MAVEL

www.mavel.cz

Company Overview

2017 EXPO ASTANA

MAVEL

Since 1990 Mavel is a premier global manufacturing and engineering company specializing in turbines and related technology for hydroelectric power plants from 30 kW to 30+ MW per unit.

Mavel has more than 100 proprietary Kaplan, Francis, Pelton and Micro turbine designs, state of the art European production facilities and worldwide service capability.

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Installations

LOCATIONS/PARTNERS

Armenia, Australia, Austria, Belarus, Bulgaria, Canada, Costa Rica, Czech Republic, Democratic Republic of Congo, Estonia, Finland, France, Germany, Greece, Indonesia, Italy, Japan, Kazakhstan, Kyrgyzstan, Laos, Latvia, Lithuania, Macedonia, New Zealand, Norway, Pakistan, Panama, Poland, Portugal, Russia, Slovakia, Slovenia, South Korea, Spain, Switzerland, Turkey, Uganda, Ukraine, USA and Vietnam

SUMMARY

490+ Turbines Ordered

320+ Installations

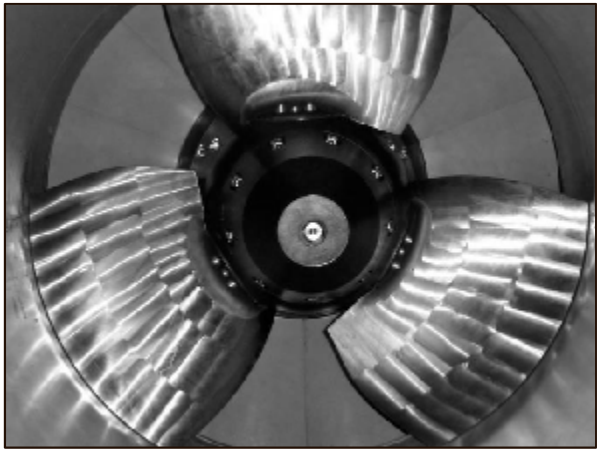
490+ MW Total Power

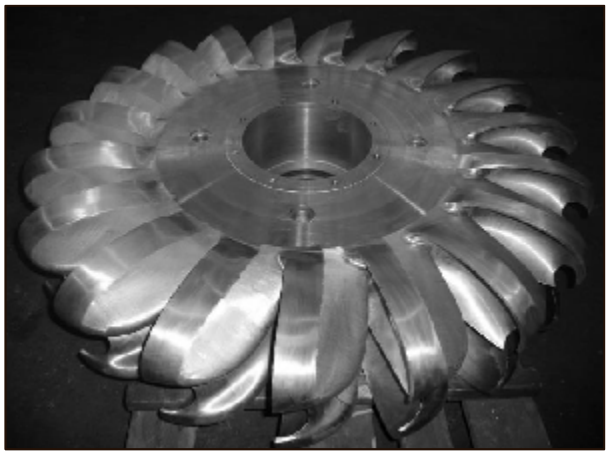
Turbine Technology

Kaplan – Francis – Pelton – Micro

100+ Proprietary Designs

30 kW to 30+ MW





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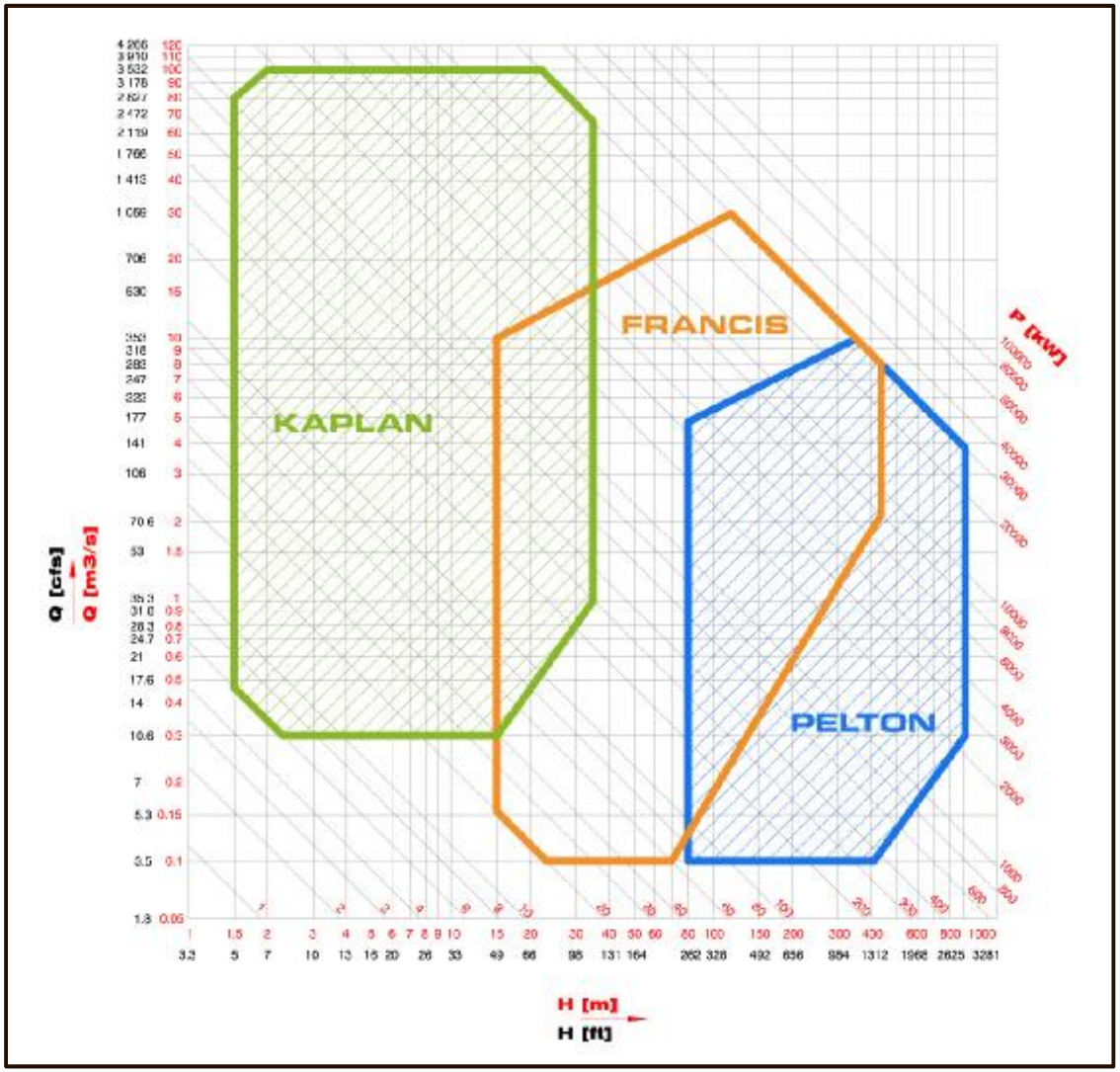
Turbine Application Range



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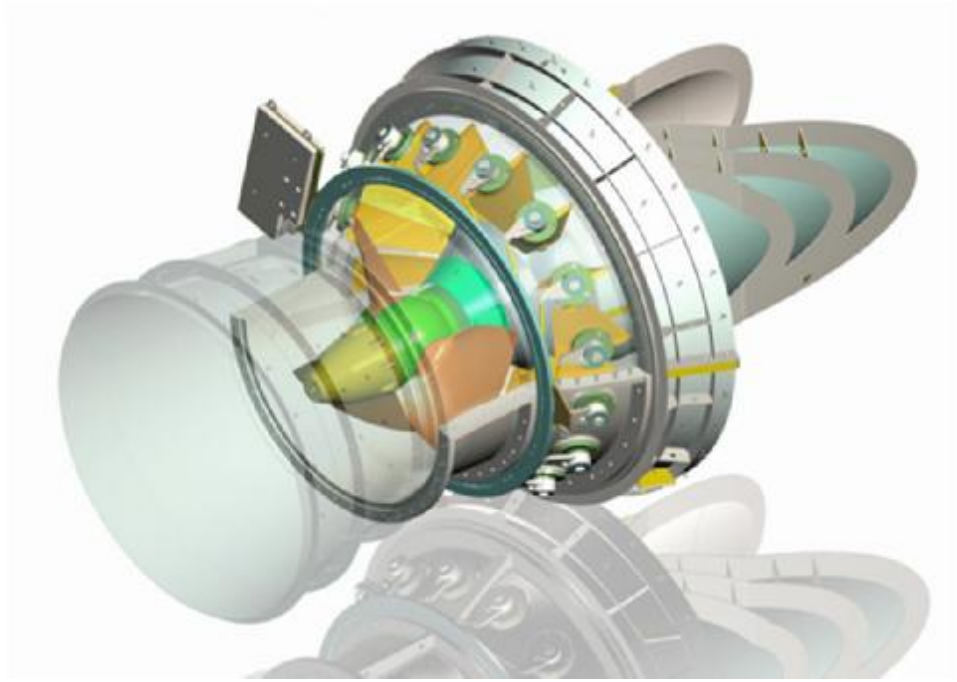
Mavel Kaplan Turbines

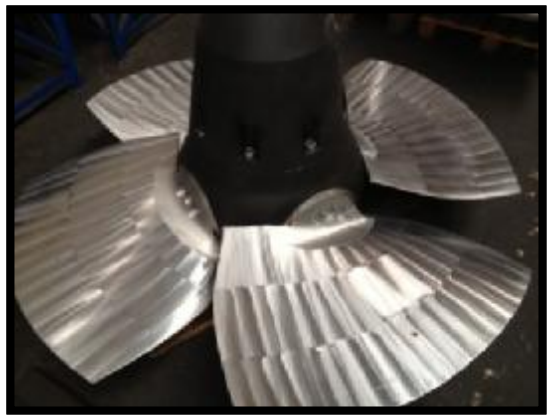
The Kaplan turbine was invented in the Czech Republic in 1912 by Viktor Kaplan. Over the past 100 years the design has improved significantly and a number of Kaplan turbine variations have evolved. Mavel's Kaplan turbines include the PIT, Vertical, Bulb, Z and S with both vertical and horizontal configurations.

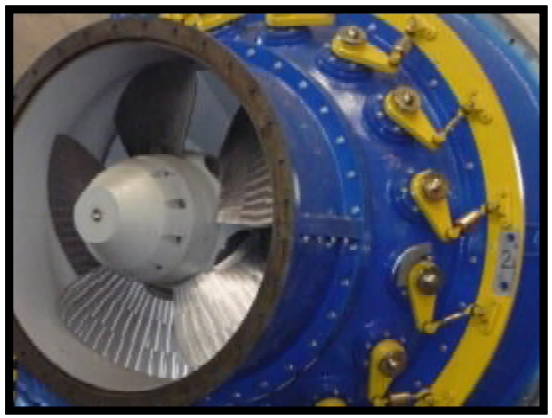


Mavel Kaplan PIT Turbine

Mavel Kaplan Turbine Range

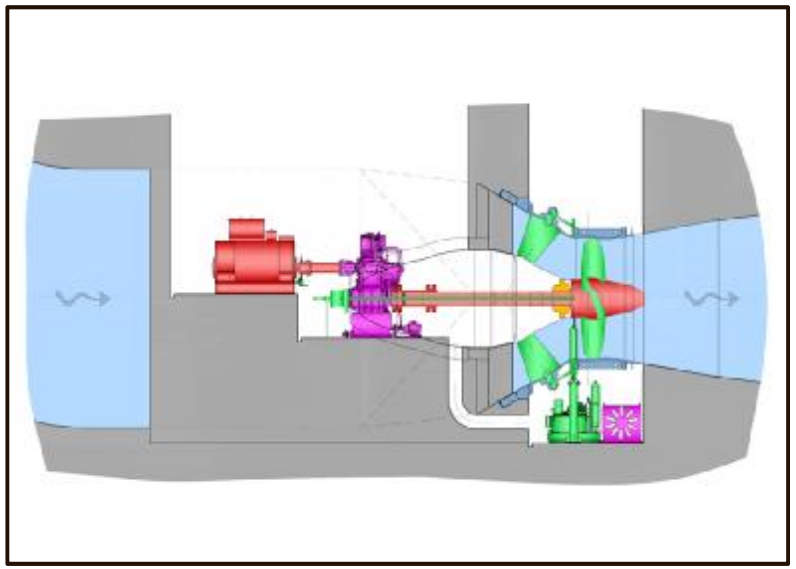
Mavel's Kaplan turbines are designed for sites up to 20 MW per unit. The turbines are available with runner diameters from 560 mm to 5500 mm, utilize three to six runner blades and can be single or double regulated. They are ideal for run-of-the-river sites with low heads ranging from 1.5 to 35 meters [5 to 115 ft] and optimal flows per turbine between 1.2 and 200 cms [45 to 7060 cfs].





Kaplan PIT Turbine

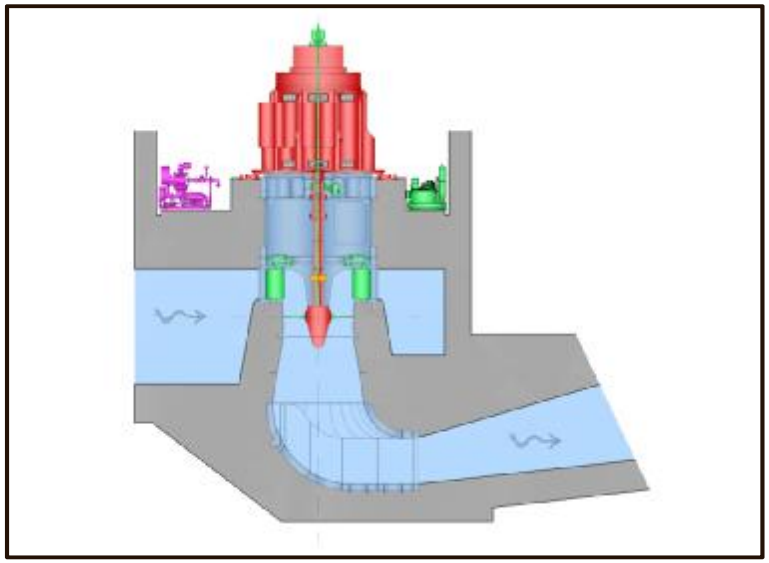
Runner Diameters	1050 mm to 5500 mm
Number of Runner Blades	3 or 4
Head	1.5 to 12 meters [5 to 39.5 ft]
Flow	15 to 150 cms [530 to 5340 cfs]
Power Output	400 kW to 8 MW
Transmission	Belt Drive or Parallel Gearbox



Longitudinal Section of Mavel Kaplan PIT Turbine

Kaplan Vertical Turbine

Runner Diameters	850 mm to 5500 mm
Number of Runner Blades	4, 5 or 6
Head	1.5 to 35 meters [5 to 115 ft]
Flow	3.5 to 200 cms [124 to 7060 cfs]
Power Output	70 kW to 20 MW
Transmission	Direct Drive, Belt Drive or Parallel Gearbox



Longitudinal Section of Mavel Kaplan Vertical Turbine

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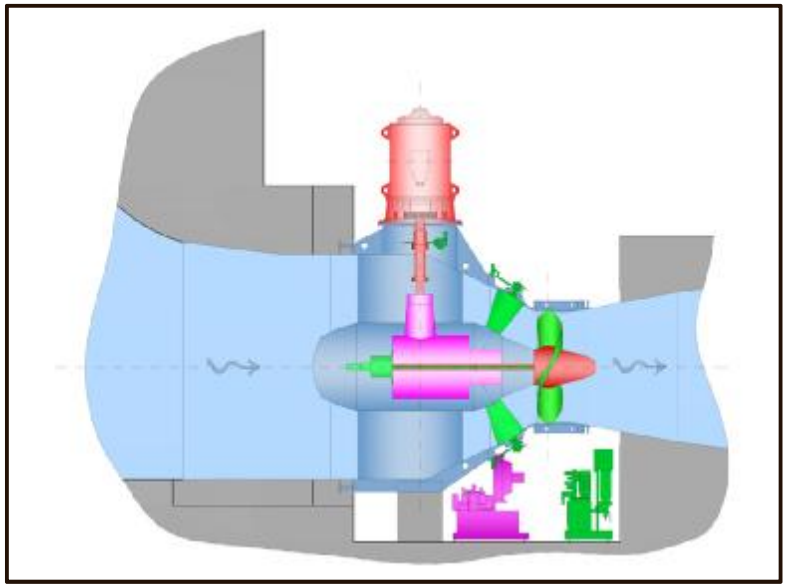
Kaplan Bulb Turbine

Runner Diameters	1050 mm to 2500 mm
Number of Runner Blades	3 or 4
Head	1.5 to 12 meters [5 to 39.5 ft]
Flow	5 to 45 cms [180 to 1590 cfs]
Power Output	100 kW to 3 MW
Transmission	Direct Drive, Belt Drive or Bevel Gearbox



Longitudinal Section of Mavel Kaplan Bulb Turbine

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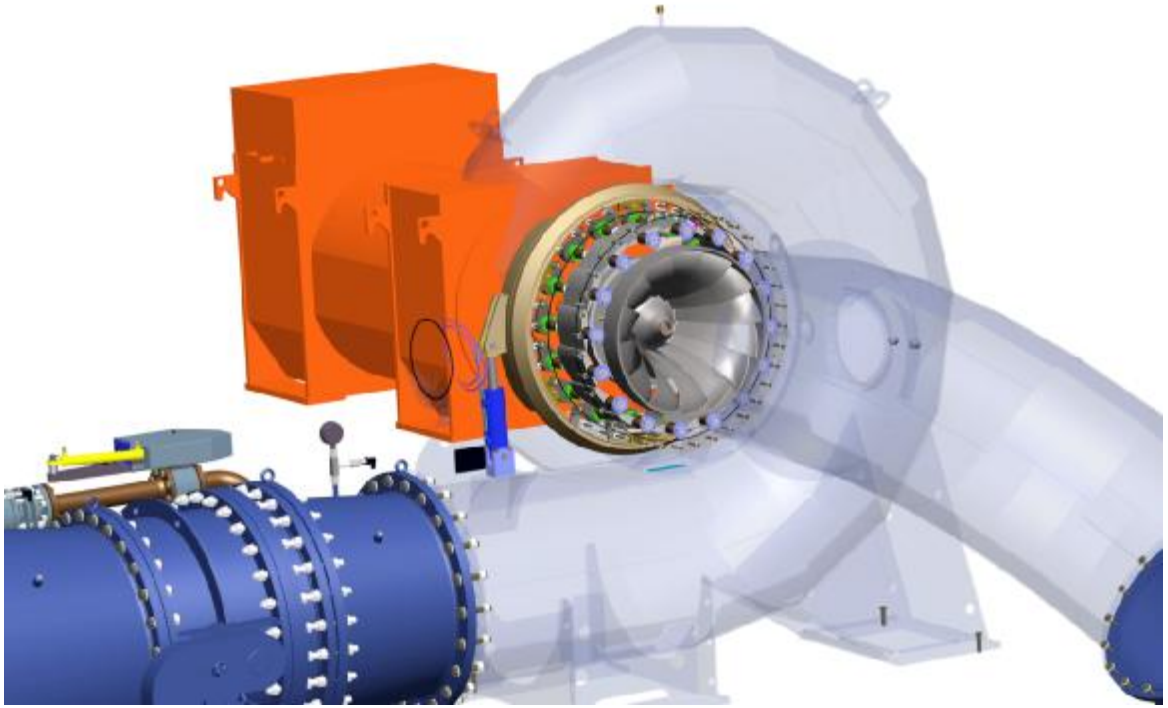
Mavel Francis Turbines

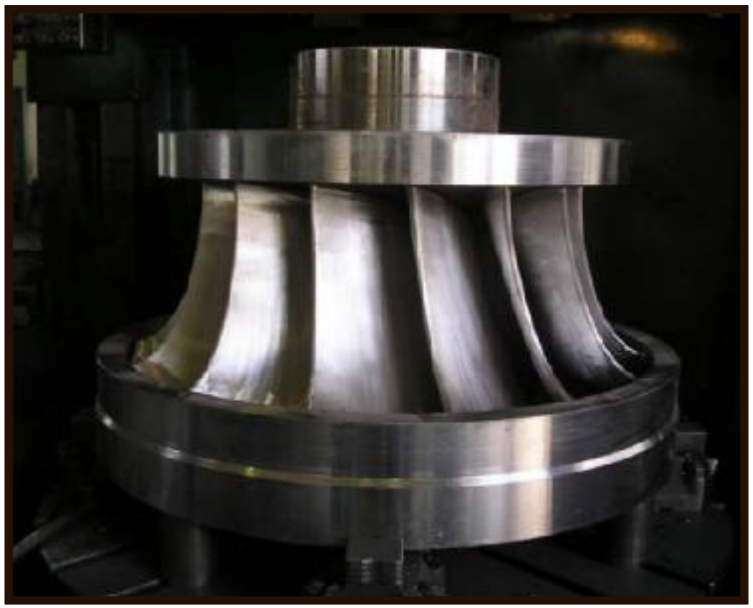
The Francis turbine was invented in Massachusetts in 1848 and is the most common water turbine in use today. Mavel's Francis turbines are available with runner diameters from 400 mm to 2500 mm and may be installed in horizontal or vertical configurations.



Mavel Horizontal Francis Turbine

Mavel Francis Turbine Range

Mavel has installed almost 70 Francis turbines since 1993, including six 5 MW units for a cascade of three plants on the Piedra River in Panama for total installed power of 30 MW. The final plant in this cascade was commissioned in the second quarter of 2013.

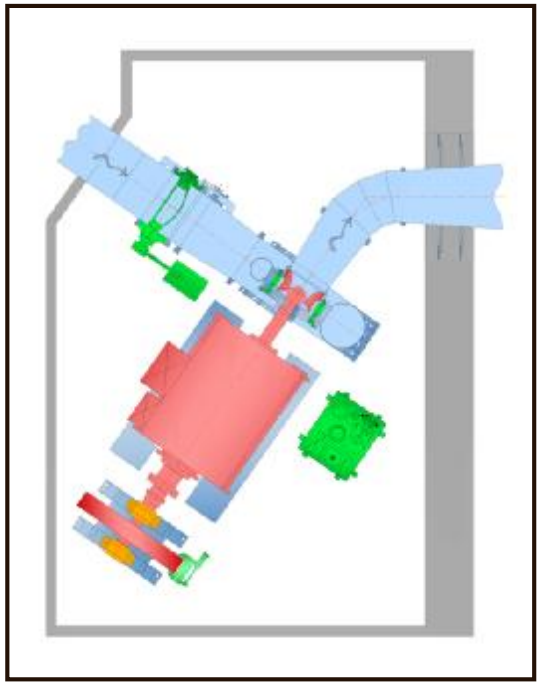


Mavel Francis Turbine Parameters

Runner Diameters	400 mm to 2500 mm
Head	15 to 300 meters [50 to 1000 ft]
Flow	0.5 to 35 cms [18 to 1240 cfs]
Power Output	Up to 30 MW
Transmission	Runner Assembled to Generator or Turbine Shaft

Horizontal Francis Turbine

Runner Diameters	400 mm to 1500 mm
Head	15 to 300 meters [50 to 1000 ft]
Flow	0.5 to 20 cms [18 to 706 cfs]
Power Output	100 kW to 12 MW
Transmission	Runner Assembled to Generator or Turbine Shaft



Ground Plan View of Mavel Horizontal Francis Turbine

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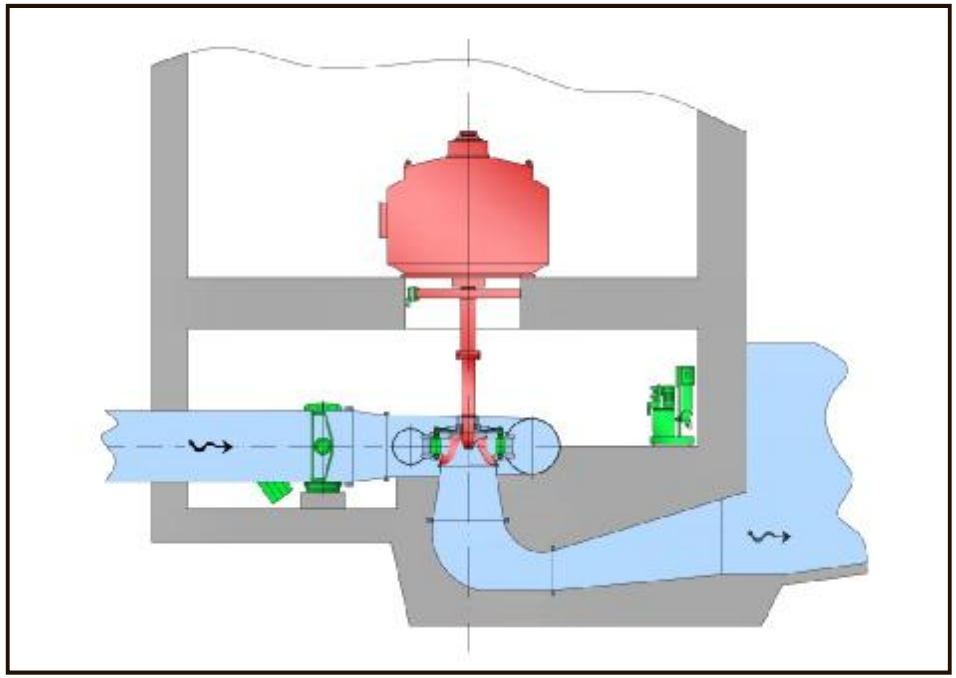
Vertical Francis Turbine

Runner Diameters	1000 mm to 2500 mm
Head	Up to 300 meters [1000 ft]
Flow	Up to 35 cms [1236 cfs]
Power Output	Up to 30 MW
Transmission	Runner Assembled to Generator or Turbine Shaft



Longitudinal Section of Mavel Vertical Francis Turbine

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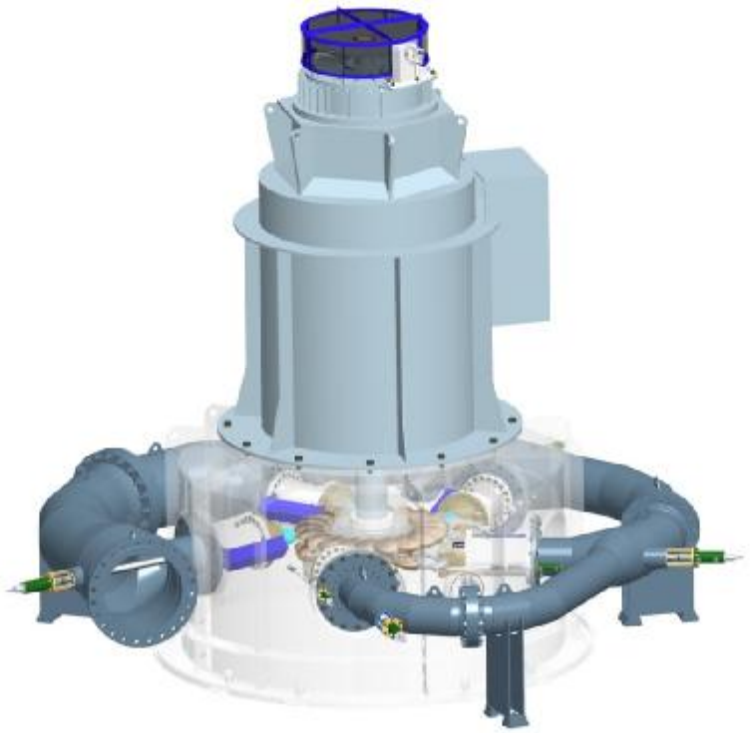
Mavel Pelton Turbines

The Pelton Turbine was invented in the late 1800's during the California gold rush. Mavel's Pelton turbines are available with runner diameters from 500 mm to 2500 mm. These impulse turbines can utilize either a vertical or horizontal configuration and one to six jets. The use of multiple jets can provide two to four times the normal output for a given runner diameter.



Mavel Vertical Pelton Turbine

Mavel Pelton Turbine Range

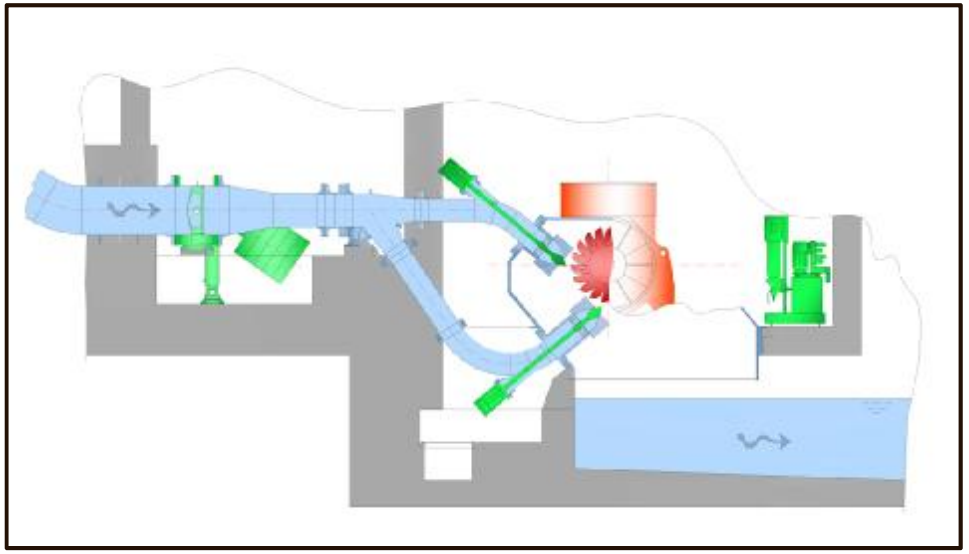
The installations include the 3 MW Vlahi Project in Bulgaria, the two turbine 12.9 MW Yeghesis project in Armenia and the 11.8 MW Upper Clowhom Project in British Columbia.

Mavel Pelton Turbine Range

Runner Diameters	Up to 2500 mm
Number of Jets	1 to 6
Head	50 to 1000 meters [165 to 3300 ft]
Flow	0.1 to 10 cms [4 to 353 cfs]
Power Output	Up to 30+ MW
Transmission	Runner Assembled to Generator or Turbine Shaft

Horizontal Pelton Turbine

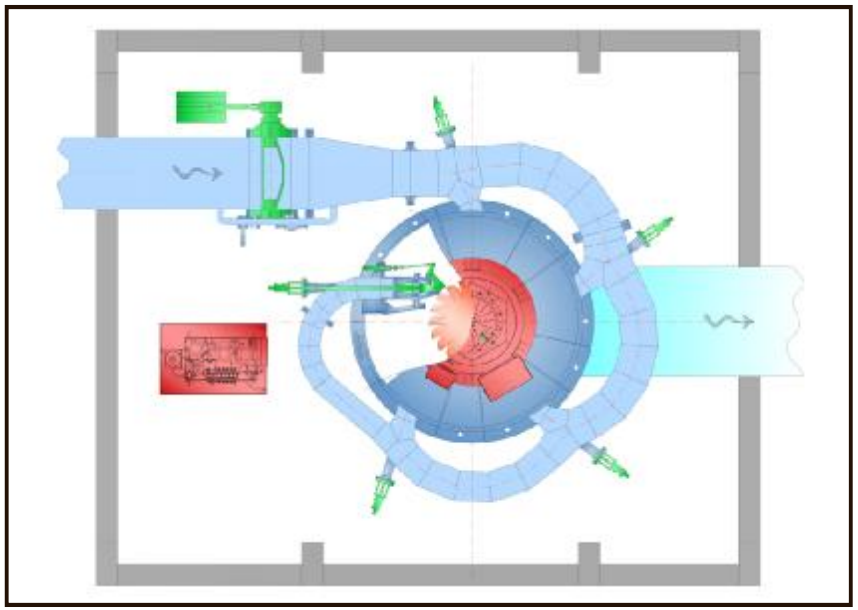
Runner Diameters	500 mm to 1800 mm
Number of Jets	1, 2 or 3
Head	50 to 1000 meters [165 to 3300 ft]
Flow	0.1 to 6 cms [4 to 212 cfs]
Power Output	Up to 30+ MW
Transmission	Runner Assembled to Generator or Turbine Shaft



Longitudinal Section of Mavel Horizontal Pelton Turbine

Vertical Pelton Turbine

Runner Diameters	500 mm to 2500 mm
Number of Jets	3, 4, 5 or 6
Head	50 to 1000 meters [165 to 3300 ft]
Flow	Up to 10 cms [up to 353 cfs]
Power Output	Up to 30+ MW
Transmission	Runner Assembled to Generator or Turbine Shaft



Ground Plan View of Mavel Vertical Pelton Turbine

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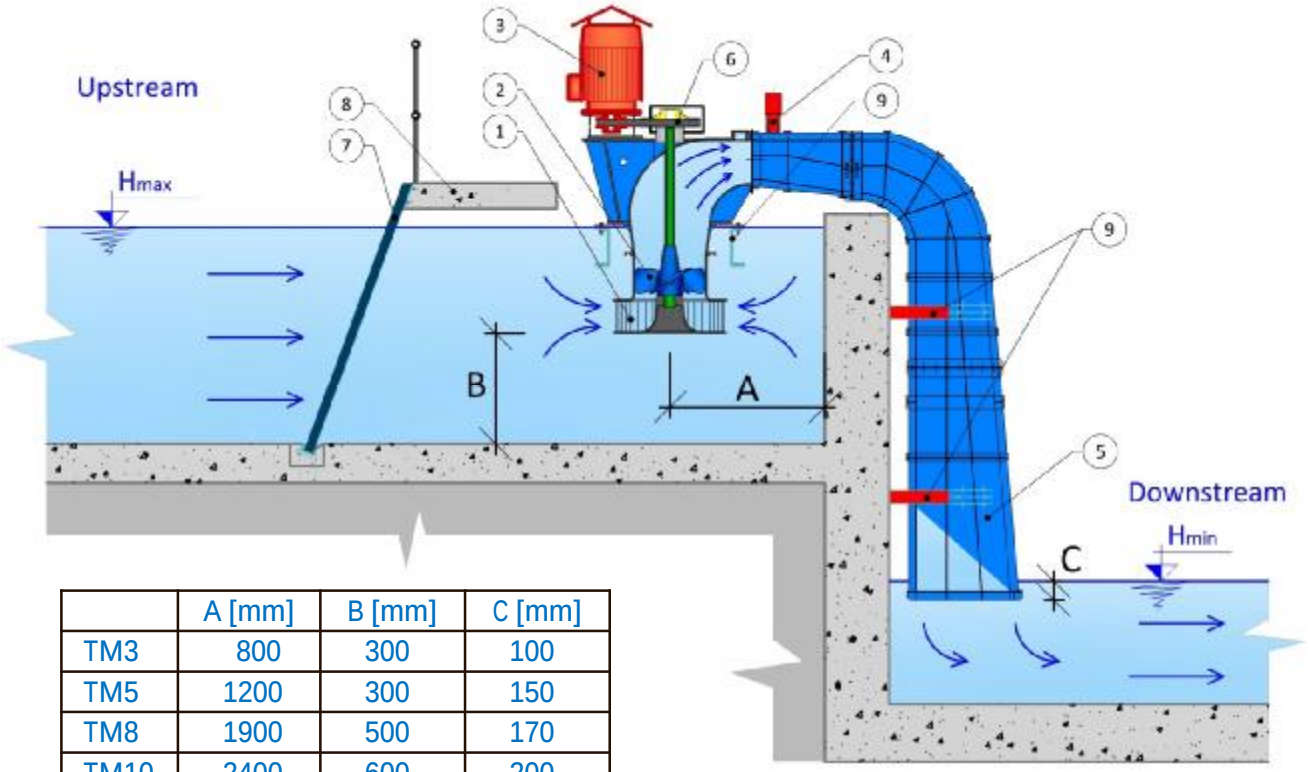
Mavel TM Micro Turbines

Mavel TM Micro Turbines are ideal for low head sites from 1.5 to 6 meters [5 to 20 ft] with flow from 0.15 to 5 cms [5 to 177 cfs]. They have power output of up to 160 kW per unit. The TM Micro turbines have no need for a powerhouse and are sold as complete packages comprising of turbine, generator, inlet, draft tube and electric and control systems. The packages are easy to install and cost effective.



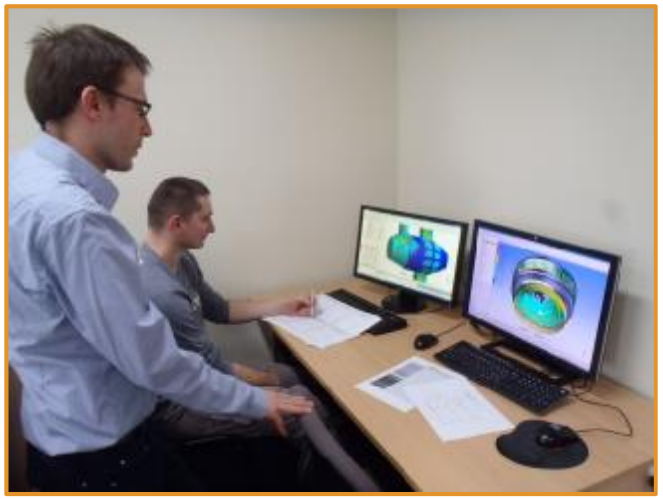
	A [mm]	B [mm]	C [mm]
TM3	800	300	100
TM5	1200	300	150
TM8	1900	500	170
TM10	2400	600	200

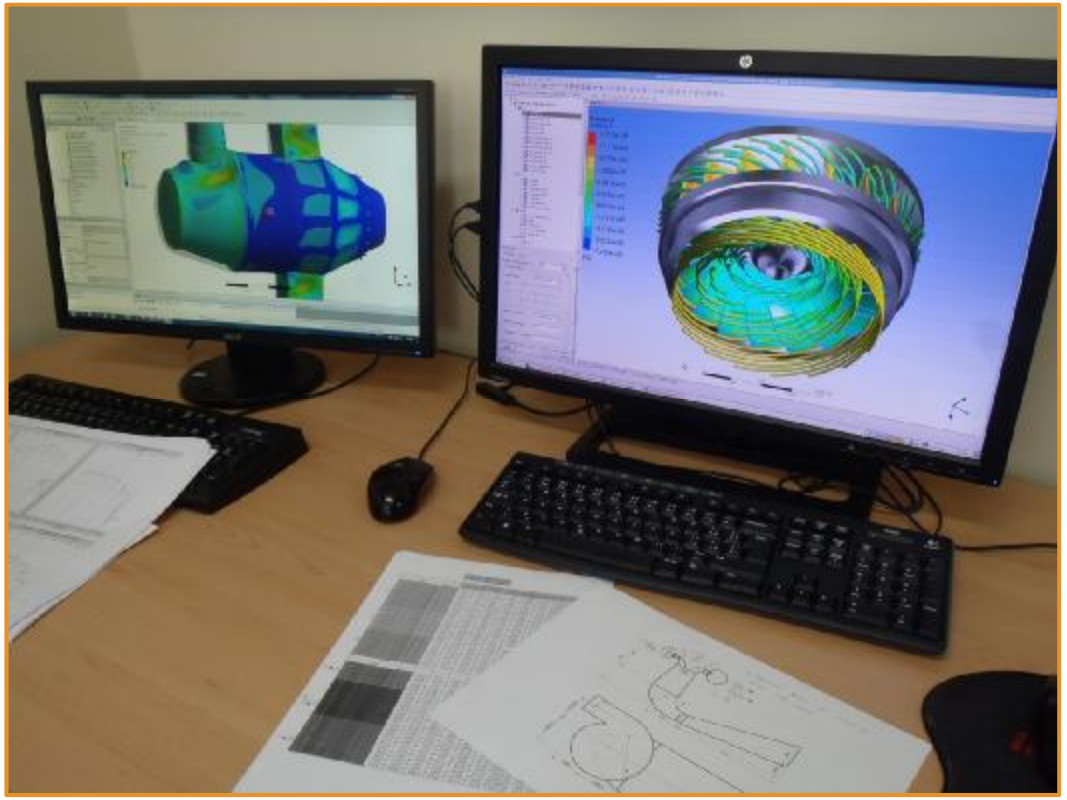
MAVEL´S DELIVERY	
1	DISTRIBUTOR
2	TURBINE TM
3	GENERATOR
4	ELECTROMAGNETIC VALVE
5	DRAFT TUBE
6	BELT DRIVE

SUPPLIED BY OTHERS	
7	TRASH RACKS
8	SERVICE BRIDGE
9	SUPPORTING STRUCTURE

Research & Development Engineering

R&D Department





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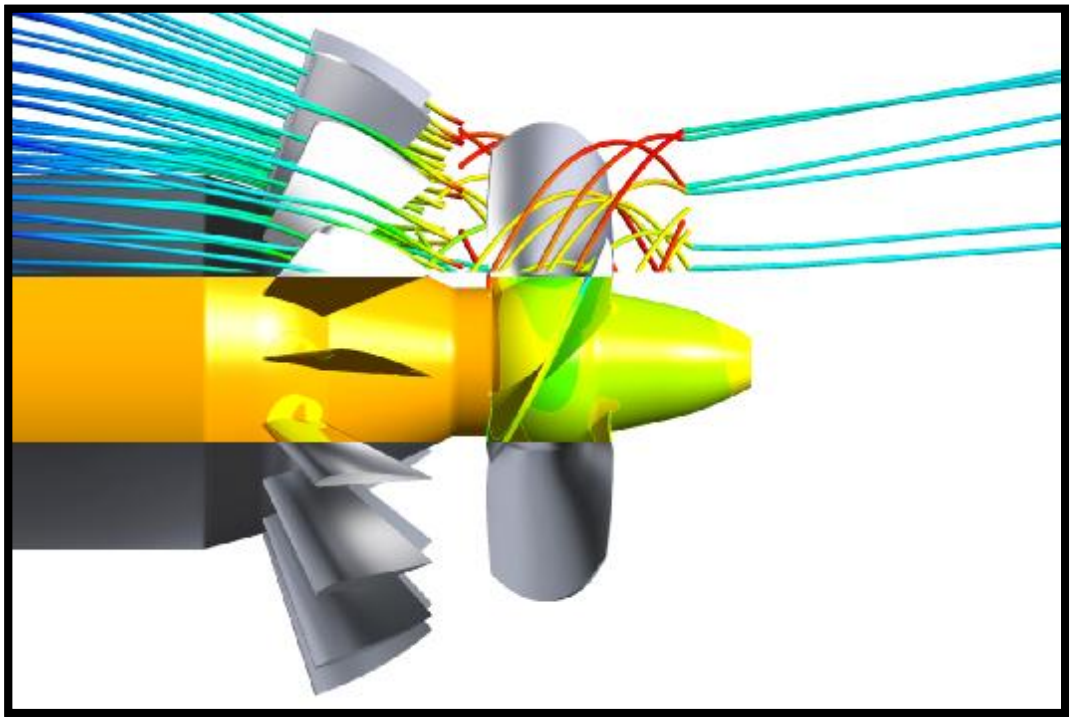
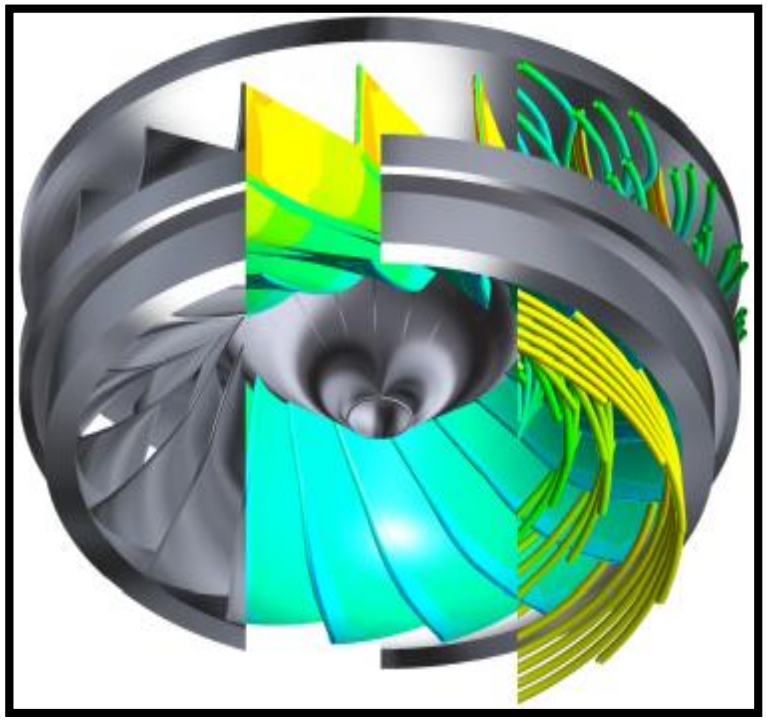
Research & Development



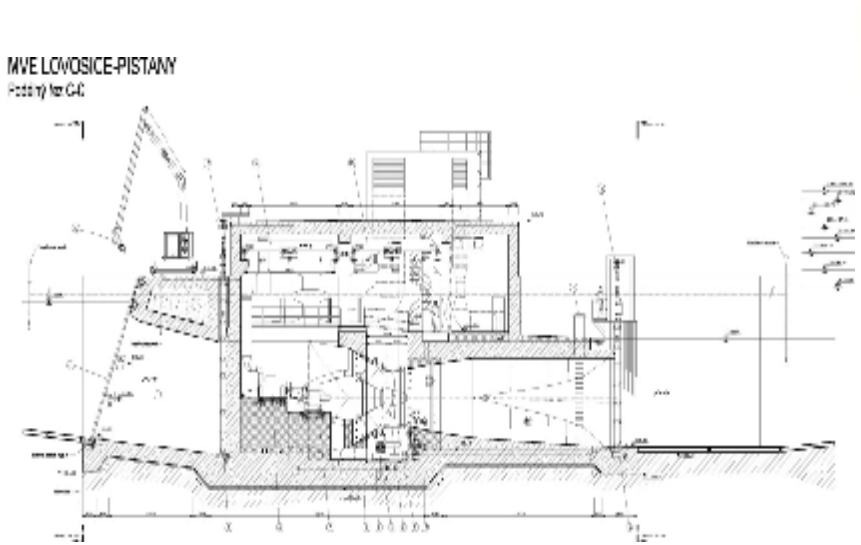


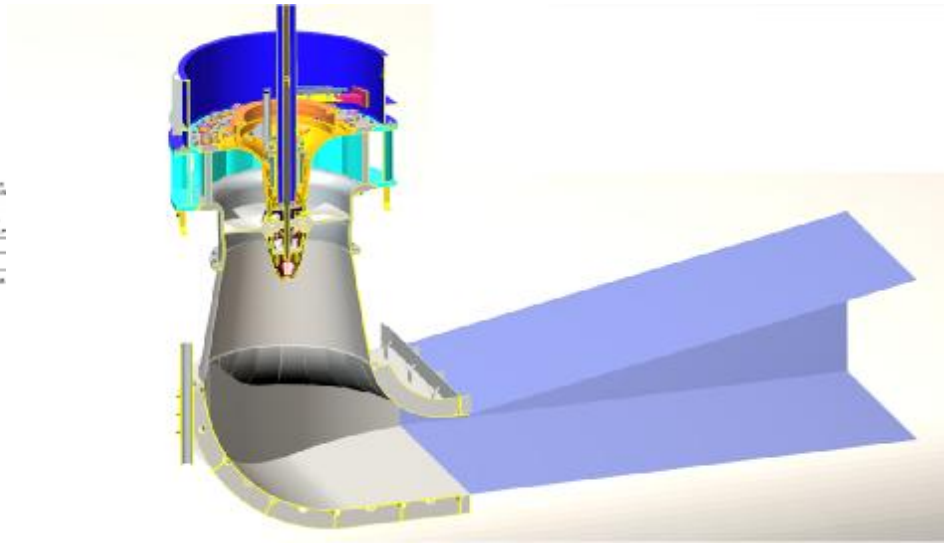
Examples of the Visualizations from Flow Calculations

Engineering

Mavel employs 60 engineers combining degrees in:

* civil
* hydraulic
* mechanical
* electrical





Example of Technical Drawing and of 3D Model

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Production & Services

Production Capability

Production Facilities	Two Production Halls
Combined Properties	Land: 27,000 SM Production/Storage: 10,300 SM Administration: 2,600 SM
Production Capabilities	Milling, Boring, Drilling, Pressing, Grinding, Sawing, Metal Rolling, Cutting, Turning, Painting, Welding, Coating, Assembly and Testing
Engineers	60
Production Machines	40
Total Crane Capacity	85 ton
Quality Control	ISO Certified / Specialized Team
Specialized Machinery	6-axis milling (2013) 5-axis milling (2010)

Runners Milled From Forgings

www.mavel.cz

Precision 5-Axis Milling

www.mavel.cz

Precision 6-Axis Milling

Services

Mavel provides the following services to support its customers:

* proposal of an optimal solution from a technical and economic viewpoint
* evaluation and quality control of sub-suppliers
* engineering, visualization, manufacturing
* installation, testing and commissioning supervision
* field services – warranty, repair and testing
* diagnostic – field and in-house
* refurbishments and repairs – field and in-house

These services are available to customers around the world.

Company ISO and OHSAS Certification

Quality Control.....ISO 9001:2008

Environmental Qualification.....ISO 14001:2004

Health and Safety Qualification.....OHSAS 18001:2007

Welding Qualification.....ISO 3834-2:2005

Reference Projects

Hluboká n. V. HPP, Czech Republic

1x Kaplan Turbine

[272 kW]

www.mavel.cz

Bělov HPP, Czech Republic

2x Kaplan Turbines

[1 696 kW]

www.mavel.cz

Liběchov HPP, Czech Republic

1x Kaplan Turbine

[2 450 kW]

www.mavel.cz

Lovosice HPP, Czech Republic

4x Kaplan Turbines

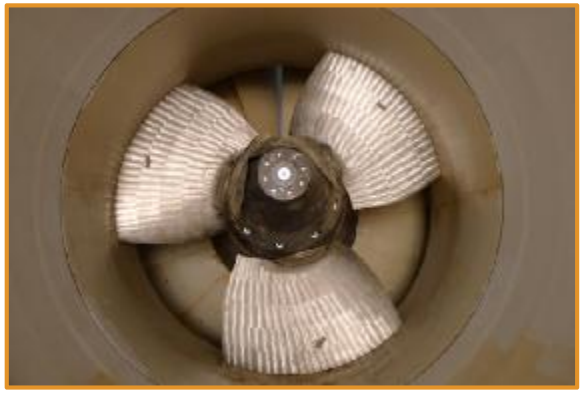
[2 648 kW]

www.mavel.cz

Roudnice HPP, Czech Republic

4x Kaplan Turbines

[4 000 kW]



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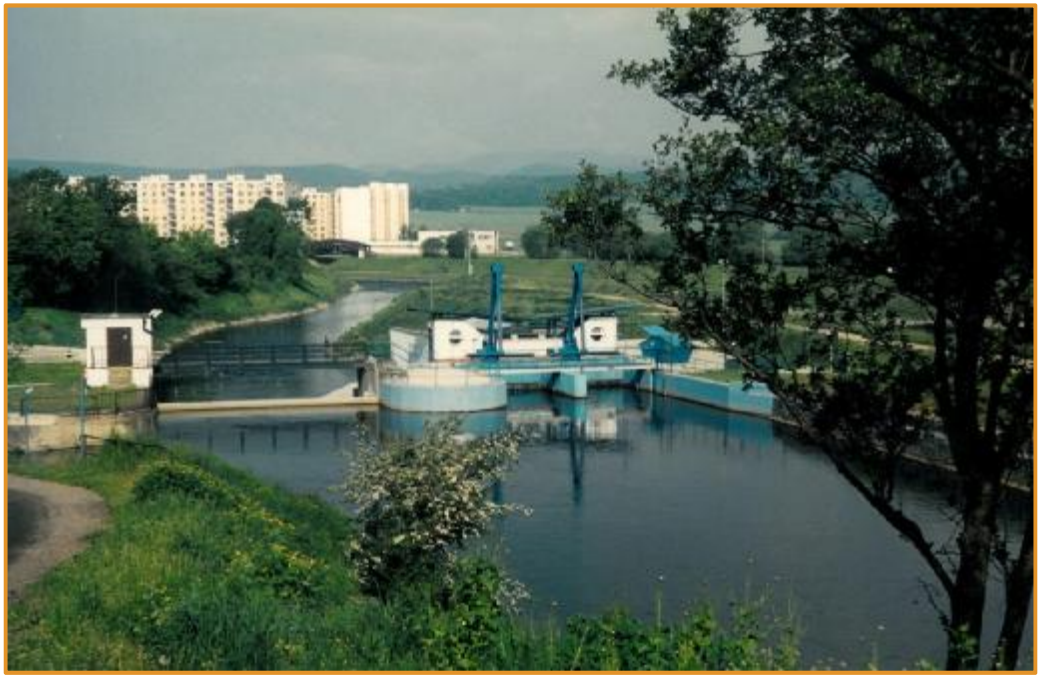
Zvolen HPP, Slovakia



2x Kaplan Turbines

[800 kW]

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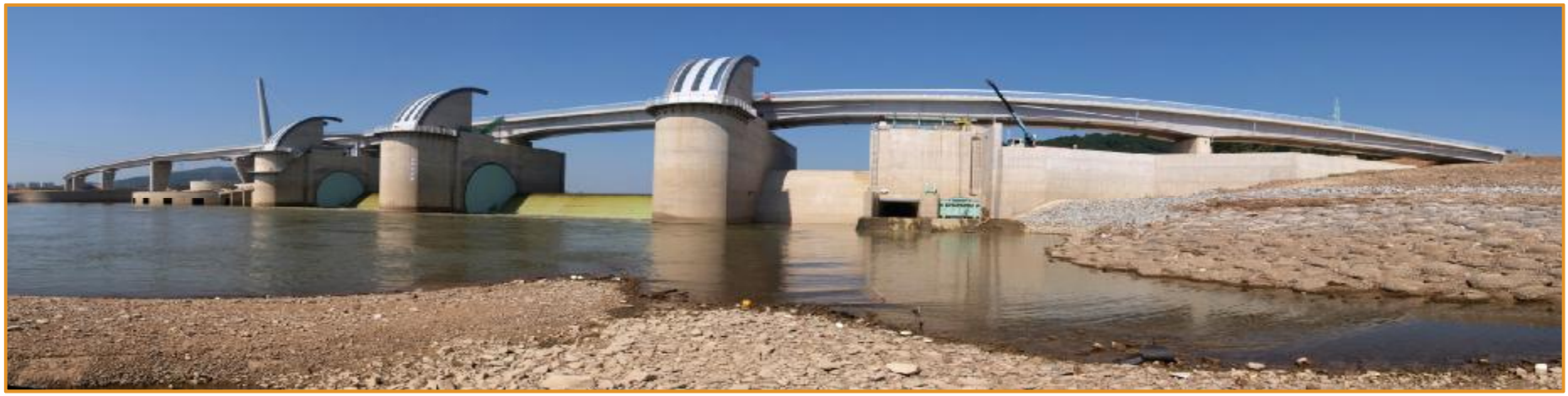
Gangjeong HPP, South Korea

2x Kaplan Turbines

[3 298 kW]



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Yipo HPP, South Korea

3x Kaplan Turbines

[3 330 kW]

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Grodnenskaya HPP, Belarus

5x Kaplan Turbines

[18 870 kW]

www.mavel.cz

Rio HPP, USA

1x Francis Turbine

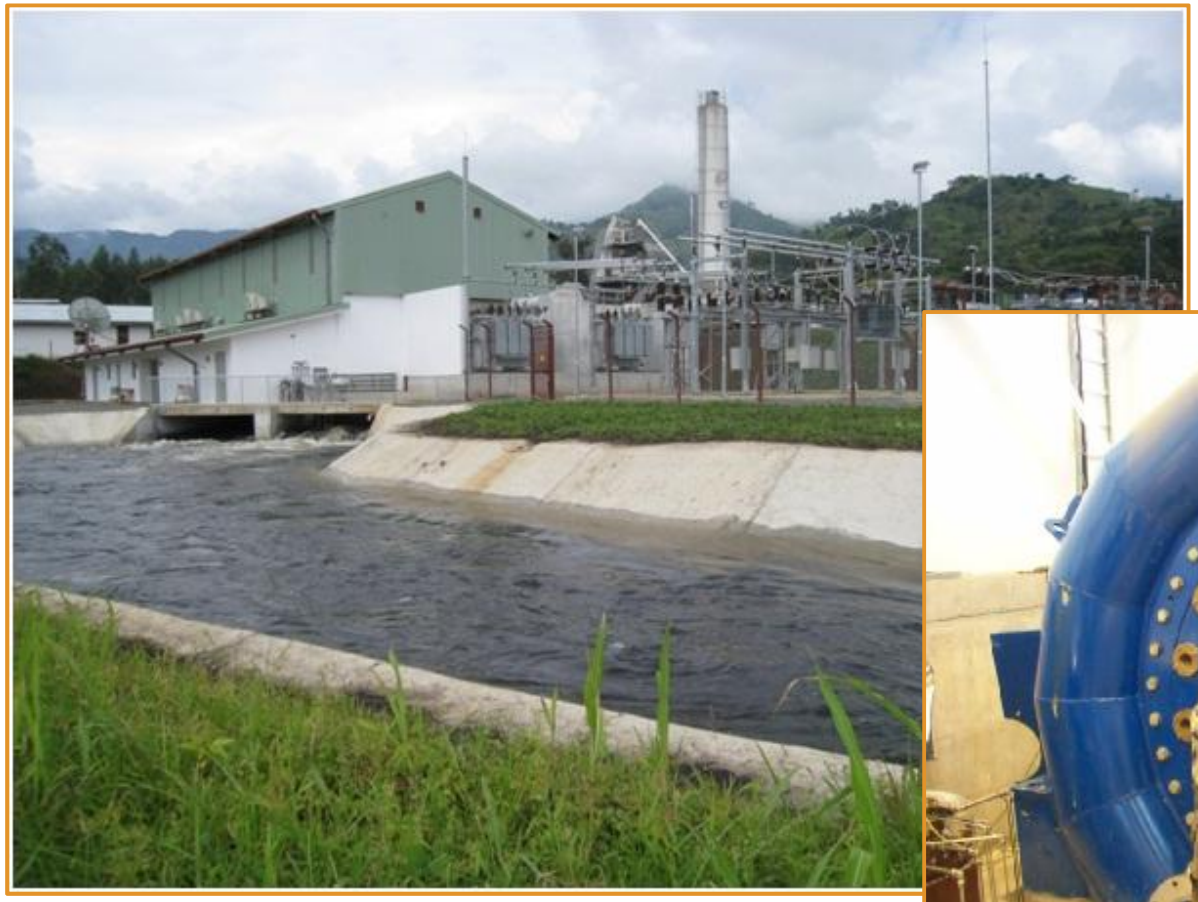
[887 kW]

Las Perlas HPP, Panama

2x Francis Turbines

[10 200 kW]

Bugoye HPP, Uganda



2x Francis Turbines

[14 332 kW]

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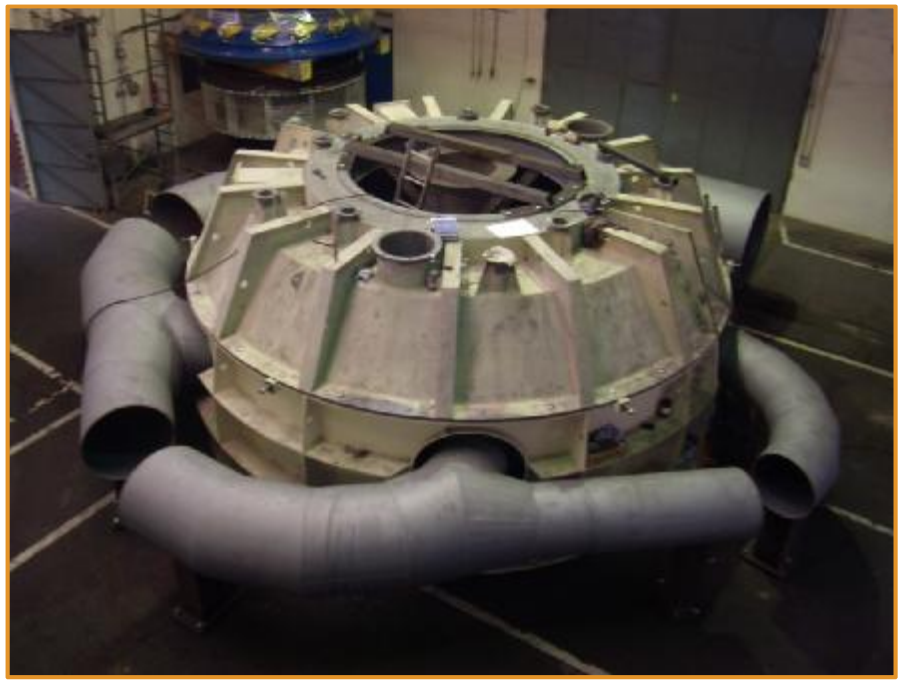
Upper Clowhom HPP, Canada

1x Pelton Turbine

[11 300 kW]



Kyoto HPP, Japan

1x TM5 Micro Turbine

[4 kW]

Český Krumlov HPP, Czech Republic

2x TM5 Micro Turbines

[60 kW]

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Olawa II HPP, Poland

3x TM10 Micro Turbines

[300 kW]

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Head of the U Canal HPP, USA

8x TM10 Micro Turbines

[1 240 kW]

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