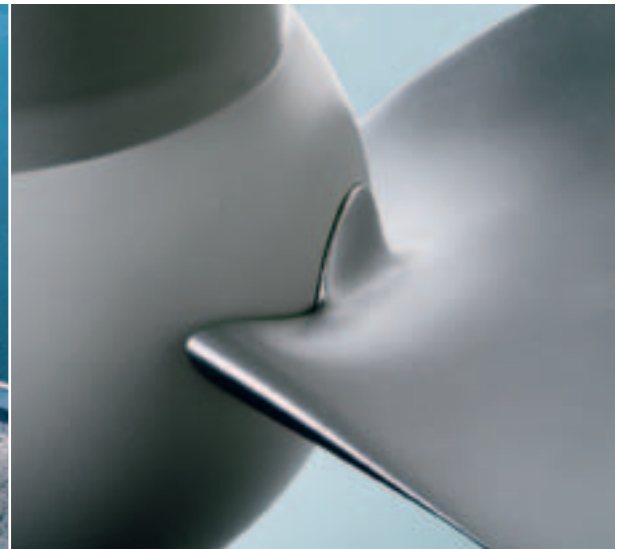


## Fish-friendly turbines. Going with the flow



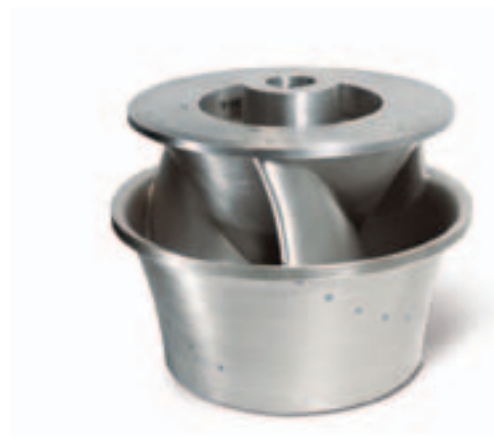
Voith turbine technology makes hydropower stations not only more economical but also more eco-friendly. State-of-the-art turbine blades improve the water quality and ensure that fish are largely protected against injuries when passing through the turbine. Worldwide, Voith has installed more than 40 000 generators and turbines and the company can look back on more than 140 years of experience in hydropower.

With the Alden and Minimal Gap Runner turbine, Voith Hydro is the leading developer and supplier of fish friendly turbines. Thanks to this technology, the fish population remains stable. The Alden turbine rotates more slowly than conventional turbines and has only three rotor blades, whose shape minimizes

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Alden turbine

the shear force, the pressure change rates and minimum pressures within the water passage. Fish can thus pass through the turbine much better. Depending on the fish species, the survival rate of adult animals is 98 to 100 percent.

The American research laboratory Alden developed the innovative runner concept, and Voith Hydro optimized it:

- low collision-induced fish mortality
- optimum number of blades and guide blades
- improved hydraulic profile of individual components
- reduced rotation speed
- excellent water flow geometry, which supports downstream fish passages

### Minimum Gap - maximum gain for the environment

An alternative to the Alden turbine are fish-friendly Kaplan turbines. In order to preserve fish populations, Voith developed the Minimum Gap Runner (MGR) technology as part of the US Department of Energy's Advanced Hydro Power Turbine System (AHTS) program. The MGR blades are precisely contoured to a fully spherical hub and periphery. This minimizes the gap size, which remains constant across the pitch range. Studies have proven that nearly 100 percent of all fish passing through the turbine survive. In addition, the MGR technology also ensures that the turbine operates more efficiently in most cases. This is not the case with conventional turbines: during the adjustment of conventional Kaplan blades a larger gap is created at the inner and the outer blade peripheries. Vortices created through this process, higher water speeds, pressure fluctuations and shear present a danger to fish swimming through the turbine.

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