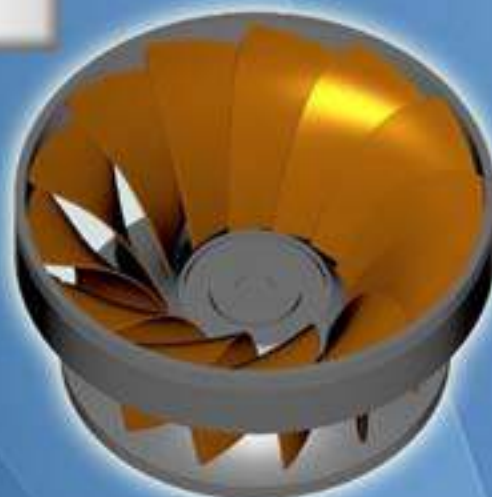
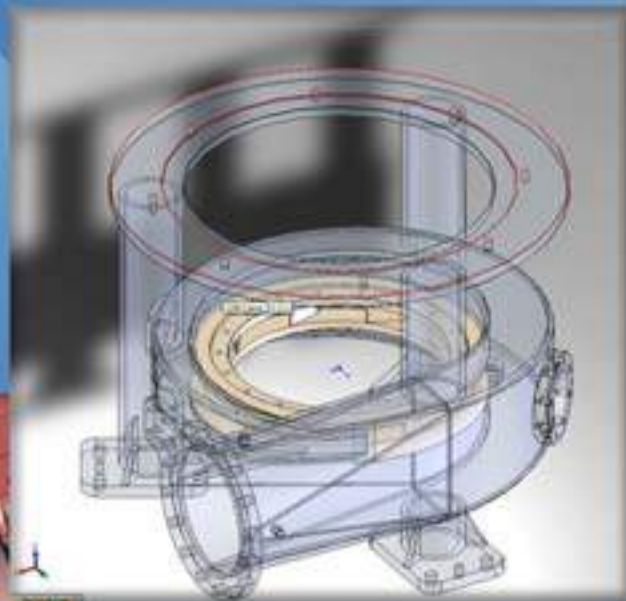
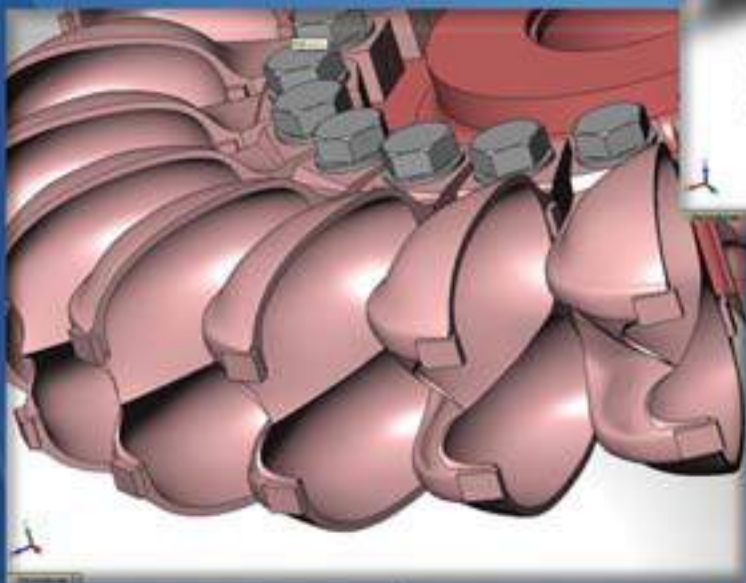


*Green Power Generation*

## **HYDRO POWER PLANT TURBINES**



## SMALL SCALE HYDRO POWER PLANTS

**Ercole Marelli Power** offers a wide range of solutions for hydropower applications. EMP employs new design techniques, synthetic materials and electronic technologies in the construction of small and mini power plants. This enables the company to offer a range of standardised machinery with the following characteristics:

- stout structure and reduced weight;
- minimum number of components and simplified geometry;
- easy replacement of series components;
- un-manned operation.



All our design reflects decades of experience, continuous research and performance monitoring of numerous units installed world-wide.

**Ercole Marelli Power** total quality program guarantees our customers a complete range of mechanical and electrical equipment featuring:

- exceptional stoutness and simplicity of constructions;
- cheap routine maintenance;
- short on-site erection time;
- great flexibility ensuring high plant efficiency;
- compact, simple and extremely reliable regulation system.

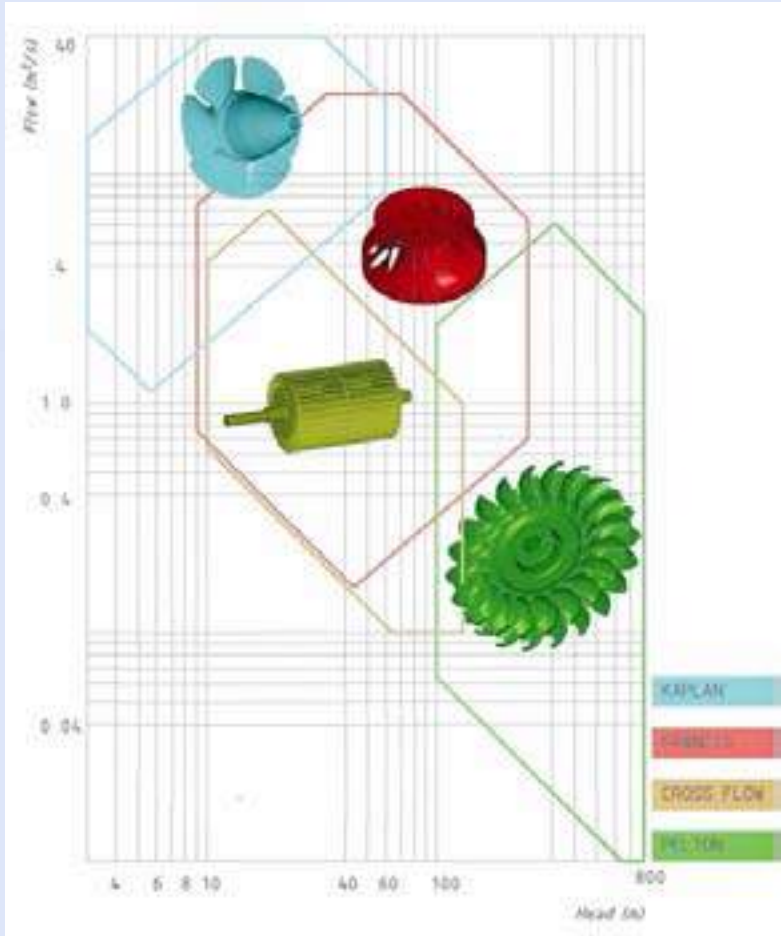


Ercole Marelli Power concept of project engineering is not confined to turbines. All our plant components adhere to the latest trends in terms of structural simplicity, easy maintenance, stoutness and low cost.

Limiting environmental impact is another key concern in plant design, ensuring that civil works are kept to an absolute minimum with optimal landscape integration.



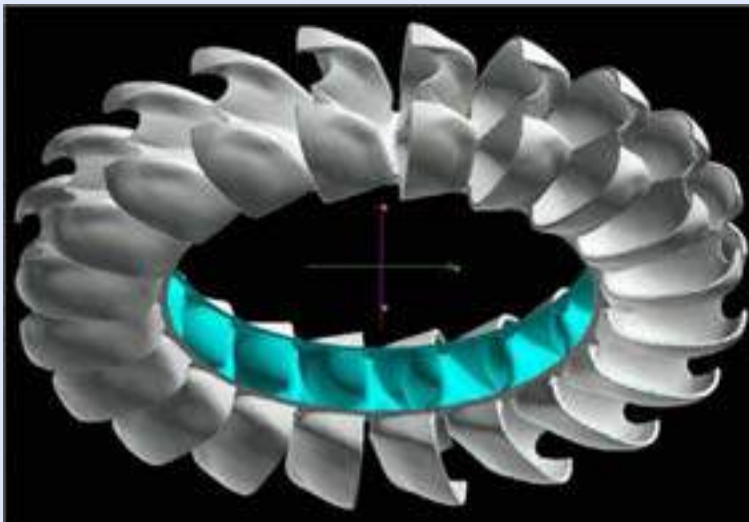
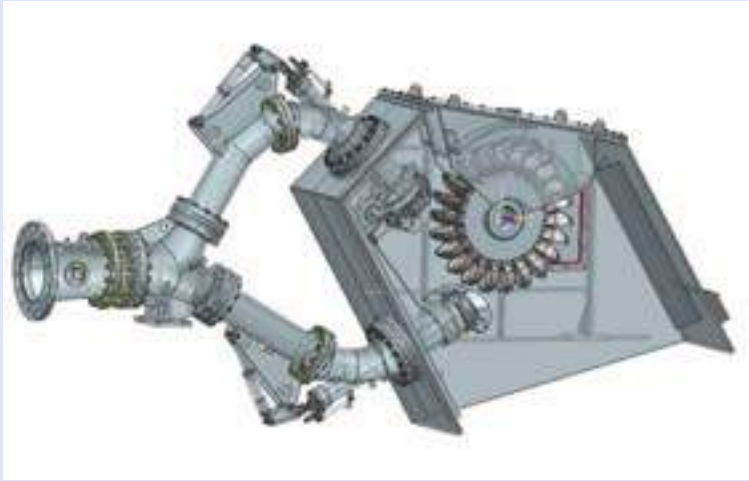
**RANGE OF STANDARD PRODUCTION**



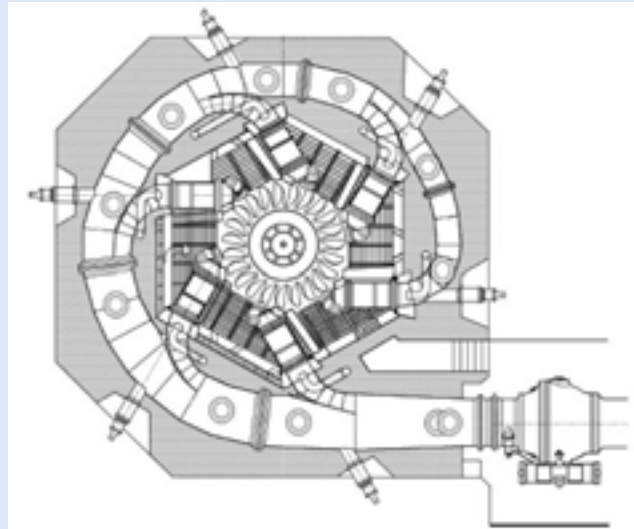


## PELTON TURBINES

These turbines are particularly suitable for exploiting plant conditions where there is a low flow utilisation as compared with the water head. Situations where reaction turbines would have excessive speed and would encounter particularly serious problems such as cavitation.



One of the most interesting aspects of the Pelton turbine is its flexibility in the presence of marked changes in flow capacity. In fact this machine consists of a flow regulating system which divides up the flow capacity into various injectors, from one to a maximum of six.

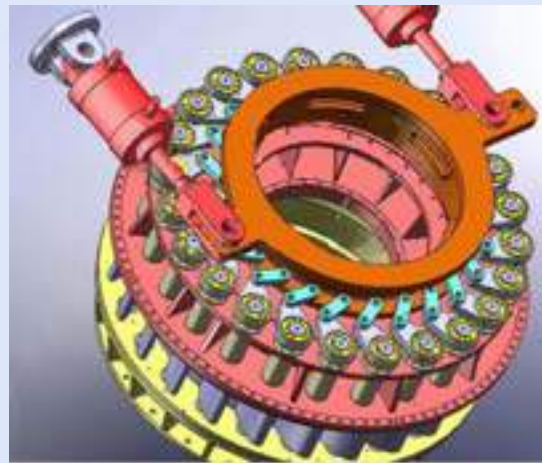
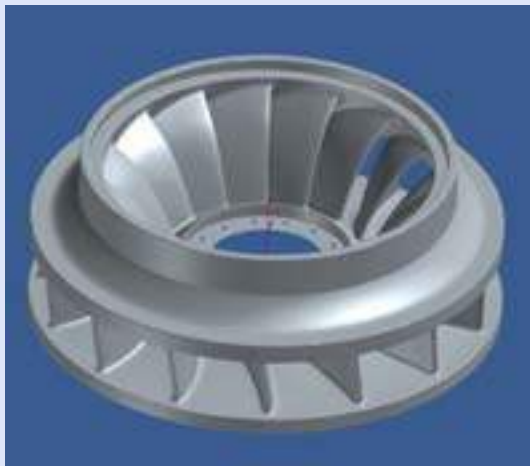


Each injector is also capable of regulating its own portion of flow capacity, up to a minimum value of about 15% without creating any noticeable phenomena of load loss. The schematic figure shows that the turbine efficiency is at a constant level on the average down to very low rated flow capacities, thanks to this multiple jet inlet system.



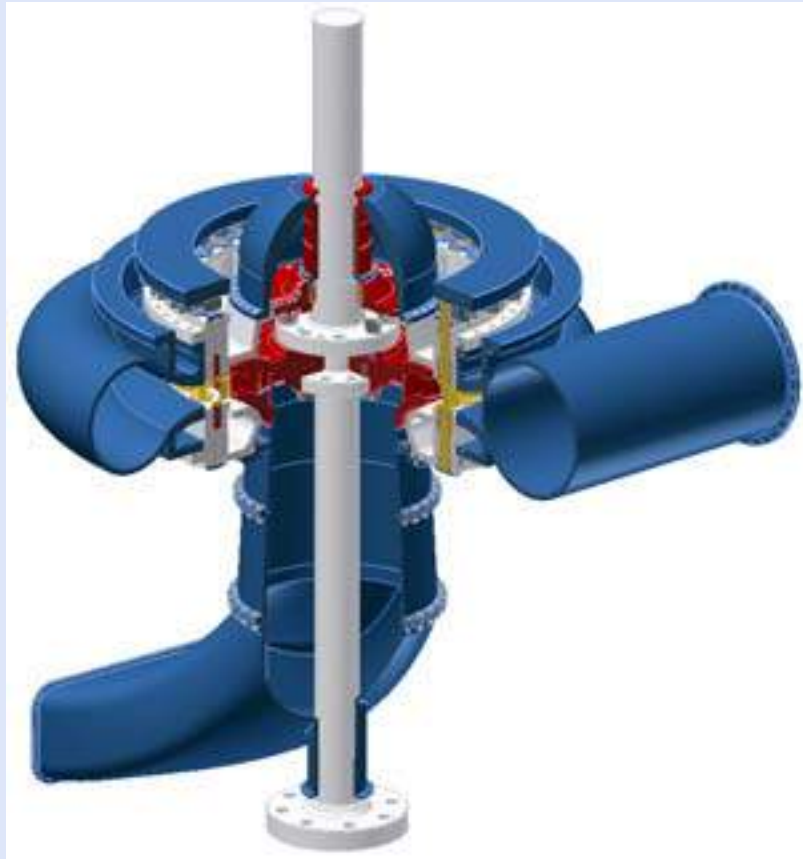
## FRANCIS TURBINES

These types of turbines are suitable for a wide range of water heads, normally from 10 to over 300 meters. This type of machine can also be used where the water head varies, even with percentages exceeding 50% of nominal, for lake level fluctuation or in an aqueduct due to the effect of the growing head losses from capacity used. The capacity may also change and still keep a high level of working efficiency and reliability. However, it is advisable not to go down to levels below 35-40% of the designed machine values.



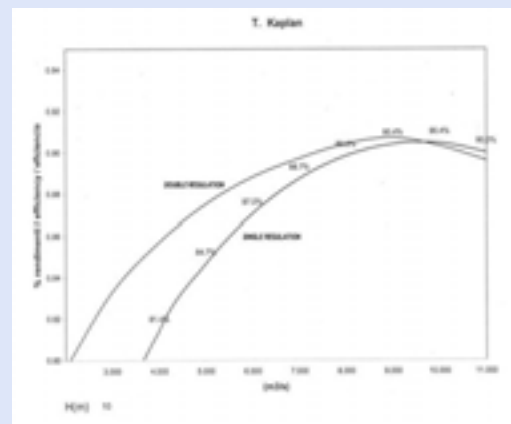
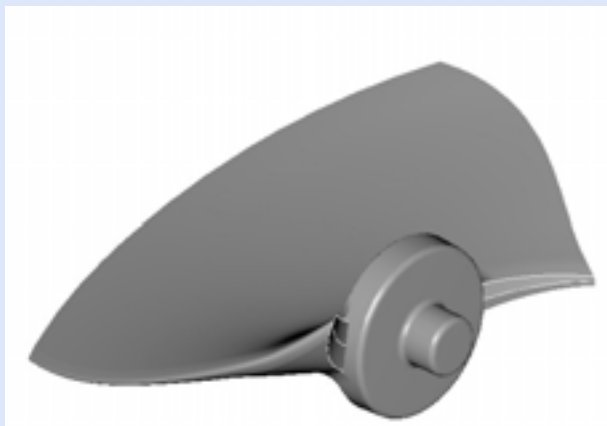
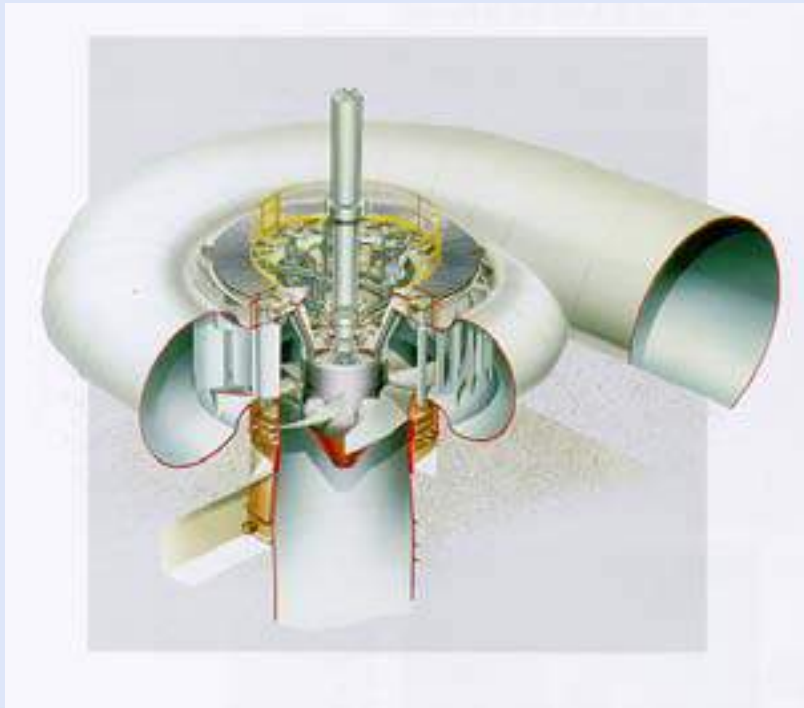


The Francis turbine may also be produced with a single runner or in some cases with double outlet runner, opposite to each other with a single spiral casing. In this case, the wheel will be symmetrical and each half is calculated at 50% of the total machine carrying capacity. This makes it possible to increase the speed of the machine with evident cost saving also for the generator.

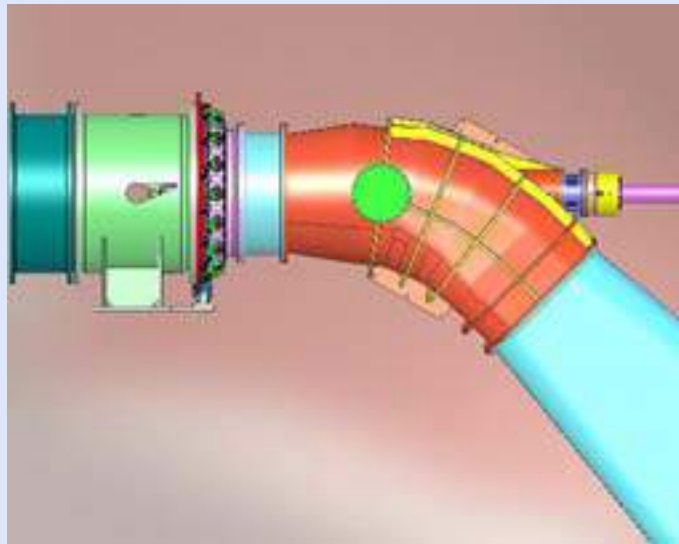
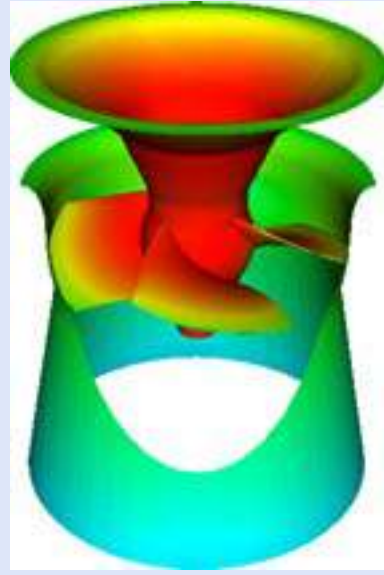
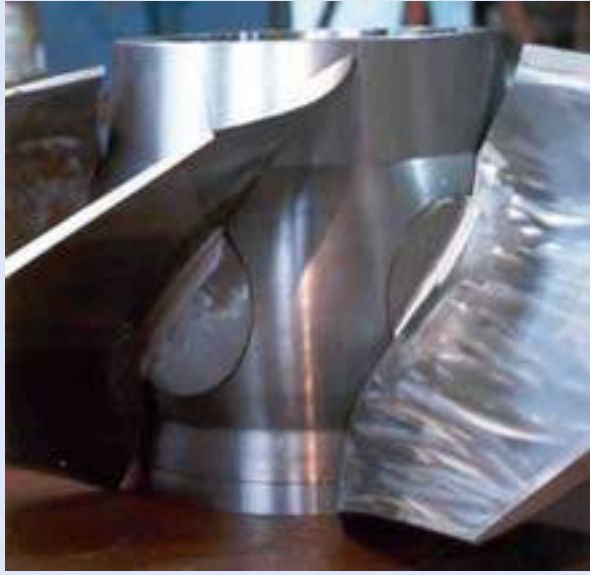
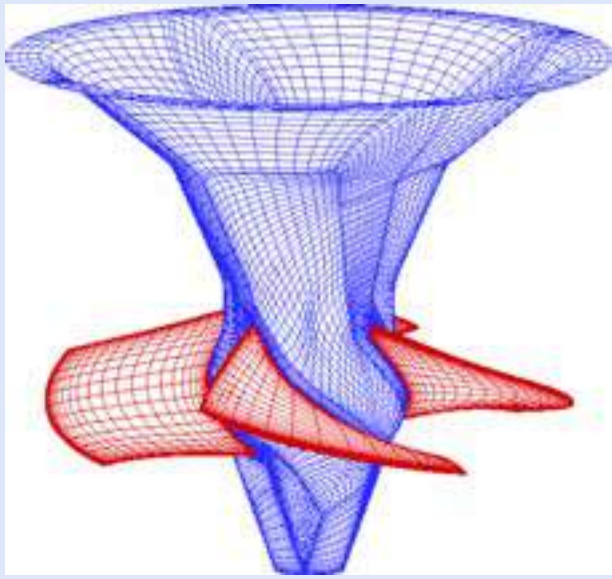


## KAPLAN TURBINES

These types of turbines are usually used in plants using low water heads, frequently between 3 and 50 m. Our standard production includes machines capable of developing capacities starting from 2 cu.m/s. up to 40 cu.m./s. Kaplan turbines, with horizontal, vertical and also slanting centre lines, may be produced with various configurations, depending on the plant specifications. At the present, the most common ones have tubular stators or goblet shaped with free chamber, but certain kinds of plants still use turbines with a spiral shaped admission stator.

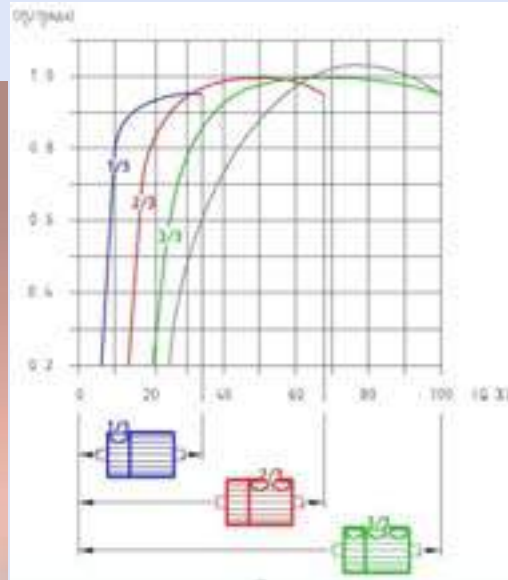
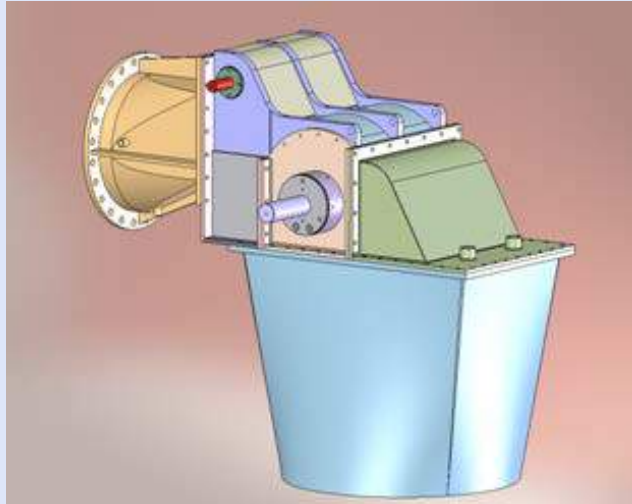






## CROSS FLOW TURBINES

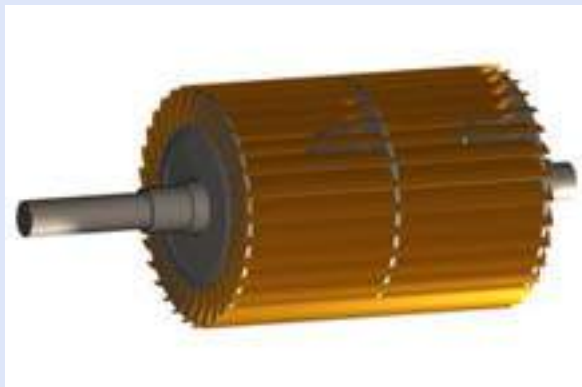
Cross Flow turbines manufactured by Ercole Marelli Power are a modern version of the Banki turbine. The Cross Flow turbine was invented by an Australian engineer (AGM Michell) and patented by him in 1903. Hungarian Professor Donat Banki later refined the design.



The standard models manufactured by Orengine have the following characteristics:

- Flow Range 20 l/s to 12,000 l/s;
- Head range 10m to 150m;
- The maximum power does not normally exceed 2,000 kW.

These turbines can be manufactured with a vertical or horizontal inlet. However, the shaft is always horizontal.



Rectangular water jets are used. The water enters the runner radially, then it passes through the runner and strikes the blades again on exit (hence, the term "Cross Flow"). Angular momentum is imparted to the runner on both passes.

Due to the cross flow pattern of flow, potential obstructions such as leaves, ice, small stones etc. are flushed out by the water (assisted by centrifugal force), thus making the runner self cleaning.



In situations where a wide flow variation is expected, the machine can be built with two compartments. The compartments are sized in the ratio of 1:2. The split compartments, in combination with control of the guide vanes, allow the flow capacity to be varied from 15% to 100% whilst still retaining optimum efficiency and reliability.





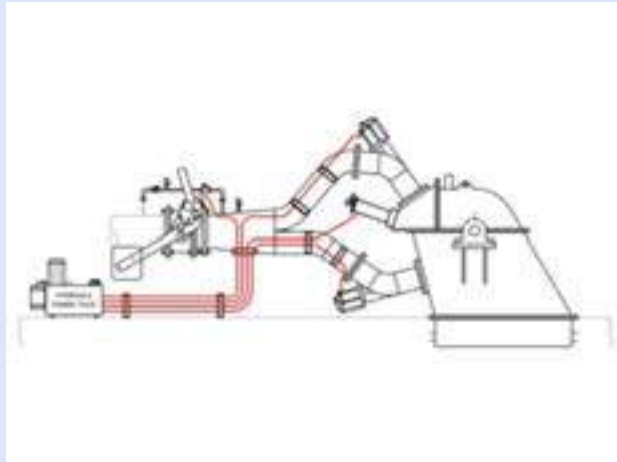
## TURBINE GOVERNORS

The Ercole Marelli Power hydraulic power units include functions such as control of valves, overspeed tripping devices, all turbine distributor manoeuvres and jet deflector manoeuvres in Pelton turbines.

Particular advantages of these units are their compatibility with all types of hydro turbines, a simple design and the use of standard components that ensure high operating reliability, easy maintenance and availability of spare parts.

Normal operating pressure for the Ercole Marelli Power hydraulic power units is 50 - 130 bar.

Sizing of the units is determined by the power required to shut down the servomotor: the pump size and the reservoir for the necessary hydraulic oil is dimensioned to suit each individual installation.



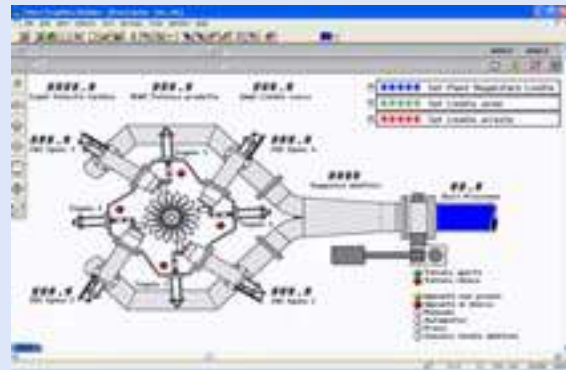
OTC is a complete controller that incorporates many features.

It may be adopted to all types of hydro turbines, making it just as suitable for upgrading of existing plants as it is for new plants.

Its main features are:

- Automatic frequency control;
- Automatic load control;
- Water level control;
- Turbine start and stop sequence.

Our hydraulic power unit provides a highly suitable solution for all hydro power plants.



## RESEARCH & DEVELOPMENT

Tomorrow is shaped by the today choices. Ercole Marelli Power's research and development has allowed us to reduce costs and time of development respecting the environment. Ercole Marelli Power's research and development carries out mechanical and other standard and special tests of turbine and its components in order to design turbine with best characteristics.

