Sensor Fish

Making hydroelectric dams and facilities more fish-friendly

Hydropower provides over 6% of the United States’ electricity. The vast majority of that power comes from traditional, large hydroelectric dams.

Most large dams in the U.S. were built in the 1970s or earlier and will soon need to be relicensed — a process that includes evaluating and often reducing a dam’s environmental impact. Key to that evaluation is examining how fish fare when swimming through dams, and we’ve created a technology that does just that.

TECHNOLOGY

Sensor Fish is a small autonomous sensor device that analyzes the physical conditions fish experience as they pass through dams and other hydro structures. This synthetic “fish” is helping existing hydroelectric dams and new, smaller hydro facilities become more fish-friendly. The measurements derived from Sensor Fish can improve the environmental performance of hydropower.

FAST FACTS

» Measures physical stresses small and fish experience such as pressure, acceleration, strain, and turbulence

» Same size as salmon; with other models being developed to mimic other fish species
  - Length: ~3.5 inches
  - Diameter: ~1 inch
  - Weight: ~1.5 ounces

» Applicable for use in:
  - Most hydro turbines such as Kaplan, Francis, and gravitation water vortex turbines
  - Small hydropower, pumped storage hydroelectric facilities
  - Spillways, irrigation structures, and pumping stations

» Records:
  - Approximately 5 minutes of data with flash memory (turbine passage is usually less than 2 minutes)
  - 2,048 measurements per second
  - Up to 174 pounds per square inch of pressure

Example of the pressure, acceleration, and rotational velocity data collected by the Sensor Fish device during passage through a Kaplan turbine.
- Acceleration up to 200 times the force of Earth’s gravity (200 Gs)
- 2,000 degrees per second of rotational velocity
- Temperatures between -40 and +260 degrees Fahrenheit

» Neutrally buoyant — allows device to float below surface like a real fish
» Automatically floats to surface at end of test by dropping a small pair of environmentally-friendly weights
» Features four LED lights that flash green, orange, and yellow for easier retrieval and diagnostics
» Built-in radio-frequency transmitter to assist recovery
» Powered by a rechargeable 3.7-volt lithium-ion battery that lasts approximately 5 minutes

ABOUT PNNL

Pacific Northwest National Laboratory is a Department of Energy Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America’s most intractable problems in energy, the environment and national security. PNNL employs 4,400 staff and has an annual budget of $1 billion, and has been managed by Ohio-based Battelle since its inception in 1965.

The Sensor Fish device: A) 3D CAD model showing the principle acceleration/rotation axes; B) Photo of the actual device.