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Hydropower Turbine Retrofit Improves Dissolved Oxygen Levels

Retrofitting turbine air venting systems to increase dissolved oxygen levels can prevent downstream fishery impacts

What Is The Problem?

Adequate dissolved oxygen in reservoirs and rivers is critical to aquatic ecosystems and may be required to avoid impacts on both endangered species and recreational fish stocks. In some cases, dam releases through hydroelectric powerplants can contribute to reduced dissolved oxygen downstream as they release water from levels in the upstream reservoir that are oxygen depleted. Low dissolved oxygen-related issues are estimated to occur in 8 percent of Reclamation reservoirs. However, many factors affect dissolved oxygen, including the time of year, especially warm summer months. Although needs vary by species, dissolved oxygen levels of 5 milligrams per liter (mg/L) or more are necessary to support most fish species.

Numerous approaches have been tested for raising dissolved oxygen levels in hydroelectric powerplant discharges, including: in-structure aeration, selective intake depth, forebay gas injection, downstream aeration weirs, spillway operation, and penstock air or oxygen injection.

What Is The Solution?

General Electric (GE) Hydro and Reclamation's Montana Area Office have collaborated to develop a method to retrofit existing hydroelectric turbines to inject sufficient air into the water to raise downstream dissolved oxygen levels. The air is injected/ sucked into the flow passing the turbine as the water falls down the draft tube walls. In-structure aeration is typically most efficient because a smaller volume of water is treated relative to treating the reservoir. GE Hydro has a proprietary method of modifying the existing turbine vacuum breaker components to accept large quantities of air into the bottom portion of the turbine. Depending on flow conditions and dissolved oxygen levels, one or more turbines can be modified to significantly raise downstream dissolved oxygen levels.

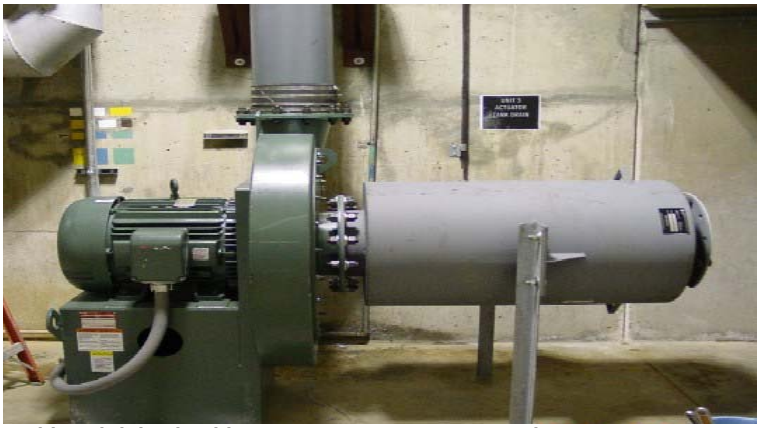
Who Can Benefit?

This technology may be used at hydroelectric powerplants where low dissolved oxygen problems exist in the tailwater, and where other solutions are cost prohibitive. The owners and managers of these facilities can benefit by using this cost-effective solution to low dissolved oxygen conditions, which could avoid potential fines and/or disruptions to power generation associated with adverse effects to fisheries.

Where Have We Applied This Solution?

In 2005, one of the three turbines at Reclamation's Canyon Ferry Powerplant near Helena, Montana, was retrofitted with an air pump to alleviate fishery impacts due to periodic downstream low dissolved oxygen levels. Air is injected at a rate of about 6,000 cubic feet per minute into a turbine flow rate of 1,750 cubic feet per second. Summer dissolved oxygen levels have been raised from an average of 4.6 to 6.0 mg/L.

Reclamation's installation cost for retrofitting the turbine air venting system was approximately $175,000, and the ongoing operating cost is about $21,600 per year. Fishery impacts have been significantly reduced after installing the air venting system.



Turbine air injection blower at Canyon Ferry Powerplant.

Future Development Plans

There are no specific future development plans for turbine air injection retrofit installations at Reclamation facilities. Potential future applications will be evaluated case-by-case as dissolved oxygen problems are identified. Reclamation will continue to collect additional dissolved oxygen and turbine performance data at Canyon Ferry Powerplant.

More Information

A report documenting dissolved oxygen conditions before and after the Canyon Ferry Powerplant application is available at http://www.usbr.gov/research/science-and-tech/research/results/canyon ferry DO.pdf

Contact Information

Michael Horn, Environmental Applications and Research, mailto:mhorn@usbr.gov, 303-445-2203
Paul Backlund, Facility Operations Specialist, Canyon Ferry Field Office, mailto: pbacklund@usbr.gov, 406-475-3923

Collaborators

Reclamation's Science and Technology Program, Montana Area Office and Canyon Ferry Field Office as well as General Electric Hydro