

Harnessing the flow

Exploring over a century of innovation, from lighting up the first home with hydropower to advancements in turbine design, **Gilbert Gilkes & Gordon Ltd** has been an integral player in the hydropower industry. In this exclusive interview, delve into the company's rich history, recent accomplishments, and outlook for the future



Above: Laser scanning a Pelton runner for inspection post machining

Could you provide a brief overview of the early days of Gilbert Gilkes & Gordon Ltd and its significant contributions to the hydropower industry?

Gilbert Gilkes & Gordon Ltd is a hydro turbine manufacturing company with a long history. It was established in 1853 as "Williamson Brothers" in Halfpenny Mill, Kendal, UK.

Initially focused on agricultural equipment, the company received its first order for a small hydropower turbine on August 17, 1856. The turbine was a Vertical Shaft Vortex type, producing 5 bhp under a net head of 30ft and running at 300 rpm. This installation was located just one mile away from the company's original village location. Between 1856 and 1881 approximately 440 Vortex machines were sold.

In 1879, Williamson Brothers installed a water turbine, No 428 at Cragside, the residence of Lord Armstrong in Northumberland, England. This installation marked the first use of hydropower to generate electricity for lighting an entire house.

In 1881, the Williamson Brothers sold the business to Gilbert Gilkes, who focused the business on the sales and production of water turbines. Gilbert Gilkes

was a vigorous Quaker entrepreneur, and he started a major export drive which led to the sale of about 600 turbines at home and in more than 20 countries

In 1894 Gilbert Gilkes & Co Ltd was formed. 1889 had seen the introduction of Pelton turbines which are suited to higher heads than the Vortex. This led to a strong market for private house lighting as well as for export to countries where there was a British engineering influence, notably tea estates and mines in mountainous parts of the world.

Subsequently, in 1897, Gilkes installed the first turbine for a hydro power scheme at Balmoral, Scotland for HM Queen Victoria. The system was later rebuilt and upgraded in 2004 to resume generating electricity on the British Royal Family's Private Estate.

In 1919, Eric Crewdson, the grandfather of the current Chairman at Gilbert Gilkes & Gordon Ltd, invented and patented the tangential flow impulse turbine known as the 'Turgo Impulse Turbine'. This innovative turbine combined the benefits of a Pelton type impulse turbine with a higher specific speed. Positioned between a Pelton and Francis machine in terms of head and flow characteristics, Turgo turbines excel in handling "dirty and abrasive water" without compromising performance. The first 30kW Turgo

turbine was installed at Invergeldie Lodge near Crieff in Scotland in 1919.

In 1928, the water turbine business of James Gordon & Co. was taken over giving our company its current name of Gilbert Gilkes & Gordon Ltd. James Gordon's principal assets were a range of water turbine designs, a group of overseas agents and a London office. As a result, Gilkes export sales became and remained a very important part of the business.

Since then, over 1,000 Turgo installations ranging from 25kW to 7.5MW have been established worldwide. Gilkes has supplied Turgo turbines to 65 countries across various continents including Grytviken in South Georgia (the southernmost hydro installation globally), Alaska, Japan, and Zimbabwe.

How has your company played a role in shaping the evolution of the industry over the past decades?

In the 1800s, the firm gained recognition for supplying water turbines and expanded its offerings to include small-scale machines for university engineering laboratories. The first such machine was sold to Moscow University around 1890 after Gilbert Gilkes acquired the company, renaming it Gilbert Gilkes & Co. This move allowed the company to stay connected with progressive engineering ideas through academic installations.

From the 1930's to the 1970's the company continued to innovate and further improved the Turgo turbine, in 1936 and 1960, often working with academia to validate results.

In 1934 the Company installed its own water turbine testing facility - thought to be the first for any UK water turbine manufacturer.

Recently, between 2011 and 2017, Gilkes funded three PhD research projects in collaboration with Lancaster University to increase the performance of our impulse turbines. These studies, embraced CFD, high-performance computing and laboratory testing to achieve significant gains in efficiency over our existing Pelton and Turgo designs. The success of these projects highlighted the importance of embracing engineering simulation for maintaining Gilkes quality and competitiveness. As a result, Gilkes invested in software, hardware and expertise in fluid flow and structural analysis. CFD and FEA are now embedded at Gilkes as in-house tools to analyse and optimise all our products on a daily basis.

What are some key milestones or achievements that have defined your company's journey in the industry?

Key milestones and projects include:

- **1879** - first domestic hydroelectric installation in the world at Craggside, Northumberland
- **1895** - Eight large Vortex machines sold to Duck Reach Hydro plant, Tasmania - still running in 1953!
- **1897** - Sale of turbine to Queen Victoria at Balmoral
- **1900** - more than 1400 turbines sold at home and abroad
- **1919** - patent awarded for the Turgo Impulse turbine
- **1934** - a water turbine test facility was created at our Kendal factory
- **1953** - 18.5MW Pelton turbines exported to English Electric in Australia
- **1969** - Queen's Award for Export Achievement

- **1977 - 1980** - around 40 turbines supplied to the Philippines for rural electrification.
- **1983** - introduced the Twin Jet Turgo Impulse Turbine
- **1996** - Rehabilitation of the Kinlochleven Hydro Station (first major hydro station in Britain) still serviced and maintained by Gilkes.
- **1996** - Received the Royal Warrant as manufacturer of water turbines.
- **2010** - Second Queen's Award for Export Achievement
- **2015** - Commissioning of 50 UK schemes within 12 months to meet the FIT 2015 pre accreditation deadlines.
- **2019** - celebrated 100 years of the Turgo The company has supplied over 6800 turbines globally, to over 80 countries.

How has the company's approach to hydropower manufacturing evolved over the years?

Over time, companies have adapted their offerings to align with changing customer needs and technological advancements. Initially focusing on supplying only the turbine component of a hydro scheme, companies now provide comprehensive "water to wire" packages to meet complex and challenging customer requirements. These packages encompass not just water turbines but also generators, digital control solutions, switchgear, and balance of plant components essential for seamless integration and efficient operation of a hydroelectric plant.

The comprehensive water to wire packages offered by companies like Gilkes are expertly assembled by their hydro team. By thoroughly understanding customer site specifications and effectively applying project management techniques, Gilkes ensures the successful delivery of projects globally, meeting deadlines and staying within budget constraints for customers worldwide.

The transition from merely providing turbines to delivering entire hydroelectric systems globally has required Gilkes to reassess its traditional manufacturing methods. Embracing a project-centric approach, the company now operates within a complex international supply chain to efficiently deliver various technical components and services to customer sites. Timely delivery of these components is crucial, as they must meet specified quality standards upon arrival for seamless assembly, installation, and commissioning by Gilkes and their partnering service providers. This meticulous process ensures that projects are executed successfully on time and within budget constraints. ➔



Above: **16MW Pungwe B Project, Zimbabwe**

About Gilkes

Throughout its 170-year history the company has supplied over 6,800 turbines to more than 85 countries worldwide. Gilkes currently employs approximately 160 staff members, including a diverse team of skilled engineers, designers, sales engineers, and support personnel at its UK headquarters. It also has offices in Tacoma, US and Tokyo, Japan to directly serve the North American and Far East small hydro markets.

❶ What are some of the notable projects that your company is currently involved in within the hydropower sector?

- **Blind Slough:** Full replant of a 1955 Pelton turbine with a modern 2197kW Twin Jet Pelton
- **Grytviken:** Supply of a new micro hydro turbine in addition to the existing 250kW twin jet Turgo providing power to the British Antarctic Survey on the island of Grytviken.
- **New Lanark:** Refurbishment of 1931 Boving twin runner Francis turbine at UNESCO world heritage site, New Lanark Mills, Glasgow.
- **Nkwilo:** In April 2024 we shipped the Turbine out to Tanzania for the Nkwilo small hydro project. The 414kW, 13.5" single jet Turgo Turbine is to be installed on the Nkwilo HPP and will provide power to the Tanesco grid in Sumbawanga.
- **Northwater:** 500kW, 550mm Francis turbine for Northwater water treatment plant in Denver, Colorado. Following the plant's commissioning, our engineers conducted comprehensive operator training for the plant staff.
- **Glen Finglass:** Refurbishment of 1965 Harland Vertical Francis Turbine. Including a redesign of the guide vane mechanism.

Can you highlight any recent accomplishments or advancements that have set your company apart in the industry?

During the UK Feed-in Tariff era, Gilkes successfully

supplied and commissioned nearly 300 turbines with capacities ranging from 50kW to 2MW. By early 2011, it became evident that the Feed-in Tariff was effectively supporting the growth of the UK small hydro sector, leading to a rise in project enquiries and contracts. In response to this increased demand, Gilkes established its first service centre in Fort William, Scotland. Subsequently, two more service centres were opened in Scotland, complemented by a service team at the Kendal headquarters in England. This strategic expansion allows Gilkes to provide comprehensive preventative maintenance services and spare parts for their fleet of hydro turbines across the UK.

In recent years Gilkes has invested in several technology advancements and updated engineering methods to support the shift from purely new build hydro to the refurbishment and modernisation of existing equipment.

In 2020 Gilkes invested in the addition of a 5-axis milling machine to strengthen our in-house machining capability, significantly increasing productivity levels and enabling Gilkes to continue to be highly competitive in the global market.

As well as onshoring a complex and high value component back to the UK, the project also moved the Gilkes team into new areas of expertise including 3D scanning, laser measurement, tool optimisation & real-time sensing. 3D scanning, in particular, has become an invaluable tool as the UK hydro market has shifted to a greater proportion of renovation projects. Often, these projects require the replacement of a worn turbine runner for which the existing drawings are insufficient or unavailable. The recent restoration of the twin-Francis turbine at New Lanark Mills World Heritage Site provides an excellent example. With limited drawings of the original 1931 Boving design and both runners badly damaged, Gilkes used reverse-engineering to recreate the original design and optimise it for modern manufacturing methods. The least damaged blade was laser-scanned, re-surfaced in CAD and patterned round to create a 3D model of the original runner. CFD and FEA were then used to verify the performance and integrity of the design and validate modifications made for CNC machining.

How does the company envision its role in the current landscape of hydropower turbine manufacturing?

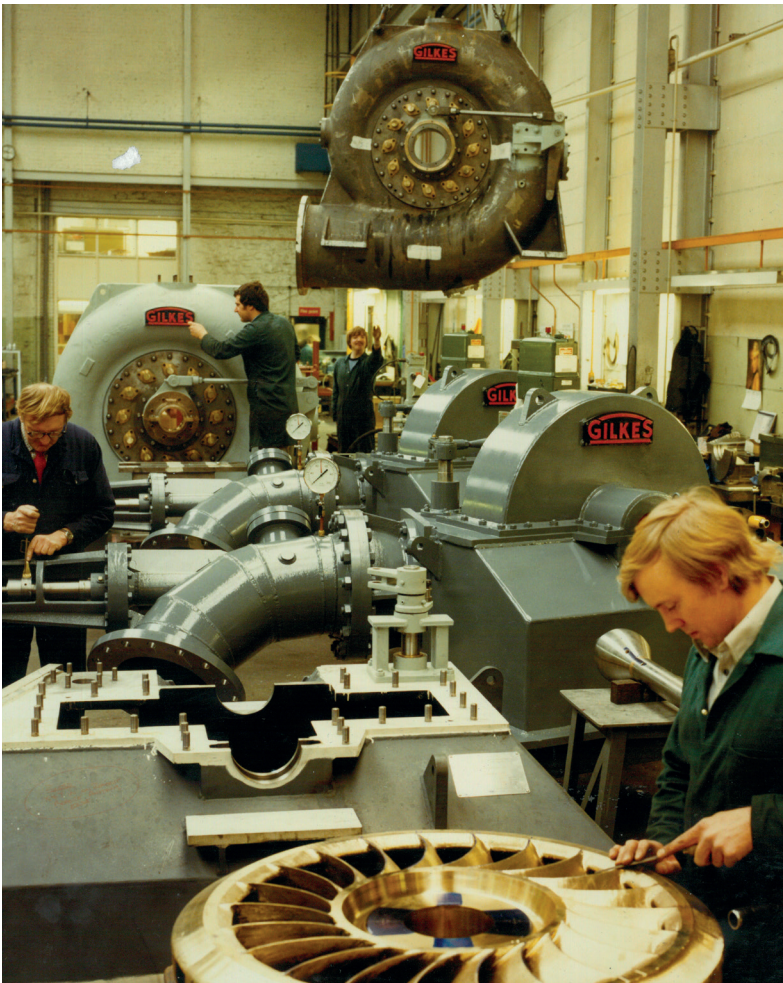
Following the successful feed in tariff in the UK, which enabled a boom in development in Scotland by landowners and small-scale developers, Gilkes has over 2,000 turbines on the UK mainland, and with the lack of current incentives, the focus is now shifting to the preservation, rehabilitation, and optimisation of these existing schemes.

Nobody quite understands equipment as well as the original manufacturer and that is why we are utilising all our experience as designer and manufacturer to move our clients away from a 'breakdown & fix' mindset to a strategy whereby we 'predict & prevent'.

Regular service contracts allow our experienced personnel to regularly assess the risk of break down, mitigate that risk, and maximise generation.

A significant portion of our projects focus on public utilities rather than private developers. Many of these projects involve existing water conveyance networks where energy recovery turbines can be installed

Below: Multiple turbines for the Philippines – early 1980s





Left: Operator training during commissioning of Northwater Hydro Plant, Denver, Colorado

to extract potential energy from pressurized water sources.

Energy recovery solutions cater to various applications in the water industry, helping recover lost energy when water pressure needs reduction before use in specific processes. The generated power can either be exported to the grid for revenue generation or used onsite in islanded mode to offset energy costs. Gilkes specialises in manufacturing a variety of turbines that can be tailored to specific sites, effectively harnessing the water’s potential energy and converting it into electricity.

In developing countries and those with rural landscapes such as Africa, hydro projects are crucial for providing power to communities that previously lacked access. Mini Grid Systems are becoming more common, incorporating various renewable energy sources in a single grid. Small hydro schemes are essential components of these grids due to the ample available resource.

Gilkes has extensive experience integrating hydropower into rural mini grids and islanded applications to supply electricity to isolated communities.

What are your insights and perspectives on the future direction of the hydropower industry?

The future of global hydropower development hinges on policy reform and collaboration among various stakeholders. Sharing knowledge among developers, consultants, equipment suppliers, and others is crucial for advancing the industry. Educating policymakers about the benefits of hydropower is essential to ensure its recognition alongside other renewable energy sources.

Small hydropower is environmentally and socially responsible. These scalable installations offer a quick return on investment and have a long asset life, making them an attractive option for various landscapes and locations. With minimal environmental impact and rapid development timelines, small hydropower

projects can play a significant role in combating climate change.

Globally, there is also an increasing need to modernise and optimise aging installations to maintain their lifespan and increase generation.

The USA in particular has a number of incentives and grants currently in place to support the future of hydropower facilities. The most recent seeing the selection of 46 hydroelectric projects receiving up to \$71.5 million in incentive payments to increase generation efficiency.

Gilkes has a great deal of experience in these projects, ranging from single-part replacements or upgrades to the rehabilitations of whole hydro installations back to their optimum working levels, and have recently worked on the Blind Slough refurbishment project in Alaska, who were recipients of some of the funding.

Could you share any strategies or initiatives that your company is pursuing to contribute to the industry’s growth and sustainability?

Hydropower turbine technology, along with other core elements like generators and power systems equipment in a hydropower scheme, are established and mature technologies. The industry’s growth areas lie in operations and maintenance of these schemes. Promising advancements include leveraging information communications technology for enhanced remote operation and maintenance capabilities. Utilizing reliability-centered maintenance techniques can help minimize lost generation revenue and reduce operating costs associated with maintaining hydro scheme assets.

To enhance industry sustainability, Gilkes strives to offer customers seeking to upgrade hydro schemes solutions that minimize civil works, particularly within the powerhouse. By reusing core components like turbine cases and pipework, the company contributes to waste reduction, lower carbon emissions, and decreased embodied energy. These practices not only benefit the environment but also result in cost savings for customers undergoing modernization projects. ●

Below: Redesigned guide vane mechanisms for Glen Finglas refurbishment

