Consumers Energy Installs New System To Improve Au Sable River Temperatures

Consumers Energy installed in mid-July a system to enhance Au Sable River water temperatures below Mio Dam. Called an upwelling system, it is designed to improve downstream habitat for fish and other aquatic organisms that prefer cold water.

As summer weather warms the Mio Pond, the warmer outflow water temperatures can stress cold water species in the river downstream. The upwelling system has been designed to use cooler water from the depths of Mio Pond to relieve those temperature stresses on fish downstream of the dam.

During the summer of 2007, Consumers Energy collected data to create a computer model of the Mio Pond and its powerhouse. This data included tributary inflows and temperatures, pond bathymetry (contours), meteorological conditions, and powerhouse characteristics. The computer model then was developed during 2008.

Consumers Energy presented the results of the modeling to the Muskegon, Manistee, Au Sable Coordination (MMAC) Team. In addition to the Consumers Energy staff, the MMAC Team includes representatives from the Michigan Department of Natural Resources, the U.S. Forest Service, the U.S. Fish and Wildlife Service and the Michigan Hydro Relicensing Coalition. Based on the results of the computer simulations, an air diffuser upwelling system (bubble curtain) was proposed as the best method available to cool water temperatures downstream of the dam. Following consultation with the MMAC Team, Consumers Energy proceeded with design and fabrication of the system.

The upwelling system is designed to lift cooler, water off the bottom of the impoundment pond so it can be drawn into the turbines and passed downstream. It also helps draw cooler, denser inflows along the pond bottom toward the intake.

The system acts very much like an air bubbler in a home aquarium. A compressor pumps air through porous hoses anchored to the bottom of the pond impoundment. The emerging air bubbles draw the cooler bottom water upward as they rise. This cooler water then passes through the turbine inlets and is drawn into the turbines and discharged downstream.

The trick to the design of the upwelling system is not to allow the cooler bottom water to mix with the warmer water in the upper portion of the water column. Instead, the goal is for the upwelled water to largely remain unmixed as it is drawn into the intake. Among other factors, this is accomplished by how the porous hose is configured, it's location relative to the intake and the amount of air flow used to operate the system.

During the week of July 13, workers from Kleinschmidt Associates and Mobley Engineering – the Consumers Energy contractors responsible for the design and fabrication of the upwelling system – were at Mio Dam putting together the system components. The system includes two individual upwelling units, one for each turbine inlet. The porous hose is arranged in a "spider web" configuration, which creates a circular upwelling pattern. On July 16, the two upwelling units were finished and floated into position. A float line then was filled with water, pulling the diffusers to the bottom of the pond impoundment. Compressed air was sent into the diffuser piping and after

several minutes, bubbles began to appear on the surface. Different air flow rates were tested to determine best operating conditions for the system.

One of the challenges encountered in the installation was the lack of warm water so far this summer at Mio. Because of relatively cool summer weather, the temperature difference from the top of Mio Pond to the bottom is not as large as in the past. The larger the temperature difference the more effective the upwelling system is and the easier it is to determine what air flow should be used. An added challenge was the wind. Strong winds blowing across the pond caused warm and cold water to mix, so the temperature from the surface to the bottom was essentially the same. Such transient conditions are not uncommon at Mio and after calmer conditions return, normal temperature stratification or "layering" may be reestablished.

The cool water at the bottom of the reservoir is a limited resource during a typical summer. At maximum capacity, the upwelling system could upwell or "use" all of the available cooler water in a matter of days. This is why simply changing to a "bottom draw," as some have suggested in the past wouldn't be an effective solution.

Based on the computer modeling, the initial operating strategy will be to run the system 24-hours per day, once the daily average temperature of the water coming from Mio is above about 68^{o}F (or 20^{o}C), after July 1. Consumers Energy will continue to monitor the Au Sable water temperatures and the operation of the Mio upwelling system to optimize use of the system.

Consumers Energy also has installed upwelling systems at the Hodenpyl Dam on the Manistee River and the Croton Dam on the Muskegon River. Data is being collected for a potential upwelling system at the Tippy Dam on the Manistee. Each of these systems must be designed to recognize the different characteristics and cold water management strategies for each hydroelectric facility. Installation of the upwelling systems are part of Consumers ongoing efforts to protect the fisheries and other recreational opportunities associated with operation of its' generation facilities.

- David McIntosh, Senior Engineer, Consumers Energy