

CASE STUDY



Fish-Friendly Turbines

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Development of Fish-Friendly Turbines

BACKGROUND

The need for replacement or rehabilitation of aging turbines at several hydroelectric stations in combination with declining runs of anadromous salmonids in the Columbia River Basin stimulated efforts to find turbine design solutions which increase energy generation, reduce maintenance, and afford safer fish passage. As part of the U.S. Department of Energy Advanced Hydro Turbine System (AHTS), Normandeau Associates, Inc., conducted a large scale experiment to test the hypothesis that fish survival in passage through a new turbine design was equal to or greater than through an existing conventional Kaplan type turbine. The potential for enhanced survival by minimizing gaps at the hub and blade tips was surmised from an earlier experiment conducted by Normandeau at Rocky Reach Dam on the mid-Columbia River. The AHTS turbine installed at Wanapum Dam, on the Columbia River, featured minimum gap between the blade and hub, as well as between the blade tip and discharge ring at all blade tilts, altered geometries of the stay vanes, wicket gates, and draft tube. This experiment, including post-passage distribution and fish behavior, was conducted at several turbine operating efficiencies utilizing over 8,000 HI-Z tagged fish obtained, direct survival, physical condition, and post passage distribution.

THE CHALLENGE

The challenge was to execute a multi-faceted, statistically based, study of the AHTS including experiments recommended by national laboratories, regulatory agencies, and turbine design engineers within strict time constraints for in-river emigrating juvenile salmonids.

THE SOLUTION

The high precision of the results provided confidence to the operator of the project and regulatory agencies to move forward with the installation of AHTS type turbines for safe fish passage, increased power production, and overall lower total dissolved gas saturation. Study results provided flexibility for operating turbines over a wide range of discharges as the estimated survival exceeded the NOAA Fisheries Biological Opinion criterion of 95% for this project.

