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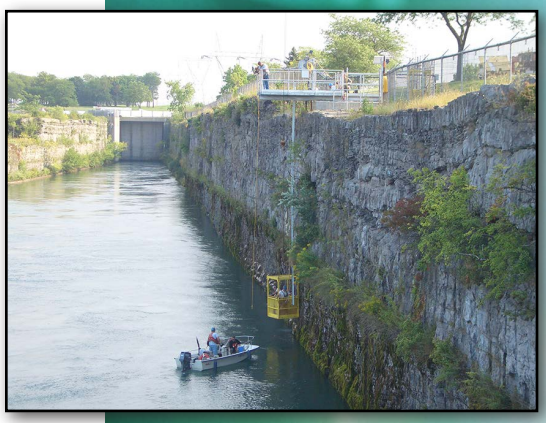
Success Story

Acoustic Doppler Current Profiler Helping NYPA Optimize Hydroelectric Operations on Niagara River



Workers installed the Acoustic Doppler Current Profiler in a diversion channel of the Niagara River

The New York Power Authority's (NYPA) Niagara Power Project includes a hydroelectric generating plant and a pumped storage generating plant on the Niagara River. The intake channels for the plants are located upstream from Niagara Falls. Due to the high volume of the river flows as well as international treaty, transmission system, and market requirements, it is crucial for NYPA to accurately measure the flow of water through the intake channels. NYPA had been measuring water levels in the channel and performing calculations to estimate water flow, but wanted a more reliable measurement method. NYPA teamed with EPRI to install an Acoustic Doppler Current Profiler (ADCP) system in one of the intake channels. The ADCP measures water currents by transmitting sound waves at a constant frequency into the water, which ricochet off particles suspended in the moving water and reflect sound back to the instrument. The ADCP system is providing insights into control system enhancements that could increase operational efficiencies and annual generation at the two Niagara Power Project plants. NYPA is monitoring the data provided by the ADCP and comparing it with flow calculations for the intake channel pending a decision about integrating the ADCP into the control system for the plants.

NYPA and EPRI Team Install ADCP in Niagara Power Project Intake Channel

NYPA's Niagara Power Project is located about 4.5 miles downstream from Niagara Falls and consists of two main facilities. The Robert Moses Niagara Power Plant is a 2,516 megawatt (MW) hydroelectric plant with 13 turbines and the Lewiston Pump-Generating Plant is a 240 MW pumped storage plant with 12 pump turbines. There is a large forebay between the two plants and a reservoir behind the Lewiston plant. Water flows by gravity through two underground conduits into a transition and then into the forebay. The Lewiston plant pumps water from the forebay into the reservoir or provides generating flows into the forebay. The Lewiston plant typically provides additional on-peak generation and regulates the flow from the river, as well as providing storage for future generation. The Niagara Power Project's operations are very complex due to the large water flows, the hydraulic dynamics, the transmission system requirements, and the New York Independent System Operator market constraints. In addition, a treaty between the United States and Canada regulates the amount of water that can be used for hydroelectric generation.

"The ADCP is providing valuable data that allows us to measure the actual water flow in the intake channel."

~ Jiankang Zhu, New York Power Authority

Challenge

NYPA needed to measure the water flow in a channel of the Niagara River to potentially optimize operations at its nearby power plant and pump generating plant.

Solution

An Acoustic Doppler Current Profiler flow measurement system was installed in the channel.

Results and Benefits

NYPA now has near real-time flow measurement data whereas they had previously relied on calculations based on water level.

The data from the ADCP are being used in simulations to determine how the information could contribute to control system enhancements.

The two intake channels for the Niagara Project are located on the Niagara River above Niagara Falls. Accurate and timely knowledge of the flow rates in the intake channels is important for optimal operation of the Niagara Power Project. One of the channels is more than 300 feet wide with water depths up to 350 fleet and water flows up to 110,000 cubic feet per second. NYPA was monitoring the water flows in this channel based on water levels but it wanted a more accurate and precise method of determining flow rates. NYPA asked EPRI to help install an ADCP system that could accurately and precisely measure the flow of water through the channel.

ADCP Providing Valuable Flow Measurement Data

ADCP systems measure how fast water is moving across an entire water column and can be used in both marine and riverine settings. The ADCP measures water currents by transmitting sound waves at a constant frequency into the water, which ricochet off particles suspended in the moving water and reflect sound back to the instrument. Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return, whereas particles moving toward the instrument send back higher frequency waves. This difference in frequency is called the Doppler shift, and the ADCP uses this shift to calculate how fast the particle and the water around it are moving.

A team of experts from EPRI, NYPA, the U.S. Geological Survey, Oak Ridge National Laboratory, and the equipment manufacturer established a flow measurement concept and conducted feasibility tests prior to installing the ADCP. Construction of the platform for attaching the ADCP and installation of the system was completed in 2010, followed by calibration tests to determine average time sampling intervals. Since then, NYPA has been monitoring the data provided by the ADCP and comparing it with flow calculations for the intake channel. NYPA has not integrated the ADCP into its control system, but having improved flow rate measurements is helping to optimize plant operations. "The ADCP is providing valuable data that allows us to measure the actual water flow in the intake channel," says Jiankang Zhu, a NYPA research and technology development engineer. "These data are very important as a reference to verify our control system calculations." Zhu is the recipient of an EPRI Technology Transfer award for successfully implementing the ADCP flow measurement system.

Related EPRI Products

Title	Product ID
Application of an Acoustic Doppler Current Profiler to Measure Hydro Plant Diversion Flows—New York Power Authority's Niagara Project	1023420
Flow Measurements at St. Lawrence Power Plant	1020327

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com)

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