

**2001 HYDRO R&D FORUM  
RESEARCH SYNOPSIS**

**Project Title:**

Characterizing Turbulent Flows in Hydropower Draft Tubes and Tailraces

**Keywords:**

Flow, Field measurements, Unsteady Hydrodynamics, Velocity profiles

**Scope of Project:**

This project involves full-scale, time-varying turbulence measurements and data analyses that will provide information on the size, duration, and frequency of turbulent eddies, collectively known as the coherent structure of the flow, in draft tubes and tailwaters. The project will involve the collection of coincident three-dimensional velocity time series data at multiple points in the draft tube and tailwater. This approach is being pursued because: 1) draft tube turbulence is inherently a three-dimensional phenomenon and must be analyzed as such, 2) robust instrumentation to capture such data is becoming widely available, and 3) time series data lend themselves well to automated computations of biologically relevant indices of turbulence below hydropower turbines. Flow measurements will be made at representative Kaplan turbines and in physical models of those turbines.

**Benefits of Project (either Achieved or Expected):**

Traditional measurement and modeling techniques for flow regimes in turbines are not well suited for studying the inherently chaotic and time-dependent nature of these large-scale turbulent eddies. Because so little is known of the coherent structure of draft tube flows and how this structure varies with geometric scale, new field measurements are needed to characterize draft-tube/tailwater turbulence. The challenge for these new field studies is to identify relevant characteristics of these eddies that represent flow kinetics and are useful for subsequent studies of the effects on fish of turbulence in these regions of turbine systems. Once the relevant indices of turbulence are defined, they will be used to design controlled laboratory experiments of biological response, leading to a more comprehensive understanding of the fate of fish that pass through turbines.

**Status of Project:**

To be completed in 2003.

**Organizations/Companies Involved:**

Oak Ridge National Laboratory and TVA

**Funding Details (amount, funding agencies):**

\$336,000 in FY 2001 and \$539,000 in FY 2002 (latter subject to future appropriations), U.S. Department of Energy Office of Biopower and Hydropower Technologies.

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