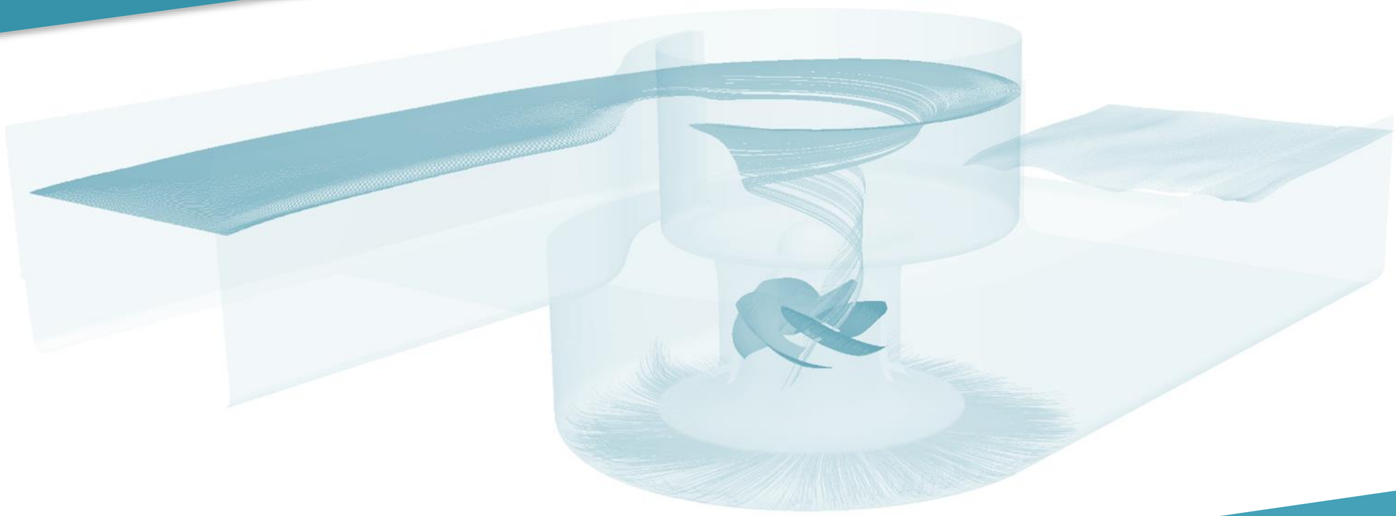
B-200

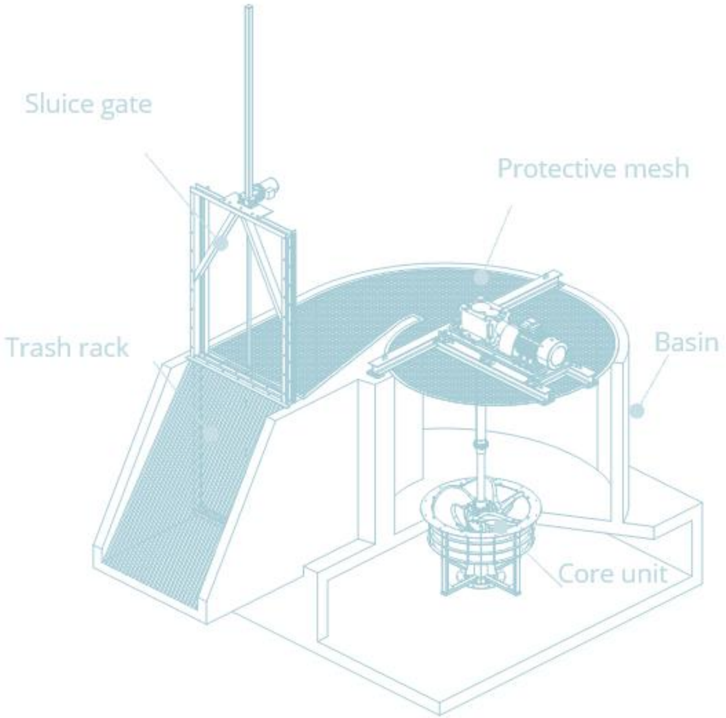
TURBULENT
Hydropower inspired by Nature

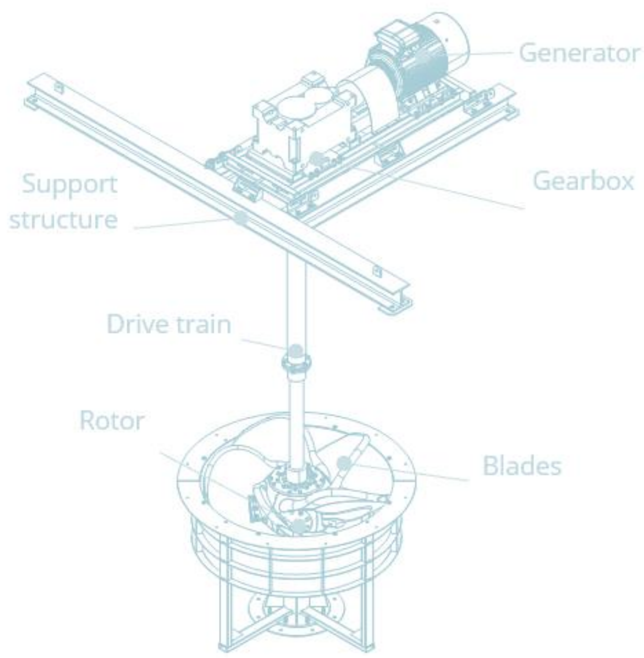


Fish-friendly propeller style water wheel with low RPM
Nominal power of 70 – 200kW, depending on flow and head
Body and rotor of turbine in corrosion proof stainless steel 304
SKF co-engineered heavy-duty sealing system for harsh environments and continuous dry-running
Designed to pass sand, stones, and river debris
Industry standard drivetrain and repair
Three-phase 400V/50Hz (60Hz optional)
Highly robust induction hydro generators

70 – 200 kW Vortex Turbine (Above Water design)

The vortex turbine is a low head hydropower technology designed to have a minimal impact on your local environment and is designed to be installed next to existing underutilized low height difference structures in rivers and canals such as weirs, unpowered dams, sluice gates, and canal falls. Due to the incredibly energy-dense design, the vortex turbine is also very suitable to be used in greenfield sites in remote areas where the small size and light weight help with the transport to the site. A simple and robust design ensures years of operation with minimal repair and maintenance. All electrical systems are based on tried and tested components that have proven themselves for hundreds of years in the industry. This, together with our 25 years turbine rotor warranty* will guarantee your investment.





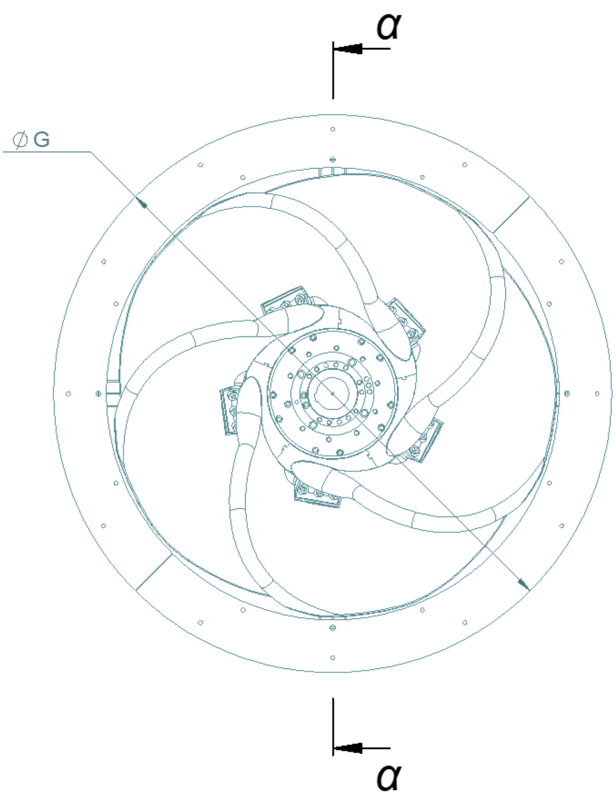
 Our technology was designed with the collaboration of several Universities and recognized by MIT for its promising innovations. All components are produced with partners and suppliers following ISO 9001:2015 standards. *we offer 25 years on the metal rotor parts, the generator and gearbox should be maintained according to the manufacturers' indications.

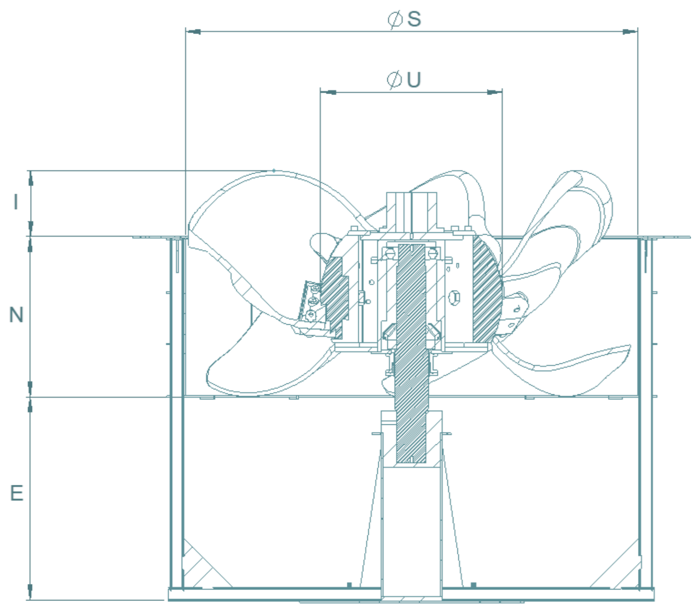
Co-funded by the Horizon 2020 programme of the European Union

TURBULENT

General Datasheet

Vortex turbine models 70 to 200 kW	Value	Unit
Min Flow	3,0	m3/s
Max Flow	9,0	m3/s
Min Head	2,4	m
Max Head	4,7	m
Frequency	50 – 60	Hz
Voltage	110 – 480	V
Number of Blades	5	-
Min. Speed	50	rpm
Max Speed	195	rpm
Blade tilt angle range	(-14) to 14	deg
Minimal Basin height	1.6	m
Maximal Basin height	4	m





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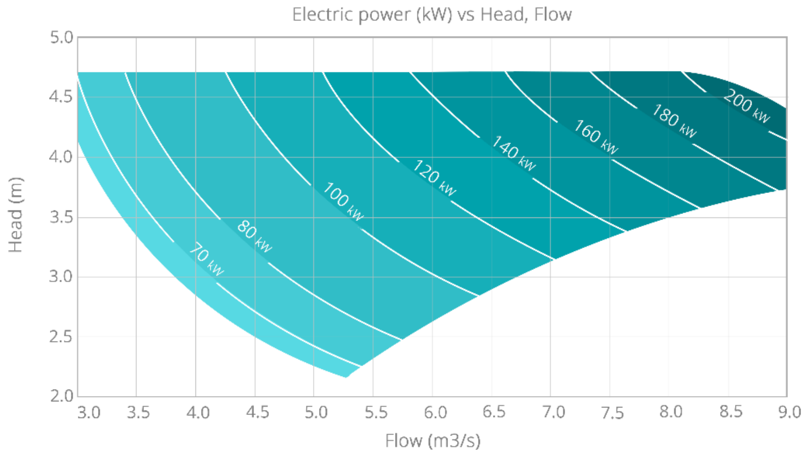
Representative Models*	70 kW	85 kW	100 kW	150 kW	200 kW	Unit
Turbine hydraulic output	78	94	111	167	222	kW
Electrical output	70	85	100	150	200	kW
Maximal Energy generation per year	560.000	680.000	800.000	1.200.000	1.600.000	kWh
Nominal flow *	3,5	3,8	5,7	7,1	8,9	m^3/s
Nominal head *	3,7	4,2	3,2	4,0	4,2	m
Impeller Diameter*	1,4	1,5	2	1.9	2	m
Turbine core weight	1.000	1.100	1.700	1.800	2.000	kg
Generator and gearbox weight	900	1061	1442	1735	2591	kg
Drive train weight	60,8	71,1	81,4	115,7	149,9	kg
Electrical power cabinet dimensions	600x600 x1800	600x600 x1800	600x800 x1800	600x800 x2000	600x800 x2000	d x w x h (mm)
Electrical power cabinet weight	380	400	420	500	600	kg
Electrical control cabinet dimensions	420x1000 x1700	420x1000 x1700	420x1000 x1700	420x1000 x1700	420x1000 x1700	d x w x h (mm)
Electrical control cabinet weight	164	164	164	164	164	kg
Shipping Volume	33,2 (20ft container)	33,2 (20ft container)	33,2 (20ft container)	33,2 (20ft container)	33,2 (20ft container)	m^3
Shipping total weight (w/o container)	2510	2800	3810	4315	5505	kg
Basin outlet orifice W	1442	1545	2060	1957	2060	mm
Basin larger width N	5250	5625	7500	7125	7500	mm
Basin smaller width A	5110	5475	7300	6935	7300	mm
Generator gearbox height R	896	960	1280	1216	1280	mm
Basin Height E	1739	1863	2484	2360	2484	mm
Basin discharge structure depth K	1135	1220	1620	1540	1620	mm
Turbine core flange diameter G	1740	1870	2490	2370	2490	mm
Turbine rotor tip diameter S	1415	1515	2020	1920	2020	mm
Turbine rotor hub diameter U	570	610	810	770	810	mm
Core outlet height E	635	680	910	860	910	mm
Core rotor height in basin I	210	220	290	280	295	mm
Core rotor height N	500	540	720	680	720	mm

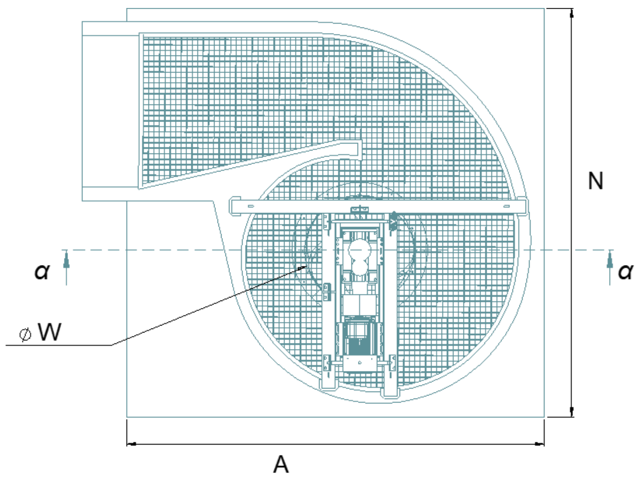
*A wide range of other models / head and flow combinations is available (see power range graph below).
All turbines can be transported in a 20 feet container. If needed, the turbines can be delivered in smaller subassemblies to simplify local transport.
International shipping code is HS841011 (Hydroelectric generators <1MW).

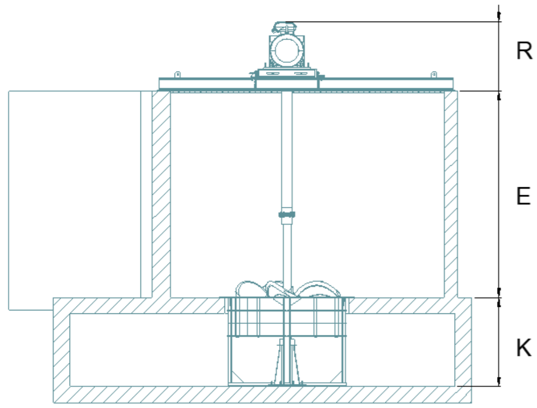
Power Range and Maintenance



Maintenance item	Maintenance interval
Lubrication	Yearly
Generator visual check	Yearly
Inspect fasteners	Yearly
Replacement of seals	Every 3 years
Re-greasing of gearbox bearings	Yearly
Electrical controls check	Yearly

Civil Works





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Additional Works and Requirements

Additional Works

- Civil works and installation need to be coordinated with local contractors. On request Turbulent will assist in this.
- Permits might be needed in your area. These can be building permits, water rights, electrical grid connection right, ...

Requirements

- Ambient operating temperature from -20 to 45°C
- Relative atmospheric air humidity of 5 to 95%

Power Electronics

On-Grid – Simple, clean energy

Turbulent T-2000 turbines are outfitted with induction generators that allow them to be directly connected to the grid without needing specialized power electronics. Once the turbine is connected you will be using mainly the clean energy from your hydropower plant at a considerably lower cost.

- Optional: parallel grid operation. When the grid goes out, the turbine keeps producing energy for your house.

Smart Off-Grid - Reliable remote electricity, combined hydro with other sources

This option can be used when no grid is available. With this option we outfit the turbine with power electronics to create a top-quality microgrid that turns river flow into immediately useful electricity. Features include:

- Pure Sine Wave Inverter for grid quality energy that will ensure proper functioning of all your electrical devices
- Controlled dump loads + Power Factor Correction (PFC) for optimal load management
- Can be grid-connected with uninterrupted switching between on- and off-grid
- Starting battery for generator to enable a restart and a turbo mode that allows peaks larger than the turbine power for a few minutes (such as the start-up of a heavy pump)
- Other energy sources such as solar, wind, or diesel can be easily integrated. Because we create our own grid you can use on-grid inverters.

Peak demand Off-Grid - Reliable electricity anywhere, combined hydro with peak demand capability

In a lot of off grid situations the mini grid will have a large peak every morning and evening due to the community cooking together, in small industries this can be related to the start-up of a set of machinery that exceeds the nominal power delivered by the turbine. To keep the grid functioning properly, extra peak power capacity is needed. Turbulent has develop a proprietary technology that can enable up to 3 times the nominal power output of the turbine for several hours. This way you can do whatever you want without worries of shutting down your grid. The best kind of electricity is the one you do not have to think about.

- Peak consumer loads up to 3x turbine rated power are allowed, ensuring energy availability during peak demand such as morning and evening hours.
- Batteries dimensioned for peak-shaving and increased uptime till 99%

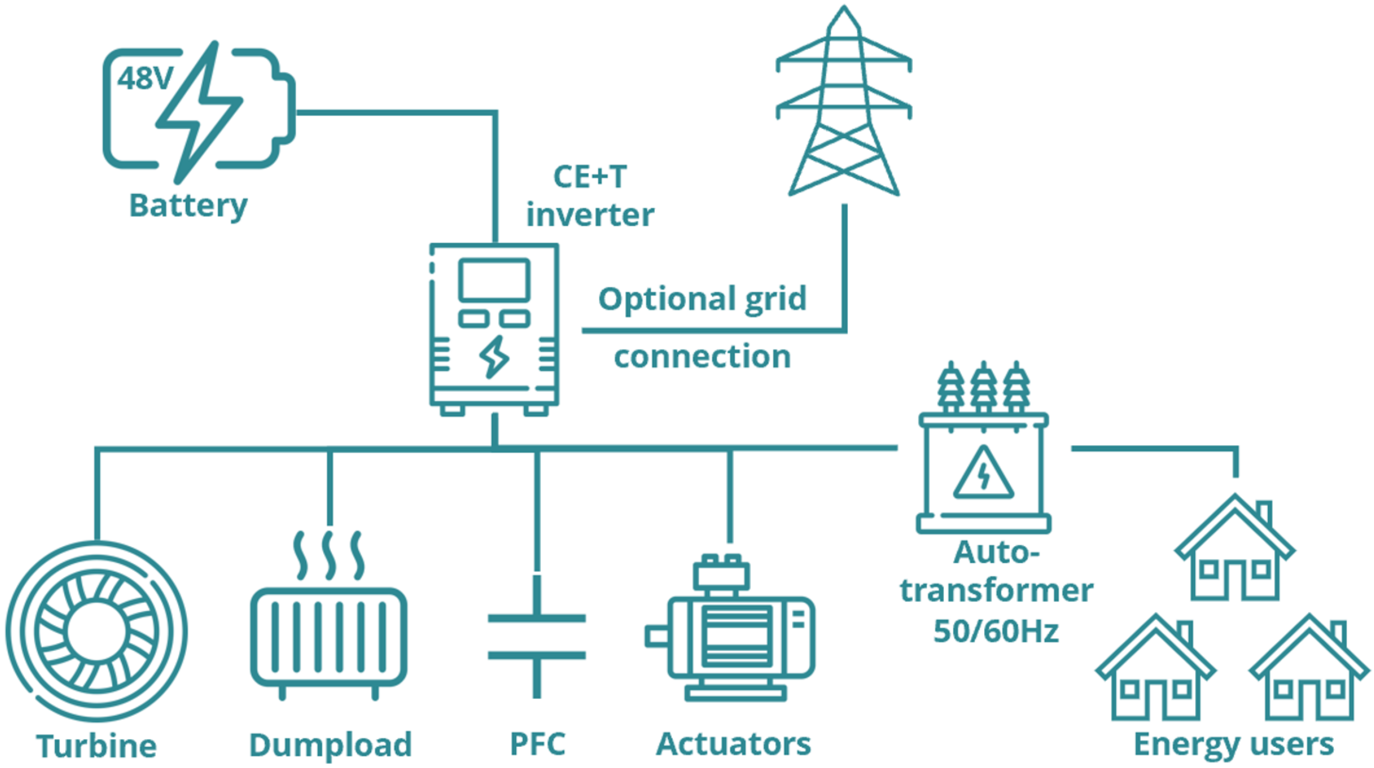
Optional

- Climate control cabinet
- Water-level monitoring
- Flood detection
- MID Certified meter
- 4G modem
- Extended safety monitoring
- Controls additional sluice gate

Electrical compliance

- IEC 61439 – Low voltage switchgear and control gear assemblies
- IEC 60204 – Safety of electrical machines
- IEC 60364 – Low-voltage electrical

Off grid schematic



Remote Control and Monitoring

A range of control and monitoring solutions can be provided to fit your specific project requirements, all building up to the latter:

Manual:

- On/Off + emergency button
- Manual sluice gate and turbine operation
- Remote monitoring by Turbulent via mobile/PC

Automatic:

- Automatic control of turbine and continuous fault detection
- Sluice gate control for Active flood protection + increased power output.
- Remote monitoring by Turbulent via mobile/PC
- Optional: Multiple consumer lines individually controlled.

Premium:

- Remote control via mobile/PC and locally with a touch screen control
- Detailed monitoring and web dashboard with shareable dashboard
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