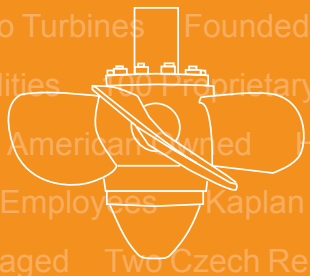
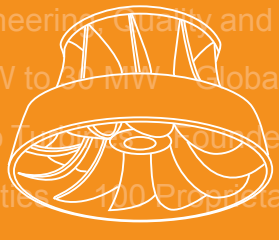
MAVEL





HYDRO TURBINE TECHNOLOGY

Mavel

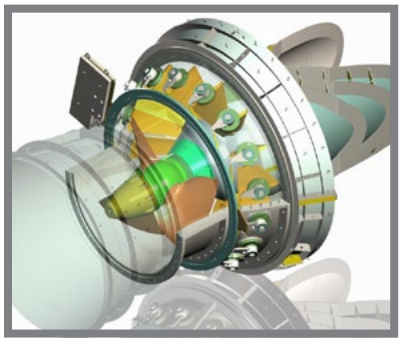
Mavel was founded in 1990 with the mission of contributing to the development of renewable energy resources around the world by providing customers with hydro power technology that combines innovation, quality and value. Since that time, Mavel has built an engineering-driven organization capable of providing customers with hydroelectric turbines and related equipment that optimize the value of their projects through utilizing its in-house team of design engineers and production specialists. Turbines are produced at the company's state-of-the-art manufacturing facilities in the Czech Republic and installed under the supervision of Mavel's global service team. Today, Mavel is a worldwide leader in the provision of hydroelectric equipment for hydroelectric power plants utlizing turbines with power outputs from 30 kW to 30 MW.

Mavel's success is due to the unique combination of (1) expertise and experience with a **full range** of hydroelectric turbines, (2) **global** sales / service capability and (3) sole focus on **small hydroelectric** power projects.


MAVEL

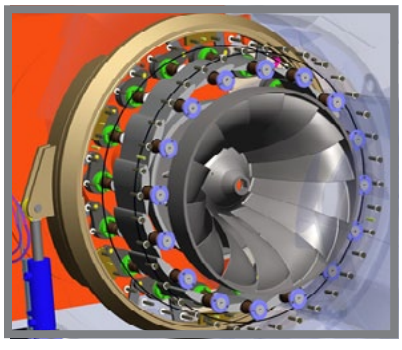
TURBINES

Kaplan



The Kaplan turbine was invented in the Czech Republic by Victor Kaplan in 1912–1914. The Kaplan turbine design has improved significantly since that time. Mavel's Kaplan turbines involve design modifications such as a vertical scroll case turbine, bulb turbine, PIT turbine, "S" turbine and "Z" (Saxo) turbine. They have three to six runner blades and can be single or double regulated. Mavel's Kaplan turbines are optimal for run-of-river projects with low heads from 1.5 to 35 meters (5 to 115 feet). Kaplans comprise 70% of Mavel's turbine production.

Francis

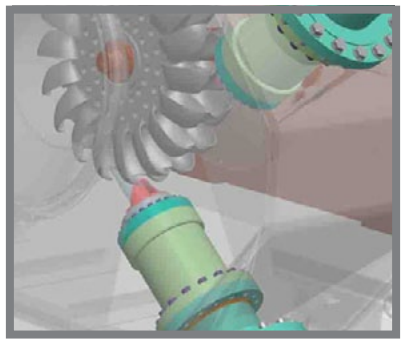


The Francis turbine was invented in Lowell, Massachusetts in 1848 by James B. Francis. This turbine, which powered the Industrial Revolution, is designed for medium head and medium flows and is still the most common water turbine in use today. Mavel's line of Francis turbines is designed for heads from 15 to 300 meters (50 to 1000 feet). They are available with a runner diameter from 400 mm to 2500 mm, can be configured as a horizontal or vertical unit and have installed power of up to 30 MW. Mavel's Francis turbines are installed in Europe, the Americas, Africa and Asia.

A complete range of hydroelectric turbines from 30 kW to 30 MW and over 100 proprietary designs

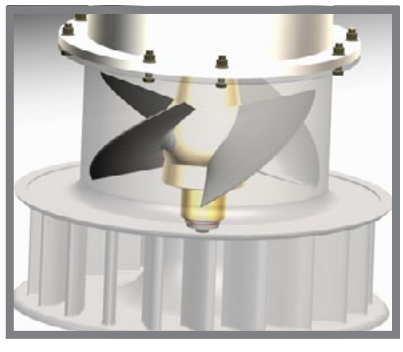
Pelton

The Pelton turbine was invented in the late nineteenth century during the California Gold Rush by Lester Allan Pelton. This impulse turbine is designed for high heads and lower flow rates with the most common installations in mountainous areas. Mavel's Pelton turbines have a vertical or horizontal configuration, are designed to have a runner diameter of up to 2500 mm, one to six jets and power of up to 30 MW. Mavel has installed Pelton turbines at sites in the Americas and Europe with installed power from 47 kW to 11,300 kW per unit.



TM Modular Micro

Mavel's TM Modular Micro turbines are sold as complete units for turnkey installation. With four different sizes (300 mm, 550 mm, 850 mm and 1000 mm runner diameter), the TM Modular Micro turbines are suitable for many low head sites. These turbines do not require a powerhouse. They are easy to install and come fully equipped with turbine, generator, inlet, draft tube, and electric and control systems. Mavel has installed about 70 TM Modular Micro turbines, including the small 4 kW system in Kyoto, Japan, a 300 kW three unit system in Poland, and an eight unit, 1,224 kW project as part of an irrigation system in Idaho, USA.



Production Capability

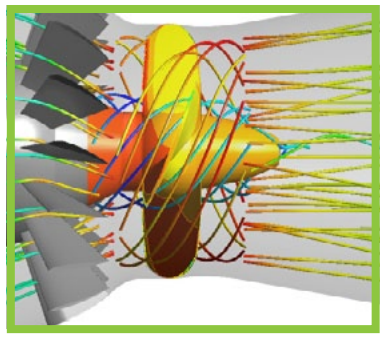
Facilities	**Two: Benešov and Rájec – Jestřebí, Czech Republic**
Property	**Land: 27,000 m² (290,630 sf)** **Production / Storage: 10,300 m² (111,000 sf)** **Administration: 2,600 m² (28,000 sf)**
Production Capabilities	**Milling, boring, drilling, pressing, grinding, sawing, metal, rolling, cutting, painting, welding, coating, assembly, turning and testing**
Engineers	**60**
Production Machines	**40**
Crane Capacity	**85 ton combined capacity**
Quality Control	**ISO 9001:2008**
Specialized Machinery	**6-axis machining center (2013)** **5-axis milling machine (2010)**
Environmental Qualification	**ISO 14001:2004**
Welding Qualification	**ISO 3834-2:2005**

Mavel has a 6-axis machining center as well as a 5-axis milling machine. Both machines mill Kaplan blades, Francis and Pelton runners and turbine components. This allows the majority, if not all, of the production processes to be completed at Mavel's Czech production facilities.

R E S E A R C H & D E V E L O P M E N T

Dedicated Team

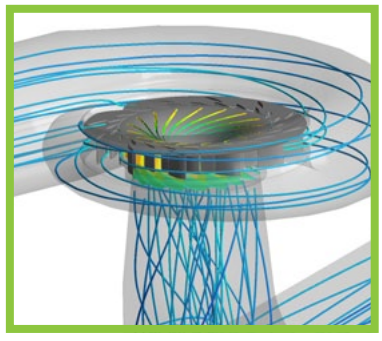
Imagination, innovation and optimization are at the core of Mavel's research and development efforts. Working on challenges defined by sales engineers, the R&D Team develops solutions with the support of the over 1,000 years combined experience of the company's 60 civil, hydraulic, mechanical and electrical engineers. They utilize state-of-the-art 3-D modeling software and are supported through partnerships with educational institutions and technical laboratories.



Fluid Dynamic Computer Simulation of Kaplan Turbine

Turbine Design and Hydraulic Profiles

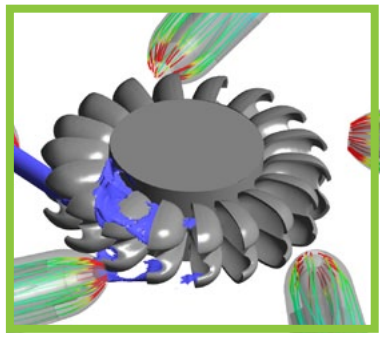
Mavel has over 100 proprietary turbine designs. Each year, the R&D Team, working with design engineers, develops new turbine designs to meet higher efficiencies, minimize civil costs, utilize new materials, simplify installation procedures and time and/or adapt proven turbine technology to customer specific needs. Design innovations have included the development of modular micro turbines, Kaplan turbines with an operating range as low as 1.5 meters and high efficiency Francis and Pelton runners suitable for heads up to 1000 meters.



Fluid Dynamic Computer Simulation of Francis Turbine

Fluid Dynamic Computer Simulations

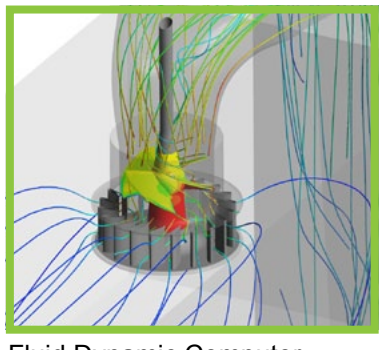
The R&D Team uses both standard and proprietary computational fluid dynamics software. This software models dynamic hydraulic flows and allows for the effective development and testing of new hydraulic profiles and turbines. This shortens the development process. The illustrations on the right depict examples of streamlined visualizations of the velocity fields inside Kaplan, Francis, Pelton and micro turbines.



Fluid Dynamic Computer Simulation of Pelton Turbine

Alternative Material and Manufacturing Processes

Mavel's R&D Team stays abreast of developments in both material and manufacturing technology. Minimizing production costs and maximizing quality and product life are key considerations in exploring material innovation. Manufacturing process and control are fundamental. The latest innovation in this area for Mavel was the installation of a state-of-the-art CNC 6-axis prototype machining center that allows for the highest accuracy transfer from design to production.



Fluid Dynamic Computer Simulation of TM Micro Turbine

Imagination, innovation and optimization drive the efforts of Mavel's dedicated research and development team.

Mavel's global service department sends specialists to sites around the world for assembly, commissioning, testing and maintenance services.

Engineering

Each hydroelectric project begins with design. Mavel's team of civil, mechanical, hydraulic and electrical engineers begin working on a project during the preparation of the sales proposal. Their work, using 3-D software, continues through design, to final manufacturing and installation documentation.

Purchasing

Mavel sources castings, forgings, raw material and large subcomponents (such as generators) from suppliers across Europe and the Americas. Each supplier is researched for quality assurance and each subcontracted item meets the same quality standards as Mavel's ISO 9001:2008 certification.

Manufacturing

Mavel manufactures its turbines and related equipment at its Czech Republic facilities, which are equipped with traditional production technology and state-of-the-art customized machine tools. These include a 6-axis machining center put into operation in 2013 and a 5-axis milling machine installed in 2010. Turbine runners are either milled from castings or forgings.

Welding and Coatings

Mavel employs experienced welders, and is certified as CSN EN 287-1. The company also has 220 SM (2,400 SF) of specialized work areas and trained technicians to oversee all special coatings and painting operations.

Assembly

Mavel's headquarters is approximately 50 kilometers southeast of Prague. The company's second production facility is just outside of the country's second largest city Brno. Final assembly is completed in one of the two halls, which have a combined 85 ton crane capacity. Each turbine is fully assembled, fitted and tested prior to preparation for transport.

Products and Services

Mavel also provides penstocks, draft tubes, weir gates, trash racks, cleaning machines, electrical equipment, installation, testing and commissioning, refurbishment and repair.

Quality Control

Mavel is an ISO 9001:2008, ISO 14001:2004 and ISO 3834-2:2005 certified company and has quality control procedures in accordance with recognized international standards. Mavel's quality control certified personnel perform most testing in-house. External specialists complete certain specialized tests, such as x-ray, chemical composition and metalography.

WATER TO WIRE SOLUTIONS

INSTALLATIONS

Fujiyoshida HPP / Japan
1 x Francis / 140 kW

One of Mavel's smallest installations is 15 kilometers from Japan's Mt. Fuji where Mavel completed commissioning of the refurbished **Fujiyoshida HPP,** a small hydroelectric power plant. Mavel installed a new horizontal Francis turbine. This doubled the installed power of the site from 70 kW to 140 kW.

From Europe to the Far East, from the Americas to Africa, customers rely on Mavel turbines to maximize the energy potential of their hydroelectric power sites on rivers and other waterways.

Nestled in the foothills of the Rwenzori Mountains of Uganda, **Bugoye HPP** utilizes two Mavel horizontal Francis turbines to harness the power of the Mubuku and Esya Rivers. Today, the project provides energy to the region with 14.33 MW of installed power.

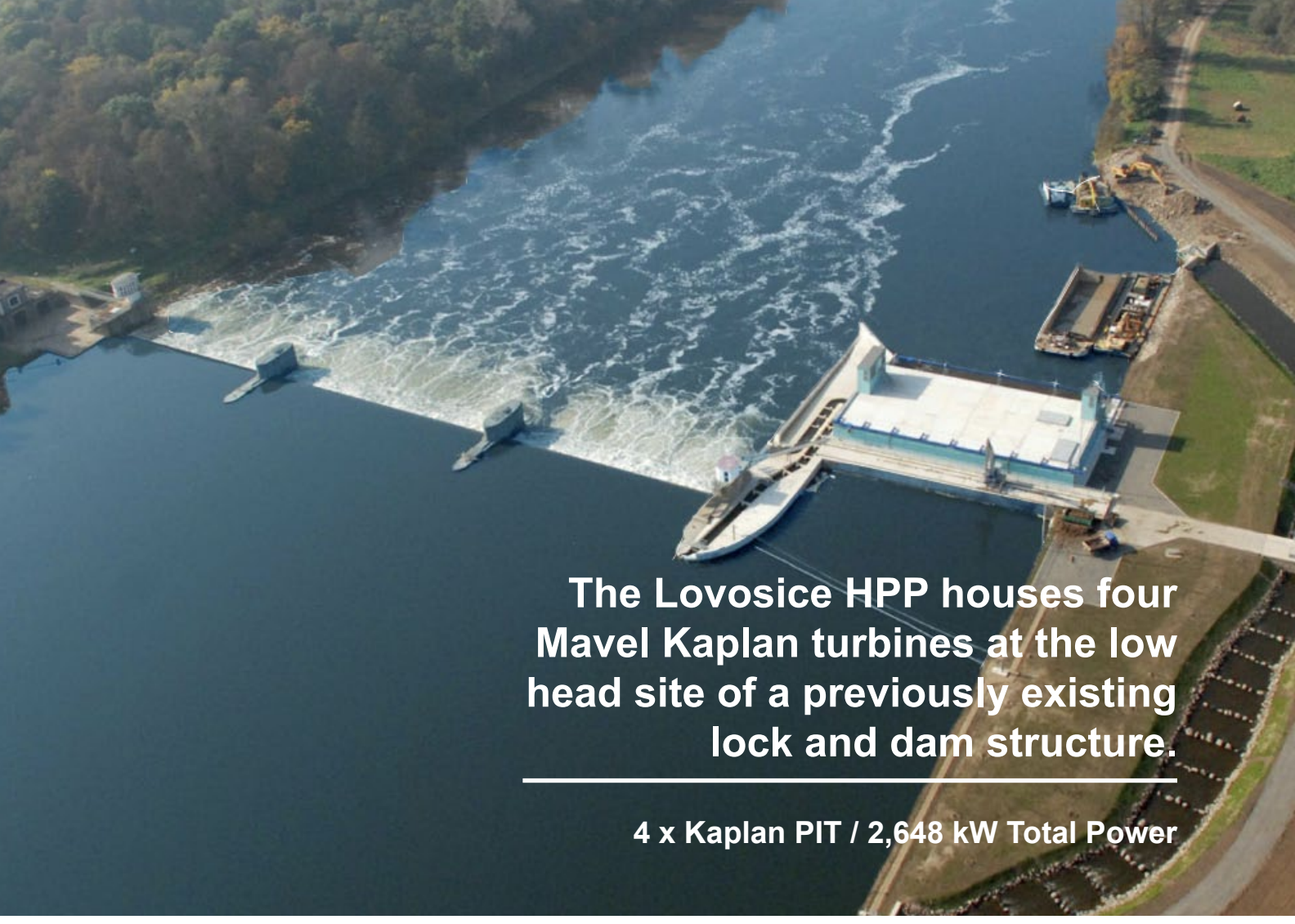
On Canada's West Coast, in British Columbia, a single 11.3 MW Mavel vertical Pelton turbine produces clean renewable energy at the greenfield **Upper Clowhom HPP**. Mavel Pelton turbines have been delivered for the **Clemina Creek HPP** and the **Serpentine HPP**, two other new 10 MW sites in the region.

Three Mavel TM10 Modular Micro turbines are installed at the **Olawa II HPP** on the Odra River in southern Poland. This was the first installation of the Mavel proprietary TM10 turbine. The innovative modular design allowed these turbines to be installed directly on an existing weir without a requirement for a powerhouse. The total installed power of the three TM10s at this site is 300 kW.

Bugoye HPP / Uganda
2 x Francis / 14,332 kW

Upper Clowhom HPP / Canada
1 x Pelton / 11,300 kW

Olawa II HPP / Poland
3 x TM10 Micro / 300 kW



The Lovosice HPP houses four Mavel Kaplan turbines at the low head site of a previously existing lock and dam structure.

4 x Kaplan PIT / 2,648 kW Total Power

The Lovosice – Pistany Hydroelectric Power Plant **(Lovosice HPP),** designed by Mavel, was built on an existing lock and dam structure on the Elbe River just outside of Prague, Czech Republic. The plant's owner stipulated specific requirements including a fish friendly design, a watertight powerhouse and turbines able to maximize available power with a 1.9 meter net head.

The watertight powerhouse has survived floods in 2011 and 2013, incorporates fish ladders made of natural stone, and utilizes four Kaplan turbines. The turbines each have three runner blades, which minimize the potential for harm to fish and maximize the power at the site.

The 2,648 kW power plant, utilizes four Mavel Kaplan PIT turbines. These 3-meter runner diameter, three runner blade, double regulated turbines have generated power at head levels as low as 1.2 meters. In addition to the turbines, Mavel's supply included gearboxes, generators, hydraulics, lubrication and cooling system, cleaning machine, trash racks and electrical and control systems.

Lovosice HPP Powerhouse Interior

Lovosice HPP Powerhouse during the 2013 flooding of the Elbe River

On the Piedra River in Panama, six Mavel horizontal Francis turbines power a three plant, 30 MW cascade providing renewable green energy to the region.

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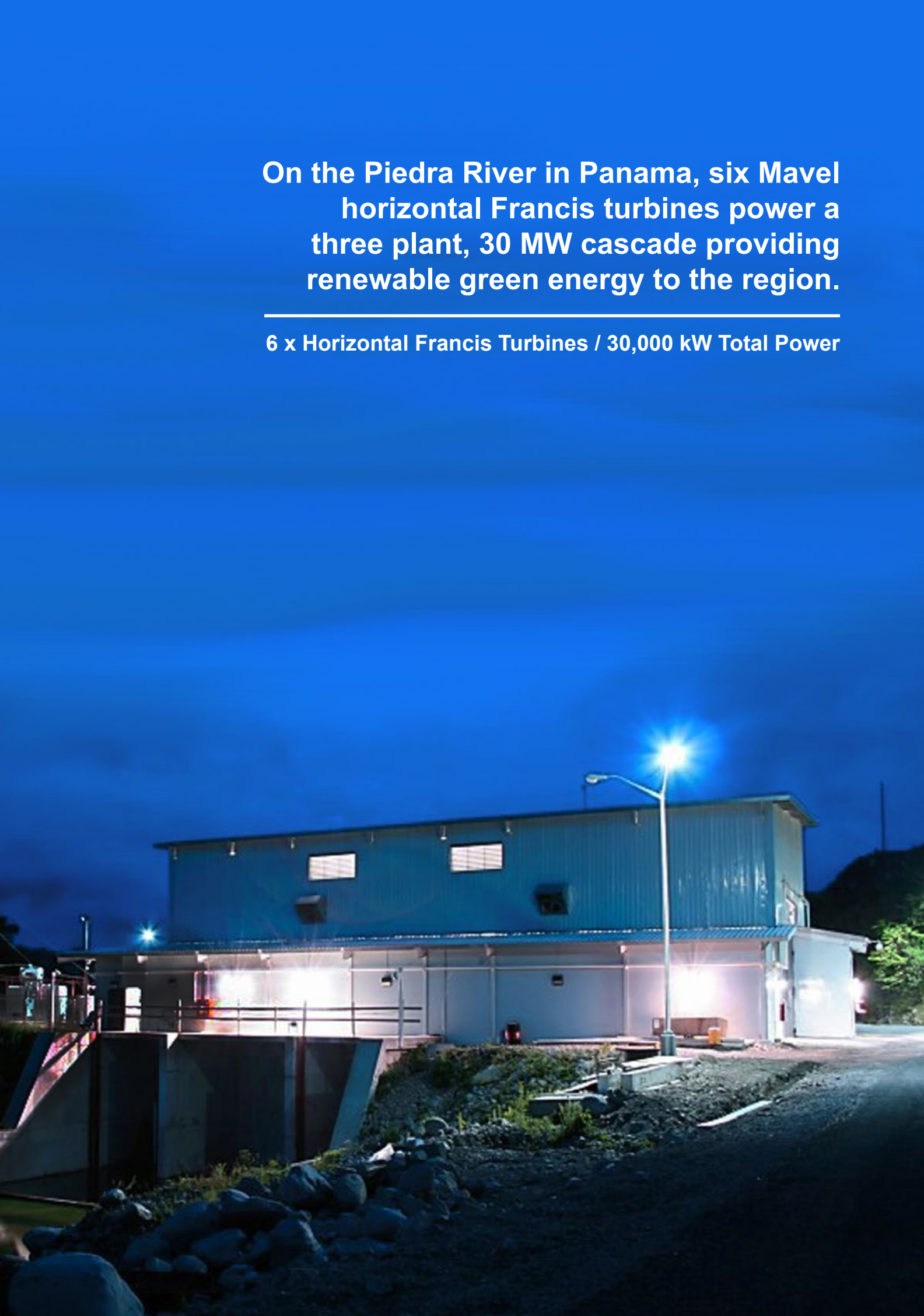
6 x Horizontal Francis Turbines / 30,000 kW Total Power



Mavel has turbine installations on 5 continents in 36 countries around the world.

Yipo HPP / S. Korea
3 x Kaplan PIT / 3,330 kW

South Korea's "Four Rivers Project" assures regulation of four major rivers and provides clean energy to the region. As part of this project, Mavel provided 11 Kaplan turbines and related equipment to five of the greenfield hydroelectric power developments.

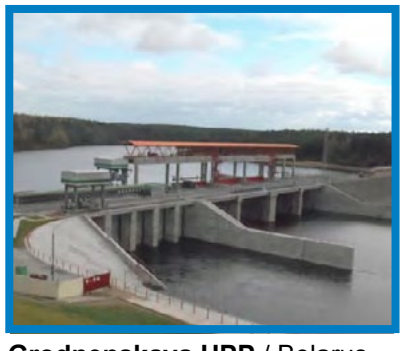
The **Yipo HPP** and **Seungcheon HPP** were completed and commissioned in 2011. For the **Yipo HPP**, Mavel provided three Kaplan PIT turbines with runner diameters of 3400 mm and three runner blades. The total combined installed power of **Yipo HPP** is 3,330 kW. For the **Seungcheon HPP**, Mavel provided two double regulated Kaplan bulb turbines with runner diameters of 1580 mm and three runner blades. Installed power totals 862 kW.

Seungcheon HPP / S. Korea
2 x Kaplan Bulb / 862 kW

The final three, **Hapcheon HPP**, **Nakdan HPP** and **Gangjeong HPP**, were commissioned in 2012. Each of these projects utilized two Mavel Kaplan PIT turbines. **Hapcheon HPP** has installed power of 5.53 MW. **Nakdan HPP** has installed power of 3.25 MW, and **Gangjeong HPP** has installed power of 3.3 MW.

Gangjeong HPP / S. Korea
2 x Kaplan PIT / 3,298 kW

Mavel provided five Kaplan PIT turbines to the **Grodnenskaya HPP** on the Neman River, near the city of Grodno, Republic of Belarus. The turbines each have runner diameters of 3000 mm and four runner blades. The total output at this site is 18.87 MW. The project, which received financing from the Czech Export Bank, was commissioned in 2012. A second project in the Republic of Belarus was signed in 2011. The **Polotskaya HPP** project will utilize five similar PIT turbines and have installed power of 24.25 MW. Commissioning is planned for 2016.



Grodnenskaya HPP / Belarus
5 x Kaplan PIT / 18,870 kW

Grodnenskaya HPP
Powerhouse Interior

KAPLAN TURBINE RANGE

Turbine Configuration	PIT, Vertical, Bulb, S, Z
Runner Diameter	550 mm to 5500 mm
Number of Runner Blades	3, 4, 5 or 6
Head	1.2 to 35 meters [5 to 115 ft]
Flow	1.2 to 200 m^3/s [45 to 7060 cfs]
Power Output	Up to 20,000 kW

FRANCIS TURBINE RANGE

Turbine Configuration	Horizontal or Vertical
Runner Diameter	400 mm to 2500 mm
Head	15 to 300 meters [50 to 1000 ft]
Flow	0.5 to 35 m^3/s [18 to 1240 cfs]
Power Output	Up to 30,000 kW

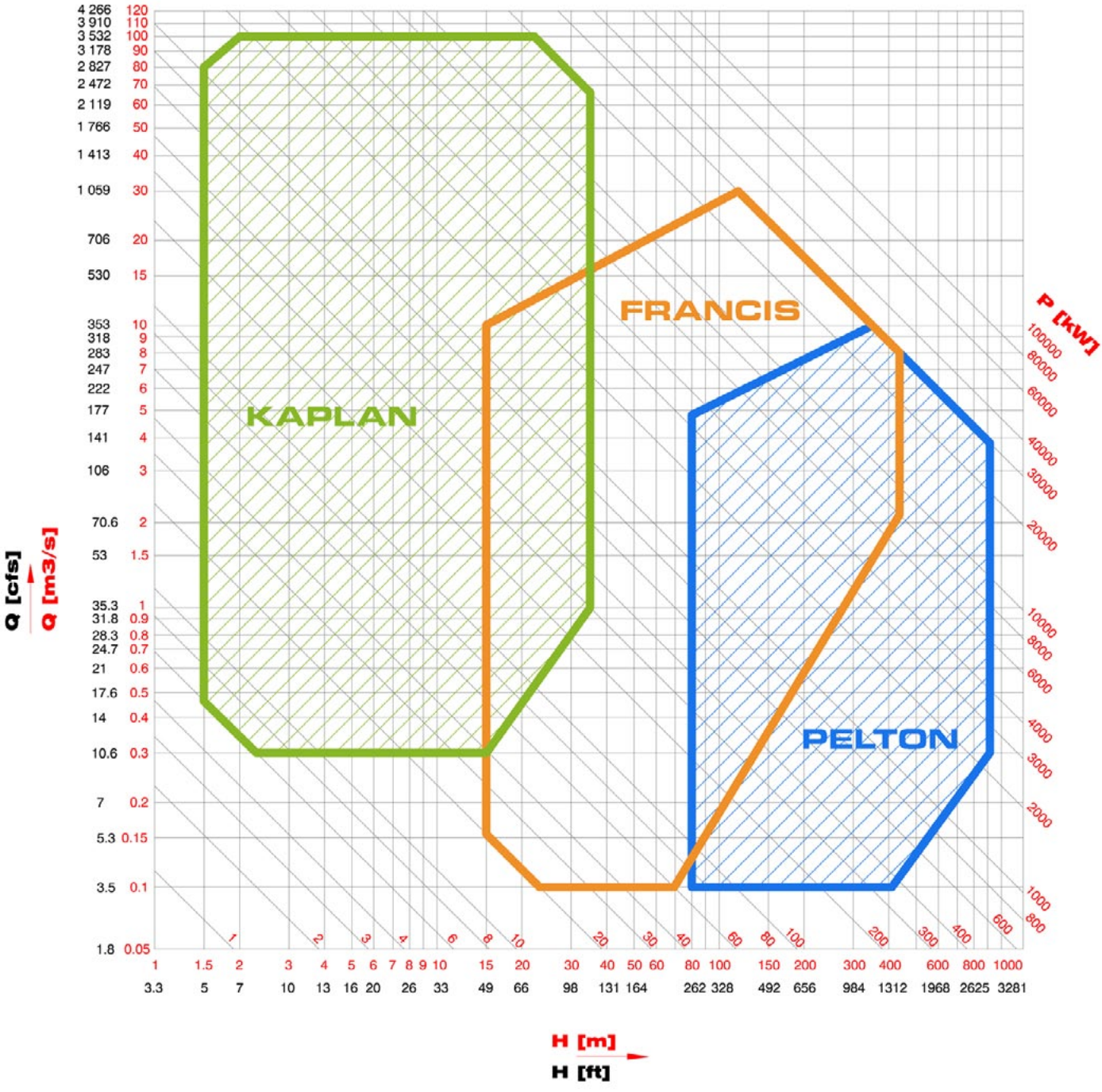
PELTON TURBINE RANGE

Turbine Configuration	Horizontal or Vertical
Runner Diameter	500 mm to 2500 mm
Number of Jets	Horizontal 1, 2 or 3 / Vertical 3, 4, 5 or 6
Head	50 to 1000 meters [165 to 3300 ft]
Flow	0.1 to 10 m^3/s [4 to 353 cfs]
Power Output	$30{,}000^+$ kW

MICRO TURBINE RANGE

Runner Diameter	300 mm to 1000 mm
Head	1.5 to 6 meters [5 to 20 ft]
Flow	0.15 to 5 m^3/s [5 to 177 cfs]
Power Output	5 to 160 kW

TURBINE APPLICATION RANGE



MANAGEMENT SYSTEM CERTIFICATION ISO 3834-2 DNV

MANAGEMENT SYSTEM CERTIFICATION ISO 9001 = ISO 14001 DNV

Hida Tunnel Kanayamazawa Třebovka Byaelva Kamin Nivnice Štampach Slavkov Killetsmuhle Muhle Vel. Folkmár Mittersill Bergmühle Žlutice Lučina Nivnička Stausee Monako Malužiná Dívčí Kámen Starina Nýrsko-Milence Nýrsko Bukovany Buškův Hamr Čelákovice Dolní Morava Jakubany II Krupina Labská Muchova Bouda Nemince Orešany Ruskovce Svit Breda Lesicovo III Rio Las Perlas Norte Las Perlas Sur Mangaio Lesičovo II Bugoye Isernia Kayalik Vales Nyagak Villa Correa Rokkason Concepcion Loziata Vydra Posada Hanga-Hanga II Kalumpang Lesichovo Želivka Fujiyoshida Pedra e Othoni Zielonka Lasberg EKOPA Potůčky Moinhos Khari Berthold Lipno Mohelno Messochora Breitwies Švařec Rosinka Žilina Slezská Harta Turček III Dlouhé Stráně Poas 1 Plock Slezská Harta Glenmaggie Predajná Shickluna Roscino Hluboká nad Vitavou Liběchov III. etapa Nakano Lenešice Shin Hayatsuki Clarkson Outfall Angelo Dam Bělov Nižbor Loziata '0' Alba Marseilles Olawa Capdenac Roudnice Liběchov Kamenný Přívoz Polockaya Laczany Brandon Dresden Hronská Dúbrava Higashi-Shinmachi Plikai Yipo Seungcheon Nakdan Stará Lubovňa Hapcheon Gangjeong Grodnenskaya Boatlock Ružbašská Milava Kuokkastenkoski Loziata II Finnholm Ledeč Lovosice Cherepish Herrfors 1 Herrfors II Karlukovo Kunino N.Mangen Sagfossen Groszowice Dobrzen Čelákovice Aläsorsakoski Yläsorsakoski Kozloduy Vääräkoski San Domenico Myczkowce CE Mancini San Francesco Podlužany Kjarna Malczyce Hausen Krapkowice Painkula Pontey I Pontey II Mittweida Žarki Wielkie Libochovice Busche Infernos Lubilanji II-uno Žagaň II Fergus Krepna Bärau II Zawada Jurbarkai Čermná n. Orlicí Gartenau Zielisko Pilskauna Pajiesio Eberbach II. Ascoli Piceno Annenieki Smolice Ogres Balskai Starowice Benátky Kosciuszko Weissthal Liču Rakowice Sinoles Bydgoszcz III Kawcze Ilukste Ledeč n/Sáz. Grivnieki Mühlen Schäftersheim Adenauerbrücke Bydgoszcz I Pakulu Prehova Weilbach Kubulova Sursee Narbonne Perugia Braslas Hes Lerma Vincellate Klášterec Doksany Kuchen Okrouhlice Zvolen Tržec Selice Tannenberg Ebenhards Felixdorf I Felixdorf II Bienertmühlewehr Skalice n/Sv Niezelgrund Zboněk Szprotawa Turá Wannenfluh Egger Počáply Ottendorf Eschenau Žagaň Trnovec Vellach Schaffermühle Lumda Weilbach Kubulova Pont

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