River Riders

Grant PUD monitors mid-Columbia River hydro operations

By Kathy Kiefer

As the Columbia River flows through Washington it encounters 11 federal and privately owned hydroelectric dams, generating close to 20,000 megawatts of power for the Northwest. With another three dams in British Columbia and many more on various tributaries, it is the largest power-producing river in North America.

Operations at one dam can have a significant impact on others downstream. Maximizing the river's potential, along with protecting and enhancing non-power uses of the river, is a major challenge that can affect the power grid throughout the Northwest.

For one stretch of the river, between Grand Coulee Dam and Priest Rapids, this is accomplished through a unique agreement known as the Mid-Columbia Hourly Coordination Agreement.

Signed in 1972, and renewed for 20 years in 1997, the MCHCA covers seven dams and nearly 13,000 MW of generation.

It defines how Chelan, Douglas and Grant PUDs, which own major dams on the Columbia, will coordinate operations with the Bonneville Power Administration to maximize power generation while reducing fluctuations in the flow of the river. A number of other utilities that buy power from the PUDs have also signed onto the agreement.

Aided by a computerized system that updates information every four seconds, dispatchers balance the systemwide demand for electricity with a growing number of constraints on the system, including operations at the dams, spill for fish, recreation, water flow through the Hanford Reach, and other environmental requirements.

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This coordinated system "reshapes" water in the river, releasing it as needed through the seven dams, beginning with Grand Coulee and the 5.2 million acre-feet of water stored in Lake Roosevelt.

This activity is carefully orchestrated to ensure that each of the dams has sufficient water to meet generation needs – Grand Coulee and Chief Joseph, the two federal dams, along with Wells (Douglas PUD), Rocky Reach and Rock Island (Chelan PUD), and Wanapum and Priest Rapids (Grant PUD).

There's a host of nuanced details required to accomplish this, most relating to the science of hydraulics. But in the simplest terms, it means that the water elevation above each dam (forebay) must be at a certain height relative to the downstream elevation to derive maximum benefit from the turbines.

Each dam in the system has an ideal forebay elevation for the most efficient operation and the dams each have a minimum forebay elevation required by their Federal Energy Regulatory Commission (FERC) license, or authorizing legislation in the case of Grand Coulee and Chief Joseph.

The agreement allows for intermittent trade-offs of maximum benefits at individual dams to spread benefits throughout the system. At times, one of the dams may actually be producing power to meet another dam operator's load. This situation can alternate as constraints and demands fluctuate each hour.

The system is one big balancing act.

Energy is constantly being produced and consumed across a wide geographic area. Every turbine at each of the dams is

electronically linked, controlled through a central operations center at Grant PUD where requests for power are made every four seconds by parties to the agreement. As needs change, the system responds almost instantaneously, while keeping frequency across the system at the 60 Hz cycles of each hydro turbine.

If, for example, a turbine at a coal-fired plant in Montana, owned by one of the other 14 parties to the agreement goes down, the system responds to the frequency change by instructing the hydro turbines to increase capacity.

There are few power generation sources as flexible or responsive as hydropower. This is made possible by two basic facts, hydro turbines can react quickly to frequency changes or disturbances in the system, and the use of water as fuel makes for efficient conversion to electricity.

This also makes hydropower a perfect match in the coordination and dispatch of intermittent wind resources onto the grid.

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Jeff Jarrell, a senior systems operator at Grant PUD, is one of the "river riders" that monitors the hourly coordination system.

An early task every morning is to review BPA's estimate of how much water will be discharged that day from Chief Joseph Dam, first in line after Grand Coulee. This is the fuel that Jarrell and other operators along the river will manage during the next 24 hours.

Chief Joseph Dam, like the others downstream, is run-of-the-river, with very little storage capacity. The discharge from Grand Coulee ultimately determines how much water reaches the dam, which in turn determines what will be available downstream.

For the rest of his shift, Jarrell will watch the draft and fill of each dam within the system. With the computer calculating how much energy is needed, when and by whom, there are other details to attend to, such as downriver predicted fill times, a power plant with a turbine out, or a spill requirement that causes the water to draft at a higher rate. Monitoring these constantly changing parameters is recognized as one of the highest stress positions in the utility industry.

At the end of the day, the Mid-Columbia hourly coordination system, as administered through the MCHCA, is essential to the Pacific Northwest.

Restrictions at each project, demands upon the system, the tremendous requirement to produce a never-ending supply of power, and the availability of the most essential component of the system, water, make for extraordinary challenges for Pacific Northwest hydropower operators.

There is no other agreement quite like the MCHCA anywhere in the country, due in part to the fact that there are no other river systems like the Columbia with such diversity of ownership and contractual rights.

Dam operators on the Columbia do not work in a vacuum. The entire river system is tied together to meet environmental, recreational, and power generation requirements. This work is done 24 hours a day, every day of the year.

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