

1.4.1.401 – Fish Protection Prize



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Project Overview

Project Summary

- The Fish Protection Prize sought new solutions, designs, and strategies to prevent fish from swimming into water infrastructure, such as water diversions and pipes and intakes at hydropower dams. Participants submitted innovative ideas to advance fish exclusion technology.
- WPTO collaborated with the U.S. Bureau of Reclamation on the Fish Protection Prize to inspire innovators to compete for \$700,000 of combined cash prizes and voucher support to help protect fish from these threats.
- Five experts in fish passage and protection served as reviewers in the Pitch Contest, and represented a number of federal and state agencies, including the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), Oak Ridge National Laboratory (ORNL), Washington Department of Fish and Wildlife, and American Fisheries Society (AFS). Three finalists were selected as Grand Prize winners.

Intended Outcomes

- Crowdsource a variety of solutions for a broad range of fish and technology types (canals, diversions, intakes of hydropower dams)
- Catalyze new solutions to improve fish exclusion technology
- Provide laboratory vouchers to enable testing and proof of concept to advance ideas.

Project Information

Principal Investigator(s)

- Tessa Greco, NREL
- Brian Bellgraph, PNNL

Project Partners/Subs

- Bureau of Reclamation

Project Status

Complete

Project Duration

- 2/1/2020
- 9/30/2021

Total Costed (FY19–FY21)

\$261,613 (NREL)



About the Fish Protection Prize

- Competition for \$700,000 in cash and prizes.
- Seeks to catalyze new solutions, designs, and strategies to improve fish exclusion technology by decreasing the numbers of entrained fish from river and canal diversions, unscreened diversion pipes, or intakes at hydropower dams.
- Proposed solutions can include:
 - Radical new ideas/technology
 - Fish exclusion ideas for any U.S. freshwater or migratory riverine species of concern at any life stage.

Project Objectives: Relevance and Approach

Relevance to Program Goals:

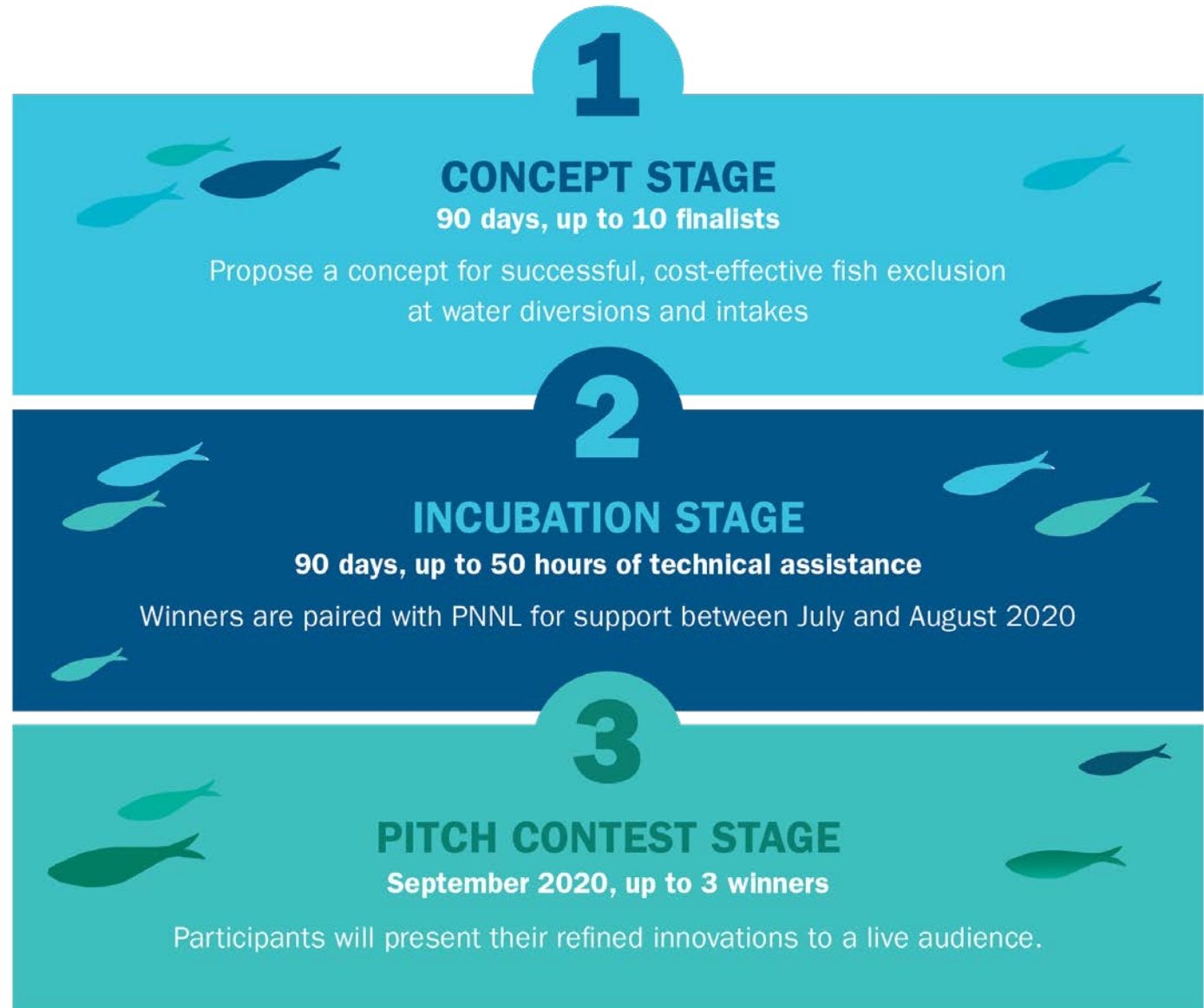
- **Addressing environmental impacts and hydrologic uncertainties:** *Develop monitoring and mitigation technologies to improve environmental performance.*
 - The development of water resource infrastructure and operational criteria must conform to federal and state regulations that protect the environment and public health and safety. One specific environmental concern is the movement of aquatic species, most notably fish, out of natural habitats and into unnatural environments, which may result in injuries or mortality. This movement is referred to as “entrainment.” Opportunities to reduce entrainment at diversions and intakes will promote more sustainable and reliable water resource systems that can provide public benefits to a larger extent.

Approach:

- The prize consisted of three stages that provided the structure and resources needed to move methods for protecting fish from water diversions and intakes from initial concept, to technical design, to prototyping, to field-tested systems.
- This prize built on the initial Fish Exclusion Prize, run by the Bureau of Reclamation, released on March 6, 2019. The winners of the first prize were announced in December 2019. This next three-staged prize asked participants to share their innovative approach—along with a design and research plan—for keeping fish away from water diversions and intakes.
- The three stages were:
 - **Concept:** A short concept application was submitted proposing a concept for successful, cost-effective fish exclusion at water diversions and intakes.
 - **Incubation:** Finalists were paired with the Pacific Northwest National Laboratory to advance their concepts and prepare for the pitch contest.
 - **Pitch Contest:** Finalists presented their pitches virtually to an expert panel of reviewers at the 2020 American Fisheries Symposium.

Contests

- **Three-stage contest** aimed at accelerating innovative solutions to advance fish exclusion technology.
- **Pathway provided for:**
 - Initial concept
 - Technical assistance
 - Pitch contest.



Project Objectives: Expected Outputs and Intended Outcomes

Outputs:

- Fish Protection Prize branding and marketing material (NREL, PNNL)
- Fish Protection Prize Website (NREL)
- Executed pitch day and select 1st, 2nd, and 3rd prize winners live during the virtual American Fisheries Society Conference in 2019 (NREL, PNNL)
- Survey to contestants summarizing the Fish Protection Prize metrics and tracking engagement with teams (NREL)
- Participation of winners in a symposium at the Fish Passage Conference in June 2022 where results from the prize were presented to a technical audience
- Final webinar showcasing the winning teams and their progress made since the Pitch Contest (NREL, PNNL)
- Final closeout video highlighting 3 winning teams (NREL).

Outcomes:

- The Fish Protection Prize sought fish exclusion concepts in the highest opportunity areas:
 - Sensory deterrents
 - Turbulence and velocity-based deterrents
 - Combination stimulus barriers
 - Diversion or intake layouts and geometry
 - Fish screen materials or coatings
 - Fish screen cleaning methods.
- The Fish Protection prize sought to build on the Phase 1 Fish Exclusion Prize, initiated and run by the Bureau of Reclamation.
- WPTO and Reclamation sought to build on the success of the Fish Exclusion Prize and open it to a broader audience that would focus on hydropower dam exclusion technologies. By doing this, the Fish Protection Prize attracted a good balance of new and revamped concepts.
- By investing cash and technical voucher support, WPTO and Reclamation intended greater chance of success and commercialization opportunity for the winners of the prize.
- Concepts that did not advance through the competition are being considered for research opportunities within Reclamation.

Project Timeline

FY 2020

(Jan.–March) Concept Stage

(June–Sept.) Incubate Stage

(Sept.) Pitch Contest held virtually at the American Fisheries Symposium

FY 2021

(Oct. 2020–Sept. 2021)
Voucher support provided to winners

FY2022

(Oct. 2021–Sept. 2022)
Voucher support provided to winners

(Aug. 2022) Final webinar for Fish Protection Prize winners

Project Costs

Lab	FY20	FY21	Total Actual Costs FY20–FY21
	Costed	Costed	Total Costed
NREL	\$177,941	\$83,672	\$261,613
PNNL			

Project Awards and Budget

	Cash	PNNL R&D Vouchers
First Place	\$200,000	\$100,000
Second Place	\$125,000	\$100,000
Third Place	\$75,000	\$100,000
Total: \$700,000	\$400,000	\$300,000

	Contribution	Breakdown
DOE WPTO	\$780,000	\$530,000 PNNL R&D Vouchers and CRADAs \$250,000 NREL Prize Admin
Bureau of Reclamation	\$500,000	\$400,000 Cash Prizes \$100,000 Vouchers

End-User Engagement and Dissemination

The external engagement strategy for the Fish Protection Prize was multi-pronged, as follows:

- Strategic Outreach and Promotion Network: Made up of experts in hydropower and fish exclusion from industry, academia, government, and research institutions to inform the Prize marketing strategy and rules development.
- Prize Advertisement: The Prize team engaged with the hydropower and fish passage industries to maximize the potential applicant pool reach.

End-User Engagement and Dissemination

- Intended beneficiaries of the Fish Protection Prize were:
 - WPTO – The WPTO partnered with the Bureau of Reclamation on this second iteration of the prize to broaden the potential attraction of applicants, and to merge the hydropower and fish exclusion communities into one collaborative platform.
 - Bureau of Reclamation – Reclamation utilized their involvement and investment in the prize to learn of fish exclusion technology advancements and explore the application potential within their own facilities in the Western United States.
 - Fish Exclusion Industry and Research Community – The prize served the fish exclusion research community and industry by introducing technology advancements and injecting cash and technical support into the sector in a crowdsourced, and low-barrier-to-entry format.
 - Hydropower Industry – Results from the Fish Protection Prize were meant to introduce creativity and new ideas into the fish exclusion for hydropower community.

Performance: Accomplishments and Progress

- [Fish Protection Prize Rules Document](#)

Three Grand Prize winners were selected based on their innovative ideas, winning pitches, and strong submission packages.

Proposal Name	Team
<u>Deal with the Devil Fish: Biometric Screen</u>	Alden Research Labs – Benjamin Mater (PI) Former ORNL Aquatic Biologist – Charles Coutant (Co-PI)
<u>Fish Diversion Materials and Inspection Improvement Coating</u>	Nicholas LaBry's team / Prometheus Innovations, LLC
<u>The Center Sender</u>	Sterling Watson's team / Natel

First Place Winner: Alden - Deal with the Devilfish: Biometric-Informed Screening Technology

Summary: Mimics filtering structures in fish for application to screening technologies to prevent fish from entering diversions and intakes through the creation of interstitial eddying, ricochet deflection, and turbulence generation.

Key Features:

- Perform computational fluid dynamics (CFD) modeling to develop a design for a fine version (~1 mm) and a coarse version (~1–10 cm) model of a screening device like a wedge wire screen.
- Will be compatible with existing infrastructure.
- Potential to reduce entrainment of fish ranging from 3 to 15 cm long, and eggs/larval fish 2–3 mm in size.

PNNL Technical Assistance: Additional CFD and physical modeling was proposed at Alden Laboratory.

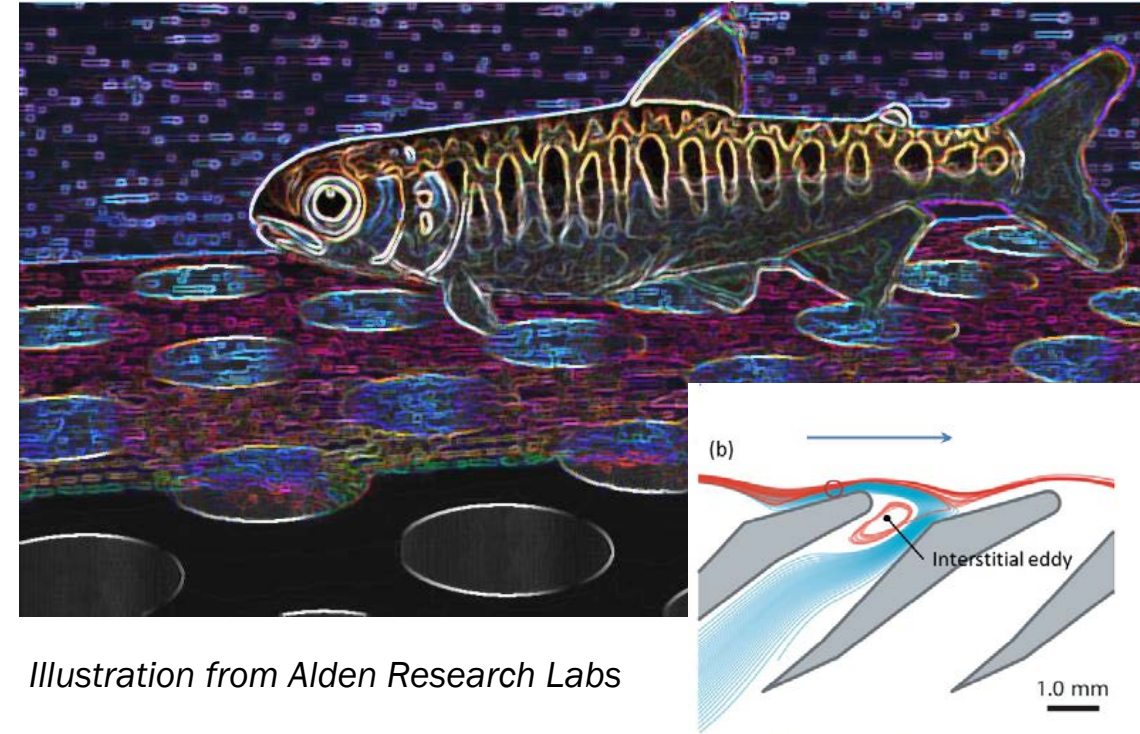


Illustration from Alden Research Labs

Team:

Alden Research Labs – Benjamin Mater (PI)

Former ORNL Aquatic Biologist – Charles Coutant (Co-PI)

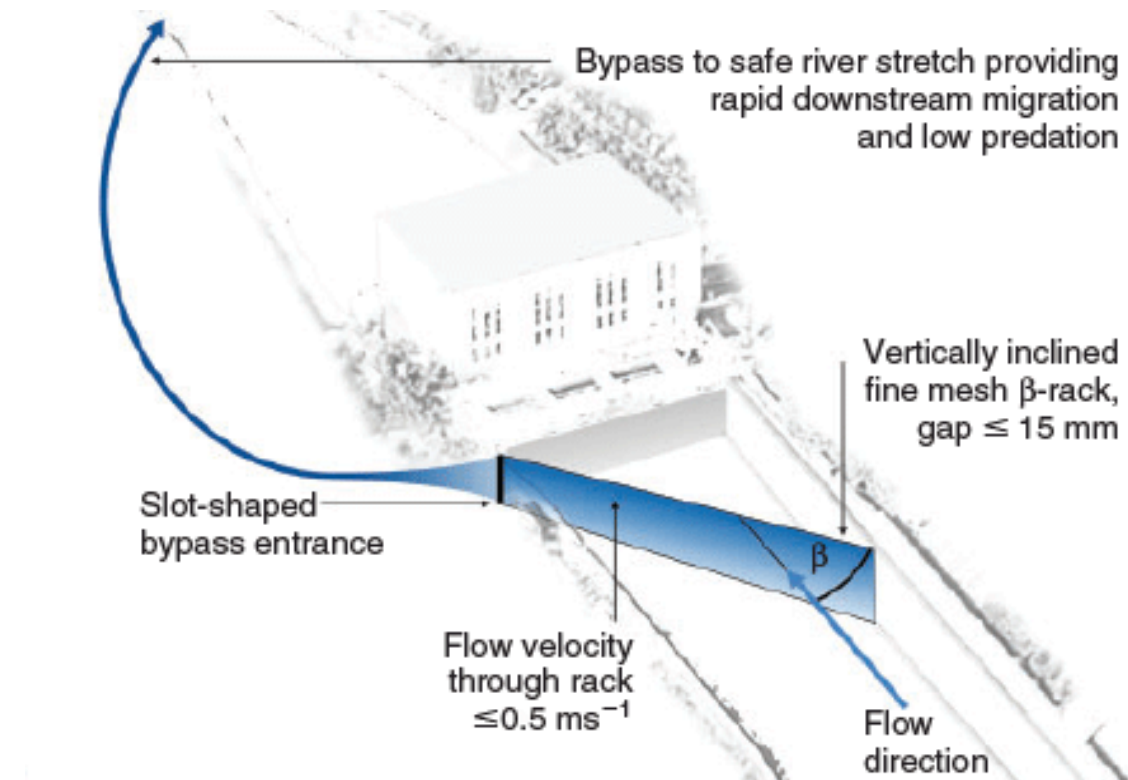
Second Place Winner: Prometheus - Fish Diversion Material & Inspection Improvements Coating

Summary: Utilizes glass microspheres with high-resolution, parallel-beam acoustic imaging to provide a large field of view in any water turbidity. This will improve the acoustic response and robustness of the high-density polyethylene (HDPE) material family used in netting and screening for fish diversion solutions. There are other applications as well.

Key Features:

- Incorporate glass microspheres into ultra-high-molecular-weight polyethylene (UHMWPE) or ultra-high-density polyethylene (HDPE) during manufacture process
- Authors claim that the microspheres are entrained within the polymer resin with no possibility of separation
- Addition of microspheres makes netting susceptible to sonar inspection
- May also reduce biofouling.

PNNL Technical Assistance: PNNL assisted with researching and testing the best netting material and determining the minimum concentration of microspheres required, as well as tested for impacts on fish behavior.



Team:

Prometheus Innovations, LLC

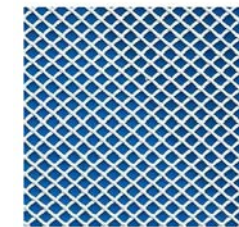


Figure 1: Polymer mesh grid with typical 1cm spacing.

Illustration from Prometheus Innovations, LLC

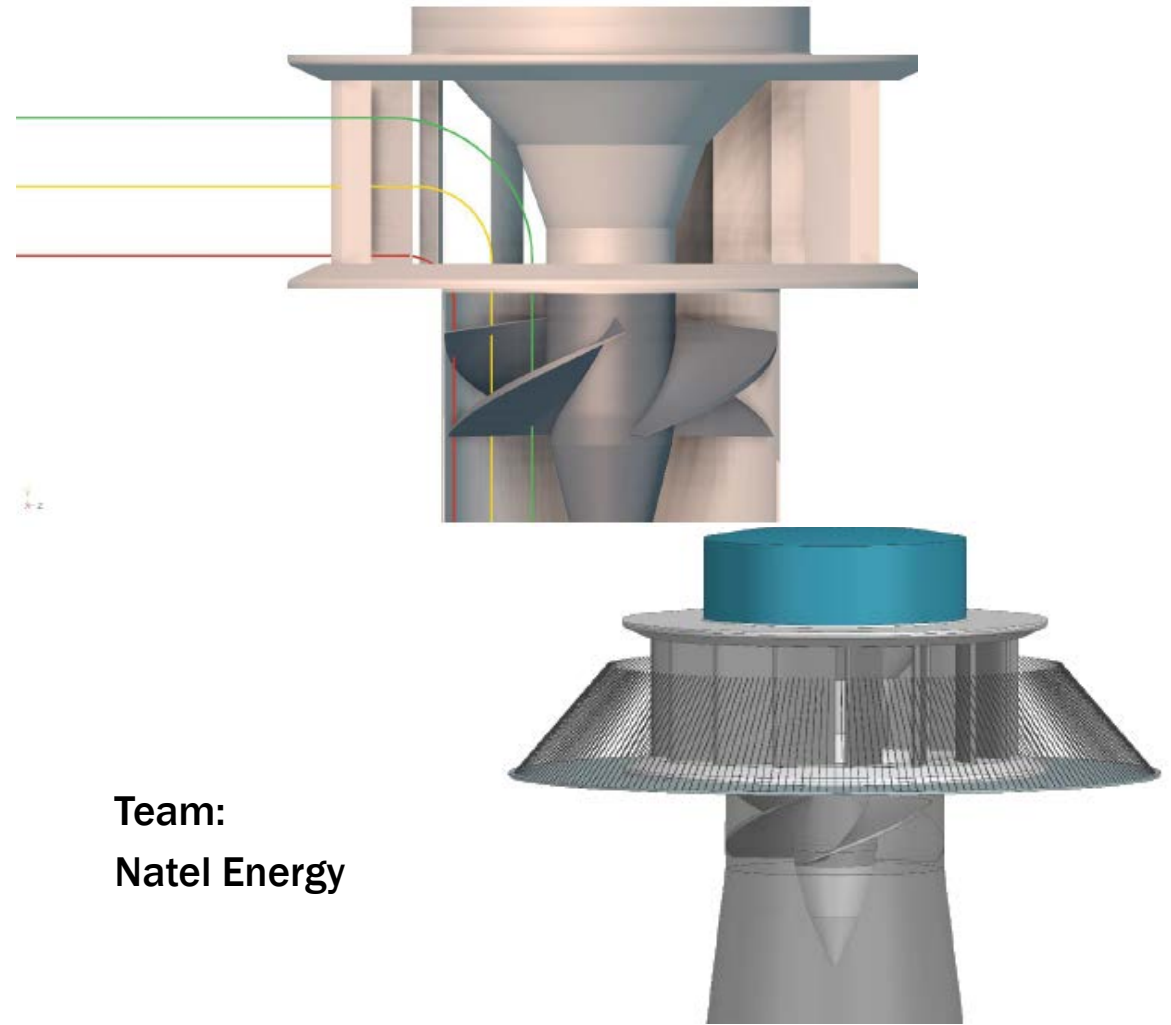
Third Place Winner: Natel - The Center Sender

Summary: Utilizes demonstrated science that indicates fish survival is higher near the turbine hub to create an add-on device to direct fish there. Proposal has options for both physical and electrified concept to direct fish.

Key Features:

- Seeks to improve outcomes for entrained fish by directing fish toward the part of the turbine (hub) with the lowest chance of strike injury/mortality
- Two distinct options (physical and electrified).

PNNL Technical Assistance: Team has identified a targeted test plan to utilize testing with live fish to further develop proof of concept. Team listed incubation lab support to establish concept in a flume and then a more detailed study of parameters to improve fish passage and validate technology with American eels.



Team:
Natel Energy

Illustration from Natel Energy