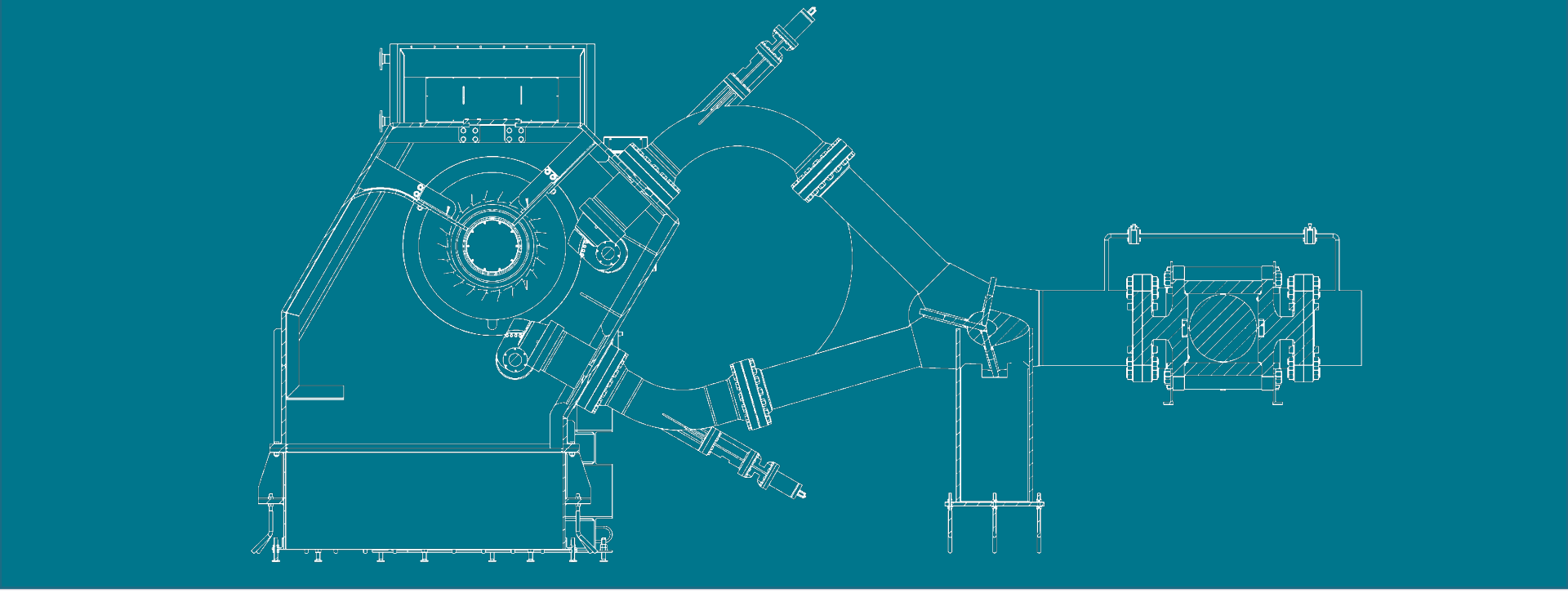
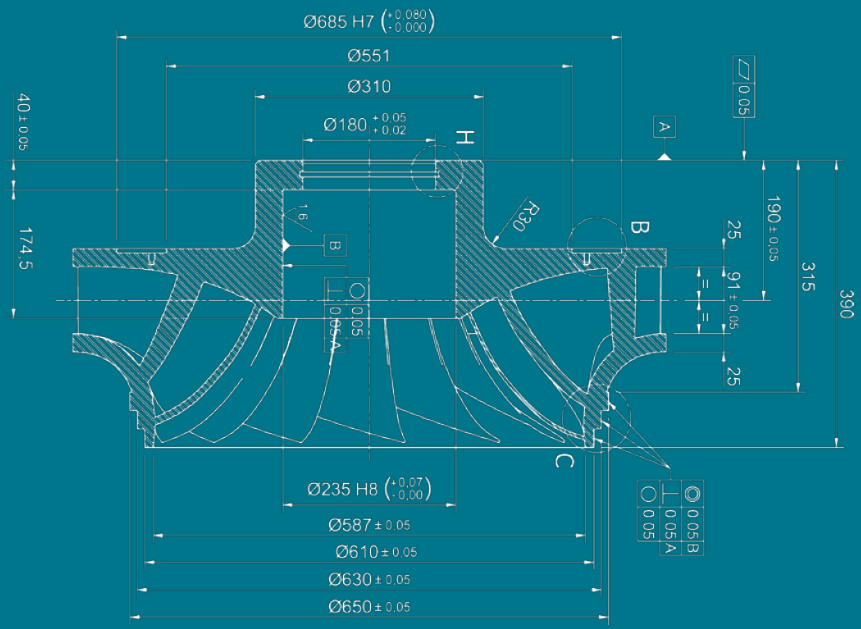


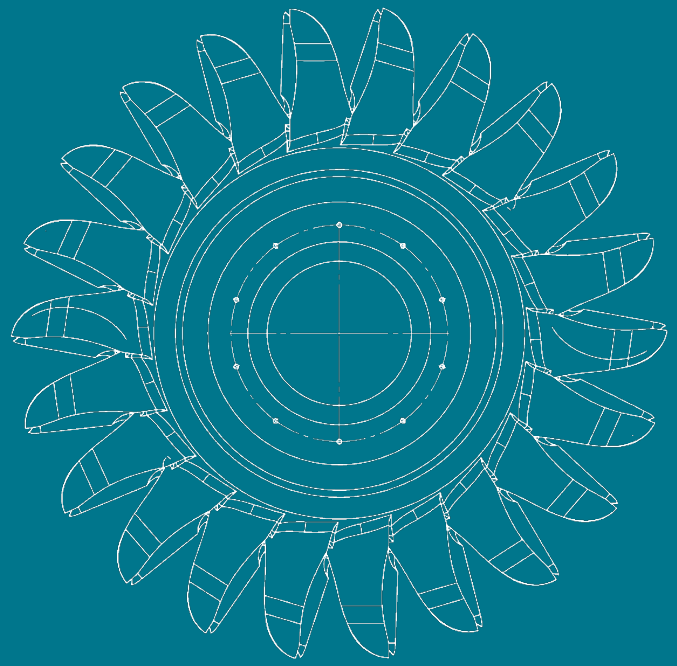
# 45 ENGINEERING

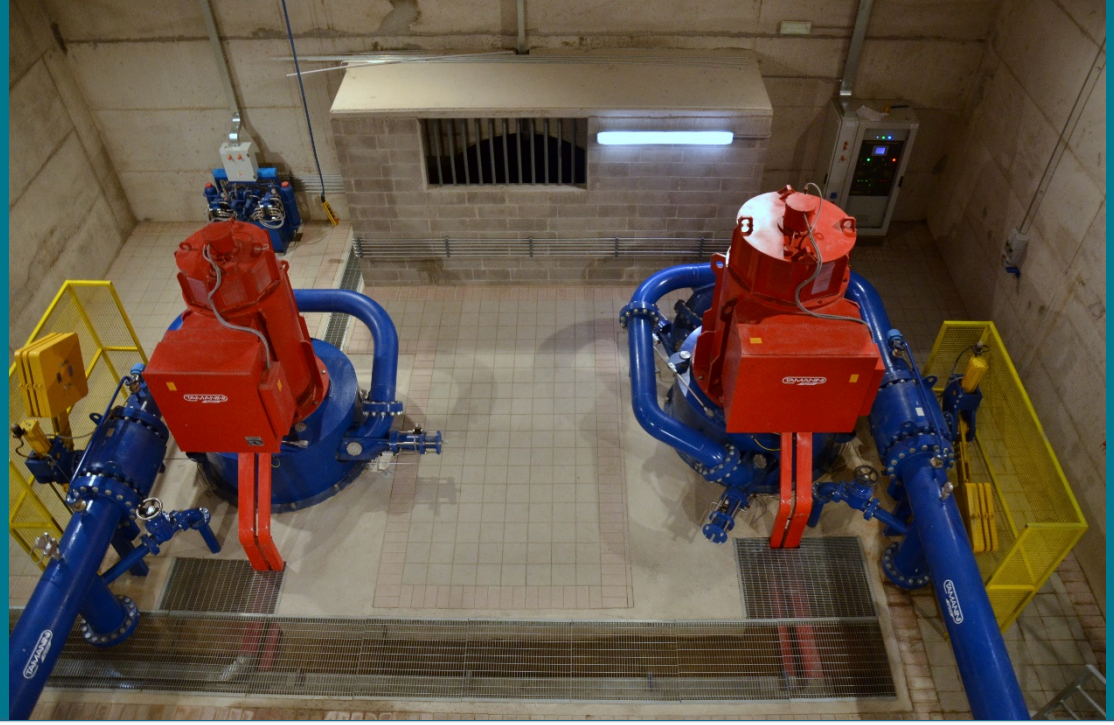
Hydropower consultants | R&D management | Mechanical engineering

# About us

**45 Engineering** is a hydropower plants consulting company. We provide professional advice to technical design firms, investors, turbine manufacturers, plant operators and banking companies. We can develop technical **due diligence** to determine the value, remaining useful life or interventions to be carried out on a hydropower plant to bring it back to the maximum efficiency as well as the costs calculation for **O&M**. We develop detailed maintenance plans and monitor the state over time. Our app **HPP Design** is our tool to help you choose the best hydraulic turbine for hydropower plants.





# Why we do it

Because the hydropower sector requires specific skills and strong experience.

The link between the potential energy of water that turns into mechanical energy and finally in electric energy has always attracted us, making us study and understand in detail all the phenomenon and different aspects involved in the process.

# What we do

**Technical Due Diligence.**

We develop technical due diligences on hydropower plants to determine value, remaining useful life, O&M costs and actions to be carried out to bring the plant back to the maximum efficiency .


# What we do

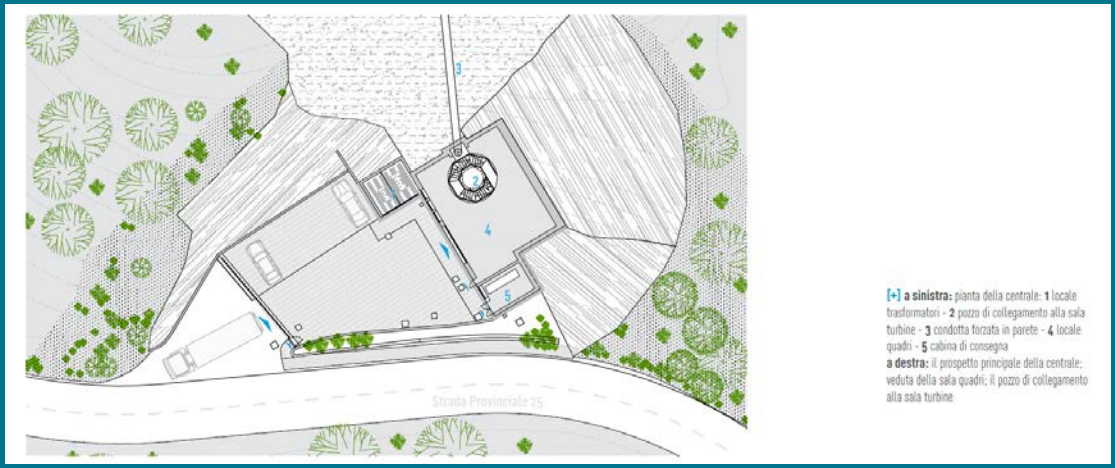
**Maintenance plans.**

We support plant operators with site inspections and detailed analyses of the HPP in order to define daily, weekly, monthly and yearly activities to be carried out and the necessary spare parts needed to maintain the asset at its highest value. Periodically, we can assess the plants conditions and schedule ordinary and extraordinary activities in terms of budget and execution scheduling.

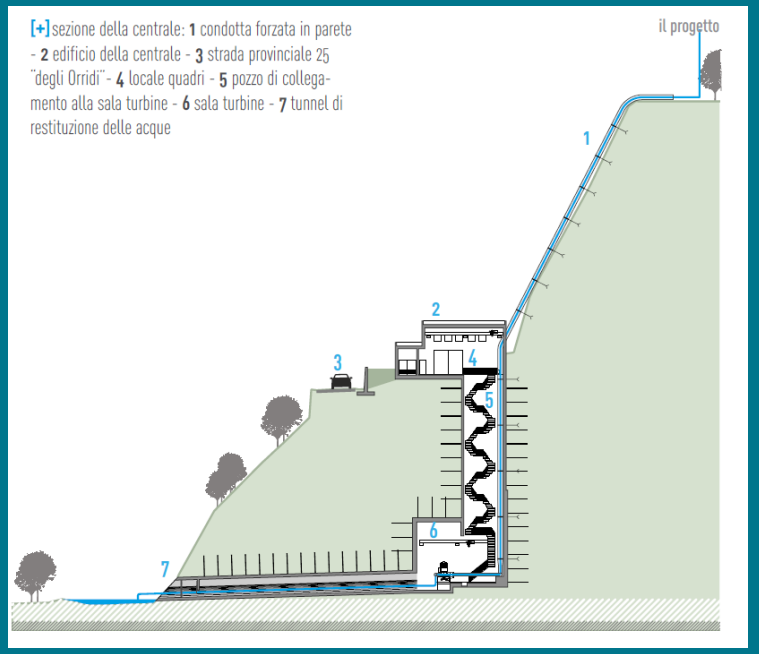
# What we do

## Electromechanical design.

We support investors to carry out the analysis of hydraulic data and set the optimal combination of turbines to install in order to maximize the investment. We can carry out transient analyses on the plant for water hammers calculation or studying hydraulic and electrical instabilities. We further prepare detailed technical electromechanical specifications for public or private tenders.




[+] **a sinistra:** pianta della centrale: **1** locale trasformatori - **2** pozzo di collegamento alla sala turbine - **3** condotta forzata in parete - **4** locale quadri - **5** cabina di consegna
**a destra:** il prospetto principale della centrale; veduta della sala quadri; il pozzo di collegamento alla sala turbine



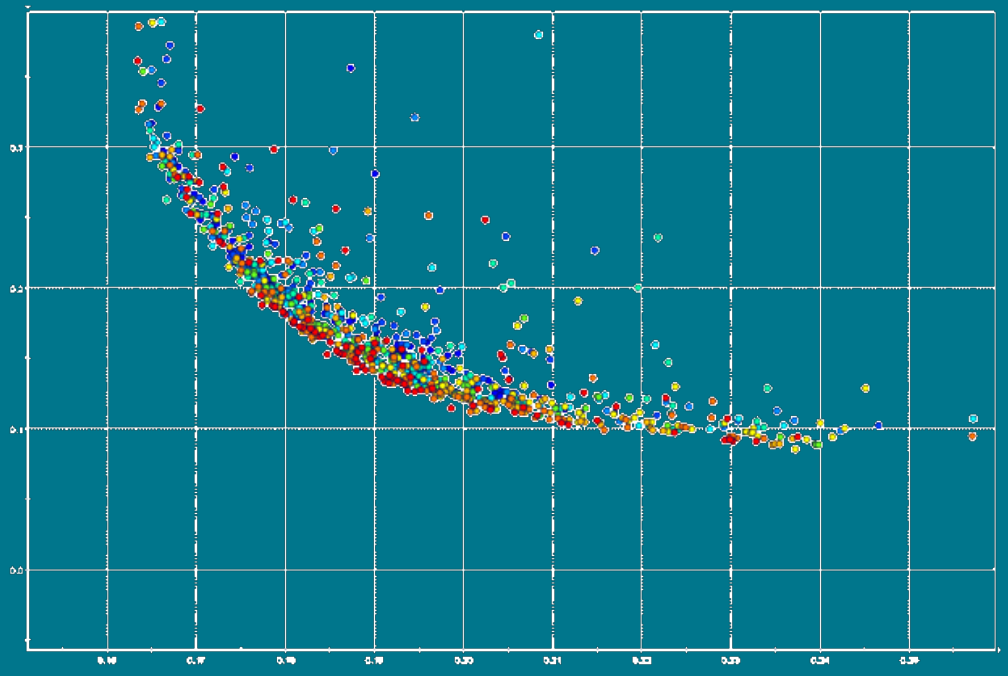

[+] sezione della centrale: **1** condotta forzata in parete - **2** edificio della centrale - **3** strada provinciale 25 "degli Orridi" - **4** locale quadri - **5** pozzo di collegamento alla sala turbine - **6** sala turbine - **7** tunnel di restituzione delle acque

# What we do

**Mechanical design of hydraulic turbine. Pelton Francis, Kaplan and Archimedian Screw.**

We design hydroelectric turbines from the hydraulic data to the final drawings. We can develop Pelton Francis, Kaplan and Archimedian Screw from 10kW to 5000kW.



## How we do it

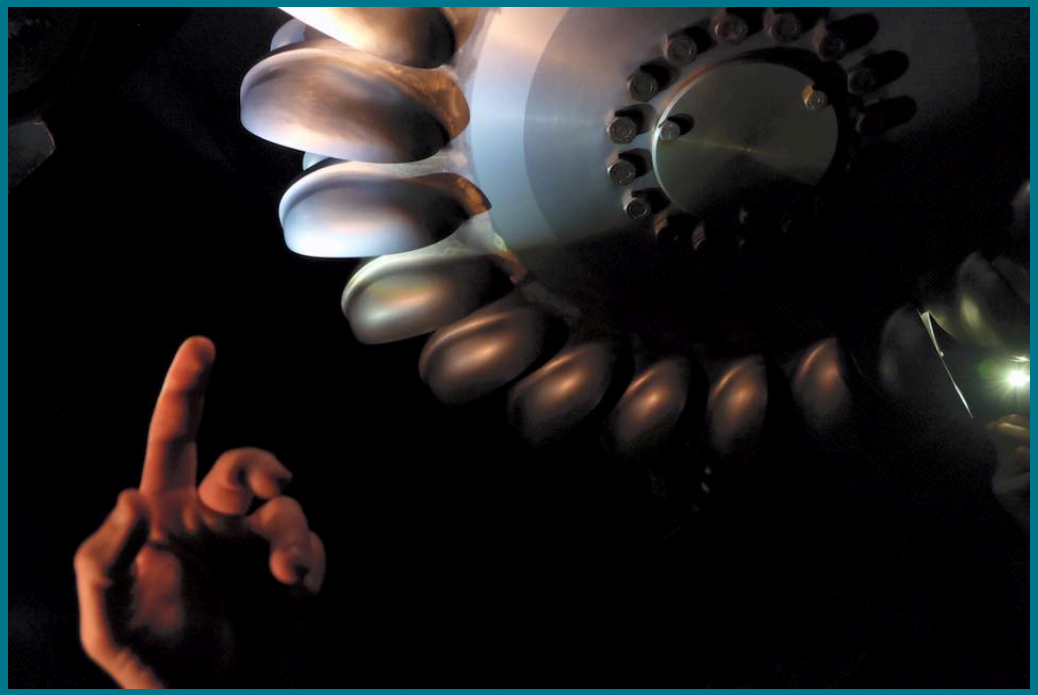
We carefully select the most advanced methods and tools in engineering.

Using dynamics and finite elements software, we can analyse complex structures in order to understand the strains and evaluate the dynamic effects. CFD analysis helps us both to understand fluids behaviour and create a development process to improve the hydraulic performances. In complex systems with multiple boundary condition we use parameterization and single/multi objective optimization algorithms in order to highlight the leading parameters and find their best values to get the required result.

# PORTFOLIO

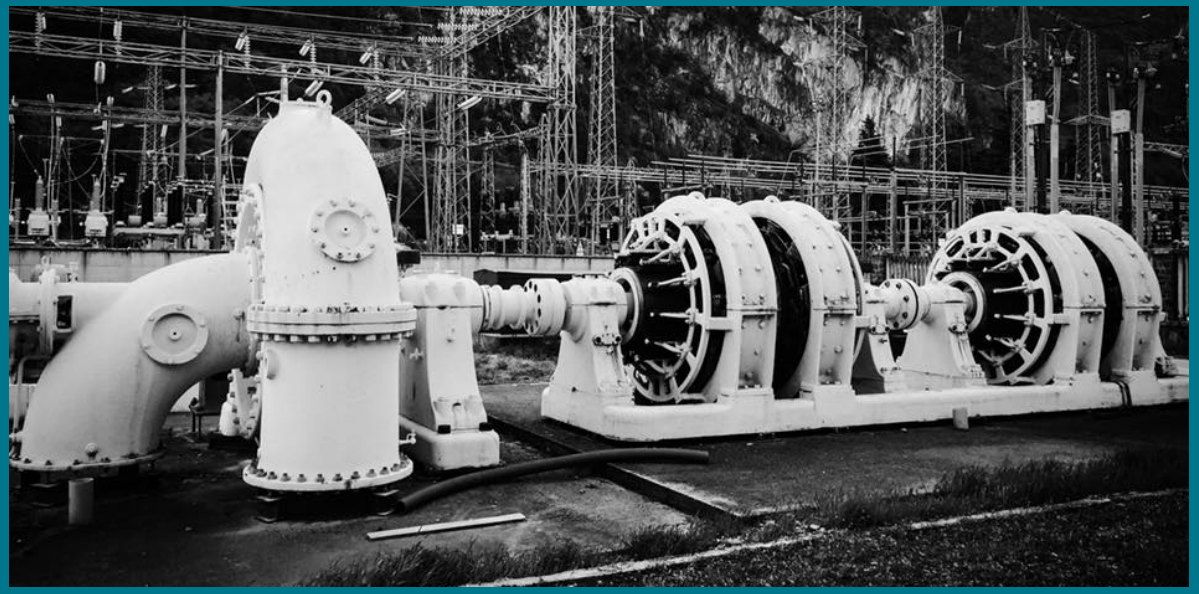
# Technical due diligence on existing and under development hydropower plants

An investment evaluation implies a technical due diligence which analyses all the clear or hidden critical aspects of the hydropower plant. The first step is the analysis of the documentation received, followed by a site inspection to verify the current state of components and the as-built compliance to the technical specifications of the plant. The next steps are the analysis of the occurred critical events register, the prediction of future ones, the analysis of the O&M plan, its compliance with the technical specifications and actual design of the plant. We further calculate the capex costs for improve the HPP efficiency divided by risk level: high (intervention to be executed immediately), medium (intervention to be executed by a limited period), and low (the intervention is useful but not essential). The DD report will include short, medium and long term O&M costs as well as a list of recommended spare parts to be hold in house and detailed photographic report.



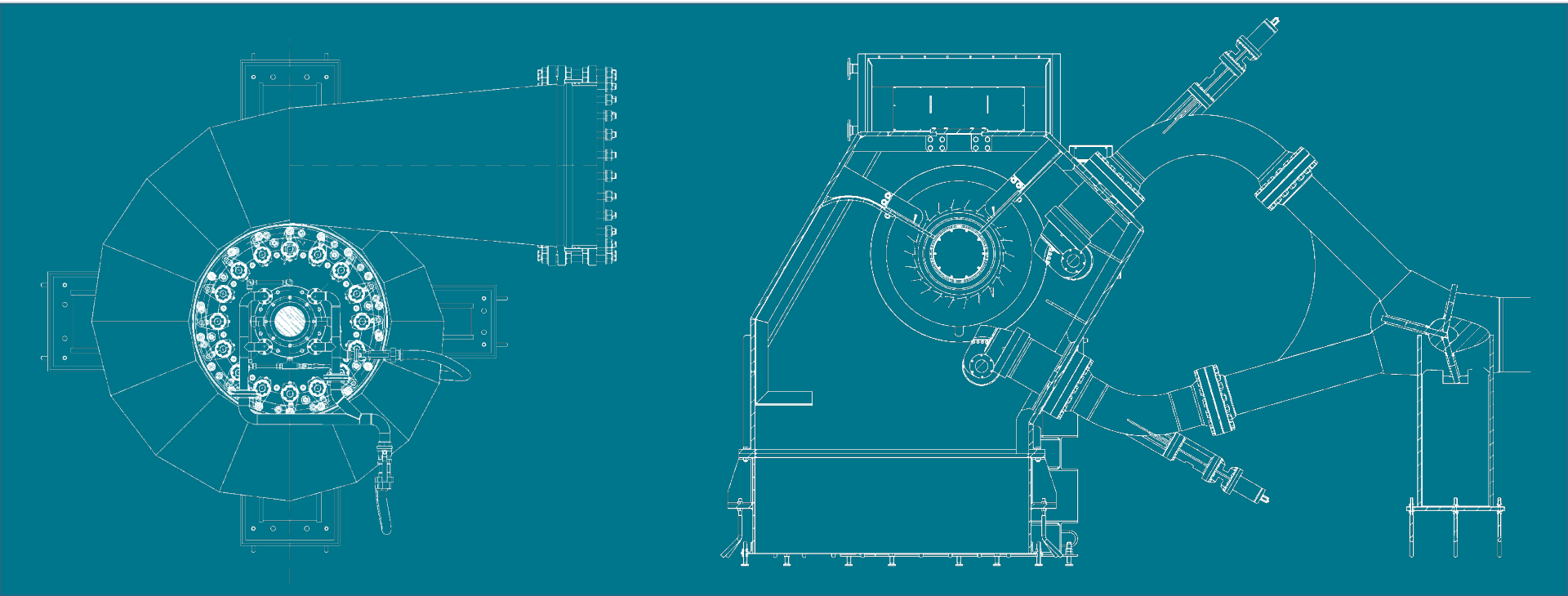
# Maintenance plans

The management of a hydropower plant includes both ordinary and extraordinary activities. In order to have full control on the activities to carry out for a good maintenance, we prepare a detailed maintenance plan that can allow the plant manager or the plant owner to have all the activities under control. A maintenance plan can improve the overall plant production, avoid downtimes, schedule ordinary and extraordinary O&M investments, provide a history of the events occurring in the plant. This helps maintaining a higher asset value. We can further plan periodical site visits to verify the compliance of the activities executed and suggest the capex needed for the optimal maintenance.



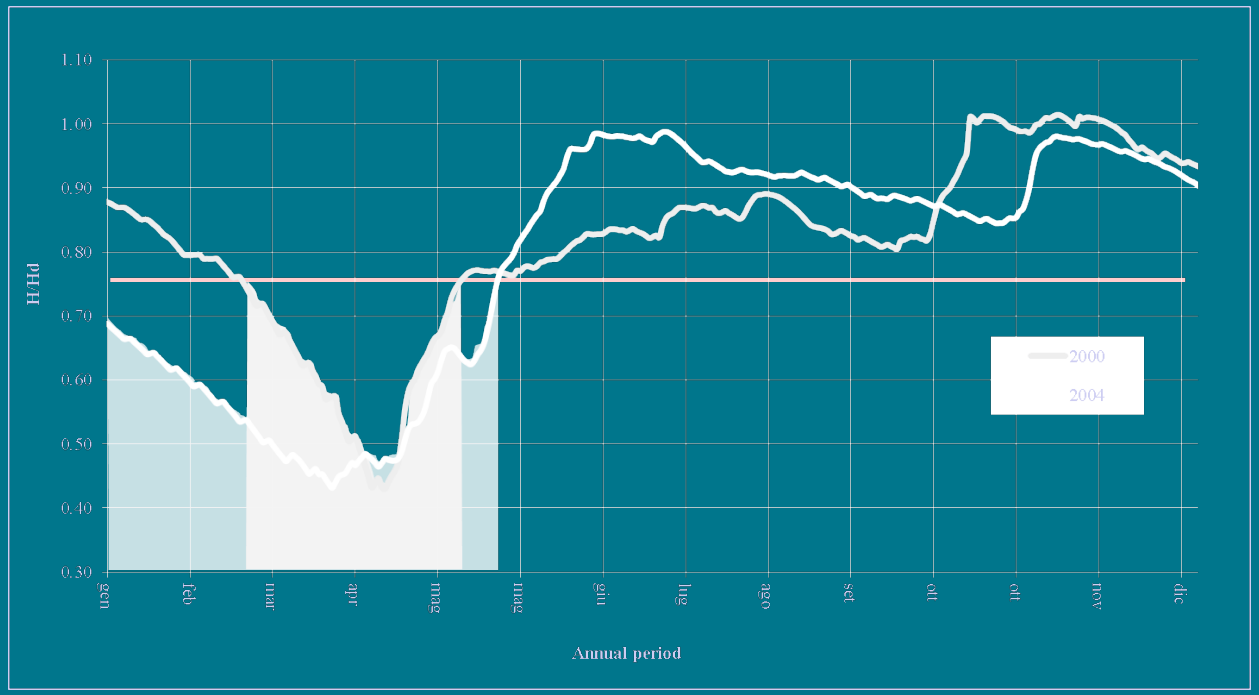
# Mechanical design of hydraulic turbine. Pelton Francis, Kaplan and Archimedean Screw.

Starting from the project data (head and discharge), we decide the design path to finalize the geometry of the conduct and the blade using CFD tests. Once the hydraulic design has been completed, the machine has to be industrialized taking into account all the mechanical parts of the machine assembly, the production technologies, costs, production times, structural checks and fatigue tests. Finally, the executive design is drawn up with the definition of the BOM, working methods and applied tolerances.



# Electromechanical design

In case of a greenfield project design, we analyse head and flow hydraulic data in order to choose the best combination of turbines to be installed to maximize the investment or the global plant production. We can carry out transient analyses on the plant to anticipate water hammers or hydraulic and electrical instabilities. The aim is to deliver the correct technical specifications of the electromechanical part to be used in a public or private tender. As owner's engineer, we can carry out expediting activities and commissioning of the plants.



# HPP-Design

We have developed a **web-app for hydropower plant designers**: HPP-design.

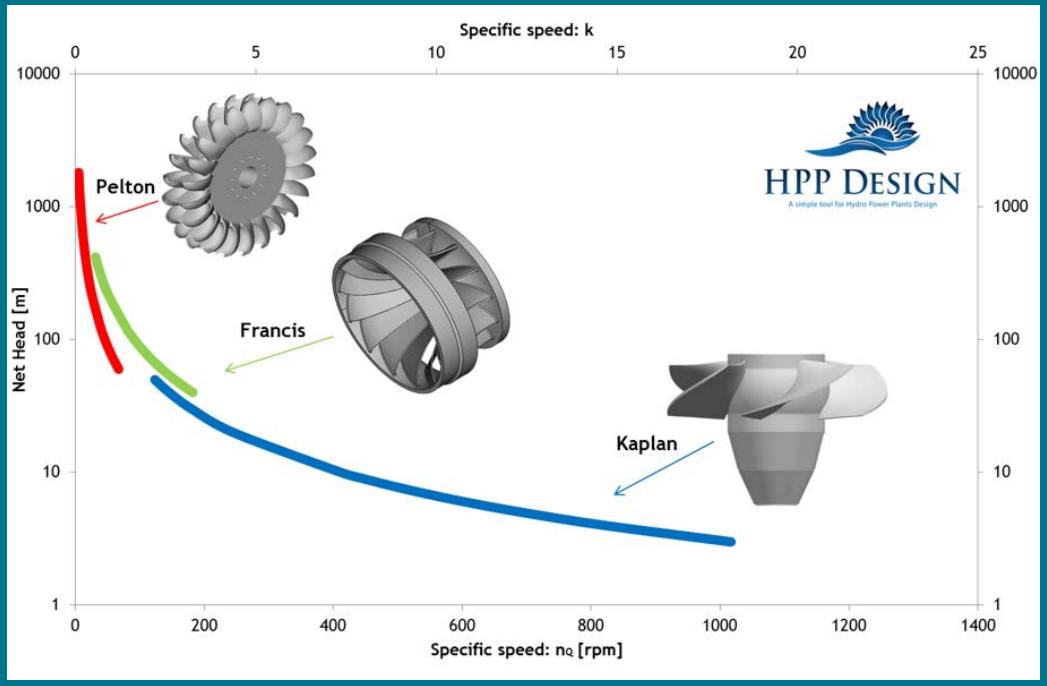
HPP-Design is an **automatic tool** to supply the main information on **dimensions, performances and technical specification on hydroelectric turbines** such as Pelton, Francis, Kaplan, Archimedean Screw and Cross Flow.

The tool is intended to:

- understand the turbine's **dimensions** and **performances**;
- verify the **different turbines** that could be used;
- define the most appropriate **functioning range** in order to maximize production, overall dimensions and costs.

All the sizing data are saved on line and it is possible to access them on each platform.

This is the link to try it out: http://hpp-design.com



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