

The Restoration Hydro Turbine (RHT) is an approach to hydroelectric turbine runner design that couples high performance with safe through-turbine fish passage. The RHT's uniquely thick and forward-slanted runner blades eliminate the need for fine fish screens, which reduces O&M and CAPEX costs and increases plant efficiency. Radial and axial turbine inflow configurations enable compact, simplified civil works, and can be integrated into matrix designs for larger-scale deployments. The RHT approach is a flexible and adaptable solution for a variety of low and medium head (<30 m / 98 ft) hydropower sites.

## Key Advantages

### Fish-Safe

Demonstrated >99% fish passage survival with proprietary blade design.

### High-Performance

Demonstrated efficiency >90%.

### Compact

Available as a pre-engineered water-to-wire solution or as a runner-only replacement.

### Cost-Saving

Reduces excavation & concrete usage; for repowering, integrates into existing water passageway without major changes; reduces/eliminates need for fish exclusion.



Above: Natel's D190 RHT prior to installation at the Monroe Hydro Plant in Culver, OR.

## Safe Fish Passage

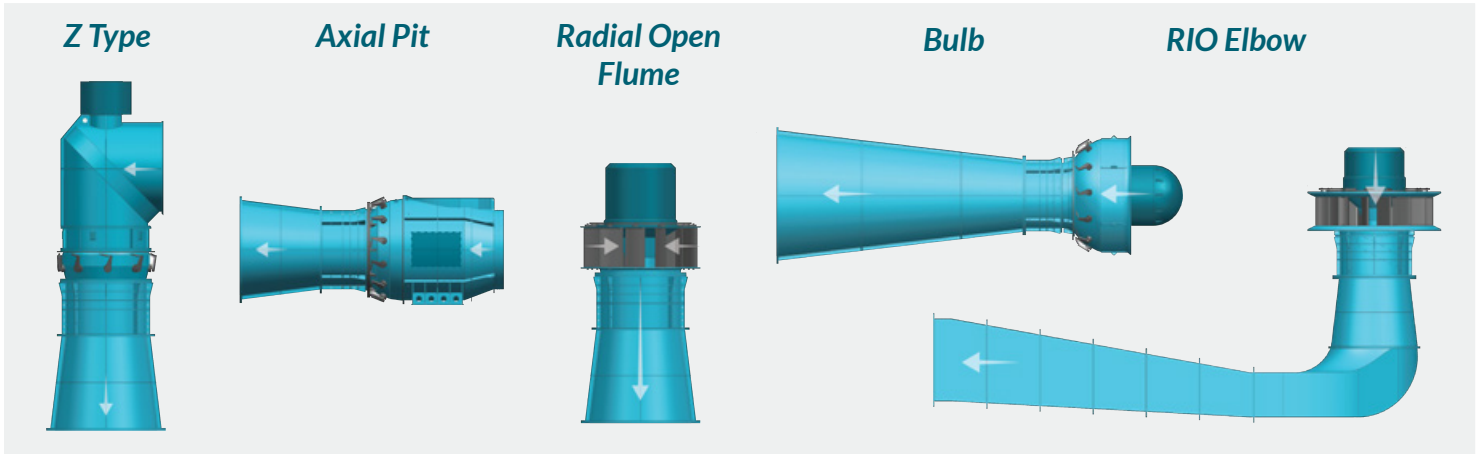
The design-stage strike testing work we conducted with Alden Laboratory in 2019 validated the benefits of the RHT's unique blade shape on fish survival.<sup>1</sup> Subsequent turbine passage studies conducted by Pacific Northwest National Laboratory<sup>2</sup> and Kleinschmidt Associates<sup>3</sup> have demonstrated the turbine's ability to enable safe downstream passage of critical migratory species including salmonids, eel, and alosines.

Findings are published in: <sup>1</sup>[Journal of Ecohydraulics, DOI 10.1080/24705357.2020.1768166](https://doi.org/10.1080/24705357.2020.1768166); <sup>2</sup>[Transactions of the American Fisheries Society, DOI 10.1002/tafs.10385](https://doi.org/10.1002/tafs.10385); <sup>3</sup>[North American Journal of Fisheries Management, DOI 10.1002/nafm.10866](https://doi.org/10.1002/nafm.10866)



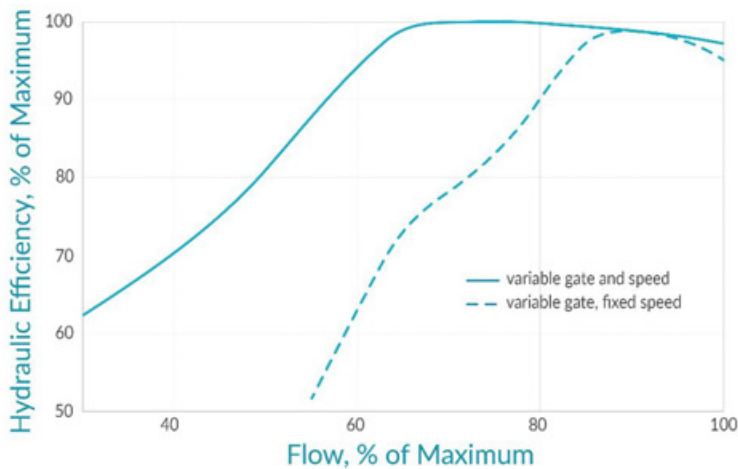
Above left: the RHT's fish-safe runner enables safe through-turbine passage for a variety of fish species at a variety of life stages. Above right: A still frame from high-speed video shows the safe passage of an American eel through a D55 RHT.

## Product Range



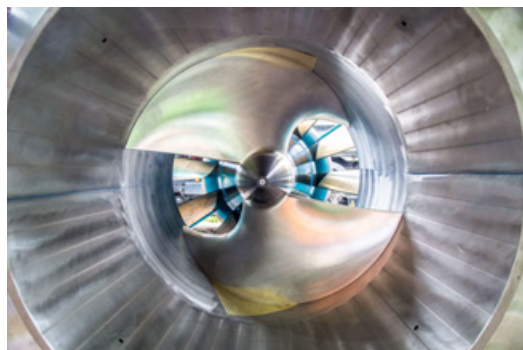
The fish-safe Restoration Hydro Turbine is available in a variety of runner diameters and generating capacities. Direct drive generation, shortened draft tubes, and submersible housings simplify plant design and minimize installation costs. The RHT can be adapted to site conditions in a variety of different configurations, including a bulb, pit, S-turbine, open flume S-turbine, and Z-turbine, which can be either pipe-fed or open flume. Scrollcase turbine and radial inflow open flume configurations are also possible.

## Performance

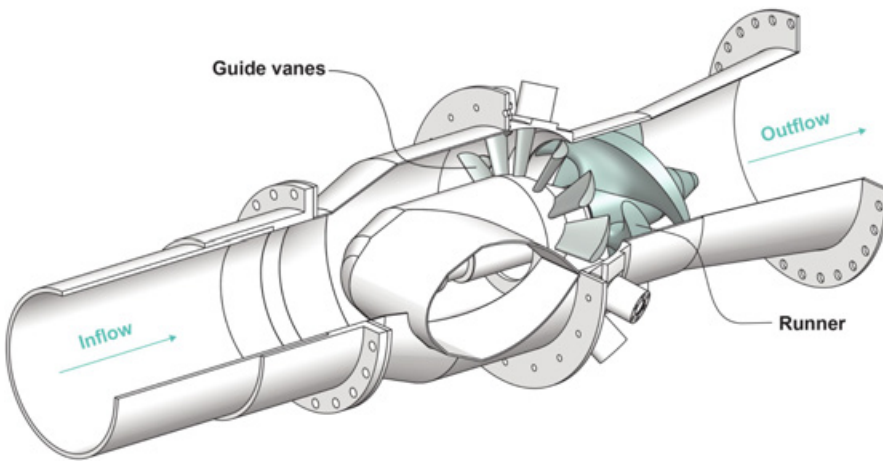


Above left: the hydraulic efficiency of the RHT portfolio. The maximum operating efficiency of the RHT is 90-93%. Above right: a submersible RHT. Below, from left to right: Natel CTO Abe Schneider inspects an American eel following its safe passage through the RHT; a two-bladed RHT runner; an installed pit RHT.

To learn more about parameters of a unit or units suitable for your application, contact Natel Energy at [info@natelenergy.com](mailto:info@natelenergy.com) or visit our website at [www.natelenergy.com](http://www.natelenergy.com).







## For Existing Hydropower Sites

Natel's RHT technology can be provided as a runner-only or a turbine-only drop-in replacement for low- and medium-head sites (up to 30 m / 98 ft), with no limitations on runner diameter. RHT runner replacements are a time- and cost-effective pathway to plant modernization, improving environmental performance while also minimizing civil works and equipment alterations.

### Versatility & Cost Savings Related to Civil Work

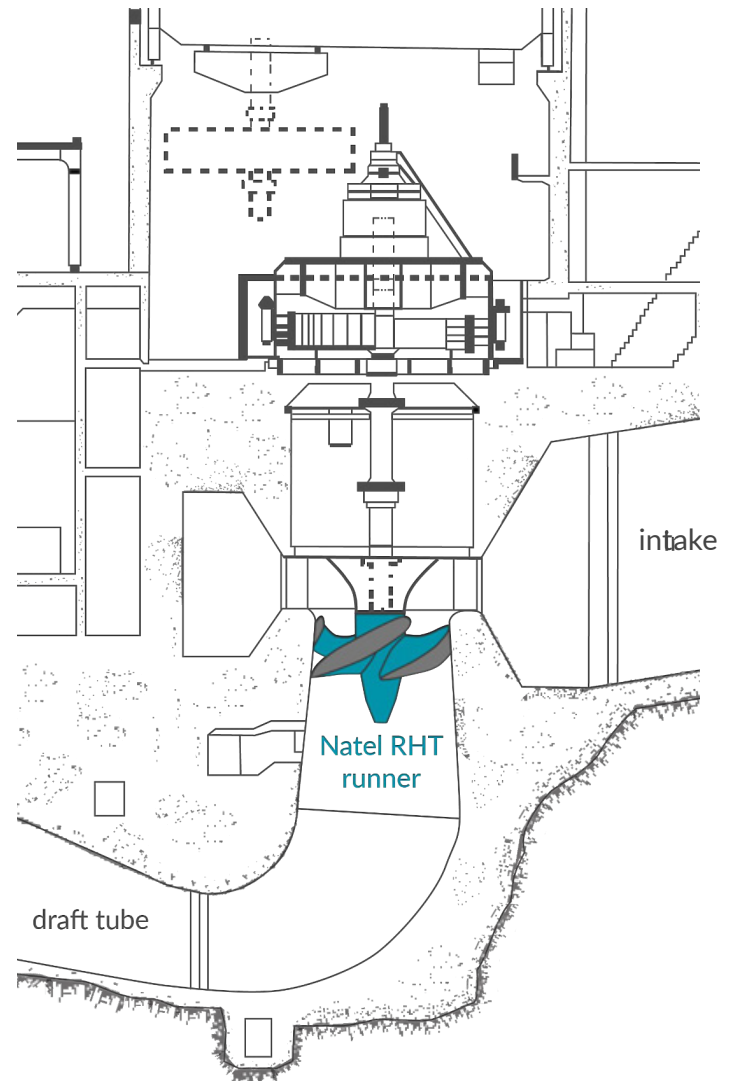
The fish-safe RHT runner is weight- and cost-competitive with similarly-sized conventional runners. Replacement RHT runners can be designed to work with existing civil works and equipment, including generators, casing/discharge rings, wicket gates, and draft tubes.

### Cost Savings Related to Fish Safety

For hydropower sites undergoing relicensing, the RHT is a clear choice for meeting fish passage requirements. For sites without fish passage requirements, the RHT offers a reliable, modern turbine or runner upgrade with the additional environmental benefits of improved sediment transport and vastly improved fish passage, and the long-term cost savings associated with eliminating fish screens and bypasses. The RHT meets a variety of draft criteria developed for the [Section 247 program](#). In particular, the RHT meets requirements totaling up to 11 points in subcategory **3(a)1: Fish Passage**.

### Energy Production

Replacing an existing propeller runner with a fish-safe RHT runner will not result in any energy penalty at all. There may be some energy production loss only if replacing a full Kaplan at a site with a highly variable flow.



Above: an example RHT runner-only upgrade, with no change to civil works required.

Left: the variable-speed RHT with adjustable wicket gates can match Kaplan turbine efficiency between about 65-100% of full load. RHT efficiency can exceed conventional propeller turbine efficiency across a wide range of load.

