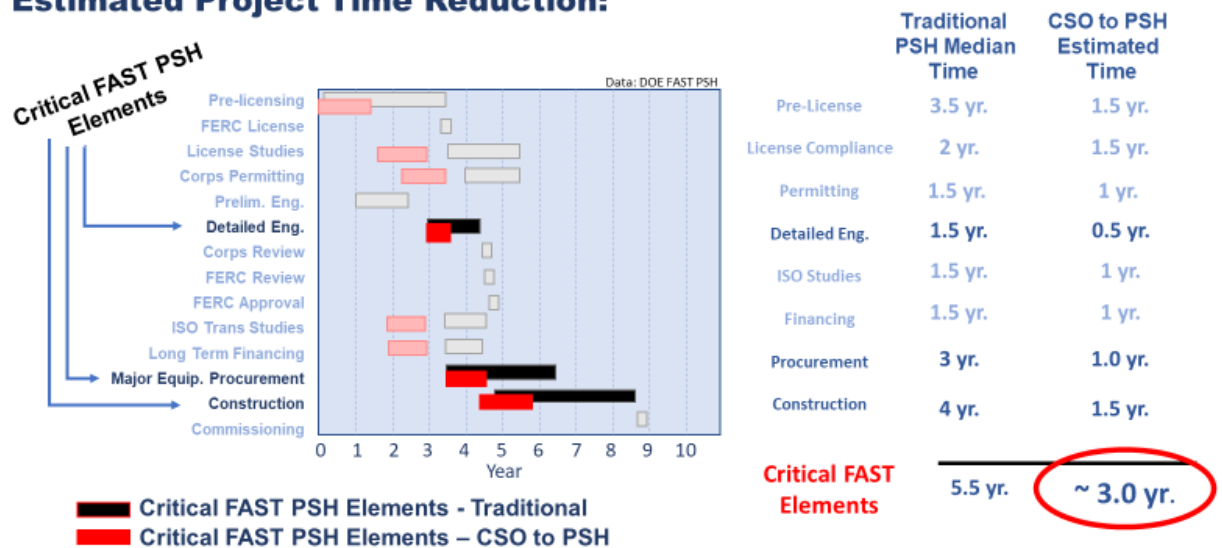
**CSO to PSH Conversion
Comparison of Estimated Capital Reduction:**



CSO to PSH Conversion has the Potential to reduce estimated Initial Capital Costs by approximately 60%

Figure 2: Slide 5 showing the cost reduction for PSH utilizing the CSO tunnel concept

**CSO to PSH Conversion
Estimated Project Time Reduction:**



Usage of CSO Tunnels could reduce Estimated FAST PSH Time Elements by ~ 40% to 50%

Figure 3: Slide 6 showing the time reduction for PSH development using the CSO tunnel concept

A press release was issued once finalists were chosen for the Pitch Contest which names Charles Smith and Move the Peak as one of the finalists to advance in the FAST Prize:

<https://www.nrel.gov/news/press/2019/nrel-names-fast-prize-concept-stage-winners.html#:~:text=The%20FAST%20Prize%E2%80%94which%20stands,reducing%20both%20cost%20and%20risk.>

Task 2: National laboratories will provide support with preparation of the Pitch Day materials including the technical volume and the presentation and associated pitch. The business pitch support includes coaching and preparation for Pitch Day and connecting with appropriate industry partners. Completed by October 7, 2019.

NREL and PNNL worked with Move the Peak, LLC over the 3-month period prior to the FAST Prize Pitch Contest, held on October 7, 2019 at the DOE EERE WPTO Water Power Peer Review meeting in Alexandria, VA to develop their pitch presentation to ensure all components and objectives of the Prize were included in their presentations. Vital components which NREL and PNNL supported in this development phase were presented in how their solution addressed reducing the time, risk and cost associated with PSH development. Move the Peak, LLC was not chosen as a winner of the FAST Prize, as noted in the press release as follows:

<https://www.nrel.gov/news/press/2019/nrel-names-fast-competition-grand-prize-winners.html>

Task 3: The Principal Investigator agrees to provide the following to DOE Office of Scientific and Technical Information (OSTI): (1) an initial abstract suitable for public release at the time the CRADA is executed; (2) a final report, within thirty (30) days upon completion or termination of this CRADA, to include a list of Subject Inventions; and (3) other scientific and technical information in any format or medium that is produced as a result of this CRADA.

With the completion of the CRADA final report, this task is complete. There is no other scientific or technical information to include or disclose as part of this CRADA.

Subject Inventions Listing:

None

ROI #:

None