GILKES

GILKES TURGO IMPULSE HYDRO TURBINE

TURBINE SELECTION

On 17th August 1856 we received our first order for a water turbine. It produced mechanical power to drive agricultural equipment. Farmers at the time required power – power which they used to cut wood and thresh corn. Advancements in technology reduced the demand for water turbines to provide this power but today we still find ourselves supplying water turbines all over the world.

Our role as a designer and supplier has, by consequence, changed. Where we were once commissioned to supply equipment to meet power and torque demands of mechanically driven equipment we are now challenged with supplying hydro equipment to produce optimum annual energy production and return on investment.

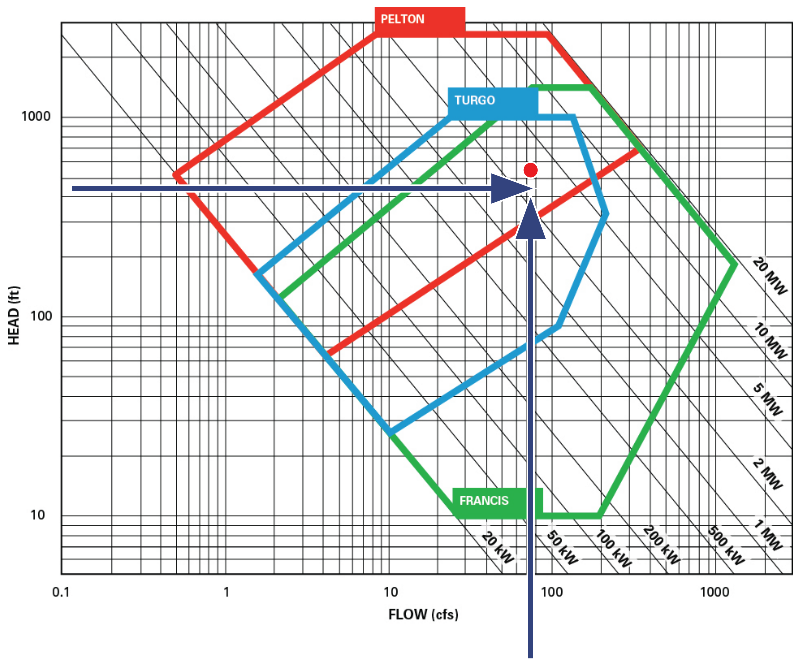
Traditionally equipment was selected based on the power requirement and a site assessment. Due to the power demands being relatively small the volume of water required was typically obtainable using the available head at site. Reaction turbines were often selected as the heads were low and the efficiencies were high and, with earlier projects, impulse turbines had not been invented.

Choosing the most suitable technology and size of turbine today requires a different approach; more technologies are available, the environment is better protected, and energy production, rather than power requirement, is the main focus.

This transition of focus from power to energy means operating time has to be considered in the turbine selection process. We continue to select turbines based on peak power performance for storage schemes. For Run-of-River projects we consider average annual flow data relative to the turbine performance across all possible technologies. If the head of the scheme is greater than 300m then only the Pelton design is feasible. For schemes with a head less than 50m then only a Francis can be considered from our range of technologies. However for all schemes with the 50m to 300m head range we consider Francis, Turgo and Pelton options.

1000 schemes, across 62 countries, have chosen the Gilkes Turgo as the optimum solution for their hydro scheme. There are a number of reasons why so many have chosen to install a Turgo turbine and we would like to share some of their reasons with you.

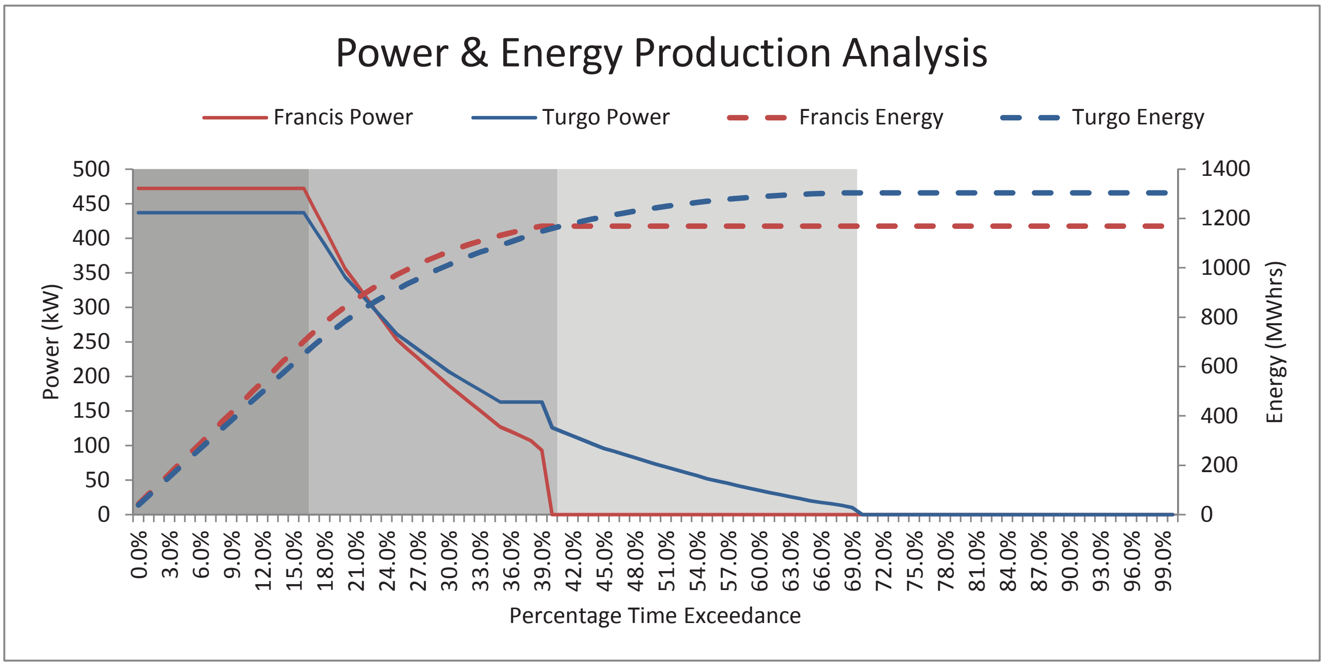
RANGE



ENERGY EFFICIENCY

Energy is what dictates the income from a hydroelectric scheme. Power is the rating of the equipment. Time links power and energy and the Turgo design is particularly good at operating over a wide range of flows. The Turgo's ability to operate in low flow conditions makes the Turgo particularly well suited to Run-Of-River hydro schemes.

During periods of high flows, i.e. when the design flow of the turbine is available to use, a well constructed Francis turbine will always produce more power (primary 'y' axis and solid line) and, consequently, more energy (secondary 'Y' axis and dashed line). As the volume of water in the river decreases the efficiency of the Turgo starts to exceed the efficiency of the Francis – the result of course being the Turgo starts to generate more power and, more importantly, more energy. Only the Turgo is running during the final stage of energy production - which equates to more than 100 days.



	Francis		Turgo	
	Average Power (kW)	Energy (MWhrs)	Average Power (kW)	Energy (MWhrs)
High Flow	472	702	437	650
Mid Flows	221	466	242	508
Low Flows	0	0	56	144
Total	N/A	1,169	N/A	1,304
Average	132	11.57	147	12.91

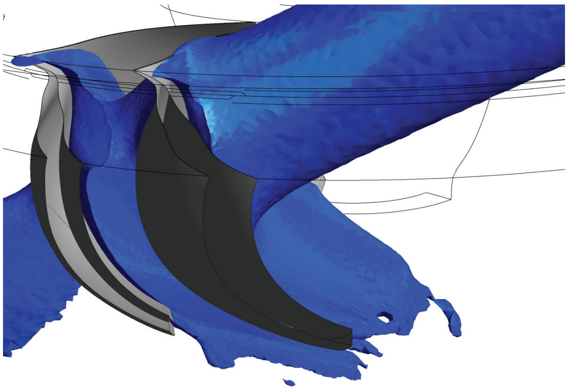
RELIABILITY

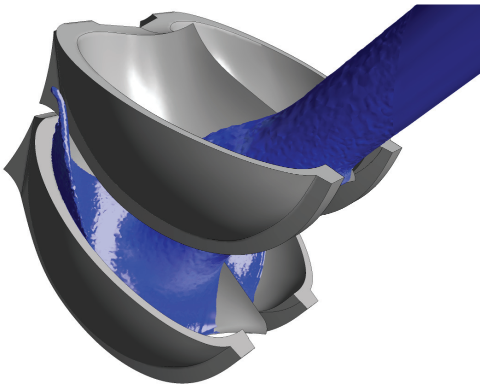
Being of a simple construction the Turgo design requires minimal maintenance. Our bearings are selected to absorb worst case scenario loads, and run at runaway speed for a designed period of time, – even though the Turgo is designed to protect itself from an overspeed condition. Being an impulse technology and having deflectors installed, the Turgo can instantly protect the penstock from surge pressures during a loss of load condition. Francis turbines, even when fitted with a flywheel, can accelerate to runaway speed in less than one second. It is not possible for the Francis runner to pass these increased volumes of water and, consequently, any unwanted transient pressure (surge) is introduced to the system. Turgo's are particularly well suited, and popular, for energy recovery in water treatment plants and we have options available for use with potable water to specifically suit that application.

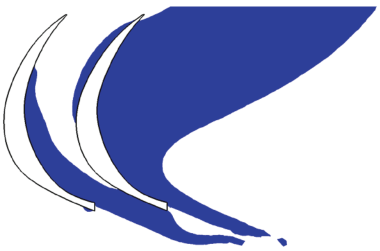
12 Inch mean diameter singlet jet Gilkes Turgo installed at Draper Irrigation Company, UT, USA. Net Head 633ft, Rated Flow 11.7cfs, Speed 1800rpm, Power 511kW, Year 2004

When operating on aggressive water, whether that is sand, silt or glacial matter the effects of the abrasion are significantly less on the Turgo design. The jet of water and the profile of the runner are critical when maintaining high efficiencies. Wear does, of course, occur but the removal of metal is small and uniform across the profile of the runner – thus having minimal negative effect on turbine performance.

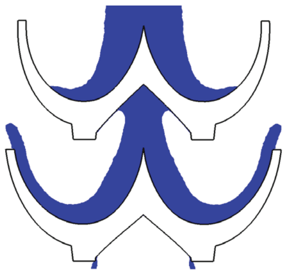
Illustrations showing the difference between the operating principle of the Pelton and Turgo Impulse Runner.







Turgo

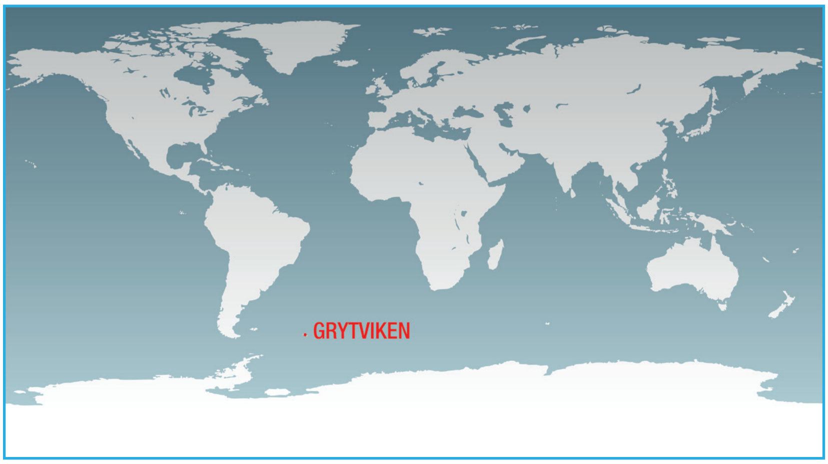


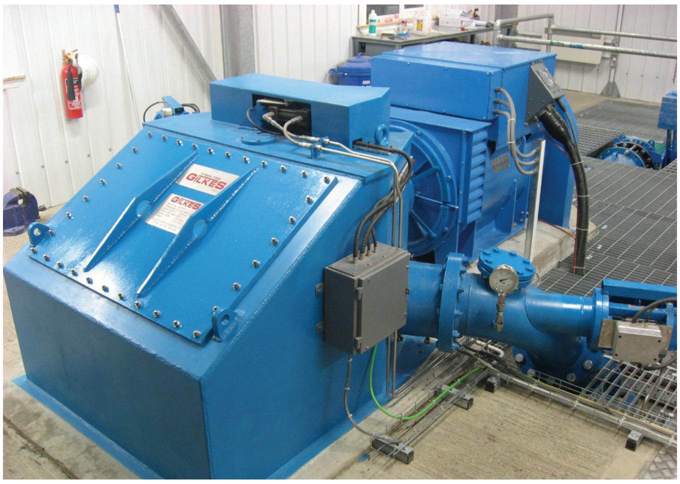
Pelton

The wear on Pelton turbines has more of a negative effect as the splitting edge starts to deflect the jet. Wear on Francis turbines increases the critical clearances within the turbine which, in turn, has a negative effect on turbine performance. The maintenance for the Turgo can be planned and it would be very unusual for any unexpected turbine costs to be incurred. The reliability of the Turgo design, and its receptiveness of poorer grid systems, makes them popular with remote energy generation schemes.

Grytviken, on South Georgia Island in Antarctica is an example of a remote Turgo operation – 12,000 miles (south) from Denver, CO, USA.

- Net Head 213ft
- Rated Flow 15.36cfs
- Speed 1000rpm
- Power 250kW
- Year 2007





Gilkes Turgo installed.

Turbine Power House

Grytviken has a population of 2. This isn't them but this is Grytviken...

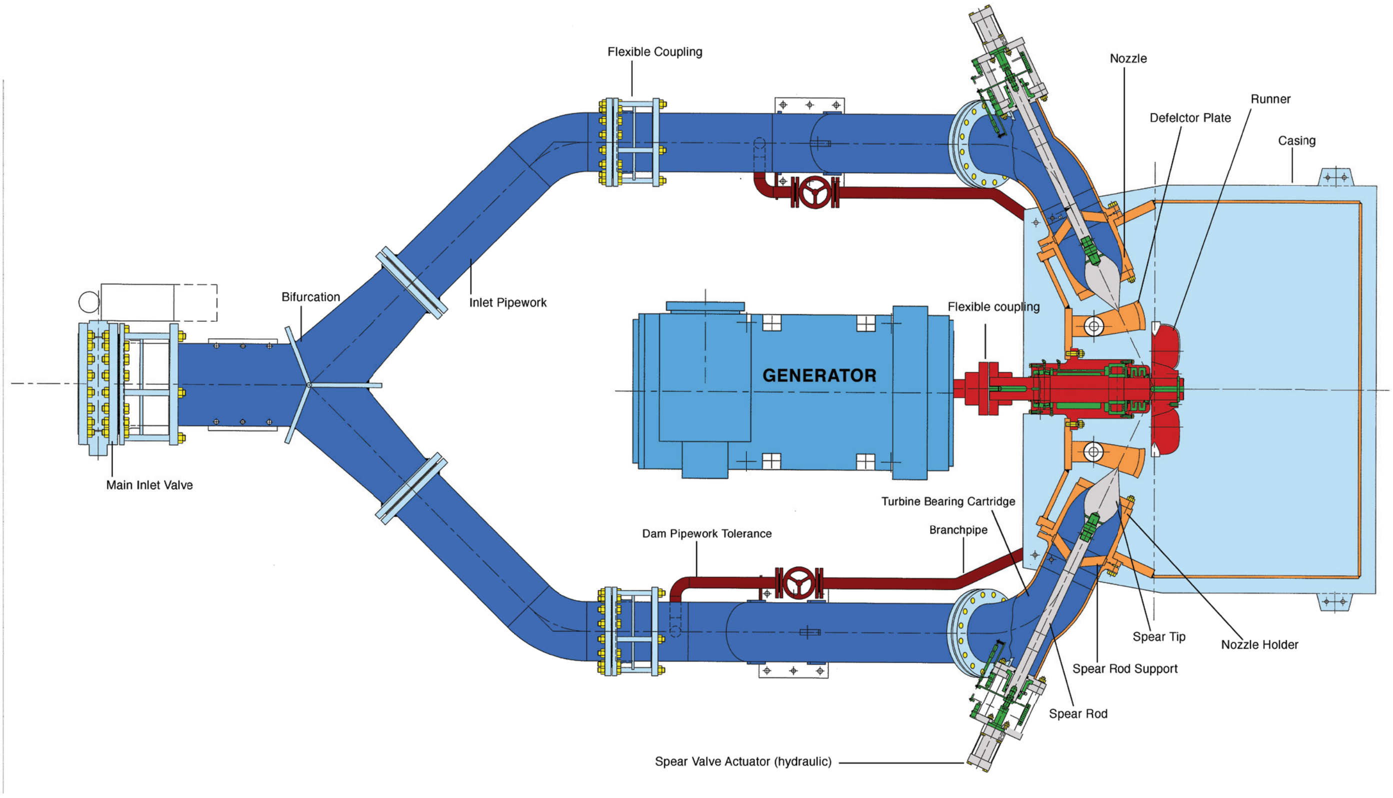
THE ORIGINAL MANUFACTURER

The Turgo impulse turbine was invented and patented by Mr. Eric Crewdson, the grandfather of our current Chairman Mr. Charles Crewdson, in 1919. Further improvements in 1936 and 1962, complete with patents, enabled the runner to operate faster and with a higher efficiency across a broad flow range. Until the 1970's Gilkes was the only manufacturer of Turgo turbines but, as with all excellent designs, others do follow. In recent years, Gilkes, as the original designer of the Turgo, has successfully improved the performance of schemes which originally opted for a Turgo manufactured by a different supplier.

The Turgo impulse design is a high capacity, medium head, free jet impulse turbine. Instead of the jet striking the centre the bucket at a right angle and splitting into two the jet on the Turgo enters the runner at an acute angle, passes through the wheel, and discharges from the other side. The runner is designed to pass a large diameter jet of water relative to the mean diameter, thus giving the turbine a high specific speed for an impulse design. For a given head and output the Turgo design will run advantageously faster than the Pelton impulse design.

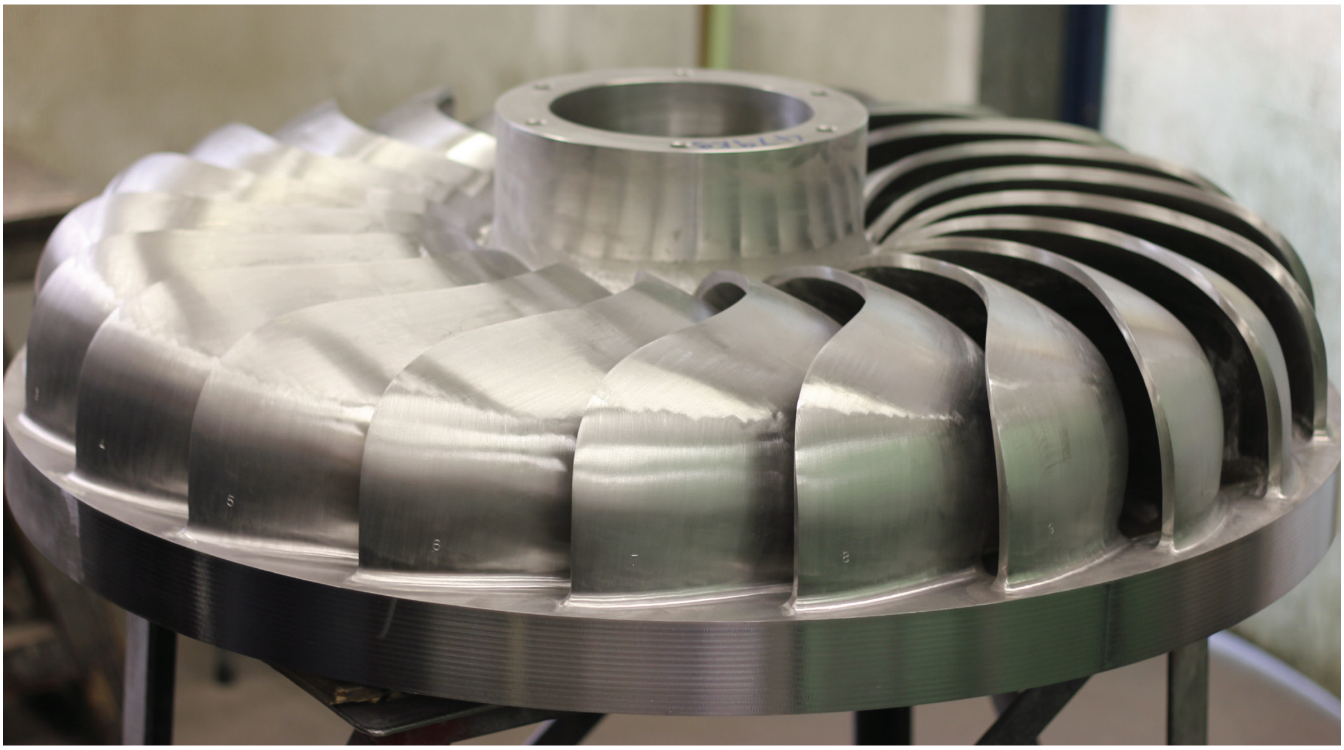
The illustration below shows the simplicity, and provides an insight into the robustness of, a typical twin Jet Turgo. The inlet pipework is often located under the powerhouse floor. The turbine can be fully automated electrically or hydraulically. Water simply discharges through the bottom of the turbine case. The runner can be mounted on a Gilkes bearing design or, for larger units; the runner can be mounted directly onto an overhung generator shaft. The Turgo is available in both a single and twin jet arrangement. The diagram shows a typical twin jet configuartion.

TYPICAL TURGO ARRANGEMENT



TURGO'S IN NORTH AMERICA

Gilkes first started exporting Turgo's into Canada in 1925 and the USA in 1969. Many of the schemes are still in operation today. The majority of our recent work with existing equipment in North America has been upgrading other manufacturer's equipment to perform to similar levels of an originally installed Gilkes Turgo.



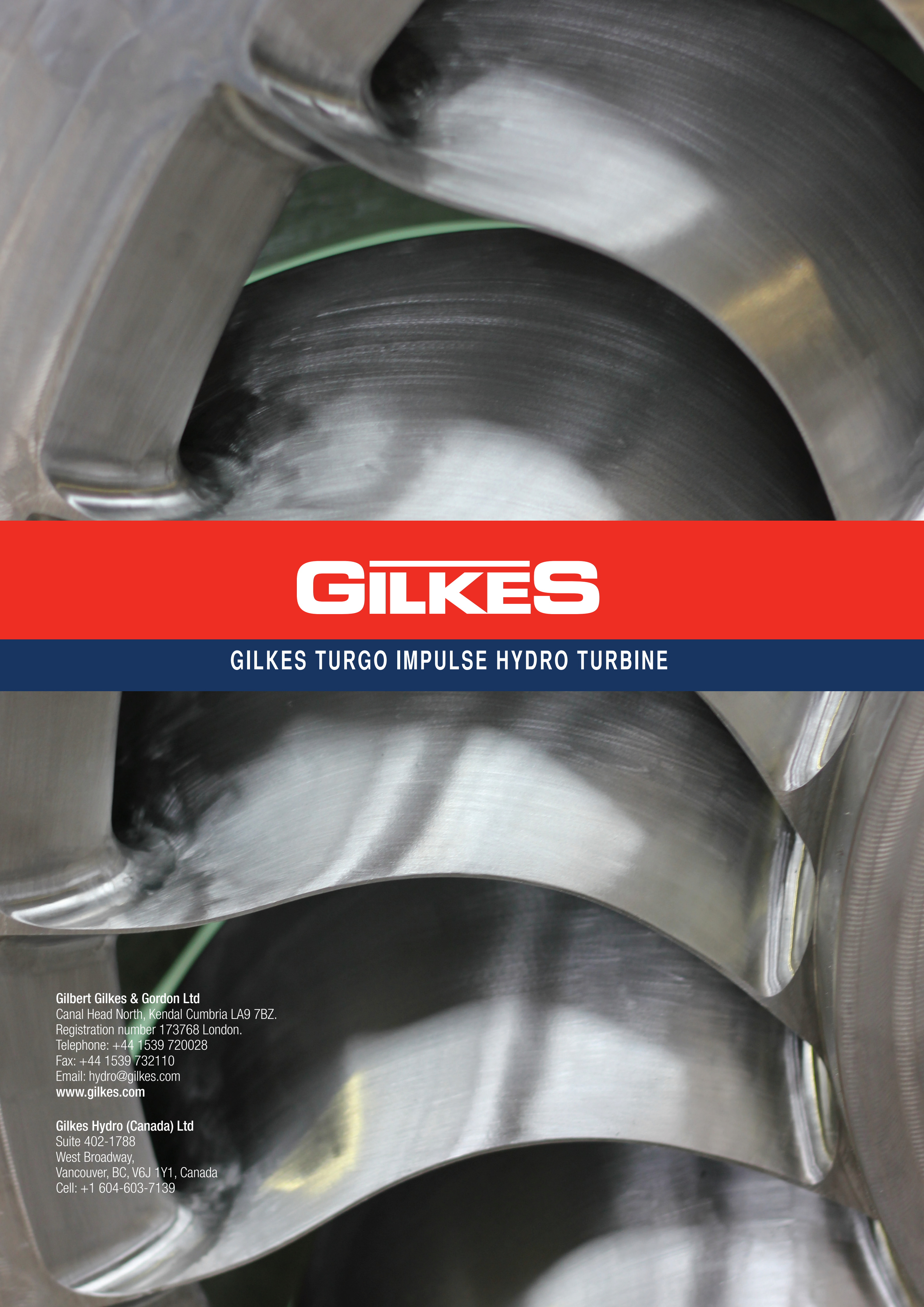
560mm mean diameter Gilkes Turgo Runner which was installed into another manufacturer's turbine, in North America, to improve performance.

CUSTOMER TESTIMONIAL

"After years of underperformance from the two Turgo machines installed at one of our premium sites we approached Gilkes to see if they, being the original inventors of the Turgo Turbine could assist us with our power and annual energy deficiency. Upon completion of the upgrade to retrofit the existing turbines with their latest design of the nozzle, spear tip and runner arrangement, we achieved an immediate increase in power!!

We were extremely pleased with Gilkes' performance on the project and are currently assessing the performance gains which we will share with you as soon as we have completed our analysis. We also eagerly await to see how this will increase our overall annual energy production once we have operated the units for a full year through both the high and low flow periods."

Rick Hopp, ROR Power.



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