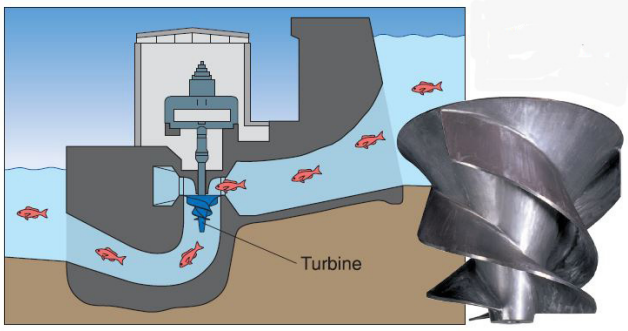
Concepts NREC

The Experts in Turbomachinery

Case Study

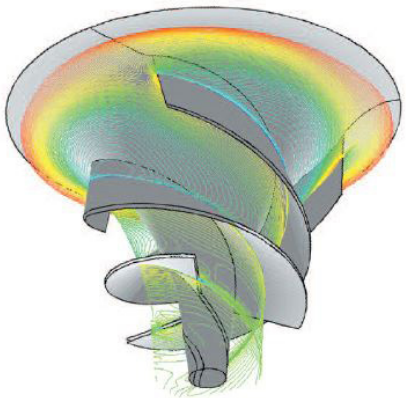
Fish-Friendly Hydroelectric Turbine Greatly Reduces Fish Kill and Preserves Efficiency

A unique turbine-impeller design could soon allow migrating fish to pass safely through a hydroelectric generator on the Mohawk River at the Brookfield Hydropower Station in Cohoes, NY. Presently, the only way for fish to travel downstream past the station dam is to be swept through the generator turbine blades along with the water flow – killing up to 40 percent of the fish.



Concepts NREC's unique turbine-impeller design will allow migrating fish to pass safely downstream when installed at the Brookfield Hydropower Station on the Mohawk River in Cohoes, New York.

In an attempt to dramatically reduce the kill rate, Alden Research Labs, with funding from the U.S. Department of Energy, conducted hydraulic research to determine which phenomena within the turbine actually killed the fish. The kill rate described in terms of fluid-dynamic conditions and statistics was then used by Concepts NREC to produce an advanced fish-friendly turbomachinery design. Alden's research identified several causes of the high kill rate including sudden expansion from a high-pressure to a low-pressure environment. Some fish, being unable to quickly adapt to significant pressure changes, were fatally injured. Some fish were being by the cutting action of the turbine blades. And some fish were exiting the turbine in such a state of trauma that they became easy prey or larger fish.



A computational fluid analysis (CFD) of the fish turbine (without shroud) shows relative velocity at midspan.

Using the information and statistical data from Alden, CN identified several areas of the turbine that could be redesigned to eliminate all these risks. Reducing direct-hit incidents required a design that would use fewer blades plus a sheath to eliminate gaps. The pressure gradient also had to be reduced, and there could be no large gradi-

Fish-Friendly Hydroelectric Turbine Greatly Reduces Fish Kill and Preserves Efficiency, continued

ents of water speed within the turbine that could set the fish spinning and tumbling into trauma.

The resulting “fish-friendly” turbine design allows a larger flow passage for smoother water flow, a more uniform pressure distribution, lower levels of damaging shear stress, and an acceptable balance between turbine efficiency and fish survivability. Test data and projections indicate that this fish-turbine design will be 90 percent efficient at producing power (well within the range of conventional turbines) yet will increase fish survivability to 98 percent. The fish-turbine’s specifications are commercially viable compared to existing turbines and will soon be validated at full scale. Under a license being granted from the Federal Energy Regulatory Commission to allow the installation of the fish-friendly turbine, the Electric Power Research Institute (supported by the New York Power Authority, Électricité de France, and Brookfield) is helping to fund the manufacture and installation of the turbine.

The result is expected to be a win-win situation for the Brookfield Hydropower Station and the fish swimming downstream. Much-needed power generation will be assured for the public, and fish will be saved to better preserve the environment

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