POWER GENERATION

HYDROELECTRIC **POWER**

Hydroelectric power (HEP) is a reliable renewable energy source that accounts for over 1,000 GW of installed capacity, or currently about 16% of the world's energy. With efficiencies that can reach 95%, HEP is a suitable method for generating electricity. Today, hydroelectric power plays a more important role as the energy mix continues to adopt other forms of renewable energy such as wind and solar power. The flexibility of HEP can provide base load and peaking power, frequency recovery, and black start capabilities that encompasses both the normal operation and auxiliary services.

ELECTRAULIC™ ACTUATION

Hydroelectric Power Generation

HEP utilizes hydrokinetic energy where the change in elevation of water generates a force to rotate a turbine(s), or also called runners, that is then converted into electrical energy. The greater the elevation of water, the greater the pressure and force that can be generated.

There are generally two types of conventional hydroelectric plants: impounded and run-of-the-river. Impounded plants block the body of water and regulates the discharge with weir, spillway, and turbine. Opposite of the impounded is a ROR that allows the body of water to flow along the powerhouse.

Along with the generating electricity, HEP development provides other services that include recreation, flood control, navigation, irrigation, and drought mitigation. The multiple purposes of HEP is valuable for communities, reduced environmental impact, and a driver for economic development worldwide.

Why REXA?

At REXA, we have more than 20 years of experience in the hydroelectric power market. We offer high-quality, low/no maintenance Electraulic™ Actuators that provide minimal environmental impact and flexible operation for low to high duty cycle requirements.

Turbine Controls

- Fast response time
- Fail-safe capabilities
- Stroke direction speed
- 50-70 mSec deadtime

Valves/Knife Gate

- Zero hysteresis
- High frequency response
- Low power consumption
- No air consumption

Gates

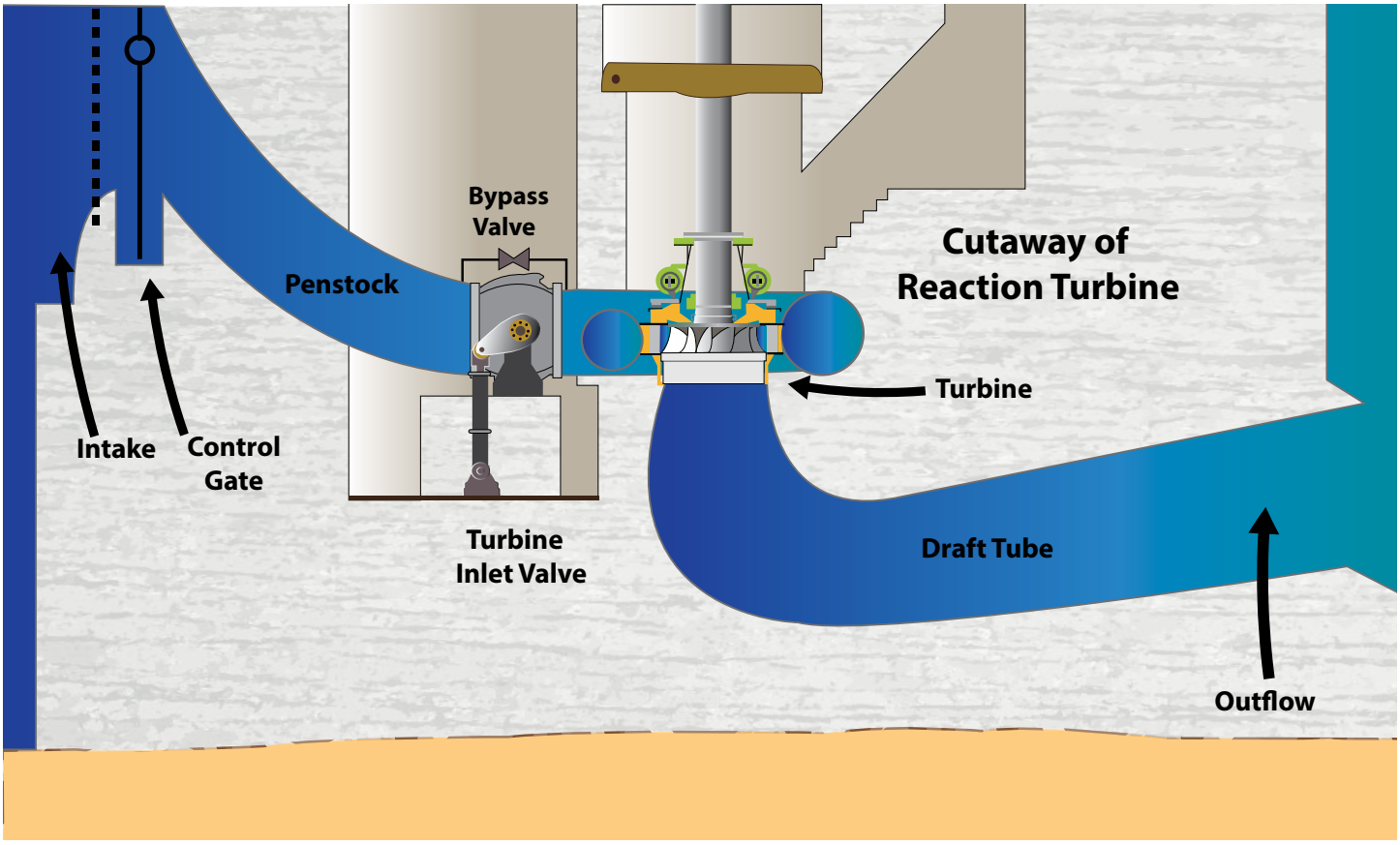
- Self contained hydraulics
- Indoor/outdoor use
- Small actuator footprint
- 100% duty cycle

Reaction Turbines

Reaction Turbine design covers a wide spectrum of turbine types to convert hydrokinetic energy into electrical energy. Reaction turbines are typically used for elevations between 5 – 200 meters. Turbine types include Francis, Propeller, Kaplan, Bulb and Banki. They can be arranged in various positions- horizontal, incline, or vertical according to the design of the plant and turbine type. The variety of turbine types and arrangements are dependent on many variables; available head levels being one of them. Axial flow propeller turbines are typically used for lower head applications, while Francis turbines can be used on a wide range of elevations.

The water, typically isolated from ambient pressure inside a penstock, being conveyed increases in pressure as it reaches the turbine allowing the flow of water to rotate turbine runner. The water travels either radially, with the axis, or a combination of both through the turbine. Most reaction turbines will utilize wicket gates to regulate the flow of water through the turbine runners. Wicket gates operation is critical for positioning as well as ability for reliable tight shutoff during an upset condition.

"We've had a lot of success with REXA Actuators in our other [coal] plants. We decided to apply them on some of our hydro turbines. They are very well suited for the application and operate well under different conditions. The units have been installed for several years and have not had any maintenance done to them…"

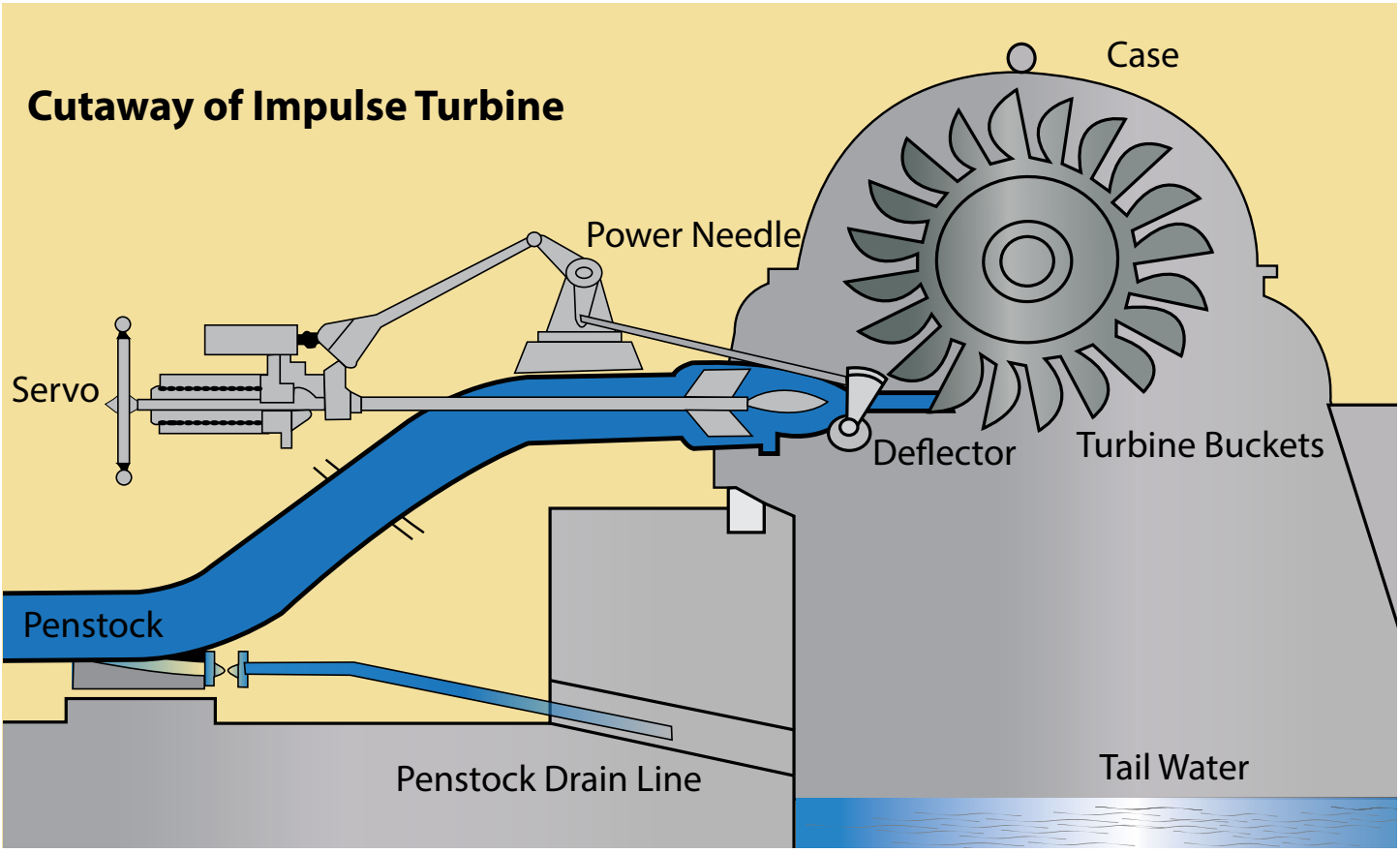


Impulse Turbines

Impulse turbines are used when there is high head available with less available flow. The head range for impulse turbines is typically 80-2000 meters. Pelton and Turgo are the types of impulse turbines. Impulse turbines can also be arranged horizontally, inclined, or vertically according to the design of the plant and turbine type. As the water is being conveyed through the penstock, it increases in pressure. Once the water comes to the turbine, the water under pressure is converted into a high velocity jet stream as it is released from a needle valve called a power needle.

The jet stream impinges on the turbine buckets rotating the unit to generate electricity. The power needle sometimes coupled with a deflector, controls the water jet. The jet stream is open to atmosphere and secured inside the deck's casing. Single or multi jet arrangements can be utilized for turbines. Controlling the speed of the power needle to go either in the closed or open direction is a critical function of the application to regulate the flow of the water jet as well as prevent water hammer in the penstock. Another critical function is having tight, precise positioning that can be under a centimeter between step changes.

"The main reason for choosing REXA Electraulic™ Actuation was having the ability to reduce the oil volumes by a significant amount while maintaining our current operations. REXA has helped us reduce the risk of spills and cut down on maintenance costs…"



Hydro Turbine Installations

- Retrofit existing hydraulic system
- Eliminate oil volume by 95% reduction
- Eliminate air over oil setup
- Redundant operation
- Modulate for auxiliary services
- Increase safety/reduce oil maintenance
- Adapt to existing mounting
- Hydraulic stability
- High reliability

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Place representative sticker here

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