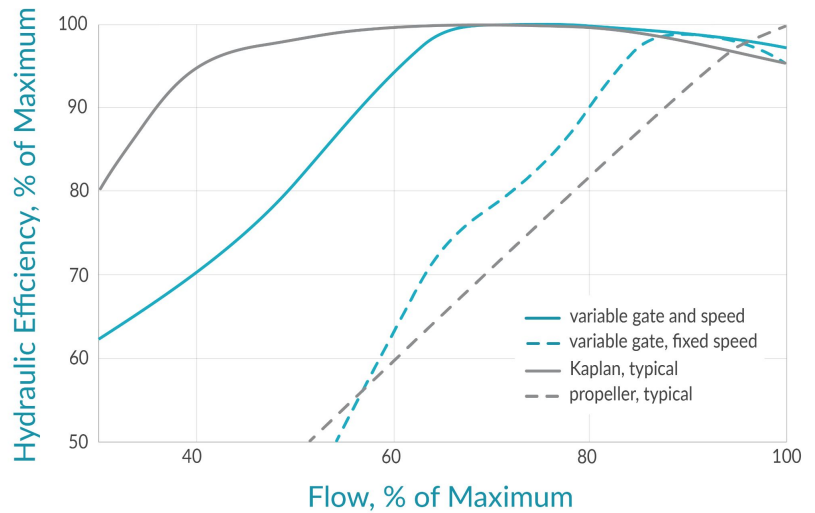




Natel's [Restoration Hydro Turbine \(RHT\)](#) represents a new class of high-performance hydroelectric turbine designed for safe downstream fish passage. Natel's patented FishSafe™ RHT designs feature distinctively thick, forward-swept blades that eliminate the need for fine fish screens and increase total plant efficiency, reducing upfront installation costs as well as recurring operations and maintenance costs. Working with OEM partners, Natel makes FishSafe™ RHT designs in flexible configurations for hydropower plants up to 40 m of hydraulic head.



Above left: D190 RHT prior to installation. Above right: a variable-speed RHT design 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.

### Natel FishSafe™ RHT Designs Are

#### High Performance

Peak hydraulic efficiency 90-93%.

#### Fish Safe

98-100% survival across species and life stages.

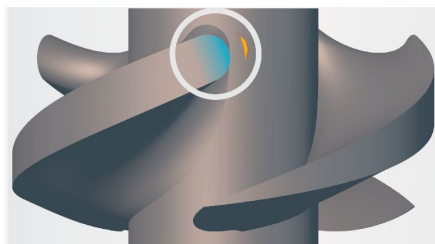
Strike testing performed with Alden Laboratory<sup>1</sup> in 2019 validated the positive effect of RHT designs' unique blade shape on fish survival. Subsequent turbine passage studies conducted with Pacific Northwest National Laboratory<sup>2</sup> and Kleinschmidt Associates<sup>3</sup> have demonstrated safe downstream passage of critical migratory species including salmonids, eel, and alosines through RHT designs.

<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).

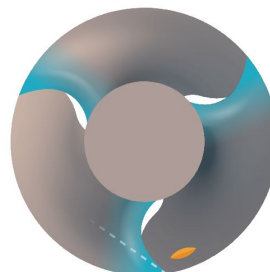
Below left: The blade shape that characterizes FishSafe™ RHT designs both reduces the likelihood that runner blades will strike fish and also reduces the severity of strikes that do occur. Below right: A still frame from high-speed video shows the safe passage of juvenile alosines through a D55 RHT.



**Thick, Curved blade**  
(deflects fish around)

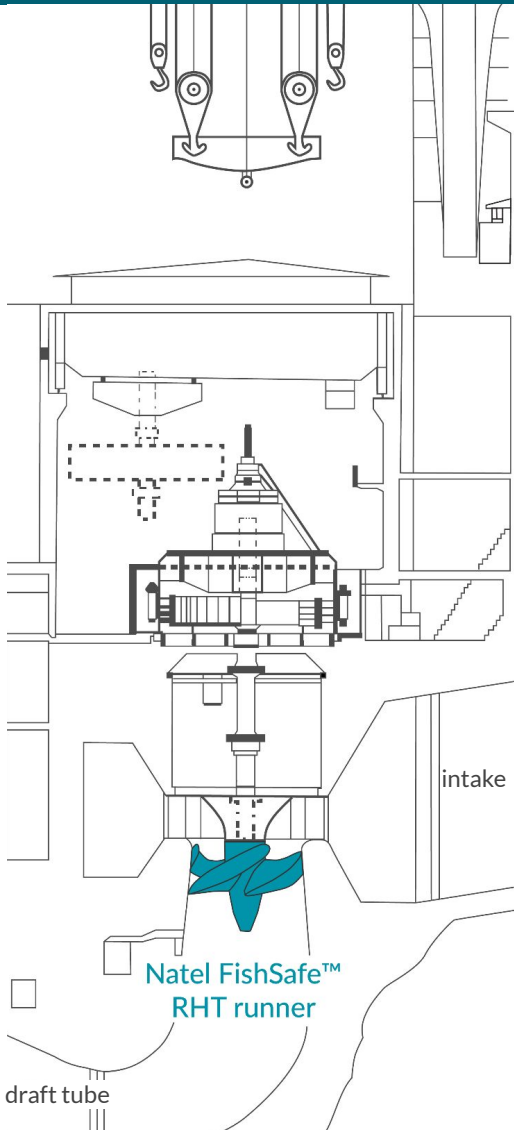


**FishSafe™ RHT Runner**



**Tip slant**  
(reduces severity of strike)





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

## Natel FishSafe™ RHT Designs Are

### Retrofit Ready

RHT runners can be designed as in-place replacements for conventional runners in existing turbines at sites up to 40 m in head. RHT runners are weight- and cost-competitive with similarly sized conventional runners and can be designed to work with existing civil works and equipment, including generators, casing/discharge rings, wicket gates, and draft tubes.

### Incentive Eligible

RHT designs meet a variety of draft criteria developed for the [Section 247 program](#). In particular, RHTs meet requirements totaling up to 11 points in subcategory 3(a)1: Fish Passage.

### Cost Saving

RHT replacement runners improve environmental performance while minimizing civil works and equipment alterations. All RHT designs eliminate the need for fine fish exclusion screens, which can reduce CAPEX and O&M costs associated with screening and alternative fish passage routes.

### Abrasion Resistant

The unique blade shape in RHT designs markedly reduces the severity of impact when the sediment in the water strikes the blade, making RHTs *six times more resistant to abrasion* than conventional propeller turbine designs.

### Available in Flexible Configurations

RHT designs are available in a wide range of diameters and generating capacities and can be adapted to site conditions in a variety of different configurations—including 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.

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).

Below, from left to right: CTO Abe Schneider inspects an American eel following its safe passage through an RHT; two-bladed RHT runner; an installed pit RHT.

