



## WICKET GATE OPERATION FOR REACTION TURBINES

**BACKGROUND:** Wicket gates are a series of adjustable vanes that control the flow of water to a reaction turbine. Each vane, mechanically in parallel, is attached to an adjustable gate ring. Actuating the gate ring either clockwise or counterclockwise positions the wicket gates to regulate water flow to the turbine. Variations of operating the wicket gates are dependent on many factors some including, axis of the turbine, available head, physical space, and turbine type.

One of the most common methods of actuating wicket gates is to use an oil pressure system or Hydraulic Power Unit (HPU) to supply pressurized oil to a servomotor(s) to adjust the wicket gates to a desired position. An HPU system usually includes an oil pressure tank (or accumulator), oil sump, air compressor, oil filtration/condition system, oil pump/motor, all coupled with a governor mechanism.

**KEY TO SUCCESS:** Is responsive, repeatable, and safe control of the wicket gates. Wicket gates need to provide optimal water flow to the turbine runner under various operating conditions. Wicket Gate positioning can vary among turbines. They can experience minimal to frequent set point changes to control water flow. Wicket gate positioning can be used to maintain system frequency after synchronization, respond to share load changes with other units on a system in parallel, adjust to outputs from an operator or other supervisory commands, and protect the unit from uncontrolled runaway and/or abnormal conditions.

**PROBLEM:**

**COMPONENTS:** Problems in the HPU can occur when the hydraulic fluid



# ELECTRAULIC™ ACTUATION

degrades. Because of this problem, most oil pressure systems are designed, in certain instances, to be excessively large and have additional components, like multiple filters, to prevent sensitive parts from being damaged. A common area where hydraulic fluid breaks down occurs in the sump from needing to accommodate for oil volume changes, constant exposure to atmosphere, and controlling the oil's temperature. Hydraulic fluid properties should have good lubrication, operability along a large temperature range, wear abilities, suitable viscosity, corrosion resistance, anti-aeration, and air/water separation for optimal performance. The degradation of the hydraulic fluid can lead to sluggish performance or disable the oil pressure system entirely increasing downtime and cost.

**ENVIRONMENTAL:** Due to the growing concern and awareness for people's health and the environment, government organizations have been enforcing strict regulations to reduce the hydroelectric industry's environmental impact. Protecting the waterways is at the top of the list and prohibiting the discharge of any oil into them is just one of the ways plants are regulated. HPU systems pose higher risk as they contain hundreds, and sometimes thousands of gallons of oil that increases the potential of being discharged into the waterways. The consequences of discharging oil into the waterways can be severe for a hydroelectric facility that can result in hefty fines with potential incarceration.

**SOLUTION:** Electraulic™ Technology provides safe, rugged, responsive, and repeatable control well suited for operating wicket gates. The true closed loop hydraulic system, achieved with the breakthrough Flow Match Valve technology, eliminates the requirement to maintain the oil and reduces volumes by 95%. The REXA technology is adaptable to different plant layouts and control configurations that can be coupled to older plant controls to the latest DSC/SCADA systems. Whether there is a need for reliable tight control and improvement for environmentally friendly solution, REXA can help you modernize your hydroelectric plant.



## RESULT

Upgrading from an oil pressure system to a REXA Electraulic™ Actuator to operate wicket gates can provide immediate benefits for a hydroelectric plant. An upgrade to a REXA Electraulic™ Actuator to operate wicket gates yield the following operational improvements:

- Gain controllability on a broad range of modes
- Virtually maintenance free
- Low environmental risk by eliminating oil volumes by 95%
- Optional usage of biodegradable oil

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